





3 1931 00075 4792

GAYLORD			PRINTED IN U.S.A.





**HANDBOOK  
of  
INDUSTRIAL  
TOXICOLOGY**

**Third Edition**

by

**E. R. PLUNKETT, M.D.**

**ROGER WILLIAMS COLLEGE LIBRARY**

**CHEMICAL PUBLISHING CO., INC.  
New York, N.Y.**

RA  
1229  
P55  
1987

© 1987

Chemical Publishing Co., Inc.

ISBN 0-8206-0321-X

*Printed in the United States of America*

*To Carol & Nancy*



## Preface

The third edition of this handbook, like the previous work, is intended as a practical, quick reference guide for those who are actively involved in protecting the health of the worker. While the entire text has been updated, an outline form is retained for rapid access, clarity, and conciseness.

In a rapidly changing occupational environment some of the material included here may soon be outdated, and other chemicals and compounds not mentioned will generate significant future interest. The TLVs used are those currently recommended by ACGIH, but it should be noted that federal and state agencies as well as foreign governments often issue different standards.

Carcinogens continue to command attention and require diligent efforts for protective strategies. In many instances, medical surveillance techniques and preventive measures for work practices are prescribed by law and must be followed as indicated in given jurisdictions. Similarly, the adverse effect on reproductive health from chemical exposures in the workplace has also received much attention, but the precise relation between exposure and specific reproductive problems is apt to remain elusive for some time to come. It can only be resolved by intense epidemiological and experimental research.

Current emphasis on research in performance assessment and evaluation in the selection and use of protective equipment is refreshing. Both ANSI and OSHA standards address eye and face protection and the American Conference of Governmental Industrial Hygienists has published "Guidelines for the Selection of Chemical Protective Clothing." Other sources of information on advances in this expanding area include the U.S. Coast Guard, U.S. Fire Administration, NIOSH, and EPA.



# ABRIN

## Synonyms:

Agglutinin • Indian licorice • Jequirity bean • Toxalbumin

## Description:

Yellow-white powder from the seeds of *Abrus precatorius*

## Occupational Exposure:

Jewelry and beadwork • Laboratory research • Weighing standard

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Ingestion, but there is no effect unless the shell of the bean is broken

### MODE OF ACTION:

Gastrointestinal irritation • Red blood cell agglutination • Liver and kidney damage have been reported

### SIGNS AND SYMPTOMS:

*Effects may be delayed*

Anorexia • Nausea, vomiting and diarrhea • Weakness and collapse • Convulsions

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Gastric lavage, followed by saline catharsis (emetics should be used with caution due to the corrosive action of abrin)

Force fluids and maintain alkaline urine

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Education to avoid ingestion

Hart, M. 1963. Hazards to health: Jequirity bean poisoning. *NEJM* 268:885.

# ACETALDEHYDE

## Synonyms:

Acetic aldehyde • Ethanal • Ethyl aldehyde

## Description:

Colorless liquid, fruity odor

## Occupational Exposure:

Disinfectants • Drugs • Dyes • Explosives • Flavorings • Lacquers •  
Mirror Silvering • Perfumes • Photographic chemicals • Plastics •  
Resins • Synthetic rubber

## Threshold Limit Value:

100 ppm • 180 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Local irritant • Central nervous system depressant • Fatty  
degeneration of liver and kidneys

### SIGNS AND SYMPTOMS:

#### *Local:*

Irritant dermatitis and burns • Conjunctivitis • Irritation  
of nose and throat

#### *Systemic:*

Headache • Bronchitis and pulmonary edema  
Chronic effects resemble chronic alcoholism

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported



## ACETALDEHYDE (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved respiratory protection • Rubber protective clothing  
Preclude from exposure those individuals with diseases of the skin and lungs

Egle, J.L. Jr. 1970. Retention of inhaled acetaldehyde in man. *J. Pharmacol. Exp. Ther.* 174(1):14.

Sroka, K.H. 1953. Zur gesundheitsgefährdung durch aldehyde. *Deutsches Mediz J.* 4:595.

## ACETIC ACID

### Synonyms:

Ethanoic acid • Ethylic acid • Vinegar acid

### Description:

Colorless corrosive liquid, vinegar odor

### Occupational Exposure:

Chemical synthesis • Dyes • Insecticides • Paints and pigments •  
Pharmaceuticals • Photographic chemicals • Plastics and resins •  
Preservative • Rubber • Solvent • Textile processing

### Threshold Limit Value:

10 ppm • 25 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Local irritant • Irritation of respiratory tract • Bronchitis •  
Ulceration of gastrointestinal tract • Liver damage •  
Hemorrhagic nephrosis.

#### SIGNS AND SYMPTOMS:

Skin and hands may become blackened, hyperkeratotic and fissured; skin burns may occur

## ACETIC ACID (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*)

Erosion and blackening of teeth

Conjunctivitis, corneal erosion and iritis

Chronic laryngitis, bronchitis, and pulmonary edema

#### *Following ingestion:*

Pain and corrosion of the mouth, pharynx, esophagus and stomach

Vomiting with hematemesis

Diarrhea and bloody stools

Laryngitis, bronchitis, pulmonary edema and pneumonia

Cardiovascular collapse

Albuminuria and hematuria

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage with limewater, if ingested, followed by administration of demulcents

Symptomatic and supportive

### DISABILITY:

Chronic respiratory effects have been reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Preclude from exposure those individuals with diseases of the eyes, skin, and lungs

Periodic examinations with attention to eyes, teeth, skin, and lungs

Capellini, A. and Sartorelli, E. 1967. Episodio di intossicazione collettiva da anidride acetica ed acido acetica. *Med. Lav.* 58:108.

Henson, E.V. 1959. Toxicology of the fatty acids. *JOM* 1:339.

# ACETIC ANHYDRIDE

## Synonyms:

Acetic oxide • Acetyl oxide • Ethanoic anhydride

## Description:

Colorless liquid, irritating odor

## Occupational Exposure:

Chemical synthesis • Dyes • Explosives • Flavorings • Perfumes •  
Pharmaceuticals • Plastics • Resins • Solvent • Synthetic fibers

## Threshold Limit Value:

5 ppm • 20 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion (unlikely) • Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Irritation and burns of the skin • Conjunctivitis, photophobia  
and corneal necrosis • Irritation of nose and throat • Cough,  
dyspnea and bronchitis • Burns of the mouth and upper  
gastrointestinal tract, if ingested

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of the body with soap and water  
Treat skin burns in the usual manner  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory  
protection • Rubber gloves, aprons and boots

## ACETIC ANHYDRIDE (*cont' d.*)

Preclude from exposure those individuals with diseases of the eyes,  
skin and lungs

Capellini, A. and Sartorelli, E. 1967. Episodio di intossicazione  
collettiva da anidride acetica ed acido acetico. *Med. Lav.* 58:108.

## ACETONE

### Synonyms:

Dimethyl ketone • 2-Propanone • Pyroacetic ether

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Celluloid • Cements • Chemical synthesis • Dyeing • Explosives •  
Pharmaceuticals • Plastics • Solvent • Varnishes and lacquers

### Threshold Limit Value:

750 ppm • 1780 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant • Depressant for central nervous system

#### SIGNS AND SYMPTOMS:

Defatting or eczematoid dermatitis • Conjunctivitis and corneal  
erosion • Irritation of nose and throat • Headache • Dizziness  
• Mental confusion • Weakness • Nausea and vomiting •  
Bronchitis • Narcosis

#### DIAGNOSTIC TESTS:

Acetone in urine, blood, or alveolar air

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

## ACETONE (*cont' d.*)

### TREATMENT (*cont' d.*):

Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Ross, D.S. 1973. Acute acetone intoxication involving eight male workers. *Ann. Occup. Hyg.* 16:73.

## ACETOPHENONE

### Synonyms:

Acetyl benzene • Hyponone • Phenyl methyl ketone

### Description:

Colorless liquid, pleasant odor

### Occupational Exposure:

Catalyst • Chemical synthesis • Perfumes • Solvent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Depressant for central nervous system

#### SIGNS AND SYMPTOMS:

Irritation of the eyes • Dermatitis • Narcosis

#### DIAGNOSTIC TESTS:

Acetophenone in expired air • Increased hippuric acid in urine

## ACETOPHENONE (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Rubber protective clothing

## ACETYLENE

### Synonyms:

Ethine • Ethyne

### Description:

Colorless gas, ethereal odor

Crude acetylene may contain phosphine

### Occupational Exposure:

Chemical synthesis • Fuel • Illuminant • Metallurgy • Plastics • Welding

### Threshold Limit Value:

1000 ppm

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Simple asphyxiant

Commercial acetylene contains acetone and is capable of causing symptoms of diabetic ketoacidosis

#### SIGNS AND SYMPTOMS:

Dizziness • Headache • Dyspnea • Nausea and vomiting • Tachycardia • Cyanosis • Loss of consciousness • Convulsions

## ACETYLENE (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved air supply in enclosed spaces

Foley, R.J. 1985. Inhaled industrial acetylene—A diabetic ketoacidosis mimic. *JAMA*. 254:1066.

Jones, A.T. 1960. Fatal gassing in an acetylene manufacturing plant. *Arch. Environ. Hlth*. 1:417.

## ACRIDINE

### Synonyms:

10-Azaanthracene • Dibenzopyridine

### Description:

Colorless platelets

### Occupational Exposure:

Chemical synthesis • Dyestuffs • Pharmaceuticals

### Threshold Limit Value:

0.2 mg/m<sup>3</sup> OSHA PEL

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Photosensitizer

## ACRIDINE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Irritation of eyes, skin and upper respiratory tract

### DIAGNOSTIC TESTS:

Acridine in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons and boots, if necessary, for handling

Baldi, G. 1953. Occupational pathology from acridine. *Med. Lav.* 44:240.

## ACROLEIN

### Synonyms:

Acrylaldehyde • Acrylic aldehyde • Allyl aldehyde • 2-Propenal

### Description:

Yellow liquid, pungent odor

### Occupational Exposure:

Artificial resins • Chemical synthesis • Herbicides • Odor warning agent • Perfumes • Plastics • Pharmaceuticals • Sewage treatment • Synthetic fibers • Textile finishes

*Note:* Acrolein may evolve when glycerol containing oils and fats are heated

### Threshold Limit Value:

0.1 ppm • 0.25 mg/m<sup>3</sup>



## ACROLEIN (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Direct irritant • Sensitizer

Appears to act on glyceraldehyde-3-phosphate dehydrogenase to suppress glycolysis

#### SIGNS AND SYMPTOMS:

##### *Local:*

Conjunctivitis and corneal damage • Skin burns • Sensitization dermatitis

##### *Inhalation:*

Rhinitis • Pharyngitis • Bronchitis with dyspnea • Pulmonary edema • Nausea and vomiting • Diarrhea • Prostration • Unconsciousness

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns as usual

Oxygen, with IPPB, if available

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons and boots

Preclude from exposure those individuals with skin and pulmonary diseases

Remove from exposures those who become sensitized

Champeix, J., et al. 1966. Bronchopneumopathie aigue par vapeurs d'acroleine. *Arch. Mal. Prof.* 17:794.

State of N.J. Dept. of Health. 1960. Acrolein. *Occup. Hlth. Bull.* 5:5.

# ACRYLAMIDE

## Synonyms:

Acrylic amide • Propenamide

## Description:

White crystalline powder

## Occupational Exposure:

Paints • Paper and textile sizes • Polymer production • Soil water-proofing in mining operations

## Threshold Limit Value:

0.3 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Neurotoxic, possibly by combining with sulfhydryl groups in neurons impairing metabolism?

### SIGNS AND SYMPTOMS:

Excessive sweating of the extremities with sensation of coldness • Paresthesias of hands and feet • Peeling and blistering ulcerations of the hands • Diminished or absent deep tendon reflexes • Muscular weakness and atrophy • Systemic complaints include anorexia, drowsiness, fatigue, tremors, hypersomnolence and emotional changes

#### *In late stages:*

Loss of touch and vibratory sense in a glove-stocking distribution  
Positive Romberg and ataxia  
Loss of deep tendon reflexes  
Foot drop  
Occasional urinary and fecal retention  
EEG changes and elevated spinal fluid protein occur

### DIAGNOSTIC TESTS:

A modified Optacon which measures changes in fingertip vibratory sensation has been suggested for subclinical evaluation

## ACRYLAMIDE (*cont' d.*)

### DIAGNOSTIC TESTS (*cont' d.*):

Electromyography, nerve conduction studies and sural nerve biopsy have also been helpful

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Recovery does occur after cessation of exposure but may require months to years

### Preventive Measures:

Adequate ventilation • Approved respirators with protective clothing and gloves

Meticulous personal hygiene

No eating or smoking in work area

Annual examination with special attention to the skin and nervous system

Preclude from exposure those individuals with central nervous system diseases

Kesson, C.M. et al. 1977. Acrylamide poisoning. *Postgrad. Med. J.* 53:16.

Spencer, P.S. and Schaumburg, H.H. 1975. Nervous system degeneration produced by acrylamide monomer. *Environ. Hlth. Perspect.* 11:129.

Tilson, H.A. 1981. The neurotoxicity of acrylamide: An overview. *Neurobehavioral Toxicol. & Terat.* 3(4): 445.

## ACRYLIC COMPOUNDS

### Synonyms:

Monomers are esters of propenoic acids and polyalcohols methyl-, ethyl-, butyl-, ethylhexyl-, methyl metha-, and others

Acrylic resins are polymers or copolymers of these and other monomers

### Description:

Most acrylic monomers are clear liquids, many with pleasant odors  
Resins are liquids and solids

## ACRYLIC COMPOUNDS (*cont'd.*)

### Occupational Exposure:

Adhesive tapes • Coatings • Contact lenses • Dentures • Glass substitute • Ion exchange resin • Light sensitive printing processes • Lubricant additive • Plasticizers • Printing inks • Solvents • Surgical applications

### Threshold Limit Value:

Acrylic acid — 10 ppm • 30 mg/m<sup>3</sup>

Acrylic resins:

Ethyl acrylate — 5 ppm • 20 mg/m<sup>3</sup>

Methyl acrylate — 10 ppm • 35 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Pain and paresthesias of fingers and palms have been reported • Dermatitis, both irritant and allergic • Respiratory tract irritation from both monomer vapors and resin dust

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

Sensitization is permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective gloves and clothing (surgical rubber gloves have been penetrated by monomers)

Remove from exposure those who become sensitized

## ACRYLIC COMPOUNDS (*cont' d.*)

- Emmett, E.A. and Kominsky, J.R. 1977. Allergic contact dermatitis from ultraviolet cured inks. *JOM*. 19:113.
- Nethercott, J.R. 1978. Skin problems associated with multifunctional acrylic monomers in ultraviolet curing inks. *Brit. J. Dermatol.* 98:541.
- Rycroft, R.J.G. 1977. Contact dermatitis from acrylic compounds. *Brit. J. Dermatol.* 96:685.

## ACRYLONITRILE

### Synonyms:

Acrylon • Cyanoethylene • 2-Propenenitrile • Vinyl cyanide

### Description:

Clear to yellowish liquid, pungent odor

### Occupational Exposure:

Copolymer resins • Manufacture of acrylic fibers • Plastics and coatings • Synthetic rubbers

### Threshold Limit Value:

2 ppm • 4.5 mg/m<sup>3</sup>

Specific OSHA regulations apply

Suspect carcinogen

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Similar to cyanide • Liver damage has been reported  
• Suspect human carcinogen

#### SIGNS AND SYMPTOMS:

Irritation of the eyes and skin with subsequent blistering if contact is prolonged • Headache • Dizziness • Weakness • Epistaxis • Nausea and vomiting • Dyspnea • Cyanosis • Collapse • Asphyxia

#### DIAGNOSTIC TESTS:

AN and thiocyanate in urine are increased  
Blood cyanide levels

## ACRYLONITRILE (*cont'd.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

Follow the protocol which should be established for cyanides  
See Appendix A

### DISABILITY:

Recovery may be expected from acute exposure with prompt treatment

The excess risk of lung and colon cancer needs further evaluation

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing and goggles or a face shield

No food or smoking in work area

Preclude from exposure those individuals with cardiovascular, respiratory, and skin diseases

Proper decontamination, support systems, oxygen, antidotes, trained first aid personnel and transportation methods should be immediately available

Regular medical surveillance of exposed workers in keeping with current medical requirements and practices

Willhite, C.C. 1982. Toxicology update: Acrylonitrile. *J. Appl. Toxicol.* 2:54.

## ALLYL ALCOHOL

### Synonyms:

1-Propenol-3 • 2-Propenol • Propenyl alcohol • Vinyl carbinol

### Description:

Colorless liquid, irritating, mustard-like odor

### Occupational Exposure:

Chemical synthesis • Fungicides • Herbicides • Pharmaceuticals •  
Plastics • Resins

### Threshold Limit Value:

2 ppm • 5 mg/m<sup>3</sup>

## ALLYL ALCOHOL (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis, photophobia, blurred vision, and corneal erosion

Skin irritation may be delayed but local pain, aching, and blister formation does occur

Dyspnea, cough, and hemoptysis can occur

Headache, malaise, nausea, and vomiting

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved respiratory protection • Rubber protective clothing

Dunlap, M. K. et. al. 1958. The toxicity of allyl alcohol. *AMA Arch. Ind. Hlth.* 18:303 and 311.

## ALLYL BROMIDE

### Synonyms:

Bromoallylene • 3-Bromo-propene • 3-Bromopropylene



## ALLYL BROMIDE (*cont' d.*)

### Description:

Colorless liquid, unpleasant pungent odor

### Occupational Exposure:

Chemical synthesis • Furnigant • Synthetic perfumes • Resins and plastics

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract • Headache • Vertigo

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

## ALLYL CHLORIDE

### Synonyms:

Chloroallylene • 3-Chloro-1-propene • 3-Chloropropylene



## ALLYL CHLORIDE (*cont' d.*)

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Chemical synthesis • Pharmaceuticals • Plastics • Resins • Synthetic perfumes

### Threshold Limit Value:

1 ppm • 3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Depressant for central nervous system?

#### SIGNS AND SYMPTOMS:

Conjunctivitis with photophobia

Headache and dizziness

Delayed skin irritation accompanied by "bone aches"

Respiratory tract irritation with pulmonary edema

Peripheral neuropathy has been reported

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of the body with soap and water

Calcium gluconate, 10 ml of 10% intravenously may help deep muscular pain

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots

Fengsheng, H. et. al. 1980. Toxic polyneuropathy due to chronic allyl chloride intoxication. *Chin. Med. J. (Peking)*. 93(3):177.

Shell Chem. Corp. Ind. Hyg. Dept. Bull. No. SD 57-80.

# ALUMINUM & COMPOUNDS

## Synonyms:

See below

## Description and Occupational Exposure:

*alkyl aluminum compounds*—serve primarily as catalysts

*alumina*—a finely ground powder used for paints and pyrotechnics

*aluminum chloride*—white crystals used in petroleum processing and the rubber industry

*aluminum metal*—silver white solid used for:

Aircraft • Alloys • Appliances • Automobiles • Construction materials • Food containers • Jewelry • Packaging • Paints • Pyrotechnics • Wire and cables • Other

*aluminum oxide*—a white powder used for:

Abrasives • Catalysts • Refractories

Corundum consists of aluminum oxide, iron, and silica

“Alundum” is an aluminum oxide produced by calcining bauxite

*aluminum silicate* (mullite)—as a residue from calcined alunite; used for cat litter

*bauxite*—the aggregate of natural aluminum bearing minerals from which aluminum metal is obtained

## Threshold Limit Value:

Aluminum metal and oxides — 10 mg/m<sup>3</sup>

Welding fumes — 5 mg/m<sup>3</sup>

Soluble salts — 2 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Salts are direct irritants

Pulmonary fibrosis—aluminosis—has been reported following exposure to finely ground aluminum powder and aluminum silicate

Pneumoconiosis associated with the abrasives, e.g., Shaver's disease, is now thought to be related to the silica content

### SIGNS AND SYMPTOMS:

Salts can produce irritation of the eyes, nose, and throat as well as dermatitis and skin burns

## ALUMINUM & COMPOUNDS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

Pulmonary changes are associated with anorexia, cough, dyspnea, chest pain, and weakness

Vital capacity and transfer factor may both be altered

Chest x-rays show: increased bronchovascular markings • small irregular opacities • occasional confluent foci

### DIAGNOSTIC TESTS:

Aluminum in serum and urine

Chest x-ray

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Progression of pulmonary fibrosis is slow

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing and chemical goggles when appropriate

Annual examination including chest x-ray where dust exposure exists

Preclude from exposure those individuals with chronic pulmonary disease

Mitchell, J., et. al. 1961. Pulmonary fibrosis in workers exposed to finely powdered aluminum. *Br. J. Ind. Med.* 18:10.

Musk, A.W. et.al. 1980. Pulmonary disease from occupational exposure to an artificial aluminum silicate used for cat litter. *Br. J. Ind. Med.* 32:367.

Shaver, C.G. and Riddell, A.R. 1947. Lung changes associated with the manufacture of aluminum abrasives. *J. Ind. Hyg. Toxicol.* 29:145.

## AMINOPHENOLS

### Synonyms:

Three isomers: ortho-, meta-, and para- (*o*-, *m*-, *p*-) hydroxyaniline.

### Description:

White to red yellow or brown crystals

## AMINOPHENOLS (*cont' d.*)

### Occupational Exposure:

Dye intermediate • Oil additive • Pharmaceuticals • Photography

### Threshold Limit Value:

None established

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

Methemoglobinemia may occur but is rare

#### SIGNS AND SYMPTOMS:

Contact dermatitis

Bronchial asthma has been reported

Methemoglobinemia can occur

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT: *TREAT AS AN EMERGENCY*

Terminate exposure

Remove all clothing

Wash and scrub total surface of body including ear canals and area beneath nails

Determine degree of methemoglobin hourly until a decrease is well established

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing

Preclude from exposure those individuals with skin and pulmonary diseases

## 2-AMINOPYRIDINE

### Synonyms:

Alpha-aminopyridine

### Description:

White crystals

### Occupational Exposure:

Dyes • Pharmaceuticals

### Threshold Limit Value:

0.5 ppm • 2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Convulsant

#### SIGNS AND SYMPTOMS:

Headache, dizziness, convulsions, nausea, and weakness •

Dyspnea

Hypertension, flushing of skin and collapse

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Wash contaminated areas of the body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Wet methods in operation

Approved respiratory protection • Protective clothing

Watrons, R.M. and Schulz, H.N. 1950. Cyclohexylamine, *p*-chloronitrobenzene, 2-aminopyridine: Toxic effects in industrial use. *Ind. Med. & Surg.* 19:317.

# AMMONIA

## Synonyms:

Two forms: Anhydrous • Aqueous

## Description:

Ammonia gas is colorless, strong pungent odor

## Occupational Exposure:

Chemical synthesis • Dyes • Explosives • Fertilizers • Glues •  
Leather tanning • Mirror silvering • Petroleum industry • Phar-  
maceuticals • Plastics • Refrigerant • Synthetic fibers

## Threshold Limit Value:

25 ppm • 18 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant and corrosive • Reflex respiratory inhibition • Bron-  
chiolitis obliterans

### SIGNS AND SYMPTOMS:

Conjunctival and corneal burns and ulceration

Irritation and burns of skin and mucous membranes

Inhalation may follow a biphasic course with initial chemical  
pneumonitis followed by some improvement and then a  
persistent obstructive respiratory failure

Pharyngeal pain • Chest pain • Cough • Dyspnea • Tachycardia  
and tachypnea • Aphonia • Laryngeal edema • Tracheitis •  
Pulmonary hemorrhage and edema • Bronchopneumonia

Chronic effects are bronchiectasis and small airway obliteration

### DIAGNOSTIC TESTS:

None specific

X-ray findings are not helpful in predicting the clinical course

Obstructive ventilatory changes

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of the body with soap and water

Oxygen and respiratory support to maintain PO<sub>2</sub>

## AMMONIA (*cont' d.*)

### TREATMENT (*cont' d.*):

- Bronchodilators and decongestants
- Diuretics and maintenance of fluid balance
- Sedation
- Corticosteroids
- Symptomatic and supportive

### DISABILITY:

- Eye damage may be permanent
- General burn scars may be disabling
- Pulmonary impairment may be permanent

### Preventive Measures:

- Adequate ventilation • Face shields • Approved respiratory protection
- Impervious protective clothing
- Preclude from exposure those individuals with eye, cardiac, and pulmonary diseases.

Flury, K.E. et.al. 1983. Airway obstruction due to inhalation of ammonia. *Mayo Clin. Proc.* 58(6):389.

Price, S.K. et.al. 1983. Fatal ammonia inhalation: A case report with autopsy findings. *S. Afric. Med. J.* 64(24):952.

Sobonya, R. 1977. Fatal anhydrous ammonia inhalation. *Hum. Path.* 8:293.

## AMMONIUM ALUM

### Synonyms:

- Aluminum ammonium sulfate

### Description:

- Colorless crystalline powder

### Occupational Exposure:

- Adhesives • Fireproofing • Food additive • Leather tanning • Mordant in dyeing • Paper • Sewage purification



## AMMONIUM ALUM (*cont' d.*)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Hydrolysis to form sulfuric acid

Depressant for central nervous system

#### SIGNS AND SYMPTOMS:

Dermatitis • Nausea, vomiting, and diarrhea • Hemorrhagic gastritis • Nephritis • Shock • Convulsions

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, exercising caution both in passing the tube and use of alkalis because of gas formation; follow lavage with demulcents

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles

## AMMONIUM PERSULFATE

### Synonyms:

Ammonium peroxydisulfate

### Description:

White crystals



## AMMONIUM PERSULFATE (*cont' d.*)

### Occupational Exposure:

Bleach • Dyes • Electroplating • Etching of zinc • Food preservative •  
Laboratory reagent • Photography

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Sensitizer

#### SIGNS AND SYMPTOMS:

Dermatitis • Urticaria • Rhinitis • "Baker's asthma"

#### DIAGNOSTIC TESTS:

Skin test may be positive

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Blandin, G. 1970. Desensitization of a hairdresser allergic to dyes and lacquers. *Rev. Franc. Allergol.* 10(4):327.

## AMMONIUM PICRATE

### Synonyms:

Ammonium carbazotate • Ammonium picronitrate • Picric acid,  
ammonium salt

### Description:

Bright yellow crystals

## AMMONIUM PICRATE (*cont' d.*)

### Occupational Exposure:

Explosives • Pyrotechnics • Rocket propellants

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Rhinitis • Papular, erythematous dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Preclude from exposure those individuals with known allergies

## AMMONIUM SULFIDE

### Synonyms:

Ammonium monosulfide

### Description:

Yellow to red liquid; deteriorates readily to hydrosulfide

## AMMONIUM SULFIDE (*cont' d.*)

### Occupational Exposure:

Metallurgy • Photography • Synthetic flavors • Textiles

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Cyanosis • Respiratory depression

*If ingested:* Burning in mouth, nausea and vomiting, diarrhea

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Oxygen

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Rubber protective clothing

## AMYL ACETATE

### Synonyms:

Banana oil • Isoamyl acetate • Pear oil

## AMYL ACETATE (*cont' d.*)

### Occupational Exposure:

Artificial leather, silk, pearls • Electrical industry • Lacquers and paints • Perfume and fruit essence • Photographic film • Polishes • Solvent • Textiles

### Threshold Limit Value:

*n*-Amyl acetate — 100 ppm • 530 mg/m<sup>3</sup>

*sec*-Amyl Acetate — 125 ppm • 665 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctival irritation • Irritation of nose and throat • Cough and chest pain • Shortness of breath • Dermatitis • Headache • Dizziness • Anorexia and nausea • Fatigue • Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Baldi, G. 1953. Pathology caused by industrial exposure to amyl, butyl and propyl acetate. *Med. Lav.* 44:469.

## AMYL ALCOHOLS

### Synonyms:

Natural compound is Fusel Oil: Grain oil • Potato oil • Potato spirit

Commercial compounds: *n*-Amyl alcohol • *tert*-Amyl alcohol •  
Isoamyl alcohol • 2-, 3-Pentanol

### Description:

Colorless liquids, aromatic odor

### Occupational Exposure:

Cements • Chemical synthesis • Explosives • Fruit essences and  
perfumes • Hydraulic fluids • Lacquers and paints • Petroleum  
refining • Pharmaceuticals • Plastics • Rubber • Textiles •  
Varnishes

### Threshold Limit Value:

Isoamyl alcohol— 100 ppm • 360 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Headache • Vertigo • Nausea, vomiting, diarrhea • Cough •

Dyspnea • Excitement and delirium • Coma

Diplopia and chromatopsia have occurred

Methemoglobinemia has been reported

#### DIAGNOSTIC TESTS:

Amyl alcohol in blood

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory  
protection • Rubber protective clothing

## AMYLENE

### Synonyms:

beta-Isoamylene • 2-Methyl-2-butene • 1,2-Pentene • Trimethyl ethylene

### Description:

Colorless liquid, unpleasant odor

### Occupational Exposure:

Chemical synthesis • Fuels

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and mucous membranes • Vertigo • Nausea • Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## ANILINE

### Synonyms:

Aminobenzene • Aminophen • Aniline oil • Benzeneamine • Phenylamine

## ANILINE (*cont'd.*)

### Description:

Colorless oily liquid which darkens to brown on exposure to air

### Occupational Exposure:

Chemical stabilizer • Dyes • Explosives • Inks • Optical whitening agents • Paints and varnishes • Perfumes • Pharmaceuticals • Photography • Plastics • Resins • Rubber industry

### Threshold Limit Value:

2 ppm • 10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Formation of methemoglobin—"anilism"

Intravascular hemolysis is possible

Depressant for cardiac and smooth muscle and for central nervous system

Sensitizer

#### SIGNS AND SYMPTOMS:

May be delayed several hours

Irritation of the eyes; corneal damage has been reported

Headache • Cyanosis • Dizziness • Weakness • Numbness of the extremities • Dyspnea • Chest pain • Tachycardia • Nausea • Vomiting • Abdominal pain • Malaise • Syncope • Convulsions

#### DIAGNOSTIC TESTS:

If ingestion has occurred, analyze the gastric aspirate

Methemoglobin determination

*p*-Aminophenol in urine

#### TREATMENT: *TREAT AS AN EMERGENCY*

Terminate the exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; this decontamination may have to be repeated

Determine the degree of methemoglobin hourly until a decrease is well established

## ANILINE (*cont'd.*)

### TREATMENT (*cont'd.*):

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless the methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour, but don't exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

### DISABILITY:

Recovery usually complete in 24–48 hours

### Preventive Measures:

Adequate ventilation of work area • Approved respiratory protection

Extreme cleanliness of work area and good personal hygiene

Protective clothing, laundered daily, in addition to use of synthetic butyl gloves and boots

Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis

Preclude from exposure those individuals with anemia, cardiovascular or pulmonary diseases

Harrison, M.R. 1977. Toxic methemoglobinemia: A case of acute nitrobenzene and aniline poisoning treated by exchange transfusion. *Anaesthesia* 32(3):270.

## ANTHRACENE

### Synonyms:

Green oil

### Description:

Colorless to yellow crystals

### Occupational Exposure:

Chemical synthesis • Dyes • Plastics • Smoke screens



## ANTHRACENE (*cont' d.*)

### Threshold Limit Value:

0.2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctival irritation with photophobia

Headache • Anorexia and nausea

Burning and itching of the skin with bronzing pigmentation  
and epitheliomata after prolonged chronic exposures

Photosensitivity

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

#### DISABILITY:

Epitheliomata may occur

### Preventive Measures:

Adequate ventilation • Protective clothing and gloves • Goggles or  
face shield

Protective skin creams may be helpful

Periodic examinations of exposed personnel with special attention to  
the skin

Preclude from exposure those individuals with chronic skin disorders  
and those who become sensitized

# ANTIMONY

## Synonyms:

Antimony regulus • Stibium

## Description:

Silver white powder

## Occupational Exposure:

Abrasives • Alloys • Cable sheathing • Foundries • Linotyping • Mining, smelting and refining • Pyrotechnics • Storage battery plates

## Threshold Limit Value:

Antimony and compounds — 0.5 mg/m<sup>3</sup>  
(suspect carcinogen in antimony trioxide production)  
Stibene (antimony hydride)—see page 501

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation (dust and fume)

### MODE OF ACTION:

Irritant • Binds sulfhydryl groups • Pneumoconiosis—antimoniosis

### SIGNS AND SYMPTOMS:

Conjunctivitis

Dermatitis (vesicular or pustular lesions) sometimes with residual pigmentation

Orange staining of dental surfaces occurs if oral hygiene is poor

Rhinitis, perforation of the nasal septum, pharyngitis, laryngitis, tracheitis, bronchitis, and pneumonitis

Bitter taste, nausea, vomiting, diarrhea, and abdominal cramps

Chronic exposures lead to dry throat, headaches, dizziness, anorexia and nausea, sleeplessness

### DIAGNOSTIC TESTS:

Blood antimony above 6 mg/100 g warrants removal from exposure

Urine antimony (normal < 2 µg/g creatinine) warrants removal from exposure

## ANTIMONY (*cont' d.*)

### DIAGNOSTIC TESTS (*cont' d.*):

Pulmonary function changes are nonspecific

Pneumoconiosis from antimony oxides is characterized by very dense small opacities in the middle and lower lung fields—onset usually after 10 or more years of exposure

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns as usual

Symptomatic and supportive

Dimercaprol has been recommended for severe systemic effects

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

No eating or smoking in work areas

Physical examinations of exposed personnel annually with special attention to skin and respiratory system

Preclude from exposure those individuals with chronic skin and pulmonary diseases

Gerhardsson, L. et. al. 1982. Antimony in lung, liver and kidney tissue from deceased smelter workers. *Scand. J. Work Environ. Hlth.* 8(3):201.

Potkonjak, V. and Pavlovich, M. 1983. Antimoniosis: A particular form of pneumoconiosis I Etiology, clinical and x-ray findings. *Int. Arch. Occup. Environ. Hlth.* 51(3):199.

## ANTIMONY TRICHLORIDE

### Synonyms:

Antimonous chloride • Caustic antimony

## ANTIMONY TRICHLORIDE (*cont' d.*)

### Description:

Colorless crystals

### Occupational Exposure:

Bronzing • Catalyst • Chemical synthesis • Fireproofing textiles •  
Laboratory reagent • Mordant

### Threshold Limit Value:

0.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Corrosive

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal ulceration

Perforation of nasal septum

Local skin burns • Headache • Chest pain • Cough • Dyspnea •

Nausea and vomiting • Abdominal pain

#### DIAGNOSTIC TESTS:

Urinary antimony levels

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns as usual

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory  
protection • Protective clothing

Taylor, P.J. 1966. Acute intoxication from antimony trichloride. *Brit. J. Ind. Med.* 23:318.

# ANTIMONY TRISULFIDE

## Synonyms:

Antimonous sulfide

## Description:

Gray powder

## Occupational Exposure:

Catalyst • Ceramics • Dyeing • Flameproofing • Pyrotechnics •  
Plasticizer

## Threshold Limit Value:

0.5 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Irritant • May cause myocardial damage

### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

Laryngitis • Tracheitis • Pneumonitis •

*If ingested:* Anorexia • Nausea • Vomiting and diarrhea •

Headache • Vertigo • Muscular pain

### DIAGNOSTIC TESTS:

Antimony in blood and urine

ECG may show prolonged ST segments, wide QRS  
complexes, and flattened T waves

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of skin with soap and water

Symptomatic and supportive

Dimercaprol has been recommended for severe systemic effects

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory  
protection • Protective clothing

## ANTIMONY TRISULFIDE (*cont'd.*)

### Preventive Measures (*cont'd.*):

No eating or smoking in work areas

Physical examination of exposed personnel annually including ECG

Brieger, H. et. al. 1954, Industrial antimony poisoning. *Ind. Med. & Surg.* 23:521.

## ARSENIC AND COMPOUNDS

### Synonyms:

Elemental arsenic

Pentavalent compounds in use:

Arsenic acid • Arsenic pentoxide • Calcium arsenate • Lead arsenate

Trivalent inorganic compounds commonly encountered:

Arsenic trichloride • Arsenic trioxide • Calcium arsenite • Cupric arsenite • Lead arsenite • Sodium arsenite

### Occupational Exposure:

Alloys • Antifouling paints • Copper smelting • Glass manufacture • Insecticides • Leather tanning • Metallurgy • Pigment production • Taxidermy • Textile printing • Wood preservative

### Threshold Limit Value:

Arsenic — 0.2 mg/m<sup>3</sup>

Arsenic compounds, soluble — 0.2 mg/m<sup>3</sup>

Arsenic compounds, organic — 0.5 mg/m<sup>3</sup> OSHA PEL

Arsenic compounds, inorganic — specific OSHA regulations apply

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Inhibits oxidative phosphorylation

Inhibits lactate utilization

Fragments myelin sheaths with destruction of axis cylinder

Increases capillary permeability

## ARSENIC AND COMPOUNDS (*cont' d.*)

### MODE OF ACTION (*cont' d.*):

Inorganic arsenicals can cause hepatic angiosarcoma, but none of these have been work related  
Pulmonary and lymphatic cancers

### SIGNS AND SYMPTOMS:

Acute industrial intoxication is more likely to arise from inhalation of ARSINE

Chronic intoxications can follow an insidious pattern

#### *General:*

Malaise and weakness • Anorexia and nausea • Weight loss

*Skin:* (usually one to six weeks after first exposure)

There may be an early erythematous flushing and pruritis

Diffuse, brown, dry, fine, scaly desquamative dermatitis—"smelter's itch"

Hyperpigmentation occurs and may be localized to areolae, axillae, and groins

Hyperkeratosis of palms and soles follows

Hair loss can occur

Brittle nails occasionally show transverse white bands—Mee's lines

Keratoses occur after 8 or more years exposure and epitheliomata after 15–20 years

#### *Eyes:*

Eyelid edema, conjunctivitis, and even corneal erosion are seen with corrosive arsenical vapors

#### *Respiratory:*

Nasal irritation with perforation of the septum

Inflammation of the mouth, pharyngitis, and hoarseness

Cough and chest pain

#### *Gastrointestinal:*

Nausea, vomiting, abdominal pain, and diarrhea

Hepatic toxicity is possible

#### *Hematopoietic:*

Anemia, leukopenia, and aplastic anemia have been reported

#### *Genitourinary:*

Hematuria and albuminuria



## ARSENIC AND COMPOUNDS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

*Central nervous system:* Effects may begin several weeks after exposure and findings are usually symmetrical

- Numbness, burning, and tingling of hands and feet beginning distally and spreading centrally
- Muscular weakness and ultimate atrophy
- Fasciculation and gross tremors can occur
- Ataxia and incoordination
- Impaired sense of touch, pain, temperature, vibration, and position can occur
- Decreased deep tendon reflexes with foot and wrist drop in later stages
- Mental confusion

### DIAGNOSTIC TESTS:

Arsenic in urine above 0.2 mg/liter is suggestive (but seafood ingestion, especially shellfish can produce substantial elevations of urinary arsenic for several days)

Hair and fingernail analysis may be helpful but reliability is questioned

### TREATMENT: *TREAT AS AN EMERGENCY*

Exposure to arsenical solutions require immediate irrigation of the eyes and thorough washing of body

If ingested, gastric lavage, using ferric chloride tincture and sodium carbonate in an approximate 30:1 ratio, followed by administration of activated charcoal and a saline cathartic

Dimercaprol for severe intoxication:

- 3 mg/kg i.m. every four hours for two days, every six hours on third day, then twice daily for ten days
- Topical dimercaprol has been recommended for arsenical skin damage, but evaluation is lacking
- Dimercaprol does not seem to help reverse neurologic changes, thus should be given early if it is to be used

Exchange transfusions and hemodialysis have been recommended in special instances

Identification and measurement of arsenic species can assist in determining proper use of chelation therapy

Symptomatic and supportive



## ARSENIC AND COMPOUNDS (*cont'd.*)

### DISABILITY:

Liver, hematopoietic and nervous system damage may be permanent

Pulmonary and lymphatic cancer

### Preventive Measures:

Wet methods where possible

Adequate ventilation • Chemical goggles for handling liquid solutions • Approved respiratory protection • Protective clothing including gloves and head hood

No eating or smoking in work area • Good personal hygiene

Physical examinations of exposed personnel periodically with special attention to skin and nervous system

Preclude from exposure those individuals with diseases of skin, blood, liver, lungs, kidney, and central nervous system

Garb, L.G. and Hine, C.H. 1977. Arsenical neuropathy: Residual effects following acute industrial exposure. *JOM*. 19(8):567.

Lovell, M.A. and Farmer, J.G. 1985. Arsenic speciation in urine from humans intoxicated by inorganic arsenic compounds. *Human Toxicol.* 4:203.

Peters, H.A. et. al. 1984. Seasonal arsenic exposure from burning chromium-copper-arsenate treated wood. *JAMA*. 251(5):2393.

Pinto, S.S. et. al. Nov/Dec. 1978. Mortality experience of arsenic exposed workers. *Arch. Environ. Hlth.* 325.

Schoolmeester, W.L. and White, R.W. 1980. Arsenic poisoning. *Southern Med. J.* 73(2):198.

## ARSINE

### Synonyms:

Arsenic hydride • Arseniuretted hydrogen • Hydrogen arsenide

### Description:

Colorless gas, garlic odor

### Occupational Exposure:

Arsine can be generated when inorganic arsenic compounds contact sources of nascent hydrogen

## ARSINE (*cont' d.*)

### Occupational Exposure (*cont' d.*):

Battery manufacture • Chemical synthesis • Etching • Lead plating •  
Metal pickling • Metal smelting and refining • Semiconductor  
manufacture • Soldering

### Threshold Limit Value:

0.05 ppm • 0.2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Red blood cell hemolysis via glutathione reduction, process  
may continue even after toxic exposure ceases  
Toxic effect on bone marrow  
Hemorrhagic hepatitis and nephritis plus tubular necrosis  
Central nervous system depressant

#### SIGNS AND SYMPTOMS: (may be delayed from 2–24 hours)

Headache • Dizziness • Weakness • Malaise  
Nausea • Vomiting • Abdominal pain  
Chest discomfort may accompany dyspnea  
Dark red urine usually within 4–6 hours past exposure can be  
followed by oliguria and anuria  
Hepatomegaly and jaundice after 24–48 hours  
Bronze skin discoloration may be due to microdeposits of  
arsenic  
Transverse nail striae may show 2–3 weeks later  
Polyneuropathy and encephalopathy have been reported  
Chronic toxicity from a cumulative effect has been reported,  
characterized by mild anemia, shortness of breath, and  
weakness

#### DIAGNOSTIC TESTS:

Acute hemolytic anemia with an increased plasma hemoglobin  
concentration  
Urine arsenic above 50 µg/liter

## ARSINE (*cont'd.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

Exchange transfusions decrease the arsenic burden and remove damaged red blood cells

Alkaline diuresis to minimize hemoglobin precipitation

Hemodialysis for the oliguric or anuric patient

### DISABILITY:

Recovery is usually complete

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Periodic examination of urine arsenic levels

Preclude from exposure those individuals with diseases of blood, liver, kidney, and central nervous system

Blackwell, M. and Robbins, A. 1979. Arsinine (arsenic hydride) poisoning in the workplace. *Am. Ind. Hyg. Assoc. J.* 40:A56.

Fowler, B.A. and Weissburg, J.B. 1974. Arsinine poisoning. *NEJM.* 291:1171.

Kleinfeld, M.J. 1980. Arsinine poisoning. *JOM.* 22(12):820.

Levinsky, W.J. et. al. 1970. Arsinine hemolysis. *Arch. Environ. Hlth.* 20:436.

## ASBESTOS

### Synonyms:

*Common names:* Earth flax • Stone flax • Mountain cork

*Amphiboles:* Actinolite (calcium magnesium iron silicate) • Amosite (ferrous magnesium silicate) • Anthophyllite (essentially magnesium silicate) • Crocidolite (blue asbestos—sodium iron silicate) • Tremolite (calcium magnesium silicate)

*Chrysotile:* White asbestos (hydrated magnesium silicate)

### Description:

Flax-like fibers

### Occupational Exposure:

Brake and clutch linings • Fillers for paints and plastics • Floor tile and roofing materials • Friction materials • Insulation and fireproofing • Textiles • Wallboards

Nonoccupational exposures are abundant

## ASBESTOS (*cont' d.*)

### Threshold Limit Value:

2 fibers/cc

Specific OSHA regulations apply

Carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION: (exact mechanism not known)

Asbestos warts from fibers that penetrate the epidermis

Asbestotic pneumoconiosis

Pleural plaques

Laryngeal and bronchogenic carcinoma

Mesothelioma of pleura and peritoneum

#### SIGNS AND SYMPTOMS:

Asbestos bodies in the sputum are fibers coated with protein and mucopolysaccharide; a marker of exposure but the number present is unrelated to extent of disease

*Asbestosis*: (after 5–25 years latency)

Believed to be dose related

Interstitial fibrosis begins in respiratory bronchioles but spreads to involve terminal bronchioles and acinae

Ultimate architectural alteration results in honeycombing—fibrosis, cysts, and emphysema

Fine basilar crepitations, dyspnea, chest pain, cough; finger clubbing occurs late

X-ray: Early fine linear opacities gradually replaced by irregular opacities especially in lower lung fields • Cysts and bullae often accompanied by elevated diaphragms

*Pleural plaques*: (may occur alone or with asbestosis)

Generally asymptomatic, but sometimes associated with pleural effusions

X-rays show thickening of the parietal pleura along the rib line or over the diaphragm • Calcification may occur

*Bronchogenic cancer*:

Generally considered work related only when associated with asbestosis

Latency period is about 20 years

## ASBESTOS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

#### *Bronchogenic cancer (cont'd.):*

Risk increases with total dose and length of exposure

Incidence among smokers is about 8 times that of nonsmokers

#### *Laryngeal cancer:*

Incidence is also greater among exposed workers who smoke

#### *Mesothelioma:*

Latency period is longer than for cancer and there appears to be no relation to smoking

Probably related to the total burden and crocidolite poses the greatest threat

None of the three types (epithelioid, sarcomatous, mixed) seem to arise from pleural plaques

### DIAGNOSTIC TESTS:

History of asbestos exposure

X-ray evidence of parenchymal fibrosis

Signs and symptoms of pulmonary fibrotic disease

Corroborative lung biopsy

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Asbestosis is a progressive disease even after cessation of exposure

Mesothelioma life expectancy is about one year

### Preventive Measures:

Adequate ventilation and dust control • Isolation of working areas • Good working practices • Full protective equipment where adequate dust control is not achieved

Physical examination of exposed personnel annually including spirometry and chest x-rays

Preclude from exposure those individuals with pulmonary disease and those who show early evidence of disease

AMA Chicago. 1984. A physician's guide to asbestos-related diseases from the council on scientific affairs. *JAMA*. 252(18):2593.

Chung, A. and Warnock, M.L. 1980. Asbestos fibers in the general population. *Am. Rev. Resp. Dis.* 122:669.

Health & Safety Executive. 1979. Asbestos. Final report of advisory committee, London: Her Majesty's Stationery Office.

## ASBESTOS (*cont' d.*)

Levine, R.J., ed. 1979. Asbestos: An information resource. NCI (USDHEW) Pub. No. 79-1681. Bethesda, MD: U.S. Gov't. Printing Office.

## ASPHALT

### Synonyms:

Asphaltum • Bitumen • Mineral pitch • Petroleum asphalt

### Description:

A dark brown to black semisolid residue from crude oil distillation;  
benzo (a) pyrene content is variable

### Occupational Exposure:

Asphalt production, handling, and transport • Insulation • Linings for antirust and sealing • Paints and varnishes • Paving • Roofing • Waterproofing

### Threshold Limit Value:

(fumes) 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Dusts and fumes may be inhaled

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Skin burns can occur from hot asphalt  
Fumes irritate the eyes  
Acne-like skin lesions and keratoses  
Melanosis and photosensitivity can occur

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Immediate cooling of asphalt on the skin facilitates removal  
Treat burns in usual manner



## ASPHALT (*cont' d.*)

### TREATMENT (*cont' d.*):

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Face shields when handling molten asphalt •  
Protective clothing that can be removed quickly if required • Good  
personal hygiene  
Actinic barrier creams may be useful  
Periodic examination of exposed personnel to detect dermatitis

Baylor, C.H. and Weaver, N.K. 1968. A health survey of petroleum  
asphalt workers. *Arch. Environ. Hlth.* 17:210.

NIOSH. 1977. Asphalt fumes: Criteria for a recommended standard.  
DHEW Pub. No. (NIOSH) 78-106. Washington, DC: U.S. Gov't.  
Printing Office.

## AZIDES

### Synonyms:

Azoimide • Bromine azide • Copper azide • Hydrogen azide (hydrazoic  
azide) • Lead azide • Potassium azide • Sodium azide • Others

### Description:

Colorless needles and liquids

### Occupational Exposure:

Chemical synthesis • Explosives • Herbicides • Laboratory reagent  
(in automated blood cell counters) • Rocket fuels  
Sodium azide can react with copper and brass plumbing to release  
lead and copper azides

### Threshold Limit Value:

Sodium azide — 0.1 ppm • 0.3 mg/m<sup>3</sup>

## AZIDES (*cont' d.*)

Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Metallic azides liberate hydrazoic acid when in contact with acid solutions

Irritant

Azide ion produces vasodilation via direct action on smooth muscle

Inhibits cytochrome oxidase

### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Severe throbbing headache and facial flush

Dizziness • Palpitation • Hypotension • Collapse • Dyspnea and chest pain • Sweating, nausea, and diarrhea

Paresthesias of extremities and dimness of vision have been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Good personal hygiene • No eating or smoking in work areas

Preclude from exposure those individuals with cardiovascular and central nervous system diseases



## AZIDES (*cont' d.*)

- Edmonds, O.P. and Bourne, M.S. 1982. Sodium azide poisoning in five laboratory technicians. *Brit. J. Ind. Med.* 39(3):308.
- Emmett, E.A. and Ricking, L.A. 1975. Fatal self-administration of sodium azide. *Ann. Int. Med.* 83:224.
- Richardson, S.G.N. 1975. Two cases of sodium azide poisoning by accidental ingestion of Isoton. *J. Clin. Path.* 28(5):350.

# BAKELITE

## Synonyms:

None

## Description:

A phenolic plastic obtained by polymerizing phenol and formaldehyde under heat and pressure

## Occupational Exposure:

Dust generation when bakelite is worked

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritation • Possible sensitizer

It is possible that some free formaldehyde could exist

### SIGNS AND SYMPTOMS:

Respiratory disease pattern tends to resemble extrinsic allergic alveolitis

Rhinitis • Weakness • Anorexia • Weight loss • Cough •  
Dyspnea • Fever • Hemoptysis

### DIAGNOSTIC TESTS:

X-rays show disseminated reticulonodular lesions

Ventilatory functions show a restrictive pattern

Biopsy of the lungs show granulomas containing bakelite

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Progressive respiratory deficiency can occur

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Physical examination annually for exposed personnel with special attention to pulmonary function

## BAKELITE (*cont'd.*)

### Preventive Measures (*cont'd.*)

Preclude from exposure those individuals with chronic pulmonary disease

Pimental, J.C. 1973. A granulomatous lung disease produced by bakelite: A clinic-pathologic and experimental study. *Am. Rev. Resp. Dis.* 108:1303.

## BARIUM AND COMPOUNDS

### Synonyms:

*Insoluble compound:* Barium sulfate

*Soluble compounds:* Barium carbonate • Barium chloride • Barium hydroxide • Barium nitrate • Barium sulfide

### Description:

White to yellow granules, powders, and crystals

### Occupational Exposure:

Beet sugar purification • Brick and tile manufacture • Electronics • Fire extinguisher • Glass and ceramics • Mold lubricant • Paper manufacture • Pharmaceuticals • Pyrotechnics • Rodenticide • Rubber and linoleum • X-ray diagnosis

### Threshold Limit Value:

Soluble compounds — 0.5 mg/m<sup>3</sup>

**Toxicity:** *SOLUBLE COMPOUNDS ARE HIGHLY TOXIC*

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

*Soluble compounds:* Irritants • Cause hypokalemia • Acidosis  
*Insoluble barium* produces a pneumoconiosis

### SIGNS AND SYMPTOMS:

*Soluble salts:*

Irritation of eyes and mucous membranes • Dermatitis and burns

## BARIUM AND COMPOUNDS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

#### *Soluble salts (cont' d.):*

*If ingested:* Nausea • Vomiting • Abdominal pain • Slow, irregular pulse • Cyanosis • Dyspnea • Muscular paralysis • Hypokalemia

#### *Insoluble compounds:*

Baritosis—a benign pneumoconiosis associated with cough but no pulmonary function abnormalities

### DIAGNOSTIC TESTS:

Barite pneumoconiosis appears on the chest x-ray as profusely distributed small (1–4 mm) irregular opacities

### TREATMENT: *TREAT SOLUBLE COMPOUND INTOXICATION AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis (use sodium or magnesium sulfates to precipitate unabsorbed barium salts in intestinal tract and aid excretion)

Vigorous diuresis

Monitor electrolytes carefully

Calcium gluconate for muscular spasms

Oxygen

Symptomatic and supportive

### DISABILITY:

Recovery is to be expected

Baritosis produces no respiratory incapacity and x-ray changes are reversible after cessation of exposure

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and aprons when indicated

Physical examination annually for employees exposed to barite dust, including chest x-ray and pulmonary function studies

Preclude from exposure to insoluble barium those individuals with pulmonary diseases

## BARIUM AND COMPOUNDS (*cont' d.*)

- Doig, A.T. 1976. Baritosis: A benign pneumoconiosis. *Thorax*. 31:30.  
Gould, D.B. et. al. 1973. Barium sulfide poisoning. *Arch. Intern. Med.* 132:891.

## BENTONITE

### Synonyms:

Colloidal clay

### Description:

Light to cream material with a precise chemical composition, but containing variable amounts of silica

### Occupational Exposure:

Ceramics and refractories • Cosmetics • Food additive • Foundry binder • Mining and milling • Oil well slurries and drilling fluids • Paper coatings • Polishes • Sealant • Thickening agent

### Threshold Limit Value:

Will vary with the silica content

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Silicosis, if quartz content is high

#### SIGNS AND SYMPTOMS:

See silicosis

#### DIAGNOSTIC TESTS:

Chest x-ray

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Pulmonary impairment can be permanent

## BENTONITE (*cont'd.*)

### Preventive Measures:

- Adequate ventilation • Approved respiratory protection
- Physical examination of exposed personnel annually including chest x-ray and pulmonary function tests
- Preclude from exposure those individuals with pulmonary diseases

Phibbs, B.P. et. al. 1971. Silicosis in Wyoming bentonite workers.  
*Am. Rev. Resp. Dis.* 103:1.

## BENZANTHRONE

### Synonyms:

Mesobenzanthrone

### Description:

Pale yellow needles

### Occupational Exposure:

Colored chemical smokes • Dyes • Fluorescent pigments

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Anorexia • Weight loss • Fatigue • Weakness  
Eczema may be associated with a grayish pigmentation of skin  
Gastritis with altered liver function studies can occur  
Loss of libido is reported

#### DIAGNOSTIC TESTS:

None established

## BENZANTHRONE (*cont' d.*)

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Symptomatic and supportive

### DISABILITY:

- No permanent effects reported

### Preventive Measures:

- Adequate ventilation
- Encourage good personal hygiene
- Annual examination of exposed personnel including liver function studies
- Preclude from exposure those individuals with diseases of the skin, gastrointestinal tract, and liver
- Remove from exposure those who become sensitized

- Joshi, A. et. al. 1982. Interaction of benzanthrone with reconstituted collagen fibrils. *Ind. Hlth.* 20:305.
- Singh, G.B. 1970. Toxicity of dyes with special reference to benzanthrone. *Indian J. Ind. Med.* 16(3):122.

## BENZENE

### Synonyms:

- Benzol • Coal naphtha • Cyclohexatriene • Phenyl hydride

### Description:

- Clear liquid

### Occupational Exposure:

- Chemical synthesis • Detergent • Dyestuffs • Explosives • Motor fuels • Oil extraction • Pharmaceuticals • Photogravure printing • Solvent

### Threshold Limit Value:

- 10 ppm • 30 mg/m<sup>3</sup>
- Suspect carcinogen

## BENZENE (*cont' d.*)

Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Benzene is metabolized in body to phenol or some other myelotoxin to cause aplastic anemia

Leukemogen • Liver damage • Central nervous system depression • Cardiac sensitization

### SIGNS AND SYMPTOMS:

#### *Acute:*

Direct irritation of eyes

Euphoria • Excitement • Headache • Vertigo • Incoherent speech • Narcosis

Central nervous system depression with respiratory paralysis

Gastrointestinal irritation with nausea, vomiting, and abdominal colic

Skin irritation with erythema and blistering

Cardiac sensitization with arrhythmias and sudden death have been reported

#### *Chronic:*

Anorexia and nausea • Weight loss • Fatigue and weakness • Headache • Dizziness • Nervousness and irritability

#### *Hematologic disorders:*

Pancytopenia • Aplastic anemia • Leukemia, myelogenous or monocytic

Other types of malignancy are suspect

### DIAGNOSTIC TESTS:

Benzene in alveolar air and blood

Urinary phenol levels of less than 10 mg/liter suggest no significant exposure (salicylate ingestion and other medicinals will also alter urinary phenol levels)

### TREATMENT:

*Acute: TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water



## BENZENE (*cont' d.*)

### TREATMENT (*cont' d.*):

#### *Acute (cont' d.):*

Gastric lavage, if ingested, followed by saline catharsis  
CPR and oxygen  
Symptomatic and supportive

#### *Chronic:*

Symptomatic and supportive

### DISABILITY:

Recovery from acute exposure is usually complete  
Chronic hematologic effects may be permanent

### Preventive Measures:

Adequate ventilation with regular atmospheric sampling  
Rotate personnel  
Approved respiratory protection • Protective clothing  
Regular determination of urinary phenols and blood counts  
Periodic examination of exposed personnel in conjunction with  
biologic monitoring  
Preclude from exposure those individuals with chronic blood  
disorders

- Aksoy, M. 1980. Different types of malignancies due to occupational exposure to benzene: A review of recent observations in Turkey. *Environ. Res.* 23:181.  
Brief, R.S. et. al. 1980. Benzene in the workplace. *Am. Ind. Hyg. Assoc. J.* 41:616.  
Irons, R. D. 1982. Toxicology updates: Benzene. *J. Appl. Toxicol.* 2:57.  
Tauber, J. B. 1970. Instant benzol death. *JOM.* 12(12):520.

## BENZIDINE

### Synonyms:

4,4'-Biphenyl diamine • 4,4'-Diaminobiphenyl • 4,4'-Diamino  
diphenyl • 4,4'-Diphenylene diamine • *para*-Diaminodiphenyl

### Description:

White to reddish powder

## BENZIDINE (*cont'd.*)

### Occupational Exposure:

Chemical synthesis • Dyestuffs • Laboratory reagent • Plastics •  
Rubber industry • Security paper

### Threshold Limit Value:

No exposure by any route  
Specific OSHA regulations apply  
Carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Bladder carcinogen

#### SIGNS AND SYMPTOMS:

Urinary frequency, dysuria, and hematuria  
Dermatitis

#### DIAGNOSTIC TESTS:

Benzidine in urine  
Urine cytology in early detection of bladder tumors  
Cystoscopy as indicated

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Closed systems • Regulated areas  
Full body protection with appropriate decontamination procedures  
when leaving controlled areas

Walker, B. J. and Gerber, A. 1982. Occupational exposure to aromatic amines: Benzidine and benzidine-based dyes. NCI Monograph No. 58.

Yamaguchi, N. et. al. 1982. Periodic urine cytology surveillance of bladder tumor incidence in dyestuff workers. *Am. J. Ind. Med.* 3:139 and 243.

## BENZOYL PEROXIDE

### Synonyms:

Benzoyl superoxide • Dibenzoyl peroxide

### Description:

Granular solid

### Occupational Exposure:

Bleaching agent • Catalyst • Chemical synthesis • Cosmetics •  
Pharmaceuticals • Plasticizer

### Threshold Limit Value:

5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Dermatitis and burns

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

#### DISABILITY:

No permanent effect reported

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Protective  
clothing including rubber gloves

No eating or smoking in work area

## BENZYL CHLORIDE

### Synonyms:

alpha-Chlorotoluene • (Chloromethyl) benzene

## BENZYL CHLORIDE (*cont'd.*)

### Description:

Colorless liquid, irritating odor

### Occupational Exposure:

Chemical synthesis • Dyes • Perfumes • Plastics and resins •  
Pharmaceuticals • Photography • Synthetic tannins

### Threshold Limit Value:

1 ppm • 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous ?

#### MODE OF ACTION:

Irritant • Sensitizer

Liver damage has been reported

Forms phosgene when heated to decomposition

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract • Conjunctivitis and  
corneal damage

Skin burns are possible

Weakness and fatigue • Headaches • Irritability • Insomnia •  
Anorexia

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with alcohol, then with soap  
and water

Treat skin burns in usual manner

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## BENZYL CHLORIDE (*cont' d.*)

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing
- Physical examination of exposed personnel at regular intervals including studies of liver function
- Preclude from exposure those individuals with liver diseases

Fishbein, L. 1979. Potential halogenated industrial carcinogenic and mutagenic chemicals. *Sci. of Total Environ.* 11:259.

## BERYLLIUM AND COMPOUNDS

### Synonyms:

- Beryl ore
- Beryllium chloride • Beryllium fluoride • Beryllium nitrate • Beryllium nitrite • Beryllium oxide • Beryllium sulfate hydrate

### Description:

- Element is a grayish-white metal
- Salts are crystals and powders of various colors

### Occupational Exposure:

- Mining and handling beryl ore appears nonhazardous
- Alloys • Atomic energy projects • Ceramic and refractory products • Chemical reagents • Electronic industry • Gas mantel hardener • Rocket fuels • X-ray tubes

### Threshold Limit Value:

- 0.002 mg/m<sup>3</sup>
- Compounds — specific OSHA regulations apply
- Suspect carcinogen

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

- Inhalation • Traumatic implantation

## BERYLLIUM AND COMPOUNDS (*cont'd.*)

### MODE OF ACTION:

Primary irritant with a direct toxic effect on tissue  
Delayed hypersensitivity mechanism is not understood

### SIGNS AND SYMPTOMS:

#### *Local effects:*

Acute conjunctivitis and corneal irritation have occurred  
Contact dermatitis from acute exposures or a delayed reaction characterized by erythema and papulovesicular lesions—recovery usually follows cessation of exposure  
Skin ulcerations are associated with contaminated wounds  
Subcutaneous granulomata follow traumatic implantation and may cause repetitious ulceration until beryllium is removed

#### *Acute:*

Inhalation effects may occur up to one week following a brief massive exposure  
Rhinitis, pharyngitis, tracheitis, and chemical pneumonitis can progress to fatal pulmonary edema  
Cough, dyspnea, chest pain, rales, hemoptysis, anorexia, weight loss, fatigue, and cyanosis  
X-rays show progressive diffuse haziness, irregular infiltrates, and increased vascular markings  
Pulmonary function tests show restrictive defect  
Recovery usually is complete within four weeks, but symptoms can persist for a year

#### *Chronic:*

Beryllium disease presents a variable picture  
Delay between onset and last exposure is likely to be greater than 10 years and then follows a pattern with remissions and exacerbations  
Cough, chest pain, dyspnea, anorexia and weight loss, pulmonary osteoarthropathy, hepatomegaly and splenomegaly, hypercalciuria and renal calculi, associated chronic skin lesions  
Pulmonary function may show restrictive, obstructive or diffusion defects

## BERYLLIUM AND COMPOUNDS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

#### *Chronic (cont' d.):*

X-rays show a mixed pattern of infiltrations along with hilar adenopathy and frequently these changes are symmetrical

### DIAGNOSTIC TESTS:

History of beryllium exposure  
Clinical pulmonary disease consistent with known facts  
X-ray evidence of interstitial pulmonary disease  
Biopsy showing granulomas and/or beryllium  
Skin testing is contraindicated

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat burns in usual manner  
Remove beryllium from all open wounds and excise deeper beryllium implants or chronic granulomas  
Dermatitis usually responds to removal from exposure, antihistamines, and steroids  
Pulmonary exposures should be hospitalized for observation, monitoring, and support with symptomatic therapy—long term corticosteroid therapy may be required

### DISABILITY:

Acute pneumonitis is now becoming rare  
Reversal of x-ray abnormalities has been reported  
Chronic pulmonary impairment does occur

### Preventive Measures:

Adequate ventilation with regular air monitoring  
Wet processes and closed systems when possible  
Protective clothing including hoods, face shields, and gloves  
Approved respiratory equipment  
Good personal hygiene • No eating or smoking in work areas  
Examination of exposed personnel before exposure, at appropriate intervals during tenure of employment, and at the termination of employment, to include chest x-rays, pulmonary function studies, and other tests as may be indicated



## BERYLLIUM AND COMPOUNDS (*cont'd.*)

### Preventive Measures (*cont'd.*):

Preclude from exposure those individuals with: Chronic conditions of skin, liver, kidneys, heart and lungs • Abnormal chest x-rays, pulmonary function studies or blood counts • Acquired sensitization • Pregnancy

Special attention must be given to all exposed personnel with unexplained or prolonged respiratory symptoms

Eisenbud, M. and Lisson, J 1983. Epidemiological aspects of beryllium-induced non-malignant lung disease: A 30 year update. *JOM*. 25(3):196.

Rees, P. J. 1979. Unusual course of beryllium lung disease. *Brit. J. Dis. Chest*. 73:192.

Sprince, N. L. et. al. 1978. Reversible respiratory disease in beryllium workers. *Am. Rev. Resp. Dis*. 117:1011.

## BICYCLOHEPTADIENE DIBROMIDE

### Synonyms:

Brominated bicycloheptadiene

### Description:

Colorless liquid

### Occupational Exposure:

Chemical research

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Sensitizer • Respiratory irritant

Bone marrow depression is possible



## BICYCLOHEPTADIENE DIBROMIDE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Conjunctivitis • Rhinitis • Dyspnea • Cough • Asthmatic breathing and pneumonia  
Anemia and purpura may occur

### DIAGNOSTIC TESTS:

Positive skin test

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Pulmonary impairment is possible  
Death has been reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Rubber protective clothing  
Preclude from exposure those individuals with a history of allergy as well as pulmonary and blood diseases  
Remove from exposure those who become sensitized

## BIPYRIDYLS

### Synonyms:

Diquat (1,1-ethylene-2,2-bipyridylium dibromide) • Morfamquat • Paraquat (1,1'-dimethyl-4,4'-bipyridylium dichloride) •

### Description:

White crystals

### Occupational Exposure:

Herbicide

### Threshold Limit Value:

Diquat — 0.5 mg/m<sup>3</sup>  
Paraquat — 0.1 mg/m<sup>3</sup>

## BIPYRIDYLS (*cont' d.*)

Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Ingestion • Percutaneous

### MODE OF ACTION:

Local irritant

Centrilobular hepatic necrosis

Renal tubular necrosis

Toxic myocarditis

Cerebral edema and hemorrhage

Diffuse alveolitis and interstitial fibrosis

### SIGNS AND SYMPTOMS: Some may be delayed 3–10 days

Irritation of the eyes with conjunctivitis and corneal erosion reaching maximum intensity in 24 hours

Nasal irritation can be accompanied by epistaxis

Spray operators can develop transverse white bands or cracking of the fingernails with ridging and occasional nail loss

Skin irritation can occur and if the surface is broken erythematous vesiculation and ulceration may occur; systemic symptoms follow if substantial absorption takes place

#### *Ingestion:*

Diquat does not appear to cause serious poisoning or delayed pulmonary fibrosis

Early soreness and inflammation of the mouth, throat, and esophagus

Nausea, vomiting, and abdominal discomfort; diarrhea may occur late

Sweating, tremors, and convulsions

Toxic myocarditis is associated with conduction defects

Jaundice and oliguria with azotemia

Dyspnea, chest tightness, cough, hemoptysis, fever, bronchopneumonia, and pulmonary edema

### DIAGNOSTIC TESTS:

Paraquat urine levels of less than 0.3 ppm in the first 24 hours have not been associated with systemic toxicity, but excretion rates above 1 mg/hour after 8 hours following ingestion carry a poor prognosis

Plasma levels above 2 mg/L at 48 hours are usually associated with a fatal outcome

## BIPYRIDYLS (*cont' d.*)

### DIAGNOSTIC TESTS (*cont' d.*):

Chest x-rays vary from streaky opacities to complete obliteration of markings

Pulmonary function tests show a restrictive defect with abnormal gas transfer

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in usual manner after thorough cleansing

*If ingested:*

Induce vomiting then gastric lavage with 1 liter of a suspension of 30% Fullers earth or bentonite •

Follow with sodium or magnesium sulfate purge •

Repeat the lavage and purge every 2 hours the first day and every 4 hours the second day

Monitor fluid and electrolyte status carefully

Use hemodialysis if indicated

Oxygen should be used sparingly since it enhances paraquat toxicity

PEEP may cause bullous formation

Cyclophosphamide and dexamethasone appear to be useful

Low-dose irradiation of whole lungs has been used

Symptomatic and supportive

### DISABILITY:

Recovery may require weeks

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing including gloves

No eating or smoking in work areas

Periodic examination of exposed personnel with attention to fingernails and skin

Urinary monitoring may be indicated in special circumstances

Preclude from exposure those individuals with diseases of the heart, lung, liver, and kidneys

Addo, E. and Poon-King, T. 1986. Leucocyte suppression in treatment of 72 patients with paraquat poisoning. *Lancet* 4:1112.

## BIPYRIDYLS (*cont'd.*)

- Grant, H. C. et. al. 1980. Cerebral damage in paraquat poisoning. *Histopathology*. 4:185.
- Howard, J. K. 1980. Paraquat: A review of worker exposure in normal usage. *J. Soc. Occup. Med.* 30:6.
- Newhouse, M. et. al. 1978. Percutaneous paraquat absorption. *Arch. Derm.* 114:1516.
- Webb, D.B. et. al. 1984. Resolution after radiotherapy of severe pulmonary damage due to paraquat poisoning. *Brit. Med. J.* 288:1259.

## BIS (CHLOROMETHYL) ETHER

### Synonyms:

BCME • Chloro (chloromethoxy) methane • Dichloromethyl ether • sym-Dichloro dimethyl ether

### Description:

Colorless liquid

### Occupational Exposure:

Chloromethylations • Ion exchange resins • Polymer manufacture  
Technical grades of chloromethyl methyl ether contain BCME as an impurity

There is evidence that formaldehyde and chloride ions in ambient air can form BCME under certain conditions

### Threshold Limit Value:

0.001 ppm • 0.005 mg/m<sup>3</sup>  
Specific OSHA regulations apply  
Carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Carcinogen

## BIS (CHLOROMETHYL) ETHER (*cont' d.*)

### SIGNS AND SYMPTOMS:

Irritation of the eyes and respiratory tract  
Pulmonary carcinoma of the oat cell, or small cell type

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

May be fatal

### Preventive Measures:

Containment in an isolated, automated system  
Meticulous housekeeping and personal hygiene  
Approved respiratory protection and protective clothing  
Annual examination of exposed personnel including chest x-rays and sputum studies where indicated.

- Travenins, S.Z.M. 1982. Formation and occurrence of bis (chloromethyl) ether and its prevention in the chemical industry. *Scand. J. Work Environ. Hlth.* 8 (suppl 3).  
Weiss, W. et. al. 1979. Lung cancer in chloromethyl ether workers. *Am. Rev. Resp. Dis.* 120:1031.

## BISMUTH AND COMPOUNDS

### Synonyms:

Bismuth nitrate • Bismuth oxide • Bismuth sulfide • Bismuth tri-chloride • Others

### Description:

Element is a gray-white metal with pink tinge  
Salts are white, yellow, and brown crystals

### Occupational Exposure:

Alloys • Catalysts • Ceramics • Cosmetics • Magnets • Paints •  
Pharmaceuticals • Semiconductors • X-ray contrast medium

## BISMUTH AND COMPOUNDS (*cont'd.*)

### Threshold Limit Value:

Bismuth telluride — 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Appears to combine with sulfhydryl groups of essential enzymes interfering with cellular metabolism

Encephalopathy, kidney and liver damage have occurred when bismuth is used medicinally

#### SIGNS AND SYMPTOMS:

Foul breath • Stomatitis and gingivitis • Metallic taste • Anorexia and nausea • Headache • Malaise • Generalized joint pains • Sleeplessness

Pruritis • Urticaria • Exfoliative dermatitis

Blue-black lines on gums and buccal mucosa

Encephalopathy

#### DIAGNOSTIC TESTS:

Bismuth in urine

#### TREATMENT:

D-penicillamine appears to be most effective

BAL may form lipid soluble complexes with an increased concentration in the brain

Symptomatic and supportive

#### DISABILITY:

No permanent effects from occupational exposure are reported

#### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the nervous system and including studies of liver and kidney function

## BISMUTH AND COMPOUNDS (*cont'd.*)

Basinger, M.A. et. al. 1983. Antidotes for acute bismuth intoxication. *J. Toxicol-Clin. Toxicol.* 20:159.

Martin-Bouyer, G. et. al. 1981. Epidemiologic study of encephalopathies following bismuth administration per os—characteristics of intoxicated subjects: Comparison with a control group. *Clin. Toxicol.* 18:1277.

## BORANES

### Synonyms:

Boron hydrides • Hydrogen borides

### Description:

Decaborane (decaboron tetradecahydride)—White crystals

Diborane (boroethane, diboron hexahydride)—Colorless gas

Pentaborane (pentaboron monohydride)—Colorless liquid

### Occupational Exposure:

Catalysts • Chemical synthesis • Fuel synthesis • Fluxing agents •  
Pharmaceutical industry • Reducing agents • Rocket propellants •  
Welding

### Threshold Limit Value:

Decaborane — 0.5 ppm • 0.3 mg/m<sup>3</sup>

Diborane — 0.1 ppm • 0.1 mg/m<sup>3</sup>

Pentaborane — 0.005 ppm • 0.01 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

There is evidence of liver and kidney damage

#### SIGNS AND SYMPTOMS: May be delayed up to 24 hours

Irritation of the eyes with keratoconjunctivitis and corneal erosion

Irritation of nose and skin

A metal-fume fever type syndrome has been reported after



## BORANES (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*)

inhalation of diborane, but with a long incubation period  
Low level exposures tend to cause headache, dizziness, drowsiness, nausea, muscular weakness, spasm, and cramps  
More serious exposures produce fatigue, euphoria, lethargy, chest tightness, cough, slurred speech, nystagmus, confusion, incoordination, and convulsions

### DIAGNOSTIC TESTS:

Boron level in urine may be unreliable

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water  
Wash contaminated areas of body with soap and water or 3% aqueous ammonia  
Gastric lavage, if ingested, followed by saline catharsis  
Oxygen, with IPPB if available  
Anticonvulsants as indicated  
Symptomatic and supportive

### DISABILITY:

Symptoms may last several days

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved respiratory protection • Impervious protective clothing including gloves and boots  
No eating or smoking in work areas  
Encourage personal hygiene  
Annual examination of exposed personnel including complete blood count, liver and kidney function studies, urinalysis, and chest x-ray  
Preclude from exposure those individuals with a history of blood disorders and diseases of the lungs, kidney, and liver

Hart, R.P. et.al. 1984. Neuropsychological function following mild exposure to pentaborane. *Am. J. Ind. Med.* 6:37.



## BORON AND COMPOUNDS (except Boranes)

### Synonyms and Description:

Borax (sodium borate, sodium tetraborate)—White powder

Boric acid (boracic acid, orthoboric acid)—Colorless crystals

Boron—Red-brown crystalline powder has no reported toxicity

Boron oxide (boric anhydride, boric oxide, boron trioxide)—

Colorless crystalline powder, reacts with water to produce heat and boric acid

Boron trifluoride (boron fluoride)—Colorless gas

### Occupational Exposure:

Alloys • Antiseptics • Cleaning preparations • Cosmetics •  
Detergents • Dyeing • Electronics • Fertilizers • Fireproofing •  
Glassware • Glazes • Herbicides • Metallurgy • Pharmaceuticals •  
Photographic industry • Preservatives • Printing • Soaps •  
Soldering flux • Tanning

### Threshold Limit Value:

Anhydrous borates — 1 mg/m<sup>3</sup>

Boron oxide — 10 mg/m<sup>3</sup>

Boron trifluoride — 1 ppm • 3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation (boron trifluoride is very corrosive) •  
Percutaneous (boric acid, especially if skin is damaged)

#### MODE OF ACTION:

Irritant • Central nervous system damage  
Renal and hepatic injury may occur

#### SIGNS AND SYMPTOMS: Unusual in occupational exposures

##### *Acute:*

Irritation of eyes and respiratory tract • Nausea •  
Vomiting • Abdominal pain • Diarrhea  
Headache and weakness  
Tachycardia • Cyanosis • Shock • Oliguria  
Erythematous rash followed by peeling  
Delirium and convulsions

## BORON & COMPOUNDS (except Boranes) (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

#### *Chronic:*

Anorexia • Nausea • Abdominal discomfort  
Conjunctivitis • Rhinitis with epistaxis  
Erythema of entire body with vesicles and papules on  
occasion, followed by desquamation  
Hair loss  
Dryness of mouth and throat with cough and dyspnea

### DIAGNOSTIC TESTS:

Boron in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Monitor fluid and electrolyte balance  
Symptomatic and supportive

### DISABILITY:

No occupational disability reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing if indicated  
Annual examination of exposed personnel including studies of liver and kidney function

Dhgarabrant, L.B. et.al. 1985. Respiratory effects of borax dust. *Brit. J. Ind. Med.* 42:831.

Garabrant, D.H. et.al. 1984. Respiratory and eye irritation from boron oxide and boric acid dusts. *JOM* 26(8):584.

Tan, T.G. 1970. Occupational toxic alopecia due to borax. *Acta Derm. (Stockholm)* 50:55.

## BROMINE

### Synonyms:

None

## BROMINE (*cont' d.*)

### Description:

Red-brown liquid, irritating fumes

### Occupational Exposure:

Bleaching agent • Chemical synthesis • Dyestuffs • Gasoline additive • Gold extraction • Military gas • Oxidizing agent • Pharmaceuticals • Solvent

### Threshold Limit Value:

0.1 ppm • 0.7 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Corrosive

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Lacrimation • Corneal ulceration

Epistaxis

Skin burns may be very deep

Brownish discoloration of tongue and pharynx

Hoarseness • Asthma • Bronchitis • Pneumonia • Pulmonary edema

Nausea • Abdominal pain • Diarrhea

Headache, vertigo, anorexia, indigestion, irritability, and joint pains have been reported by employees exposed to low atmospheric levels

Cumulative effects must be considered

#### DIAGNOSTIC TESTS:

Bromine in blood and urine

#### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Burns may be treated with a sodium bicarbonate paste or symptomatically

Symptomatic and supportive

## BROMINE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots  
Preclude from exposure those individuals with chronic pulmonary disease

Champeix, J. et.al. 1970. Clinical and experimental study of poisoning by bromine vapors. *Poumon. Coeur* 26:895.

## BROMOCHLOROMETHANE

### Synonyms:

Chlorobromomethane • Chloromethyl bromide • Méthylene chlorobromide

### Description:

Colorless liquid, chloroform-like odor

### Occupational Exposure:

Chemical synthesis • Fire extinguisher

### Threshold Limit Value:

200 ppm • 1050 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes • Dermatitis

*Gastrointestinal:* Anorexia • Nausea and vomiting •  
Abdominal pain • Weight loss

## BROMOCHLOROMETHANE (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

*Central nervous system:* Headache • Dizziness • Memory impairment • Disorientation • Paresthesias • Weakness • Tremors and convulsions • Coma

### DIAGNOSTIC TESTS:

Bromide blood level

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen

Sedation

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Preclude from exposure those individuals with central nervous system disorders

Rutstein, H.R. 1963. Acute chlorobromomethane toxicity. *Arch. Environ. Hlth.* 7:440.

## BROMOFORM

### Synonyms:

Methenyl tribromide • Tribromomethane

### Description:

Colorless liquid, chloroform-like odor

### Occupational Exposure:

Chemical synthesis • Pharmaceuticals • Solvent

### Threshold Limit Value:

0.5 ppm • 5 mg/m<sup>3</sup>

## BROMOFORM (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of the eyes, skin, and throat

Headache • Dizziness • Listlessness

Chest pain

Narcosis and coma

#### DIAGNOSTIC TESTS:

Bromoform in expired air

Bromine in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by enemas

Oxygen

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

## BUTADIENE

### Synonyms:

Biethylene • Bivinyll • Divinyll • Erythrene • Pyrrolylene • Vinyl ethylene

### Description:

Colorless gas, aromatic odor

## BUTADIENE (*cont' d.*)

### Occupational Exposure:

Latex • Paints • Plastics • Resins • Rocket fuel • Synthetic rubber

### Threshold Limit Value:

1000 ppm • 2200 mg/m<sup>3</sup>

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and upper respiratory tract and dermatitis

Headache • Vertigo • Drowsiness • Loss of consciousness

Local frostbite may follow contact with the liquid form

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## BUTANE

### Synonyms:

*n*-Butane • Butyl hydride • Methethyl methane



## BUTANE (*cont'd.*)

### Description:

Colorless gas

### Occupational Exposure:

Aerosol propellant • Chemical synthesis • Fuel • Refrigerant • Solvent

### Threshold Limit Value:

800 ppm • 1900 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Asphyxiant

#### SIGNS AND SYMPTOMS:

Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Cardiorespiratory support

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Purchon, D.W. 1980. General hazards and necessary precautions associated with the storage, handling and use of liquified petroleum gas fuel. *Environ. Hlth.* 88:221.

## BUTYL ACETATE

### Synonyms:

Three isomers: *norm-*, *sec-*, *tert-*



## BUTYL ACETATE (*cont' d.*)

### Description:

Colorless liquids, pleasant odor

### Occupational Exposure:

Artificial leather • Cosmetics • Dehydrating agent • Flavoring extracts • Gasoline additive • Lacquers • Perfumes • Photography • Safety glass • Solvent • Straw hats

### Threshold Limit Value:

N- — 150 ppm • 710 mg/m<sup>3</sup>

*sec-* and *tert-* — 200 ppm • 950 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and "polisher's keratitis" (fine vacuolar lesions of cornea)

Dermatitis

Mild irritation of respiratory tract

Headache • Anorexia and Nausea

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Baldi, G. 1953. Pathology caused by industrial exposure to amyl, butyl and propyl acetate. *Med. Lav.* 44:469.

# ***n*-BUTYL ALCOHOL**

## **Synonyms:**

1-Butanol • Butyric alcohol

## **Description:**

Colorless liquid

## **Occupational Exposure:**

Artificial leather • Chemical synthesis • Perfumes • Pharmaceuticals •  
Photographic films • Plastics • Rubber cements • Solvent

## **Threshold Limit Value:**

50 ppm • 150 mg/m<sup>3</sup>

## **Toxicity:**

### **ROUTE OF ENTRY:**

Inhalation

### **MODE OF ACTION:**

Irritant • Central nervous system depressant

### **SIGNS AND SYMPTOMS:**

Conjunctivitis and fine vacuolar keratitis

Contact dermatitis

Respiratory tract irritation

Headache • Dizziness • Drowsiness

### **DIAGNOSTIC TESTS:**

Butyl alcohol in expired air

Blood alcohol

### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### **DISABILITY:**

No permanent effects reported

## **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

## ***n*-BUTYL ALCOHOL (cont' d.)**

Astrand, I. et.al. 1976. Exposure to butyl alcohol. Uptake and distribution in man. *Scand. J. Work Environ. Hlth.* 3:165.

## **BUTYLAMINE**

### **Synonyms:**

1-Aminobutane • *n*-Butylamine

### **Description:**

Colorless liquid, ammoniacal odor

### **Occupational Exposure:**

Dyestuffs • Emulsifying agent • Pesticides • Pharmaceuticals • Photography • Rubber • Synthetics • Textiles

### **Threshold Limit Value:**

5 ppm • 15 mg/m<sup>3</sup>

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation • Percutaneous

#### **MODE OF ACTION:**

Irritant

#### **SIGNS AND SYMPTOMS:**

Irritation of eyes, nose, and throat

Skin burns

Headache and flushing of skin of face

#### **DIAGNOSTIC TESTS:**

None established

#### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### **DISABILITY:**

No permanent effects reported

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

# BUTYL CATECHOL

## Synonyms:

*para-tertiary-Butylcatechol* • 4-*tert*-Butyl-1,2-dihydroxybenzene

## Description:

Colorless crystals

## Occupational Exposure:

Manufacture of polyester resins, rubber, plastics and paint •  
Petroleum products

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

None

### MODE OF ACTION:

Contact irritant and sensitizer

### SIGNS AND SYMPTOMS:

Depigmentation in areas of contact  
Allergic contact dermatitis

### DIAGNOSTIC TESTS:

Patch test may be positive

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Vitiligo and sensitization may be permanent

## Preventive Measures:

Rubber protective clothing  
Remove from exposure those individuals who become sensitized

Horio, T. et.al. 1977. Depigmentation due to *para-tertiary-butyl* catechol. *Int. Arch. Occup. Environ. Hlth.* 39(3):127.

## BUTYL FORMATE

### Synonyms:

Butyl methanoate

### Description:

Colorless liquid

### Occupational Exposure:

Chemical synthesis • Flavors • Lacquers • Perfumes • Resins • Solvent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of the eyes and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## *n*-BUTYL-GLYCIDYL ETHER

### Synonyms:

BGE • 1-*n*-Butoxy-2,3-epoxypropane

## ***n*-BUTYL-GLYCIDYL ETHER (cont'd.)**

### **Description:**

Colorless liquid, irritating odor

### **Occupational Exposure:**

Chemical synthesis • Stabilizer for chlorinated solvents • Viscosity reducing agent

### **Threshold Limit Value:**

25 ppm • 135 mg/m<sup>3</sup>

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation • Percutaneous

#### **MODE OF ACTION:**

Irritant • Sensitizer • Central nervous system depressant

#### **SIGNS AND SYMPTOMS:**

Irritation of eyes • Rhinorrhea • Cough • Anorexia • Nausea • Vomiting • Headache • Diplopia • Inability to concentrate • Ataxia • Lethargy

#### **DIAGNOSTIC TESTS:**

None established

#### **TREATMENT:**

Irrigate eyes with water  
Wash contaminated areas of skin with soap and water  
Symptomatic and supportive

#### **DISABILITY:**

Central nervous system effects can last for months

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing  
Remove from exposure those who become sensitized

Wallace, E. 1979. Effects of *n*-butyl glycidylether exposure. *J. Soc. Occup. Med.* 29:142.

## BUTYL 2-METHYL-2-PROPENOATE

### Synonyms:

Butyl 2-methacrylate • Methacrylic acid, butyl ester • 2-Propenoic-2-methyl butyl ester

### Description:

Clear liquid, aromatic odor

### Occupational Exposure:

Preparation of synthetic resins

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and respiratory tract

Dermatitis

Nausea, dizziness, and drowsiness

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles, approved respiratory protection, impervious gloves, aprons, and boots as indicated

## ***tert*-BUTYL PERBENZOATE**

### **Synonyms:**

*tert*-Butyl peroxybenzoate • Peroxybenzoic acid

### **Description:**

Yellowish liquid, aromatic odor

### **Occupational Exposure:**

Chemical intermediate • Polymerization initiator for polyethylene, polystyrene, polyacrylates, and polyesters

### **Threshold Limit Value:**

None established

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Irritant

#### **SIGNS AND SYMPTOMS:**

Irritation of eyes, skin, and respiratory tract

#### **DIAGNOSTIC TESTS:**

None established

#### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing as required



## *p-tert*-BUTYL PHENOL

### Synonyms:

4-(1,1-Dimethyl ethyl) phenol

### Description:

Colorless liquid

### Occupational Exposure:

Antioxidant in mineral oil • Detergent-germicide solutions • Glues and resins for adhesives

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Liver damage • Depigmentation mechanism not understood

#### SIGNS AND SYMPTOMS:

Redness and soreness at site of skin contact, followed by slowly progressive loss of pigment

Nonexposed parts of the body may also be affected

#### DIAGNOSTIC TESTS:

Areas are easily detected by use of a Wood's UV lamp

Patch tests may aggravate depigmentation

*p-tert*-Butyl phenol in urine

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Leucoderma may be permanent

### Preventive Measures:

Protective gloves and clothing • Approved respiratory protection

Periodic examination of exposed personnel for early skin lesions can be aided by use of a Wood's lamp

Remove from exposure those who develop vitiligo

## *p*-tert-BUTYL PHENOL (*cont'd.*)

Calnan, C.D. and Cooke, M.A. 1974. Leucoderma in industry. *J. Soc. Occup. Med.* 24:59.

James, O. et.al. 1977. Occupational vitiligo induced by *p*-tert-butyl phenol, a systemic disease? *Lancet* II:1217.

## BUTYL TOLUENE

### Synonyms:

*para*-tert-Butyl toluene • 1-Methyl-4-*tert*-butyl benzene • TBT

### Description:

Colorless liquid

### Occupational Exposure:

Chemical synthesis • Solvent

### Threshold Limit Value:

10 ppm • 60 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Irritation of respiratory tract • Headache •  
Dizziness • Metallic taste • Nausea • Weakness

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## BUTYL TOLUENE (*cont' d.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

## *n*-BUTYRALDOXIME

### Synonyms:

Butanaloxime

### Description:

Liquid

### Occupational Exposure:

Printing ink antioxidant

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Appears to inhibit aldehyde dehydrogenase thereby permitting an antabuse-like response following ingestion of alcohol

#### SIGNS AND SYMPTOMS:

Congestion of conjunctiva, nose, and throat • Maculopapular rash on face, neck, and upper trunk • Drowsiness • Palpitation

#### DIAGNOSTIC TESTS:

Increased acetaldehyde in blood

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Effects disappear in 24 hours

## ***n*-BUTYRALDOXIME** (*cont' d.*)

### **Preventive Measures:**

Adequate ventilation

Employees should be instructed that ingestion of alcohol following exposure at work may result in symptoms

# CADMIUM AND COMPOUNDS

## Synonyms:

Cadmium chloride • Cadmium metal • Cadmium oxide • Cadmium sulfide • Others

## Description:

Chemical element is silvery white metal  
Salts are yellow, orange, and brown crystals

## Occupational Exposure:

Alkaline storage batteries • Alloys • Amalgams • Catalysts • Ceramics • Dyes • Electroplating • Engraving • Fluorescent lamps • Fungicides and insecticides • Glazes • Jewelry • Lubricants • Metallizing • Nuclear reactors • Pigments • Photo cells and photoconductors • Photographic industry • Pyrotechnics • Semiconductors • Soldering, brazing, and welding

## Threshold Limit Value:

0.05 mg/m<sup>3</sup>

## Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Ingestion—by swallowing irrespirable particles cleared through mucociliary transport and environmental contamination  
Inhalation

### MODE OF ACTION:

Inhibits sulfhydryl enzymes  
Direct damage to pulmonary epithelium and renal tubular epithelium  
Liver and bone marrow disturbances have been reported

### SIGNS AND SYMPTOMS:

#### *Acute:*

May resemble metal fume fever after 4–10 hours delay  
Irritation of eyes, nose, and throat • Chest tightness • Cough • Dyspnea • Headache • Vertigo • Weakness • Myalgia • Chills • Nausea • Vomiting • Abdominal colic • Diarrhea  
Sometimes after a delay of 1–3 days, pulmonary edema with rales, wheezing, hemoptysis and prostration occur and the patient may develop a progressive pulmonary fibrosis

## CADMIUM AND COMPOUNDS (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

#### *Chronic:*

- Onset may be delayed years beyond last exposure
- Rhinitis, perforation of nasal septum and anosmia
- Yellow staining of teeth can occur along with caries
- Anorexia, insomnia, fatigue, weight loss, pallor, and anemia
- Dyspnea and obstructive pulmonary changes occur even in the absence of an acute or subacute pneumonitis history
- Impaired renal function is characterized by proteinuria (low molecular weight protein) which may persist for many years
- Osteomalacia appears to be secondary to renal tubular damage

### DIAGNOSTIC TESTS:

- Do not use blood cadmium levels to monitor body burden or exposure
- Urinary cadmium levels above 10 $\mu$ g/l indicate exposure and if kept below 15  $\mu$ g/day will probably prevent renal damage

### TREATMENT: *TREAT ACUTE EXPOSURES AS EMERGENCIES*

- Hospitalize where patient can be carefully monitored and supported
- Edathamil calcium disodium appears to offer some advantages over BAL

### DISABILITY:

- Pulmonary and renal changes may be permanent

### Preventive Measures:

- Adequate ventilation with regular monitoring • Approved respiratory protection • Meticulous personal hygiene
- No eating or smoking in work areas
- Physical examination of exposed personnel annually including spirometry, chest x-ray, and urinalysis
- Cadmium urine levels should be kept at or below 10  $\mu$ g/gm creatinine
- Preclude from exposure those individuals with chronic diseases of lungs, liver, kidneys, and blood

## CADMIUM AND COMPOUNDS (*cont' d.*)

- Barnhart, S. and Rosenstock, L. 1984. Cadmium chemical pneumonitis. *Chest* 86:789.
- Blainey, J.D. et.al. 1980. Cadmium induced osteomalacia. *Brit. J. Ind. Med.* 37:278.
- DeSilva, P.E. and Donnan, M.B. 1981. Chronic cadmium poisoning in a pigment manufacturing plant. *Brit. J. Ind. Med.* 38(1):76.
- Lee, J.S. and White, K.L. 1980. A review of the health effects of cadmium. *Am. J. Ind. Med.* 1(3):307.

## CALCIUM CARBIDE

### Synonyms:

Acetylenogen • Carbide

### Description:

Gray-black lumps

### Occupational Exposure:

Alloys • Generating acetylene gas • Pyrotechnics • Reducing agent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant (forms calcium hydroxide and acetylene in the presence of moisture)

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal ulcerations • Irritation of respiratory tract • Fissuring and ulceration of lips and fingers • Onychia and paronychia

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## CALCIUM CARBIDE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves or barrier creams

Preclude from exposure those individuals with chronic skin diseases

## CALCIUM CHLORIDE

### Synonyms:

Calcium chloride dihydrate

### Description:

White crystals

### Occupational Exposure:

Brine • Concrete mixes • Dehydrating agent • Dust control ("street salting") • Fabric sizing • Fire extinguisher • Fungicide • Glues and cements • Pharmaceuticals • Wood preservative

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Epistaxis and perforation of nasal septum • Skin irritation with erythema and peeling • Nausea and vomiting

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive



## CALCIUM CHLORIDE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Approved respiratory protection • Rubber protective clothing or coveralls

## CALCIUM CYANAMIDE

### Synonyms:

Calcium carbimide • Cyanamide • Lime nitrogen • Nitrolime

### Description:

Colorless crystals

### Occupational Exposure:

Chemical synthesis • Defoliant • Fertilizer • Herbicide • Pesticide • Steel hardening

### Threshold Limit Value:

0.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Dissolves in body fluids to release free cyanamide, ammonia, and calcium carbonate

Cyanamide inhibits aldehyde dehydrogenase

#### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

Rhinitis with perforation of nasal septum, pharyngitis and tracheobronchitis

Erythematous dermatitis over exposed body surfaces, especially involving the finger and palmar creases

## CALCIUM CYANAMIDE (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

Systemic absorption can result in erythematous flushing of the face, torso, and upper extremities associated with headache, nausea, dyspnea, tachycardia, and hypotension—attack is potentiated by the ingestion of alcohol

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

NO ALCOHOL

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Murakami, H. 1961. Calcium cyanamide poisoning. *Ind. Med. & Surg.* 30:35.

## CALCIUM OXYCHLORIDE

### Synonyms:

Bleaching powder • Chloride of lime

### Description:

White powder, contains calcium hypochlorite

### Occupational Exposure:

Algicide • Bleaching agent • Chemical synthesis • Deodorant • Disinfectant • Fungicide • Oxidizing agent • Pesticide • Water treatment

## CALCIUM OXYCHLORIDE (*cont' d.*)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant, evolves free chlorine

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal ulceration • Gingivitis and dental erosion • Rhinitis and laryngitis • Dermatitis and skin burns

If ingested, can cause oral, esophageal, and gastric burns

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective gloves or clothing as required

## CALCIUM OXIDE

### Synonyms:

Burnt lime • Calx • Fluxing lime • Lime • Quicklime

### Description:

White lumps or crystals

## CALCIUM OXIDE (*cont'd.*)

### Occupational Exposure:

Binding agent • Bleach • Chemical synthesis • Dehairing agent •  
Dehydrating agent • Flux • Fungicide • Insecticide • Laboratory  
reagent • Refractory material • Sewage treatment

### Threshold Limit Value:

2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Reacts with water to form calcium hydroxide and release heat  
Alkaline caustic reaction  
Thermal effects  
Sensitivity to cobalt and nickel contaminants can occur

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal ulceration  
Rhinitis with perforation of the nasal septum; sometimes oral  
ulcerations  
Tracheitis and pneumonia  
Dermatitis with fissuring, vesiculation and burns  
Fingernail brittleness

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

Eye injury could be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory  
protection • Rubber protective clothing

Weiler, K.J. and Ruessel, H.A. 1980. Skin damage in construction  
workers caused by cement, lime and plaster. *Beruf. Umwelt* 28:182.

# CALCIUM SULFATE

## Synonyms:

Alabaster • Gypsum • Mineral white • Plaster of Paris • Satin spar • Selenite • Terra alba

## Description:

White, blue, gray or red crystalline powders

## Occupational Exposure:

Dessicant • Dyeing • Food additive • Metallurgy • Mining • Paper manufacture • Pigment • Polishing powders • Pottery molds • Soil conditioner • Wallboard

## Threshold Limit Value:

10 mg/m<sup>3</sup> total dust

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis • Rhinitis with epistaxis • Irritation of the pharynx and trachea

Skin irritation can occur

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

Decrements in pulmonary function have been reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Oakes, D. et.al. 1982. Respiratory effects of prolonged exposure to gypsum dust. *Ann. Occup. Hyg.* 26:833.

# CAMPHOR

## Synonyms:

2-Bornanone • 2-Camphanone • Gum camphor • Laurel camphor

## Description:

Clear crystalline masses, penetrating odor

## Occupational Exposure:

Chemical synthesis • Cosmetics • Explosives • Flavoring • Insecticides • Lacquer • Mildew preventive • Pharmaceuticals • Plastics • Pyrotechnics

## Threshold Limit Value:

2 ppm • 12 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Irritant • Central nervous system stimulant

### SIGNS AND SYMPTOMS:

Irritation of the eyes and nose

Anosmia has been reported

Ingestion produces: Irritation of the throat, nausea and vomiting • Headache, dizziness, mental confusion • Increased muscular excitability and convulsions

### DIAGNOSTIC TESTS:

Camphorol in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

Resin hemoperfusion has been used effectively

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots

## CAMPHOR (*cont'd.*)

- Gronka, P.A. et.al. 1969. Camphor exposures in a packaging plant.  
*Am. Ind. Hyg. Assoc. J.* 30:276.  
Kopelman, R. et.al. 1979. Camphor intoxication treated by resin  
hemoperfusion. *JAMA* 241(7):727.

## CARBON BLACK (amorphous)

### Synonyms:

- Acetylene black—obtained from the combustion of acetylene
- Activated charcoal—derived from wood and vegetables
- Animal charcoal—obtained from charred bones, meat, and blood
- Gas black—from the incomplete combustion of natural gas
- Lamp black—made by burning oils, fats, and resins
- Thermal black—obtained by thermal decomposition of natural gas or oil

### Description:

- Fine black powder

### Occupational Exposure:

- Catalyst • Deodorant • Electrical insulation • Electroplating • Filters • Inks • Pharmaceuticals • Pigment • Tire manufacturing • Waste treatment

### Threshold Limit Value:

- 3.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

- Inhalation

#### MODE OF ACTION:

- Irritating effects are believed due to contaminants

#### SIGNS AND SYMPTOMS:

- Nuisance irritation
- Dermal folliculitis and keratosis have been reported
- Chronic bronchitis and decreased pulmonary function values have been reported



## CARBON BLACK (amorphous) (*cont'd.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic

### DISABILITY:

None anticipated

### Preventive Measures:

Adequate ventilation • Eye and respiratory protection as indicated

Cocarla, A. et.al. 1976. Carbon black pneumoconiosis. *Int. Arch. Occup. Environ. Hlth.* 36(3):217.

Nau, C.A. et.al. 1976. Properties and physiological effects of thermal carbon black. *JOM* 18(11):733.

Oleru, U.G. et.al. 1983. Pulmonary function and symptoms of Nigerian workers exposed to carbon black in dry cell battery and tire factories. *Environ. Res.* 30:161.

## CARBON DIOXIDE

### Synonyms:

Carbonic acid gas • Carbonic anhydride

### Description:

Colorless, odorless gas

### Occupational Exposure:

Aerosol propellant • Beverage industry • Chemical synthesis • Cloud seeding • Dry ice • Fire extinguisher • Food preservation • Mines, caves, tunnels, wells, silos • Pharmaceuticals • Refrigerant • Welding

### Threshold Limit Value:

5000 ppm • 9000 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation



## CARBON DIOXIDE (*cont'd.*)

### MODE OF ACTION:

Asphyxiant

Initial stimulant then depressant to central nervous system

### SIGNS AND SYMPTOMS:

Concentrations above 1% can produce subclinical physiological changes

Above 5% concentration, headaches and some dyspnea may be apparent

Concentrations between 5% and 10% cause headache, dizziness, tinnitus, increased respiratory rate, malaise, drowsiness, and unconsciousness

Concentrations of 10% or more can be life threatening in a short time

Skin burns can occur following contact with solid carbon dioxide (dry ice)

### DIAGNOSTIC TESTS:

Blood gases

### TREATMENT:

Oxygen and respiratory resuscitation

Skin burns to be treated in usual manner

Symptomatic and supportive

### DISABILITY:

Prolonged hypoxia may result in permanent damage

### Preventive Measures:

Assure adequate air supply

Protective clothing for handling dry ice

Exposed employees should meet the cardio-respiratory standards required for respirator use

Perez, E.L. and Silverman, M. 1981. Case report: CO<sub>2</sub> intoxication. *Psychiatr. J. Univ. Ottawa* 6(4):226.

Riley, R.L. and Bromberger-Barnea, B. 1979. Monitoring exposure of brewery workers to CO<sub>2</sub>: A study of cellar workers and controls. *Arch. Environ. Hlth.* 34(2):92.

# CARBON DISULFIDE

## Synonyms:

Carbon bisulfide • Dithiocarbonic anhydride

## Description:

Clear yellow liquid

## Occupational Exposure:

Degreasing • Dyes • Electroplating • Enamels • Explosives • Grain fumigation • Optical glass • Paints and paint removers • Preservatives • Rocket fuel • Soil disinfectants • Solvent • Synthetic fiber manufacture • Textiles • Varnishes

## Threshold Limit Value:

10 ppm • 30 mg/m<sup>3</sup>

## Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Enzyme inhibition via sulfhydryl groups

Interferes with conversion of dopamine to norepinephrine

Atherosclerosis by causing proliferation of the vascular endothelium

Liver and kidney damage

Optic nerve damage

### SIGNS AND SYMPTOMS:

#### *Acute:*

Conjunctivitis and keratitis

Skin irritation and burns

Nausea, vomiting and abdominal pains

Headache, dizziness, euphoria, unconsciousness, and convulsions

#### *Chronic:* Usually after 10–15 years exposure

*Central nervous system*—Peripheral neuropathies, both motor and sensory, associated with paresthesias, altered deep tendon reflexes, ataxia, and muscular atrophy • Central scotomata, contraction of the color field, optical neuritis and retinal hemorrhages • Anos-

## CARBON DISULFIDE (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

#### *Chronic (cont' d.):*

- mia* • Psychiatric—subacute encephalopathy with memory deficit, excitement, depression, delusions, hallucinations, delirium and coma
- Cardiovascular*—Atherosclerotic changes in the heart, kidneys, and brain with hypertension and coronary artery disease
- Gastrointestinal*—Anorexia, chronic gastritis, liver dysfunction
- Genitourinary*—Hypertensive nephrosclerosis with albuminuria and hematuria
- General*—Debility, fatigue, anemia, dermatitis, altered menses, impotence, and thyroid disturbances

### DIAGNOSTIC TESTS:

- Carbon disulfide in blood, urine, and expired air
- Iodine azide urine test is useful in evaluating exposures and may be useful in detecting hypersusceptible employees

### TREATMENT: *TREAT AS AN EMERGENCY*

- Oxygen with cardiorespiratory support as indicated
- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Symptomatic and supportive

### DISABILITY:

- Effects of mild overexposure soon disappear
- Recovery from encephalopathy may leave residual psychiatric symptoms
- Peripheral neuropathies may be permanent
- Mortality from coronary artery disease is increased
- Extensive vascular changes carry a poor prognosis

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots
- Examination of exposed personnel at regular intervals with special attention to the cardiovascular, genitourinary, and central nervous systems

## CARBON DISULFIDE (*cont' d.*)

### Preventive Measures (*cont' d.*):

Periodic iodine azide test with judicious interpretation

Rotation of employees has been suggested

Preclude from exposure those individuals who have diseases of the central nervous system, gastrointestinal tract, liver, kidneys, heart, and blood

Beuchamp, R.O., Jr. et.al. 1983. A critical review of the literature on carbon disulfide toxicity. *CRC Crit. Rev. Toxicol.* 11(3).

Fajen, J. et.al. 1981. A cross-sectional medical and industrial hygiene survey of workers exposed to carbon disulfide. *Scand. J. Work Environ. Hlth.* 7(suppl. 4):20.

Raita, C. et.al. 1981. Impaired color discrimination among viscose rayon workers exposed to carbon disulfide. *JOM* 23(3):189.

## CARBON MONOXIDE

### Synonyms:

Carbonic oxide • Flue gas

### Description:

Colorless, odorless, tasteless gas

### Occupational Exposure:

Wherever incomplete combustion of carbonaceous materials occurs

Occurs as a metabolite within the body following inhalation of methylene chloride

Chemical synthesis • Manufacture of metal carbonyls • Emissions from combustion engines, foundries and furnaces, catalytic crackers, Kraft paper mills, etc.

### Threshold Limit Value:

50 ppm • 55 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Inhalation

## CARBON MONOXIDE (*cont' d.*)

### MODE OF ACTION:

- Combines with hemoglobin with an affinity over 200 times greater than that of oxygen
- Also combines with myoglobin and cytochrome oxidase
- Shifts the oxyhemoglobin dissociation curve to the left
- Impairs intracellular oxygen diffusion
- May have a specific cytotoxic action that causes demyelination

### SIGNS AND SYMPTOMS:

- The lowest no-effect level of carboxyhemoglobin is not clear; smokers frequently have levels above 10%
- Carboxyhemoglobin < 10%: usually no symptoms
- 10–30%: Headache • Drowsiness • Faintness • Nausea and vomiting • Increased pulse rate • Increased respiration • Often ECG ST segment depression
- 30–40%: As above plus: Diminished visual ability • Decreased blood pressure • Cardiac arrhythmias • Muscular incoordination
- 40–60%: As above plus: Mental confusion • Marked weakness, even collapse
- > 60%: Unconsciousness • Convulsions • Death

### DIAGNOSTIC TESTS:

- Serial quantitative carboxyhemoglobin determinations
- The classical cherry red discoloration is absent more often than not
- Early mass exposures have frequently been misjudged to be food poisoning episodes
- Among comatose patients who have had CT scans, it has been shown that bilateral areas of low density in the globus pallidus are associated with a poor outcome

### TREATMENT: *TREAT AS AN EMERGENCY*

- Early oxygen and resuscitative efforts are essential:
  - 100% oxygen can reduce the half life of COHb to about  $\frac{1}{6}$ th that which occurs at room air
  - Hyperbaric oxygen can further shorten the half life of COHb considerably
  - Both methods increase the oxygen dissolved in blood

## CARBON MONOXIDE (*cont'd.*)

### TREATMENT (*cont'd.*):

Monitor fluid and electrolyte balance  
Symptomatic and supportive

### DISABILITY:

Acutely affected patients may show neurologic residual effects related to basal ganglia or cerebellar damage and additionally may show disorientation, memory loss, and personality changes

A rare complication is *postanoxic encephalopathy*; following a coma of over 24 hours there is a transient improvement with subsequent irritability, confusion, fever, ataxia, and decerebrate rigidity.

### Preventive Measures:

Adequate ventilation with regular monitoring of work atmospheres where indicated

Approved respiratory protection

Preclude from exposure those individuals with cardiopulmonary diseases and blood disorders that would make them vulnerable

Burney, R.E. et.al. 1982. Mass carbon monoxide poisoning: Clinical effects and results of treatment in 184 victims. *Ann. Emerg. Med.* 11(8):394.

Jackson, D.L. and Menges, H. 1980. Accidental carbon monoxide poisoning. *JAMA* 243(8):772.

## CARBON TETRACHLORIDE

### Synonyms:

Perchloromethane • Tetrachloromethane

### Description:

Colorless liquid, characteristic odor

Decomposes to phosgene at high temperatures

### Occupational Exposure:

Chemical extractions • Chemical synthesis • Dry cleaning • Fire extinguisher • Fumigant • Pharmaceuticals • Solvent



## CARBON TETRACHLORIDE (*cont' d.*)

### Threshold Limit Value:

5 ppm • 30 mg/m<sup>3</sup>

Specific OSHA regulations apply

Suspect carcinogen

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Direct damage to liver, kidney, and lungs • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Irritation of eyes, nose, throat, and skin

Headaches, dizziness, mental confusion, and incoordination; unconsciousness may follow

Nausea, vomiting, abdominal pain, and diarrhea

Cough, dyspnea, and cyanosis

Cardiac arrhythmias

*After several days delay:* Jaundice and hepatomegaly • Oliguria, proteinuria, and hematuria

##### *Chronic:*

Defatting dermatitis with fissuring

Anorexia, nausea, vomiting, abdominal pain, and weight loss

Apathy and mental confusion

Headaches and dizziness

Renal and hepatic decompensation

Restriction of visual fields and diminished visual acuity

*Ingestion* produces a clinical picture similar to that of acute inhalation, but liver damage may become obvious early on

#### DIAGNOSTIC TESTS:

Carbon tetrachloride in serum, urine, and expired air

Altered serum enzymes

## CARBON TETRACHLORIDE (*cont'd.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Gastric lavage, if ingested, followed by saline catharsis
- Cardiorespiratory support as indicated
- Monitor fluid and electrolytes carefully
- Intravenous acetylcysteine may minimize hepatorenal damage
- Dialysis has been suggested

### DISABILITY:

- Recovery can be prolonged and permanent disability is possible

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Polyvinyl protective clothing as indicated
- Substitute less hazardous solvents if possible
- Physical examination of exposed personnel at regular intervals including studies of liver and kidney function
- Preclude from exposure those individuals with diseases of liver, kidneys, and central nervous system, or alcoholism

Hadi, S.F. and El Mikatti, N. 1981. Acute carbon tetrachloride poisoning. *Intensive Care Med.* 7(4):203.

Ruprah, M. et. al. 1985. Acute carbon tetrachloride poisoning in 19 patients: Implications for diagnosis and treatment. *Lancet.* 1027.

## CASTOR POMACE

### Synonyms:

None

### Description:

- The white powder residue after dehydration and oil extraction of castor beans
- Contains an irritant fraction (ricin) and a sensitizer (believed to be chlorogenic acid)



## CASTOR POMACE (*cont' d.*)

### Occupational Exposure:

Castor oil mills • Fertilizer • Laboratory workers • Livestock food •  
Pomace handlers

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation of pomace dust

#### MODE OF ACTION:

Ricin is a potent toxin

Chlorogenic acid is believed to be the sensitizer

#### SIGNS AND SYMPTOMS:

Following ingestion there may be a delay of one or more days before onset of anorexia, nausea, abdominal cramping and diarrhea; prostration and gastrointestinal bleeding may also occur

After dust inhalation patients develop sneezing, cough, runny eyes and nose, chest tightness and wheezing; hay fever and urticaria have also been reported

#### DIAGNOSTIC TESTS:

None established for ricin

Positive skin test to castor seed extract

RAST assay

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Substitute an oil-type pomace or use a pomace with minimal ricin and allergen content

## CASTOR POMACE (*cont'd.*)

### Preventive Measures (*cont'd.*):

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Good housekeeping
- Preclude from exposure those individuals with chronic diseases of skin and lung
- Remove from exposure those who become sensitized

Pevny, L. 1979. Allergy due to castor bean meal. *Derm. Beruf. Umwelt* 27:159.

Topping, M.D. et.al. 1981. Castor bean allergy in the upholstery department of a furniture factory. *Brit. J. Ind. Med.* 38:293.

## CERIUM

### Synonyms:

None

### Description:

- Metal is silver gray
- Salts may be orange, red, or white crystalline powders

### Occupational Exposure:

- Abrasives • Alloys • Capacitors • Catalysts • Enamels • Glass and ceramic coatings • Lighter flints • Opacifiers • Refractory oxides • Steel manufacture

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation (ore concentrate)

#### MODE OF ACTION:

Pneumoconiosis

#### SIGNS AND SYMPTOMS:

Usually none

## CERIUM (*cont' d.*)

### DIAGNOSTIC TESTS:

Discrete nodular shadows throughout the lung fields on x-ray

### TREATMENT:

Symptomatic

### DISABILITY:

None reported, including pulmonary impairment

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Annual chest x-ray

Husain, M.H. 1980. Rare earth pneumoconiosis. *J. Soc. Occup. Med.* 30:15.

## CHLORINATED NAPHTHALENES

### Synonyms:

Six isomers: mono-, di-, tri-, tetra-, penta-, hexa-chloronaphthalene

### Description:

Liquids to amorphous waxes depending on the degree of chlorination;  
varied colors

### Occupational Exposure:

Cable insulation • Coatings • Electric condensers • Foundry crayons •  
Lubricants • Solvent • Wood preservative

### Threshold Limit Value:

tri- — 5 mg/m<sup>3</sup>

tetra- — 2 mg/m<sup>3</sup>

penta- — 0.5 mg/m<sup>3</sup>

hexa- — 0.2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

## CHLORINATED NAPHTHALENES (*cont'd.*)

### MODE OF ACTION:

Irritant • Liver damage • Photosensitizer

### SIGNS AND SYMPTOMS:

Erythema with pruritis and scaling occurs but the most common lesion is chloracne: pustules, papules, and comedones primarily on the exposed surfaces about 3 months after exposure

Fume inhalation produces headache, fatigue, vertigo and anorexia and may not be accompanied by chloracne

Acute yellow atrophy is associated with nausea, indigestion, weight loss, jaundice, restlessness, fever, and coma

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing

Encourage good personal hygiene

Kleinfeld, M. et.al. 1972. Clinical effects of chlorinated naphthalene exposure. *JOM* 14(5):377.

## CHLORINE

### Synonyms:

None

### Description:

Green-yellow gas, suffocating odor

## CHLORINE (*cont' d.*)

### Occupational Exposure:

Bleaching agent • Chemical synthesis • Chlorinated solvents • Disinfectant • Military gas • Pesticides • Plastics • Refrigerants

### Threshold Limit Value:

1 ppm • 3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant (reacts with moisture to form hydrochloric acid)

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal burns

Dental corrosion has been reported

Dyspnea • Cough • Retrosternal pain • Hemoptysis • Epigastric pain • Nausea • Vomiting • Sweating • Weakness • Headache

Skin burns in severe exposures

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen with IPPB

Codeine for cough suppression

Decongestants and bronchodilators are helpful

Sedation if necessary

Symptomatic and supportive

#### DISABILITY:

Recovery anticipated in 12–24 hours

In severe exposures ventilatory dysfunction may persist for several years

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Preclude from exposure those individuals with pulmonary and cardiac disease

## CHLORINE (*cont'd.*)

Chester, E. et.al. 1969. The prevalence of chronic obstructive pulmonary disease in chlorine gas workers. *Am. Rev. Resp. Dis.* 99:365.

Jones, R.N. et.al. 1981. Longitudinal changes in pulmonary function following single exposure to chlorine gas. *Am. Rev. Resp. Dis.* 123:125.

## CHLORINE DIOXIDE

### Synonyms:

Chlorine peroxide

### Description:

Reddish-yellow gas

### Occupational Exposure:

Antiseptic • Biocide • Bleach • Chemical synthesis • Detanning leather • Oxidizer • Water purification

### Threshold Limit Value:

0.1 ppm • 0.3 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Corrosive

#### SIGNS AND SYMPTOMS:

Severe conjunctivitis • Rhinorrhea • Cough • Dyspnea • Wheezing • Headache • Vomiting  
Pulmonary edema can occur

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen and supportive respiratory therapy as indicated

## CHLORINE DIOXIDE (*cont' d.*)

### DISABILITY:

Symptoms may persist several days

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Preclude from exposure those individuals with chronic pulmonary disease

Gloemme, J. and Lundgren, R.D. 1957. Health hazards from chlorine dioxide. *AMA Arch. Ind. Hlth.* 16:169.

## CHLORINE TRIFLUORIDE

### Synonyms:

Chlorine fluoride

### Description:

Colorless gas, sweetish odor

### Occupational Exposure:

Fluorinating agent • Incendiary • Rocket propellant

### Threshold Limit Value:

0.1 ppm • 0.4 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Hydrolyzes to release chlorine, hydrogen fluoride, and carbon dioxide

Irritant

#### SIGNS AND SYMPTOMS:

Severe irritation of the eyes, respiratory tract, and skin could be expected

## CHLORINE TRIFLUORIDE (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## CHLOROACETALDEHYDE

### Synonyms:

Monochloroacetaldehyde

### Description:

Clear liquid, acrid odor

### Occupational Exposure:

Chemical synthesis • Fungicide

### Threshold Limit Value:

1 ppm • 3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant (corrosive)

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal damage • Skin burns

### DIAGNOSTIC TESTS:

None established



## CHLOROACETALDEHYDE (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## CHLOROACETIC ACID

### Synonyms:

Chloroethanoic acid • MCA • Monochloroacetic acid

### Description:

Colorless crystals

### Occupational Exposure:

Bacteriostat • Chemical synthesis • Herbicide • Preservative

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal irritation • Irritation of respiratory tract • Skin burns

#### DIAGNOSTIC TESTS:

None established

## CHLOROACETIC ACID (*cont' d.*)

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Treat burns in usual manner
- Symptomatic and supportive

### DISABILITY:

- No permanent effects reported

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection

## CHLOROACETOPHENONE

### Synonyms:

- Alpha-Chloroacetophenone • 2-Chloro-1-phenyl ethanone • Phenacyl chloride

### Description:

- Clear crystals

### Occupational Exposure:

- Chemical warfare agent • Riot control (MACE—chloroacetophenone in a trichloroethane—hydrocarbon mixture)

### Threshold Limit Value:

- 0.05 ppm • 0.3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

- Inhalation
- Percutaneous absorption is a possibility in severe exposures

#### MODE OF ACTION:

- Irritant • Sensitizer

## CHLOROACETOPHENONE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Conjunctivitis • Pharyngitis • Dyspnea • Cough • Rales with wheezing and tachypnea • Pruritis • Papulovesicular rash • Skin burns • Otitis externa • Hair loss • Headache • Malaise • Nausea and vomiting • Fever • Syncope

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Oxygen  
Bronchodilators  
Treat burns in usual manner  
Steroids  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Impervious protective clothing  
Remove from further exposure those who become sensitized

Thornburn, R.M. 1982. Injuries after use of the lacrimatory agent chloroacetophenone in a confined space. *Arch. Environ. Hlth.* 37(3):182.

## CHLOROBENZENES

### Synonyms:

Dichlorobenzenes: *o*-, *m*-, *p*- • Monochlorobenzene • Trichlorobenzenes

### Description:

Colorless liquids and crystals

## CHLOROBENZENES (*cont'd.*)

### Occupational Exposure:

Chemical intermediate • Disinfectant • Dyestuffs • Fumigant • Heat transfer agent • Insecticide • Pharmaceuticals • Solvent

### Threshold Limit Value:

*o*-dichloro — 50 ppm • 300 mg/m<sup>3</sup>  
*p*-dichloro — 75 ppm • 450 mg/m<sup>3</sup>  
monochloro — 75 ppm • 350 mg/m<sup>3</sup>  
1,2,4-trichloro — 5 ppm • 40 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant • Liver and kidney damage are possible

#### SIGNS AND SYMPTOMS:

Conjunctivitis and rhinitis • Headache • Skin burns from prolonged contact

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing  
Physical examination of exposed personnel on a regular basis including studies of liver and kidney function  
Preclude from exposure those individuals with liver and kidney disease

## CHLOROBENZENES (*cont' d.*)

Fishbein, L. 1979. Potential halogenated industrial carcinogenic and mutagenic chemicals. *Sci. of Total Environ.* 11:259.

### CHLOROBENZILIDENE MALONITRILE

#### Synonyms:

*ortho*-Chlorobenzilidine malonitrile • CS • OCBM

#### Description:

White crystalline solid

#### Occupational Exposure:

Riot control agent

#### Threshold Limit Value:

0.05 ppm • 0.4 mg/m<sup>3</sup>

#### Toxicity:

##### ROUTE OF ENTRY:

Inhalation

##### MODE OF ACTION:

Irritant

##### SIGNS AND SYMPTOMS:

Conjunctivitis with pain, lacrimation and erythema of eyelids

Nasal irritation with sneezing and rhinorrhea; sometimes epistaxis

Burning in throat and chest accompanied by cough and chest tightness

Hypersalivation, temporary alteration of taste and nausea

Burning sensation of exposed skin followed by erythema and vesiculation

Headache and lethargy

Pulmonary edema has been reported

#### DIAGNOSTIC TESTS:

None established

## CHLOROBENZYLIDENE MALONITRILE (*cont'd.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water;  
benzalkonium chloride 1% solution applied locally has been  
suggested

Treat burns as usual

Symptomatic and supportive

### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Impervious protective clothing

Ballantyne, B. and Swanston, D.W. 1978. The comparative acute mammalian toxicity of 1-chloroacetophenone (CN) and 2-chlorobenzylidene malonitrile (CS). *Arch. Toxicol.* 40:75.

Krape, R. and Thalmann, H. 1981. Acute exposure to CS tear gas and clinical observations. *Schweiz Med. Wochenschr.* 111:2056.

## CHLOROFLUOROCARBONS

### Synonyms:

Bromotrifluoromethane • Chlorofluoromethane • Chlorotrifluoromethane • Dibromodifluoromethane • Dichlorodifluoromethane • Dichlorofluoromethane • Dichlorotetrafluoromethane • Hexafluoroethane • Trichlorofluoromethane • Others

### Description:

A group of hydrocarbons containing halogens in varying positions—encompasses the “Freons”

Generally colorless liquids and gases

### Occupational Exposure:

Dielectrics • Electrical insulation • Fire extinguishers • Hydraulic fluids • Lubricants • Plastics • Refrigerants • Solvents • Wax coatings

## CHLOROFLUOROCARBONS (*cont' d.*)

### Threshold Limit Value:

- Bromotrifluoromethane — 1000 ppm
- Dibromodifluoromethane — 100 ppm
- Dichlorodifluoromethane — 1000 ppm
- Dichlorofluoromethane — 10 ppm
- Trichlorofluoromethane — 1000 ppm

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Asphyxiant • Cardiac sensitization and arrhythmias

If heated to high temperatures, may undergo decomposition to hydrochloric acid, hydrofluoric acid, carbonyl fluoride, and phosgene

#### SIGNS AND SYMPTOMS:

Irritation of the upper respiratory tract is possible and reduced ventilatory capacity has been reported

Dermatitis can occur

Cardiac arrhythmias

Dizziness and narcosis

Peripheral neuropathy has been reported

#### DIAGNOSTIC TESTS:

Specific compound in expired air or in blood

#### TREATMENT:

Symptomatic and supportive

Use no adrenalin

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection when indicated

Angerer, J. et. al. 1985. Exposure to fluorotrichloromethane (R-11).  
*Int. Arch. Occup. Environ. Hlth.* 56:67.



## CHLOROFLUOROCARBONS (*cont'd.*)

- Raffi, G.B. and Violanti, F.S. 1981. Is Freon 113 neurotoxic? A case report. *Int. Arch. Occup. Environ. Hlth.* 49:125.
- Valic, F. et.al. 1977. Effects of fluorocarbon propellants on respiratory flow and ECG. *Brit. J. Ind. Med.* 34(2):130.

## CHLOROFORM

### Synonyms:

Trichloromethane

### Description:

Colorless liquid, sweetish odor

### Occupational Exposure:

Artificial silk • Cleaning agent • Fire extinguisher • Floor polishes •  
Fumigant • Pharmaceutical • Plastics • Resins • Solvent

### Threshold Limit Value:

10 ppm • 50 mg/m<sup>3</sup>

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Central nervous system depressant • Cardiac depressant • Liver  
and kidney damage

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and respiratory tract

Dermatitis

Dizziness • Fatigue • Mental confusion

Anorexia • Nausea and vomiting

Respiratory and cardiac depression with hypotension

Narcosis

#### DIAGNOSTIC TESTS:

Chloroform in expired air and blood



## CHLOROFORM (*cont' d.*)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Cardiorespiratory support  
Symptomatic and supportive

### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves  
Preclude from exposure those individuals with liver and kidney disease  
Physical examination of exposed personnel at periodic intervals including liver and kidney function tests

Winslow, S.G. and Gerstner, H.B. 1978. Health aspects of chloroform—A review. *Drug Chem. Toxicol.* 1(3):259.

## CHLOROFORMATES

### Synonyms:

*sec*-Butyl-, ethyl-, glycol-, isopropyl-, methyl-, others

### Description:

Most are clear liquids, pungent odor

### Occupational Exposure:

Chemical synthesis

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

## CHLOROFORMATES (*cont' d.*)

### MODE OF ACTION:

Irritant and corrosive

### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Skin burns

A metal fume fever-type response has been reported

Pulmonary edema can occur

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in usual manner

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation (odor threshold is 10 ppm) • Chemical goggles •  
Approved respiratory protection • Rubber gloves, aprons, and  
boots

Bowra, G.T. 1981. Delayed onset pulmonary edema following accidental exposure to ethyl chloroformate. *J. Soc. Occup. Med.* 31:67.

## CHLORONITROBENZENES

### Synonyms:

Three isomers: *o*-, *m*-, *p*-

### Description:

Yellow liquid or crystals, aromatic odor

### Occupational Exposure:

Chemical synthesis • Dyes • Explosives

## CHLORONITROBENZENES (*cont' d.*)

### Threshold Limit Value:

0.5 ppm • 3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Methemoglobin formation

#### SIGNS AND SYMPTOMS:

Symptoms may be delayed

Headache • Cyanosis • Dizziness • Weakness • Numbness of extremities • Dyspnea • Chest pain • Tachycardia • Nausea • Vomiting • Abdominal pain • Malaise • Syncope • Convulsions

#### DIAGNOSTIC TESTS:

Methemoglobin determination

#### TREATMENT:

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; this decontamination may have to be repeated

Determine the degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB if available

Methylene blue is usually not recommended unless the methemoglobin level is above 40%; use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in 1 hour, but do not exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## CHLORONITROBENZENES (*cont' d.*)

### Preventive Measures:

- Adequate ventilation of work area • Approved respiratory protection •
- Extreme cleanliness of work area and good personal hygiene •
- Protective clothing, including impervious gloves and boots
- Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis
- Preclude from exposure those individuals with anemia, cardiovascular or pulmonary diseases

## CHLORONITROPROPANE

### Synonyms:

1-Chloro-1-nitropropane

### Description:

Liquid

### Occupational Exposure:

Fungicide • Rubber cements

### Threshold Limit Value:

2 ppm • 10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Decomposes when heated to nitrogen oxides and phosgene

#### SIGNS AND SYMPTOMS:

No adverse human effects on record

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

## CHLORONITROPROPANE (*cont' d.*)

### TREATMENT (*cont' d.*):

Wash contaminated areas of body with soap and water

If exposure to products of decomposition has occurred treat appropriately

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## CHLOROPICRIN

### Synonyms:

Nitrochloroform • Trichloronitromethane

### Description:

Colorless oily liquid

### Occupational Exposure:

Chemical synthesis • Disinfectant • Fumigant • Fungicide • Insecticide • Military gas

### Threshold Limit Value:

0.1 ppm • 0.7 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and nose

Bronchitis and pulmonary edema

Nausea and vomiting

Skin irritation

## CHLOROPICRIN (*cont'd.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen, with IPPB

Bronchodilators and decongestants

Codeine for cough

Sedation

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Preclude from exposure those individuals with chronic cardiopulmonary diseases

## CHLOROPRENE

### Synonyms:

2-Chlorobuta-1,3-diene

### Description:

Clear liquid

### Occupational Exposure:

Manufacture of synthetic rubber

### Threshold Limit Value:

10 ppm • 35 mg/m<sup>3</sup>

### Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

## CHLOROPRENE (*cont' d.*)

### MODE OF ACTION:

Irritant • Central nervous system depressant • Damage to liver, kidneys, and lungs

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal necrosis

Irritation of nose and respiratory tract

Dermatitis

Alopecia, frequently of the scalp

Sperm count depression among male workers and increased miscarriages in wives has been reported

The reported excess in skin and lung cancers requires further evaluation

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### DISABILITY:

Reproductive and carcinogenic effects are unresolved

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Physical examination of exposed personnel at regular intervals with evaluation of reproductive function and special attention to skin, lungs, liver, and kidneys

Preclude from exposure those individuals with chronic diseases of the skin, lungs, liver, and kidneys

Gooch, J.J. and Hawn, W.F. 1981. Biochemical and hematological evaluation of chloroprene workers. *JOM* 23(4):268.

Sanotskii, I.V. 1976. Aspects of the toxicology of chloroprene: Immediate and long term effects. *Environ. Hlth. Perspect.* 17:85.



# CHROMIUM AND COMPOUNDS

## Synonyms: (common forms)

Chromic acid • Chromic anhydride • Lead chromate  
Chromium metal  
Dichromate salts—sodium, potassium and others  
Hexavalent compounds—irritants, corrosives, and carcinogens  
Trivalent compounds—generally considered nontoxic • Chromic oxide • Chromic sulfate

## Description:

Metal is silvery gray  
Compounds frequently black or green crystals

## Occupational Exposure:

Anodizing • Antioxidants • Batteries • Catalysts • Chemical synthesis • Dyes • Explosives • Leather tanning • Paints • Refractories • Steel alloys • Welding • Wood preservatives

## Threshold Limit Value:

Chromium — 0.5 mg/m<sup>3</sup>  
Chromium fume and dust — 0.1 mg/m<sup>3</sup>  
Chromium insoluble salts — OSHA 1 mg/m<sup>3</sup>  
Chromium II compounds — 0.5 mg/m<sup>3</sup>  
Chromium III compounds — 0.5 mg/m<sup>3</sup>  
Chromium VI compounds — 0.05 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous through broken skin

### MODE OF ACTION:

Irritant • Corrosive • Sensitizer • Carcinogenic

### SIGNS AND SYMPTOMS:

*Eyes:* Conjunctivitis • Keratitis • Ulcerations of the lids  
*Skin:* Dermatitis has been reported from both trivalent and hexavalent forms, but more serious effects are related to hexavalent chromes; hyperkeratosis also occurs • Sensitization dermatitis • Corrosive lesions—"chrome holes"—most frequently on the hands and forearms



## CHROMIUM AND COMPOUNDS (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

*Upper respiratory tract:* Nasal irritation with epistaxis, rhinitis and perforated septum • Anosmia • Sinusitis and papillomas • Pharyngitis and laryngitis

*Pulmonary:* High concentrations may cause cough, chest pain, wheezing, fever and pneumonitis; asthma has been reported also • Chromite dust has produced pneumoconiosis with slightly impaired pulmonary function • Bronchogenic carcinoma is associated more frequently with long exposure to less soluble chromium compounds

*Gastrointestinal:* Dental erosion and discoloration • Anorexia, nausea, and abdominal pain • Impaired liver function

### DIAGNOSTIC TESTS:

Patch tests for sensitization

Chromium in blood and urine indicates exposure

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Allergic dermatitis may be treated with local cortisone or a 10% solution of ascorbic acid to reduce hexavalent forms to trivalent and thus diminish penetration

Skin ulcers will respond to the application of 10% EDTA in a lanolin base every 24 hours with curettage as necessary

Chelation and hemodialysis have been suggested for acute intoxications

Symptomatic and supportive

### DISABILITY:

Skin lesions usually not disabling

Anosmia and sensitization may be permanent

Pneumoconiosis has not caused serious impairment

### Preventive Measures:

Adequate ventilation with regular monitoring of the work environment • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots

No eating or smoking in work area

Vaseline applied to the nose before going to work may reduce nasal irritation

## CHROMIUM AND COMPOUNDS (*cont'd.*)

### Preventive Measures (*cont'd.*):

Physical examination of exposed personnel on a regular basis including chest x-ray, pulmonary function, liver and kidney function tests and special attention to the skin

Urinary chrome monitoring may be helpful

Remove from exposure those who become sensitized

Hayes, R.B. et.al. 1979. Mortality in chromium chemical production workers: A prospective study. *Int. J. Epidemiol.* 8(4):365.

Lindberg, E. and Hedenstierna, G. 1983. Chrome plating: Symptoms, findings in the upper airways and effects on lung function. *Arch. Environ. Hlth.* 38:367.

Lindberg, E. and Vesterberg, O. 1983. Monitoring exposure to chromic acid in chrome plating and measuring chromium in the urine. *Scand. J. Work Environ. Hlth.* 9:333.

## CINNAMON

### Synonyms:

Chinese cinnamon oil • Oil of cassia • Saigon cinnamon

### Description:

A yellow brown liquid extract from the bark of the tree *Cinnamomum zelanicum*—cinnamic aldehyde

### Occupational Exposure:

Carminative • Cosmetics • Food flavoring • Perfumes • Soaps

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant (cinnamic aldehyde) • Sensitizer

## CINNAMON (*cont' d.*)

### SIGNS AND SYMPTOMS:

Irritation of eyes  
Cough • Wheezing • Chest tightness  
Contact dermatitis  
Hair loss

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

### DISABILITY:

Skin sensitization can be permanent

### Preventive Measures:

Encourage personal cleanliness  
Remove from exposure those who become sensitized

Ludera-Zimoch, G. 1981. A case of urticaria with immediate topical and generalized reaction to cinnamon oil and benzoic aldehyde. *Przegl. Dermatol.* 68:67.

Uragoda, C.G. 1984. Asthma and other symptoms in cinnamon workers. *Brit. J. Ind. Med.* 41(2):224.

## COAL

### Synonyms:

None

### Description:

Black or brownish-black masses

### Occupational Exposure:

Coal mining and allied industries

## COAL (*cont' d.*)

### Threshold Limit Value:

- Dust (respirable fraction < 5% SiO<sub>2</sub>) — 2 mg/m<sup>3</sup>
- (respirable fraction > 5% SiO<sub>2</sub>) — respirable quartz value

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

- Simple CWP is the retention of abnormal quantities of coal dust in the lungs
- Complicated pneumoconiosis is a progressive fibrotic reaction associated with reticulin deposits and focal emphysema

#### SIGNS AND SYMPTOMS:

- Simple pneumoconiosis is associated with minor respiratory complaints and can be accompanied by slight changes in pulmonary function and has little effect on life expectancy; it does tend to progress with continued exposure but may arrest or even regress once exposure ceases
- Complicated pneumoconiosis is more likely to progress without regard to exposure; the incidence seems higher among those exposed to coal with a greater silica content; in advanced cases the compensatory emphysema and pulmonary hypertension lead to a shortened life expectancy accompanied by pronounced respiratory symptoms

#### DIAGNOSTIC TESTS:

- Chest x-rays, using the ILO classification of radiographs of pneumoconiosis
- Complicated pneumoconiosis is accompanied by reduction in pulmonary function and diffusing capacity

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Varies with the state of disease

#### Preventive Measures:

Adequate dust control with regular monitoring of work environment

## COAL (*cont'd.*)

### Preventive Measures (*cont'd.*):

Annual examination of exposed personnel including chest x-ray and pulmonary function tests

Those who develop x-ray evidence of CWP should be moved to jobs with low dust exposures

Guidelines for the Use of ILO International Classification of Radiographs of Pneumoconiosis (rev. ed.). Occupational Safety and Health Series No. 22 (rev.) Geneva, Switzerland ILO 1980.

Huxley, J.F. et.al. 1979. Simple pneumoconiosis and exposure to respirable dust: Relationships from twenty-five years research at ten British coal mines (Report No. TM/79/13) Edinburgh, Scotland: *Inst. of Occup. Med.*

Kleinerman, J. et.al. 1979. Pathology standards for CWP. Report of the Pneumoconiosis Committee of the College of American Pathologists to the National Institute for Occupational Safety and Health. *Arch. Pathol. Lab. Med.* 103, 375.

## COAL TAR PITCH

### Synonyms:

Pitch

### Description:

A dark brown to black residue from the distillation of coal tar

Contains resins, phenols, benzo(a)pyrene and polynuclear aromatic hydrocarbons

### Occupational Exposure:

Coal briquetting • Bonding agent • Foundry cores • Paints and coatings • Paving and roofing • Sealant • Wood preservative

### Threshold Limit Value:

Coal tar pitch volatiles (benzene soluble fraction) — 0.2 mg/m<sup>3</sup>

Carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

None (fume exposure)

## COAL TAR PITCH (*cont'd.*)

### MODE OF ACTION:

Irritant • Carcinogen • Phototoxin

### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal ulcers • Papillomata of lids

Skin photosensitization reaction with erythema and itching

Comedones and folliculitis may occur

Hyperpigmentation of the exposed body surfaces and frequently the scrotum

After several years of exposure, employees may manifest:

Keratoacanthoma or "tar mollusca"

Pitch warts or tar warts on exposed body surfaces and scrotum, even after cessation of exposure

Epitheliomata, usually of head, neck, upper extremity and scrotum

Pulmonary cancer has been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic

### DISABILITY:

None established

### Preventive Measures:

Adequate ventilation • Eye and respiratory protection as indicated •

Protective clothing

Encourage good personal hygiene

Physical examinations at regular intervals to assess potential effects

Preclude from exposure those individuals with chronic skin disease

Emmett, E.A. et.al. 1977. Phototoxic keratoconjunctivitis from coal-tar pitch volatiles. *Sci.* 198:841.

Jarvis, H. 1980. Scrotal cancer in a pitch worker. *J. Soc. Occup. Med.* 30(2):61.

Nishio, K. ; 1982. Occupational skin diseases: Skin affections caused by tar and pitch. *J. Uoeh.* 4(suppl.):215.

Silverstein, M. et. al. 1985. Mortality among workers exposed to coal tar pitch volatiles and welding emissions: An exercise in epidemiologic triage. *AJPH.* 75(11):1283.



# COBALT AND COMPOUNDS

## Synonyms:

Cobalt blue • Cobalt chloride • Cobaltous nitrate • Cobaltous oxide • Cobaltous phosphate octahydride

## Description:

Metal is gray, compounds vary

## Occupational Exposure:

Alloys • Catalyst • Ceramics • Chemical synthesis • Diamond polishers • Electroplating • Explosives • Hard metal industry (tungsten carbide) • Pigments

## Threshold Limit Value:

Cobalt metal fume and dust — 0.1 mg/m<sup>3</sup>

Cobalt carbonyl — 0.1 mg/m<sup>3</sup>

Cobalt hydrocarbonyl — 0.1 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Conjunctivitis

Dermatitis characterized by urticaria and erythematous papules

Cardiomyopathy has been reported in the hard metal industry and is quite similar to the focal degenerative changes reported among beer drinkers who consumed beer to which cobalt chloride had been added

Polycythemia has also been reported in hard metal workers (cobalt appears to induce a bone marrow hypoxia thus stimulating erythropoiesis)

Hard metal disease may follow several patterns:

Obstructive airways syndrome after 6–18 months exposure: • Cough, dyspnea and wheezing relieved completely by cessation of exposure • Chest x-rays are normal

Interstitial pneumonitis similar to allergic alveolitis • Several hours after exposure the patient develops

## COBALT AND COMPOUNDS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

dyspnea, chest tightness, cough and rales which subside in 12–24 hours • Chest x-rays may show minor changes such as slight linear opacities in the lower zones • These patients exhibit a more intense patch test reaction to cobalt, but symptoms subside if exposure ceases

Interstitial fibrosis after 10 years or more exposure: Cough, dyspnea, tachypnea, and clubbing of digits • Chest x-rays reveal nodular and reticular densities which progress to pulmonary fibrosis • Pulmonary function tests show restrictive disease

### DIAGNOSTIC TESTS:

Positive patch tests  
Cobalt in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if salts have been ingested  
Symptomatic and supportive

### DISABILITY:

Sensitization may be permanent  
Hard metal disease is disabling

### Preventive Measures:

Adequate ventilation with regular atmospheric monitoring • Chemical goggles • Approved respiratory protection • Gloves if appropriate  
Physical examination of exposed personnel at periodic intervals including chest x-ray and pulmonary function tests and with special attention to the skin  
Preclude from exposure those individuals with chronic skin and lung diseases  
Remove from exposure those who become sensitized

Demedts, M. et.al. 1984. Cobalt lung in diamond polishers. *Am. Rev. Resp. Dis.* 130(1):130.



## COBALT AND COMPOUNDS (*cont' d.*)

- Kitamura, H. et.al. 1978. Cemented tungsten carbide pneumoconiosis. *Acta Pathol. Jpn.* 28:921.
- Morgan, L.G. 1983. A study into the health and mortality of men exposed to cobalt and oxides. *J. Soc. Occup. Med.* 33(5):181.
- Payne, L.R. 1977. The hazards of cobalt. *J. Soc. Occup. Med.* 27:20.
- Sjögren, I. et.al. 1980. Hard metal lung disease: Importance of cobalt in coolants. *Thorax* 35:653.

## COKE

### Synonyms:

None

### Description:

The carbonaceous residue from the dry distillation of coking coal. During the coke manufacturing process many polynuclear aromatic hydrocarbons are given off; it is these emissions that cause disease.

### Occupational Exposure:

Cokeries • Metal production • Manufacture of graphite and electrodes  
• Production of synthetic gases

### Threshold Limit Value:

OSHA (PEL): TWA — 150 µg/m<sup>3</sup>  
Carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Carbon monoxide exposure • Photosensitivity • Polycyclic aromatic hydrocarbons are carcinogenic

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Dermatitis • Pulmonary and genitourinary cancers

## COKE (*cont' d.*)

### DIAGNOSTIC TESTS:

Sputum and urine cytology • Chest x-rays

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Pulmonary and genitourinary cancer

### Preventive Measures:

- Adequate ventilation with regular monitoring of the work area •
- Chemical goggles • Approved respiratory protection
- Annual examination of exposed personnel including chest x-rays and pulmonary function testing and with special attention to the skin, respiratory, and genitourinary systems
- Preclude from exposure those individuals with diseases of the skin, heart, lungs, and renal system

Lloyd, J.W. 1971. Long-term mortality study of steel workers: Respiratory cancer in coke plant workers. *JOM* 13:53.  
Redmond, C.K. et.al. 1976. Cancer experience among coke by-product workers. *Ann. N.Y. Acad. Sci.* 271:102.

## COPPER AND COMPOUNDS

### Synonyms:

Copper acetate • Copper sulfate • Cupric oxide • Cupric oxyacetate

### Description:

Metal is reddish  
Compounds are mostly blue

### Occupational Exposure:

Algicide • Alloys • Catalysts • Construction materials • Cookware •  
Electrical products • Electroplating • Insecticides • Mordants •  
Paints • Pharmaceuticals • Rot-proofing agent

### Threshold Limit Value:

Dusts and mists — 1 mg/m<sup>3</sup>  
Fume and compounds — 0.2 mg/m<sup>3</sup>

## COPPER AND COMPOUNDS (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

*Eye:* Salts produce conjunctivitis • Metallic particles that penetrate the cornea cause irritation and pigmentation—chalcosis

*Skin:* Copper dust and salts both cause dermatitis • Greenish black discoloration of the skin has been reported

*Respiratory:* Dust causes irritation of the nose and throat with sneezing and rarely, perforation of the nasal septum • Fumes can result in metal fume fever—after an incubation period of up to 5 hours patients develop metallic taste, headache, dyspnea, chills, fever, and nausea; wheezing or rales may be heard and a blood count will show a leucocytosis

*Gastrointestinal:* Fume exposure can result in metallic taste, nausea, and upper gastrointestinal distress • Liver granulomas containing copper have been found among vineyard sprayers using a copper sulfate fungicide • Ingestion of salt solutions results in green-blue discoloration of the mucosa, nausea and vomiting, hemorrhagic gastritis and diarrhea; these symptoms may be followed in one or two days with hemolytic anemia and hematuria

#### DIAGNOSTIC TESTS:

Urine and serum copper levels

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Remove embedded particles from the eyes and skin as soon as possible

Gastric lavage if ingested, using milk and egg white, and follow with saline catharsis

Chelation with penicillamine or BAL has been suggested for

## COPPER AND COMPOUNDS (*cont' d.*)

### TREATMENT (*cont' d.*):

chronic intoxication  
Symptomatic and supportive

### DISABILITY:

Generally none is anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Armstrong, C.W. et.al. 1983. An outbreak of metal fume fever. Diagnostic use of urinary copper and zinc determinations. *JOM* 25(12):886.

Cohen, S.R. 1974. A review of the health hazards from copper exposure. *JOM* 16(9):621.

Pimentel, J.C. and Manzes, A.P. 1975. Liver granulomas containing copper in vineyard sprayer's lung. *Am. Rev. Resp. Dis.* 111:189.

## COTTON DUST

### Synonyms:

None

### Description:

White fibers

### Occupational Exposure:

Exposure to cotton dust in ginning, blowing, carding, spinning, or weaving of cotton • Byssinosis also occurs with exposure to the dust of flax, hemp, and sisal

### Threshold Limit Value:

OSHA (PEL) — TWA (yarn mfg.) — 200  $\mu\text{g}/\text{m}^3$   
(slashing/weaving) — 250  $\mu\text{g}/\text{m}^3$   
(all other) — 500  $\mu\text{g}/\text{m}^3$

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

## COTTON DUST (*cont'd.*)

**MODE OF ACTION:** There are several theories of causation:

Pharmacologic, in which the bronchoconstriction results from a direct action of the unknown agent or is mediated via histamine releasing agents

Endotoxic, either from bacterial endotoxins or lysosomes released within the lung; this also appears to be the mechanism for "mill fever"

Immunologic type III response to cotton dust antigens or biologic contaminants

**SIGNS AND SYMPTOMS:** (generally related to dust level and duration of exposure)

Onset begins with a reversible tightness in the chest, dyspnea and cough with a concomitant decrease in expiratory flow rates over the course of the workshift—this is especially pronounced after a weekend or other absence

Symptoms gradually worsen after many years:

grade 0—no particular symptoms on the first working day of the week

grade  $\frac{1}{2}$ —occasional chest tightness or cough on the first working day

grade 1—consistent symptoms on the first working day

grade 2—symptoms recur on the first and other working days

grade 3—persistent symptoms and permanent physical impairment

After many years there is chronic bronchitis and emphysema

In "mill fever," exposure to cotton dust is followed in 2–6 hours by headache, pharyngeal itching, chest tightness, cough, fever, malaise, generalized aching and chills—these symptoms subside as the person acclimates but will often recur after any prolonged absence

**DIAGNOSTIC TESTS:** (suggested)

History of cotton dust exposure

Pulmonary function of less than 50% of normal, i.e., FEV<sub>1</sub> and FVC

Pulmonary ventilation does not improve with the use of bronchodilators

There is no other more obvious cause of impaired function

## COTTON DUST (*cont' d.*)

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Respiratory impairment is permanent

### Preventive Measures:

Adequate ventilation with regular dust monitoring • Approved respiratory protection

Physical examination of exposed personnel at regular intervals including use of a respiratory disease questionnaire, chest x-ray, and spirometry

Preclude from exposure those individuals with pulmonary disease and those who develop byssinosis

Weill, H. (ed.). 1981. International Conference on Byssinosis *Chest*. 79 (Suppl.4).

## CREOSOTE

### Synonyms:

Brick oil • Creosote oil • Creosotum

### Description:

Wood creosote is a yellowish liquid consisting of creosol with mixed phenols

Coal tar creosote is a brownish liquid consisting of tar bases and aromatic hydrocarbons

### Occupational Exposure:

Wood preservative • Insecticide, fungicide and germicide

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion

## CREOSOTE (*cont' d.*)

### MODE OF ACTION:

Irritant and corrosive (as phenol)

### SIGNS AND SYMPTOMS:

Irritation of eyes and nose

Acne-like dermatitis

Ingestion results in:

Anorexia • Nausea • Vomiting

Tachypnea • Fever • Sweating • Weakness

Weight loss • Convulsions • Coma

### DIAGNOSTIC TESTS:

Cresol in urine

### TREATMENT:

Irrigate eyes

Wash contaminated areas of body with soap and water

Severe exposures should be treated as indicated for phenol

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Eye and respiratory protection as indicated • Rubber gloves

Smith, R.S. 1970. Responsibilities and risks involved in the use of wood protecting chemicals. *Occup. Hlth. Rev.* 21:1.

## CRESOLS

### Synonyms:

Three isomers: *o*-, *m*-, *p*- • Cresylic acid • Cresylol • Methyl phenol

### Description:

Yellow liquid, phenolic odor

### Occupational Exposure:

Chemical synthesis • Disinfectant • Dyes • Herbicide • Plastics •  
Surfactant



## CRESOLS (*cont' d.*)

### Threshold Limit Value:

5 ppm • 22 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Corrosive • Sensitizer

Central nervous system stimulation then depression

Metabolic acidosis

Liver and kidney damage

Ingestion may result in intravascular hemolysis and methemoglobinemia

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Conjunctival and corneal necrosis

Severe skin burns with early blanching of contact areas

*If ingested*, corrosion of the mouth, throat, and gastrointestinal tract with perforation of the bowel, shock, and collapse

Dyspnea • Cough • Cyanosis • Pulmonary edema

Headache • Dizziness • Weakness • Sweating • Tremors •

Convulsions • Coma

Oliguria and anuria • Hematuria • Hemoglobinuria

Shock • Acidosis

##### *Chronic:*

Chronic exposure may produce symptoms quite like those of phenol and prolonged skin contact may result in ochronosis

#### DIAGNOSTIC TESTS:

Cresol in urine

#### TREATMENT:

Terminate exposure and remove all clothing

Irrigate eyes and wash contaminated areas of body with a mixture of polyethylene glycol 300/industrial methylated spirits (PEG 300/IMS—2:1 by volume) or similar preparation that will absorb phenolic component

## CRESOLS (*cont' d.*)

### TREATMENT (*cont' d.*):

Special attention must be given to cleansing areas with matted hair, skin folds, and beneath nails where cresol may concentrate

Hospitalize serious exposures to facilitate care of acidosis, shock, convulsions, and fluid balance

Symptomatic and supportive

### DISABILITY:

Permanent impairment can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved respiratory protection • Rubber gloves, aprons, and boots

Physical examination of exposed personnel on a regular basis including liver and kidney function studies

Preclude from exposure those individuals with diseases of the central nervous system, liver, kidneys, and lungs

Brown, V.K.H. et.al. 1975. Decontamination procedures for skin exposed to phenolic substances. *Arch. Environ. Hlth.* 30:1.

Chan, T.K. et.al. 1971. Methemoglobinemia, Heinz bodies and acute massive intravascular hemolysis in lysol poisoning. *Blood* 38:739.

## CROTONALDEHYDE

### Synonyms:

beta-Methyl acrolein • 2-Butenal • Crotonic aldehyde

### Description:

Clear liquid, suffocating odor

### Occupational Exposure:

Chemical synthesis • Chemical warfare • Fuel gas warning agent • Insecticides • Lubricating oils • Resins • Rubber • Solvent • Tanning

## **CROTONALDEHYDE** (*cont'd.*)

### **Threshold Limit Value:**

2 ppm • 6 mg/m<sup>3</sup>

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Irritant

#### **SIGNS AND SYMPTOMS:**

Conjunctivitis and corneal burns • Irritation of the respiratory tract • Dermatitis

#### **DIAGNOSTIC TESTS:**

None established

#### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### **DISABILITY:**

No permanent effects reported

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## **CUMENE**

### **Synonyms:**

Cumol • Isopropyl benzene • 1-Methylethyl benzene

### **Description:**

Colorless liquid, aromatic odor

### **Occupational Exposure:**

Chemical synthesis • Solvent

## CUMENE (*cont' d.*)

### Threshold Limit Value:

50 ppm • 245 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Narcosis

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Irritation of respiratory tract • Dermatitis

#### DIAGNOSTIC TESTS:

Cumene in expired air and blood

Dimethyl phenyl carbinol in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Senczuk, W. and Litewka, B. 1976. Absorption of cumene through the respiratory tract and excretion of dimethyl phenyl carbinol in urine. *Brù. J. Ind. Med.* 33(2):100.

## CUTTING OILS

### Synonyms:

Straight oils are petroleum, animal, or vegetable products

Emulsifying oils are straight oils with emulsifiers to permit the addition of water

Synthetic coolants are water-based alkaline fluids with little or no oil content

## CUTTING OILS (*cont'd.*)

### Description:

All are liquids, and it is most important to keep in mind that all of them may contain varying amounts of antioxidants (often amines), resins, rust inhibitors, antifoaming agents, softeners, germicides, dyes, and other materials

### Occupational Exposure:

Primarily machining operations

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Mechanical blocking of skin pores

Irritant, chemical and thermal

Allergic sensitization, dermal and pulmonary

Carcinogenic

#### SIGNS AND SYMPTOMS:

Oil acne, from mechanical blockage, results in comedones, folliculitis and oil boils usually of the arms and thighs

Contact irritation of exposed body surfaces can vary with the specific irritant

Allergic sensitization may arise from resins, germicides, nickel salts, chromates or other agents and often involves wider areas of exposed skin; infrequently reported pulmonary symptoms may also involve this mechanism

Hyperpigmentation, keratoses, and benign papillomata are seen after prolonged exposures

Skin cancer is still reported on occasion; additives may be contributing factors

Dermatitis also results from use of abrasive soaps and cleansing solvents

#### DIAGNOSTIC TESTS:

None established

## CUTTING OILS (*cont' d.*)

### TREATMENT:

Symptomatic

### Preventive Measures:

Use least toxic cutting/coolant preparation

Engineering control of sprays and mists with baffles and splash guards

Goggles or face shield if indicated • Protective clothing consistent with job safety

Good personal hygiene • Barrier creams and skin lotions

Preclude from exposure those individuals with chronic skin disease

Remove from exposure those who become sensitized

Alomar, A. et. al. 1985. Occupational dermatoses from cutting oils. *Contact Derm.* 12:129.

Hendy, M.S. et. al. 1985. Occupational asthma due to an emulsified oil mist. *Brit. J. Ind. Med.* 42:51.

Ramos, H. and Lucas, J.B. ; 1974. Occupational health case report no. 5: Cutting oil mists. *JOM* 16(4):273.

Rousch, G.C. et. al. 1980. Sinonasal cancer and occupation: A case control study. *Am. J. Epidemiol.* 111:183.

## CYANIDES—CYANOGENS

### Synonyms:

Cyanates—Ammonium cyanate • Potassium cyanate • Sodium cyanate • Others

Cyanide salts—Hydrogen cyanide • Potassium cyanide • Sodium cyanide • Others

Cyanogens—Cyanogen bromide • Cyanogen chloride

Nitriles (organic cyanides)—Acetonitrile • Ethyl cyanide • Glycolonitrile • Trichloro-*s*-triazine • Others

### Description:

Gases, liquids, and crystals

### Occupational Exposure:

Chemical synthesis • Electroplating • Etching • Fumigant • Gold extraction • Insecticide • Laboratory reagent • Metal treatment • Process engraving • Rocket propellant • Rodenticide • Solvent • Welding

## CYANIDES-CYANOGENS (*cont'd.*)

### Threshold Limit Value:

Hydrogen cyanide — 10 ppm • 10 mg/m<sup>3</sup>

Cyanogen — 10 ppm • 20 mg/m<sup>3</sup>

Cyanides — OSHA (PEL—skin) — 5 mg/m<sup>3</sup>

Acetonitrile — 40 ppm • 70 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant and sensitizer

Inhibition of cytochrome oxidase and other enzyme systems

Secondary lactic acidosis

#### SIGNS AND SYMPTOMS:

*Acute:* Headache, weakness, and mental confusion • Nausea and vomiting with tachypnea and chest tightness • Shock, convulsions and coma

Subacute intoxication has been reported from low level exposures of several months duration and can resemble acute exposures but also exhibits fatigue and sleep disturbances

*Chronic:* Irritation of eyes and nose • Dermatitis and skin ulcers • Headache and tremors

#### DIAGNOSTIC TESTS:

Cyanide blood levels above 0.2 µg/ml are significant but unreliable for monitoring

The degree of lactic acidosis in acute cases appears to be a good diagnostic prognosticator

#### TREATMENT:

Preparation for therapy must be anticipated and appropriate procedures established

See Appendix A

#### DISABILITY:

Central nervous system damage occurs from prolonged hypoxia



## CYANIDES-CYANOGENS (*cont'd.*)

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing
- No food or smoking in work area
- Ear plugs for employees with perforated ear drums
- Employees should not work alone and should be instructed in emergency procedures
- Preclude from exposure those individuals with diseases of central nervous system, heart, lungs, and kidneys

Blanc, P. et.al. 1985. Cyanide intoxication among silver-reclaiming workers. *JAMA* 253(3):367.

Dequidt, J. et. al. 1974. Acetonitrile poisoning. Report of a fatal case. *Europ. J. Toxicol.* 7:91.

Graham, D.L. et.al. 1977. Acute cyanide poisoning complicated by lactic acidosis and pulmonary edema. *Arch. Intern. Med.* 137:1051.

## CYCLOHEXANE

### Synonyms:

Hexahydrobenzene • Hexamethylene • Hexanaphthalene

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Analytic chemistry • Chemical synthesis • Degreasers • Fungicide • Oil extraction • Paint thinner • Solid fuels • Solvent

### Threshold Limit Value:

300 ppm • 1050 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

## CYCLOHEXANE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract • Narcosis

### DIAGNOSTIC TESTS:

Cyclohexane in expired air

Cyclohexanol in urine (a level less than 3.2 mg/l corresponds to atmospheric concentration below TLV)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Perebellini, L. and Brugnone, F. 1980. Lung uptake and metabolism of cyclohexane in shoe factory workers. *Int. Arch. Occup. Environ. Hlth.* 45(3):261.

## CYCLOHEXANOL

### Synonyms:

Hexahydrophenol • Hexalin

### Description:

Colorless oily liquid, camphor-like odor

### Occupational Exposure:

Insecticides • Paints and varnishes • Plasticizer • Polishes • Soap • Solvent • Textile finishing

### Threshold Limit Value:

50 ppm • 200 mg/<sup>3</sup>

## CYCLOHEXANOL (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Irritation of nose and throat • Dermatitis • Headache

#### DIAGNOSTIC TESTS:

Cyclohexanol in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Annual examination of exposed personnel with attention to liver and kidney function

## CYCLOHEXANONE

### Synonyms:

Ketohexamethylene • Pimelic ketone

### Description:

Yellow liquid, peppermint odor

### Occupational Exposure:

Chemical synthesis • Degreasing • Oil additive • Plastics • Solvent

### Threshold Limit Value:

25 ppm • 100 mg/m<sup>3</sup>

## CYCLOHEXANONE (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Respiratory tract irritation • Dermatitis •  
Narcosis

#### DIAGNOSTIC TESTS:

Cyclohexanone in expired air

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## CYCLOHEXENE

### Synonyms:

1,2,3,4-Tetrahydrobenzene

### Description:

Colorless liquid

### Occupational Exposure:

Catalyst • Chemical synthesis • Oil extractant

### Threshold Limit Value:

300 ppm • 1015 mg/m<sup>3</sup>

## CYCLOHEXENE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Irritation of upper respiratory tract •  
Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## CYCLOHEXYLAMINE

### Synonyms:

Aminocyclohexane • Cyclohexanamine • Hexahydroaniline

### Description:

Colorless liquid, amine odor

### Occupational Exposure:

Chemical synthesis • Corrosion inhibitor • Dyes • Rubber chemical •  
Solvent • Water treatment

### Threshold Limit Value:

10 ppm • 40 mg/m<sup>3</sup>

## CYCLOHEXYLAMINE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Irritation of respiratory tract • Dermatitis  
Drowsiness • Dizziness • Anorexia • Nausea and vomiting

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Watrous, R.M. and Schulz, H.N. 1950. Cyclohexylamine, *p*-chloronitrobenzene, 2-aminopyridine: Toxic effects in industrial use. *Ind. Med. & Surg.* 19:317.

## CYCLONITE

### Synonyms:

Cyclotrimethylene trinitramine • Hexahydro-1,3,5-trinitro triazine • RDX • *sym*-Trimethylene trinitramine • Trinitro trimethylene triamine

### Description:

White crystals

## CYCLONITE (*cont'd.*)

### Occupational Exposure:

Explosive • Rodenticide

### Threshold Limit Value:

1.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous?

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin and respiratory tract

Headache, dizziness, nausea and vomiting may be followed by a sudden convulsion with subsequent disorientation and stupor

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Hathaway, J.A. and Buck, C.R. 1977. Absence of health hazards associated with RDX manufacture and use. *JOM* 19(4):269.

Kaplan, A.S. et.al. 1965. Human intoxication from RDX. *Arch. Environ. Hlth.* 10:877.



## CYCLOPENTADIENE

### Synonyms:

1,3-Cyclopentadiene

### Description:

Colorless liquid, irritating odor

### Occupational Exposure:

Chemical synthesis • Fungicide • Insecticide • Resins

### Threshold Limit Value:

75 ppm • 200 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Liver damage is possible

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Headache • Irritation of nose

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## CYCLOPROPANE

### Synonyms:

Trimethylene

## CYCLOPROPANE (*cont' d.*)

### **Description:**

Colorless gas, naphtha odor

### **Occupational Exposure:**

Anesthetic gas • Chemical synthesis

### **Threshold Limit Value:**

None established

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Central nervous system depressant

Cardiac irritant

#### **SIGNS AND SYMPTOMS:**

Narcosis • Respiratory depression • Cardiac arrhythmias

#### **DIAGNOSTIC TESTS:**

None established

#### **TREATMENT:**

Symptomatic and supportive

#### **DISABILITY:**

No permanent effects reported

### **Preventive Measures:**

Adequate ventilation • Approved respiratory protection

Preclude from exposure those individuals with heart disease

# DIACETONE ALCOHOL

## Synonyms:

4-Hydroxy-4-methyl-2-pentanone

## Description:

Clear liquid

## Occupational Exposure:

Antifreeze • Hydraulic fluids • Preservative • Solvent

## Threshold Limit Value:

50 ppm • 240 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Dermatitis

Drowsiness

Liver and kidney damage have been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## DIACETONE ALCOHOL (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Periodic examination of exposed personnel with special attention to liver and kidney studies

## DIAZOMETHANE

### Synonyms:

Azimuthylene

### Description:

Yellow gas

### Occupational Exposure:

Chemical synthesis • Laboratory reagent

### Threshold Limit Value:

0.2 ppm • 0.4 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

May metabolize to methyl alcohol and formaldehyde

#### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

Dermatitis

Headache • Malaise • General aching

Chest pain • Cough • Dyspnea • Fever • Asthmatic breathing •

Pulmonary edema

## DIAZOMETHANE (*cont'd.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Preclude from exposure those individuals with cardiopulmonary disease

Lewis, C.E. 1964. Diazomethane poisoning. *JOM* 6:91.

## DIBROMOCHLOROPROPANE

### Synonyms:

3-Chloro-1,2-dibromo propane • DBCP • 1,2-Dibromo-3-chloro propane

### Description:

Amber liquid, pungent odor

### Occupational Exposure:

Fumigant • Nematocide

### Threshold Limit Value:

1 ppb OSHA (PEL)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

## DIBROMOCHLOROPROPANE (*cont' d.*)

### MODE OF ACTION:

Mild irritant

Damage to the seminiferous tubules

### SIGNS AND SYMPTOMS:

Oligospermia or azospermia associated with male infertility

### DIAGNOSTIC TESTS:

Sperm count (most reliable method of detecting effects)

### TREATMENT:

Symptomatic

### DISABILITY:

The gonadotoxic effect is reversible in the presence of normal FSH levels

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Impervious protective clothing as indicated

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the genitourinary system and including a sperm count

Sandifer, S.H. et al. 1979. Spermatogenesis in agricultural workers exposed to dibromo chloro propane (DBCP). *Bull. Environ. Contam. Toxicol.* 23:703.

Whorton, D. et al. 1979. Testicular function in DBCP exposed pesticide workers. *JOM* 21:161.

Wilhite, C.C. 1982. Toxicology updates: Dibromo chloro propane. *J. Appl. Toxicol.* 2:271.

## DICHLORO ACETYLENE

### Synonyms:

None

### Description:

Colorless gas

## DICHLORO ACETYLENE (*cont' d.*)

### Occupational Exposure:

Life support systems of nuclear submarines and extraterrestrial spacecraft when operating improperly

Degradation of trichloroethylene, vinylidene chloride, and other chlorinated hydrocarbons by pyrolysis, photolysis, or contact with alkaline materials

### Threshold Limit Value:

0.1 ppm • 0.4 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Anorexia • Nausea • Vomiting

Soreness of gums, jaw pain, and herpetiform lesions of the mouth and lips

Headache

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation and careful monitoring of the work environment • Approved respiratory protection

Saunders, R.A. 1967. A new hazard in closed environmental atmospheres. *Arch. Environ. Hlth.* 14:380.



# DICHLOROBENZENE

## Synonyms:

Two isomers: *o*-, *p*-

## Description:

Clear liquid and crystals

## Occupational Exposure:

Chemical synthesis • Disinfectant • Fumigant • Insecticide • Solvent

## Threshold Limit Value:

*ortho*— 50 ppm • 300 mg/m<sup>3</sup>

*para*—75 ppm • 450 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Sensitizer • Liver damage

### SIGNS AND SYMPTOMS:

Irritation of the eyes and nose with rhinitis

Skin blisters with subsequent pigmentation

Allergic purpura has been reported following exposure to *para*-dichlorobenzene

Headache, anorexia, nausea, vomiting, weight loss, jaundice, and cirrhosis

Leukemia has been reported

### DIAGNOSTIC TESTS:

2,5-Dichlorophenol in urine (for *p*-dichlorobenzene)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

Leukemia?

## DICHLOROBENZENE (*cont' d.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Physical examination of exposed personnel on a regular basis including studies of liver function

Preclude from exposure those individuals with liver disease

Fishbein, L. 1979. Potential halogenated industrial carcinogenic and mutagenic chemicals. *Sci. of Total Environ.* 11:259.

## 3,3'-DICHLORO BENZIDINE

### Synonyms:

3,3'-Dichloro-4,4'-biphenyl diamine

### Description:

Colorless crystals

### Occupational Exposure:

Chemical synthesis • Curing agent • Pigments

### Threshold Limit Value:

Specific OSHA regulations apply

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Sensitizer? • Suspect bladder carcinogen

#### SIGNS AND SYMPTOMS:

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic

## 3,3'-DICHLORO BENZIDINE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

These are now prescribed by law and should be followed as indicated in any given jurisdiction

Gerarde, H.W. and Gerarde, D.F. 1974. Industrial experience with 3,3'-dichloro benzidine. *JOM* 16(5):322.

MacIntyre, I. 1975. Experience of tumors in a British plant handling 3,3'-dichloro benzidine. *JOM* 17(1):23.

## DICHLORO DIMETHYL HYDANTOIN

### Synonyms:

DDH • 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidenedione

### Description:

White crystals

### Occupational Exposure:

Bleach • Catalyst • Chemical synthesis • Chlorinating agent • Disinfectant • Water treatment

### Threshold Limit Value:

0.2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Forms hypochlorous acid in the presence of moisture

#### SIGNS AND SYMPTOMS:

Irritation of the eyes, skin, and respiratory tract

#### DIAGNOSTIC TESTS:

None established

## DICHLORO DIMETHYL HYDANTOIN (*cont'd.*)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Approved respiratory protection • Rubber gloves

## 1,2-DICHLOROETHANE

### Synonyms:

Ethylene chloride • Ethylene dichloride

### Description:

Colorless liquid, acrid odor

### Occupational Exposure:

Chemical synthesis • Degreaser • Fumigant • Gasolines • Paint remover • Soap • Solvent • Vinyl chloride production • Wetting agent

### Threshold Limit Value:

10 ppm • 40 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Hepatic necrosis • Renal tubular damage  
Gastrointestinal erosion, if ingested

## 1,2-DICHLOROETHANE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis

Dermatitis • Skin burns

Dizziness • Mental confusion • Narcosis

Anorexia • Nausea • Vomiting • Abdominal pain

Respiratory tract irritation

Ingestion is followed by headache, lethargy, dyspnea, pulmonary edema, oliguria, hypoglycemia, ataxia, and encephalopathy

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis and then demulcents

Cardiorespiratory support, but avoid catecholamines

Monitor electrolytes and fluid balance closely with special attention to calcium levels

Symptomatic and supportive

### DISABILITY:

No permanent effects reported from occupational exposure

### Preventive Measures:

Adequate ventilation with regular monitoring of workplace •

Chemical goggles • Approved respiratory protection • Protective clothing

Good personal hygiene

Physical examination of exposed personnel at regular intervals including studies of liver and kidney function

Preclude from exposure those individuals with liver and kidney diseases

Akimov, G.A. et.al. 1978. Neurological disorders in acute poisoning with dichloroethane. *Zh. Neuropatol. Psikhiatr. Im. S.S. Korsakova* 78(5):687.

Yodaiken, R.E. et.al. 1973. 1,2-Dichloroethane poisoning. *Arch. Environ. Hlth.* 26:281.

# DICHLOROETHYLENE

## Synonyms:

Acetylene dichloride • 1,2-Dichloroethylene • *sym*-Dichloroethylene

## Description:

Colorless liquid, ethereal odor

## Occupational Exposure:

Chemical synthesis • Lacquers • Perfumes • Pharmaceuticals •  
Refrigerant • Solvent • Thermoplastics

## Threshold Limit Value:

200 ppm • 790 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Central nervous system depressant  
Possible liver and kidney damage

### SIGNS AND SYMPTOMS:

Irritation of eyes • Vertigo and narcosis • Nausea and vomiting

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# DICHLOROETHYL ETHER

## Synonyms:

Bis (2-chloroethyl) ether • Dichloroethyl oxide • 1,1'-Oxybis (2-chloroethane)

## Description:

Colorless liquid, pungent odor

## Occupational Exposure:

Chemical synthesis • Dewaxing agents • Drycleaning • Finish removers • Soil fumigant • Solvent

## Threshold Limit Value:

5 ppm • 30 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis • Irritation of nose and upper respiratory tract • Nausea

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves



# DICHLOROHYDRIN

## Synonyms:

*sym*-Dichloro isopropyl alcohol • 1,3-Dichloro-2-propanol • GDCH •  
*sym*-Glycerol dichlorohydrin •

## Description:

Colorless liquid, ethereal odor

## Occupational Exposure:

Cements • Chemical synthesis • Lacquers and paints • Solvent

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract • Headache and dizziness

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Cardiorespiratory support

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# 1,1-DICHLORO-1-NITROETHANE

**Synonyms:**

Ethide

**Description:**

Colorless liquid

**Occupational Exposure:**

Grain fumigant • Solvent

**Threshold Limit Value:**

2 ppm • 10 mg/m<sup>3</sup>

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Irritant

**SIGNS AND SYMPTOMS:**

Irritation of eyes, skin, and respiratory tract

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection

# DIETHYLAMINE

## Synonyms:

*n*-Ethyle-ethanamine

## Description:

Colorless liquid, ammoniacal odor

## Occupational Exposure:

Dyes • Electroplating • Petroleum • Pesticides • Pharmaceuticals •  
Resins • Solvents

## Threshold Limit Value:

10 ppm • 30 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage • Dermatitis and skin burns  
• Respiratory tract irritation with cough, dyspnea, and  
pulmonary congestion

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

Permanent eye damage has been reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing where indicated

# DIETHYLAMINO ETHANOL

## Synonyms:

DEAE • N,N diethyl ethanolamine • 2-Hydroxy triethylamine

## Description:

Colorless liquid, nauseating odor

## Occupational Exposure:

Antirust agents • Emulsifying agent • Pharmaceuticals • Resins •  
Textiles

## Threshold Limit Value:

10 ppm • 50 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Irritation of eye, nose, and skin • Nausea and vomiting

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# DIETHYL ANILINE

## Synonyms:

*n*-Phenyl diethylamine

## Description:

Yellow oily liquid

## Occupational Exposure:

Chemical synthesis • Dyes • Pharmaceuticals

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Methemoglobin formation

Occasionally intravascular hemolysis

### SIGNS AND SYMPTOMS: *May be delayed*

Headache • Cyanosis • Dizziness • Weakness • Numbness of extremities • Dyspnea • Chest pain • Tachycardia • Nausea • Vomiting • Abdominal pain • Malaise • Syncope • Convulsions

### DIAGNOSTIC TESTS:

Methemoglobin determination

### TREATMENT:

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; decontamination may have to be repeated

Determine the degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB if available

Methylene blue is usually not recommended unless the methemoglobin level is above 40%; use a 1% solution in a dose

## DIETHYL ANILINE (*cont' d.*)

### TREATMENT (*cont' d.*):

of 1 mg/kg body weight and administer intravenously,  
repeat in 1 hour but do not exceed a total dose of 7 mg/kg  
Hyperbaric oxygen, blood transfusions, exchange transfusions,  
and hemodialysis have all been used  
Symptomatic and supportive

### DISABILITY:

Recovery is usually complete in 24-48 hours

### Preventive Measures:

Adequate ventilation of work area • Approved respiratory protection  
Extreme cleanliness of work area and good personal hygiene  
Protective clothing laundered daily, in addition to the use of synthetic butyl gloves and boots  
Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis  
Preclude from exposure those individuals with anemia, cardiovascular or pulmonary diseases

## DIETHYL CARBONATE

### Synonyms:

Ethyl carbonate

### Description:

Colorless liquid

### Occupational Exposure:

Chemical synthesis • Solvent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

## DIETHYL CARBONATE (*cont' d.*)

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Mild irritation of eyes and respiratory tract

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## DIETHYLENE TRIAMINE

### Synonyms:

DETA • 2,2' Diamino diethylamine

### Description:

Yellow liquid, ammoniacal odor

### Occupational Exposure:

Fuel component • Saponification agent • Solvent

### Threshold Limit Value:

1 ppm • 4 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous



## DIETHYLENE TRIAMINE (*cont' d.*)

### MODE OF ACTION:

Corrosive irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage • Dermatitis and skin burns  
Irritation of respiratory tract • Asthma has been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat burns as usual  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves  
Preclude from exposure those individuals with allergies and skin and lung diseases

## DIETHYL STILBESTROL

### Synonyms:

DES

### Description:

White crystalline powder

### Occupational Exposure:

Manufacture and processing of synthetic estrogens

### Threshold Limit Value:

Suspect carcinogen

# DIETHYL STILBESTROL (*cont'd.*)

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Hyperestrogenism

### SIGNS AND SYMPTOMS:

*Females:* Nausea and headaches • Intermenstrual or post-menopausal bleeding

*Males:* Anorexia, nausea and vomiting • Gynecomastia with areolar hyperpigmentation and tenderness • Loss of libido and impotence • Spermatic abnormalities

### DIAGNOSTIC TESTS:

Increased plasma ethinyl estradiol

Increased DES urine levels

### TREATMENT:

Remove from further exposure

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation

Isolation of work areas

Air-supplied protective work suits

Good personal hygiene

Limit work exposure time by rotation

Preclude from exposure those individuals in whom estrogen level deviations could be harmful

Harrington, J.M. et.al. 1978. The occupational hazards of formulating oral contraceptives—A survey of plant employees. *Arch. Environ. Hlth.* 33:12.

Shumunes, E. and Burton, D.J. 1981. Urinary monitoring for diethyl stilbestrol in male chemical workers. *JOM* 23(3):179.

# DIISOBUTYL KETONE

**Synonyms:**

2,6-Dimethyl-4-heptanone • Isovalerone

**Description:**

Colorless liquid, fruity odor

**Occupational Exposure:**

Chemical synthesis • Inks • Pharmaceuticals • Solvent • Stains

**Threshold Limit Value:**

25 ppm • 250 mg/m<sup>3</sup>

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Irritant • Central nervous system depressant

**SIGNS AND SYMPTOMS:**

Irritation of eye, nose, and throat • Headache and dizziness •  
Dermatitis

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection

# DIISOPROPYLAMINE

## Synonyms:

DIPA • N-(1-methylethyl)-2-propanamine

## Description:

Colorless liquid, ammoniacal odor

## Occupational Exposure:

Catalyst • Chemical synthesis

## Threshold Limit Value:

5 ppm • 20 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Irritation of eyes with hazy vision • Headache and nausea •  
Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory  
protection • Rubber gloves

# DIMETHYL ACETAMIDE

## Synonyms:

Acetic acid dimethylamide • DMAC

## Description:

Colorless liquid

## Occupational Exposure:

Catalyst • Paint remover • Solvent

## Threshold Limit Value:

10 ppm • 35 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Hepatotoxin

### SIGNS AND SYMPTOMS:

Irritation of respiratory tract • Anorexia and nausea with dyspepsia • Headache • Jaundice accompanied by pruritis

### DIAGNOSTIC TESTS:

N-methyl acetamide in urine

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Approved respiratory protection • Gloves and other protective clothing as indicated

Corsi, G.C. 1971. Sulfo patologia professionale da dimetilacetamide.  
*Med. Lav.* 62:28.

# DIMETHYLAMINE

## Synonyms:

DMA • *n*-Methyl methanamine

## Description:

Gas, pungent odor

## Occupational Exposure:

Antioxidant • Chemical synthesis • Detergents and soaps • Dyes •  
Electroplating • Pharmaceuticals • Rocket propellant • Rubber  
processing • Surfactant • Tanning leather

## Threshold Limit Value:

10 ppm • 18 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis • Respiratory irritation can occur • Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## DIMETHYLAMINO AZOBENZENE

### Synonyms:

Butter yellow • *p*-Dimethylamino azobenzene • Methyl yellow

### Description:

Yellow flakes

### Occupational Exposure:

Chemical research

### Threshold Limit Value:

OSHA cancer suspect

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Contact dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

These are now prescribed by law and should be followed as indicated in any given jurisdiction

## DIMETHYLAMINO PROPIONITRILE

### Synonyms:

DMAPN

### Description:

Colorless liquid

### Occupational Exposure:

Catalyst for acrylamide grouting • Polyurethane manufacture



## DIMETHYLAMINO PROPIONITRILE (*cont'd.*)

### Threshold Limit Value:

None

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

The metabolites of DMAPN appear to be neurotoxic and excreted in the urine where they primarily diffuse through the bladder wall to affect the genitourinary system—bladder neuropathy

#### SIGNS AND SYMPTOMS:

Urinary hesitancy or retention with slowing of the urinary stream and incomplete emptying of bladder

Peripheral extremity sensorimotor neuropathies have also been reported

Altered sensation in lower sacral dermatomes

Sexual dysfunction consisting of decreased libidos (male and female) and impotence

Irritability, weakness, insomnia, and dryness in mouth have also occurred

#### DIAGNOSTIC TESTS:

Cystometrogram consistent with bladder neuropathy

#### TREATMENT:

Cessation of exposure appears specific

#### DISABILITY:

Bladder dysfunction may persist for years, although most symptoms reverse in a short period of time

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing

Good personal hygiene

No eating or smoking in work area

Physical examination of exposed personnel at regular intervals with

## DIMETHYLAMINO PROPIONITRILE (*cont'd.*)

### Preventive Measures (*cont'd.*):

special attention to the central nervous system and genitourinary function

Remove from exposure those who become symptomatic

Preclude from exposure those individuals with central nervous system and genitourinary diseases

Keogh, J.P. 1983. Dimethylamino propionitrile. *Am. J. Ind. Med.* 4:479.

Kreiss, K. et.al. 1980. Neurological dysfunction of the bladder in workers exposed to dimethylamino propionitrile. *JAMA* 243(8):741.

## N,N-DIMETHYL ANILINE

### Synonyms:

N,N-dimethyl benzenamine • Dimethyl phenylamine

### Description:

Yellow liquid

### Occupational Exposure:

Chemical synthesis • Dyes • Laboratory reagent • Solvent • Vanillin manufacture

### Threshold Limit Value:

5 ppm • 25 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Methemoglobin formation • Central nervous system depressant

#### SIGNS AND SYMPTOMS: *May be delayed following exposure*

Headache • Cyanosis • Dizziness • Weakness • Numbness of the extremities • Dyspnea • Chest pain • Tachycardia • Nausea • Vomiting • Abdominal pain • Malaise • Syncope • Convulsions

## N,N-DIMETHYL ANILINE (*cont'd.*)

### DIAGNOSTIC TESTS:

Methemoglobin determination

### TREATMENT:

Terminate the exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules and area beneath nails; this decontamination may have to be repeated

Determine the degree of methemoglobin hourly until a decline is well established

Oxygen, using IPPB if available

Methylene blue is usually not recommended unless the methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour, but do not exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

### DISABILITY:

Recovery usually complete in 24–48 hours

### Preventive Measures:

Adequate ventilation of work area • Approved respiratory protection

Extreme cleanliness of work area and good personal hygiene

Protective clothing, laundered daily, in addition to use of synthetic butyl gloves and boots

Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis

Preclude from exposure those individuals with anemia, cardiovascular or pulmonary diseases

## DIMETHYL FORMAMIDE

### Synonyms:

N,N-dimethyl formamide • DMF • DMFA

## DIMETHYL FORMAMIDE (*cont' d.*)

### Description:

Clear liquid, fishy odor

### Occupational Exposure:

Artificial leather manufacture • Catalyst • Chemical synthesis • Dyes  
• Pharmaceuticals • Polyacrylic fiber manufacture • Solvent

### Threshold Limit Value:

10 ppm • 30 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Liver and kidney damage • Inhibition of acetaldehyde metabolism

#### SIGNS AND SYMPTOMS:

Conjunctivitis and dermatitis

Anorexia • Nausea • Vomiting • Colicky abdominal pain

Weakness • Incoordination

Alcohol intolerance with "antabus"-like reaction to alcohol:

Effect is most noticeable within 24 hours of DMF exposure and usually clears within 2 hours

Blotchy redness of face, neck, chest, and upper extremities

Dizziness, nausea, dyspnea, and chest tightness with palpitation may also occur

#### DIAGNOSTIC TESTS:

N,N-dimethyl formamide in expired air

N-methyl formamide in urine; this test also permits monitoring DMF exposures

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## DIMETHYL FORMAMIDE (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Impervious protective clothing to prevent skin contamination

Physical examination of exposed personnel on a regular basis including liver and kidney function tests

Inform employees of the possible alcohol sensitization

Preclude from exposure those individuals with liver, kidney, and cardiovascular diseases

Brugnone, F. et.al. 1980. N-N-dimethyl formamide concentration in environmental and alveolar air in an artificial leather factor. *Brit. J. Ind. Med.* 37:185.

Chivers, C.P. 1978. Disulfiram effect from inhalation of dimethyl formamide. *Lancet* 1:331.

Lyle, W.H. et.al. 1979. Dimethyl formamide and alcohol intolerance. *Brit. J. Ind. Med.* 36:63.

## DIMETHYL NITROSAMINE

### Synonyms:

DMN • N-nitroso dimethylamine

### Description:

Yellow liquid

### Occupational Exposure:

Corrosion inhibitor • Lubricants • Rocket fuels • Rubber accelerator • Solvent

### Threshold Limit Value:

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Liver damage

## DIMETHYL NITROSAMINE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Headache • Drowsiness • Dizziness • Weakness  
Anorexia • Nausea • Vomiting • Abdominal cramping  
Hepatomegaly • Jaundice • Ascites

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Permanent damage has occurred only in overwhelming exposures

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing  
Physical examination of exposed personnel at regular intervals with special attention to the liver

## DIMETHYL PHOSPHOROCHLOROIODOTHIONATE

### Synonyms:

Dimethyl chlorothionophosphate • Dimethyl thionochlorophosphate  
• DMPCT

### Description:

Amber liquid

### Occupational Exposure:

Chemical synthesis • Insecticide manufacture

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

None

## DIMETHYL PHOSPHOROCHLOROIODOTHIONATE (*cont'd.*)

### MODE OF ACTION:

Irritant

In the presence of moisture, DMPCT slowly decomposes to form hydrochloric acid

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis, the onset of which may be delayed 4-12 hours

Mild rhinitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Treat corneal damage in usual manner

Symptomatic

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection if indicated

Hart, W.P. and Swencicki, R.E. 1975. Keratitis on exposure to dimethyl phosphorochloroiodothionate (DMPCT). *JOM* 17(5):335.

## DIMETHYL SULFATE

### Synonyms:

DMS • Methyl sulfate • Sulfuric acid dimethyl ester

### Description:

Colorless oily liquid

### Occupational Exposure:

Methylating agent in chemical synthesis • Solvent



## DIMETHYL SULFATE (*cont' d.*)

### Threshold Limit Value:

0.1 ppm • 0.5 mg/m<sup>3</sup>

Suspect carcinogen

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant and corrosive

Hydrolyzes to sulfuric acid and methyl alcohol

**SIGNS AND SYMPTOMS:** After a relatively asymptomatic latent period of up to 10 hours

*Eyes:* Conjunctivitis and palpebral edema • Lacrimation and photophobia • Corneal ulceration and disturbed vision

*Skin:* Pruritis • Vesiculation • Severe blistering necrosis • Slow-healing burns

*Respiratory:* Rhinitis and perforation of nasal septum • Pharyngeal and laryngeal edema with hoarseness and dysphagia • Chest pain, dyspnea, cough, cyanosis • Bronchitis, pneumonitis, and pulmonary edema

*Systemic:* Nausea and vomiting • Prostration, delirium, convulsions, and coma • Jaundice, albuminuria, hematuria, and oliguria

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Hospitalize early

Cardiorespiratory support

Monitor electrolytes and fluid balance

#### DISABILITY:

Permanent damage has been reported



## DIMETHYL SULFATE (*cont'd.*)

### Preventive Measures:

Approved respiratory protection

Protective face shields, hoods, gloves, aprons, boots, or full suit as indicated

Preclude from exposure those individuals with diseases of the eyes, skin, cardiopulmonary system, kidneys, and liver

Roux, H. 1977. Dimethyl sulfate poisoning—13 case studies. Université Claude Bernard Lyon 11.

## DINITROBENZENE

### Synonyms:

Three isomers: *o*-, *m*-, *p*-dinitrobenzene • Dinitrobenzol

### Description:

White or yellow crystals

### Occupational Exposure:

Dyestuffs • Explosives • Celluloid production

### Threshold Limit Value:

0.15 ppm • 1 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Liver damage • Methemoglobinemia and anemia

#### SIGNS AND SYMPTOMS:

Irritation of the eyes, skin, and respiratory tract

Yellow discoloration of the hair and skin has been reported

Methemoglobinemia is accompanied by headache, cyanosis, dizziness, weakness, numbness of the extremities, dyspnea, chest pain, tachycardia, anorexia, nausea, vomiting, abdominal pain, malaise, syncope, convulsions

Hepatomegaly

Anemia with Heinz bodies

## DINITROBENZENE (*cont' d.*)

### DIAGNOSTIC TESTS:

Dinitrobenzene in urine

Methemoglobinemia (normal < 2%)

### TREATMENT: *TREAT AS AN EMERGENCY*

Terminate the exposure and remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules and area beneath nails; this decontamination may have to be repeated

Determine the degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB if available

Methylene blue is usually not required unless methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour, but do not exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Butyl rubber protective clothing

Encourage daily bathing and clothing exchange by all exposed personnel

Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis

Physical examination of workers at regular intervals including a blood count and studies of liver and kidney function

Preclude from exposure those individuals with diseases of blood, liver, and kidneys

Okubo, T. and Shigeta, S. 1982. Anemia cases after acute *m*-dinitrobenzene intoxication due to occupational exposure. *Jpn. J. Ind. Hlth.* 20(4):297.

# DINITROCRESOL

## Synonyms:

4,6-Dinitro-*o*-cresol • 3,5-Dinitro-2-hydroxy toluene • DNC • DNOC •  
2-Methyl-4,6-dinitrophenol

## Description:

Yellow crystals

## Occupational Exposure:

Dyestuffs • Herbicide • Insecticide

## Threshold Limit Value:

0.2 mg/m<sup>3</sup>

## Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Acts as a cumulative poison

Disrupts oxidative phosphorylation

### SIGNS AND SYMPTOMS:

Yellow staining of hair and skin

Maculopapular dermatitis

Headache, malaise, and weakness are common

Severe systemic effects consist of fatigue, fever, restlessness,  
thirst, profuse sweating, weight loss, tachycardia, tachyp-  
nea, dyspnea, and cough

### DIAGNOSTIC TESTS:

DNOC in blood

Amino-4-nitro-*o*-cresol in urine

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Control hyperthermia

Avoid barbiturates and atropine

Cardiorespiratory support

Symptomatic and supportive

### DISABILITY:

No permanent effects from occupational exposures anticipated

## DINITROCRESOL (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective coveralls laundered daily

DNOC blood levels weekly: it has been suggested that at 20  $\mu\text{g}$  % the employee should be removed from exposure until the level is again below 15  $\mu\text{g}$

Physical examination of exposed personnel every six months

Preclude from exposure those individuals with thyroid, liver, and kidney disease

## DINITROPHENOL

### Synonyms:

2,4-Dinitrophenol • DNP

### Description:

Yellow crystals

### Occupational Exposure:

Chemical synthesis • Dyestuffs • Explosives • Indicator chemical • Insecticide • Wood preservative

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Uncoupling of oxidative phosphorylation  
Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

*Early clinical effects:* Yellow staining of hair and sclerae, headache, dizziness, malaise, increased perspiration

*More serious effects:* Fatigue, thirst, fever and weakness, anorexia, nausea and vomiting, tachypnea, tachycardia, cyanosis, jaundice

## DINITROPHENOL (*cont'd.*)

### DIAGNOSTIC TESTS:

Dinitrophenol in urine

### TREATMENT:

Wash contaminated areas of body thoroughly

Oxygen

Monitor fluids and electrolytes

Control hyperthermia

Avoid antipyretics and barbiturates

Symptomatic and supportive

### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Good personal hygiene

Monitor nitrophenol urine levels regularly

Physical examination of exposed personnel on a regular basis including studies of liver and kidney function

Preclude from exposure those individuals with diseases of the thyroid, liver, and kidneys

Leftwich, R.B. et.al. 1982. Dinitrophenol poisoning: A diagnosis to consider in undiagnosed fever. *Southern Med. J.* 75:182.

## DINITROTOLUENE

### Synonyms:

Dinitrotoluol • DNT

### Description:

Yellow crystals

### Occupational Exposure:

Chemical synthesis • Dyes • Explosives

## DINITROTOLUENE (*cont' d.*)

### Threshold Limit Value:

1.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Formation of methemoglobin

Anemia with Heinz bodies

#### SIGNS AND SYMPTOMS: *May be delayed*

Headache • Cyanosis • Dizziness • Weakness • Numbness of extremities • Dyspnea • Chest pain • Tachycardia • Nausea and vomiting • Abdominal pain • Malaise • Syncope • Coma

#### DIAGNOSTIC TESTS:

Methemoglobin determination

#### TREATMENT:

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; decontamination may have to be repeated

Determine degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer i.v., repeat in one hour but don't exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## DINITROTOLUENE (*cont' d.*)

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Butyl rubber protective clothing
- Good personal hygiene
- Routine checks of lips, tongue, and nail beds of exposed personnel for signs of cyanosis
- Biological monitoring of urinary 2,4 dinitrobenzoic acid is useful in assessing absorption
- Preclude from exposure those individuals with anemia, cardiovascular, or pulmonary diseases

Woollen, B.H. et. al. 1985. Dinitrotoluene: An assessment of absorption during the manufacture of blasting explosives. *Int. Arch. Occup. Environ. Hlth.* 55:319.

## DIOXANE

### Synonyms:

- 1,4-Diethylene dioxide • Diethylene ether

### Description:

- Colorless liquid, ethereal odor

### Occupational Exposure:

- Adhesives • Chemical stabilizer • Cosmetics • Deodorants • Dyes • Fumigants • Paint and varnish strippers • Polishing compounds • Solvent

### Threshold Limit Value:

- 25 ppm • 90 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

- Inhalation • Percutaneous

#### MODE OF ACTION:

- Irritant • Liver and kidney damage



## DIOXANE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Irritation of the eyes, nose, and throat  
Defatting-type dermatitis  
Drowsiness • Dizziness • Headache  
Anorexia • Nausea • Vomiting • Abdominal pain  
Jaundice and renal failure have occurred

### DIAGNOSTIC TESTS:

Dioxane in urine  
beta-Hydroxy ethoxy acetic acid in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Monitor fluid and electrolyte balance in severe exposures  
Symptomatic and supportive

### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Closed systems have been recommended  
Chemical goggles • Approved respiratory protection • Protective clothing  
Physical examination of exposed personnel at periodic intervals including studies of liver and kidney function  
Preclude from exposure those individuals with liver and kidney diseases

Buffler, P.A. et.al. 1978. Mortality follow-up of workers exposed to 1,4-dioxane. *JOM* 20(4):255.

## DIOXIN

### Synonyms:

TCDBD • TCDD • Tetrachlorodibenzo-*p*-dioxin

### Description:

Liquid



## DIOXIN (*cont' d.*)

### Occupational Exposure:

Occurs as a contaminant in the manufacture of 2,4,5-T, 2,4,5-TCP, and other chlorophenols

### Threshold Limit Value:

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Chloracne

Damage to liver, kidneys, central nervous system among other effects

#### SIGNS AND SYMPTOMS:

*Dermal:* Chloracne appears to be the most sensitive indicator of dioxin exposure, coming on within a week or so after exposure as the first sign, and persisting in severe cases for over 20 years when all other symptoms have cleared • Characteristically, this appears as pale yellow cysts confined to the face beneath the eyes and behind the ears in mild cases and becoming papulo-pustular and extending to the face, neck, torso, and extremities in more severe exposures • Hyperpigmentation, hirsutism, and porphyria cutanea tarda have also been reported

*Liver:* Hepatomegaly and abnormal hepatic enzyme values tend to subside within a few months • Accompanying abdominal discomfort, anorexia and qualitative dyspepsia also subside when exposure ceases

*Neurologic:* Hyperirritability, insomnia, fatigue, and an intolerance to cold occur • Alterations in the senses of sight, hearing, and smell have been reported • Peripheral neuropathy associated with paresthesias and weakness of the lower extremities are accompanied by diminished motor and sensory nerve conduction

*Musculoskeletal:* Myalgias of the chest and lower extremities also occur

*Genitourinary:* Decreased libido • Impotence • Increased

## DIOXIN (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

urinary uroporphyrin excretion  
Other complaints have also been recorded

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Most changes reverse within a couple of months after cessation of exposure  
Peripheral nerve symptoms have persisted up to 2 years before clearing  
Skin lesions (chloracne) have persisted for over 20 years  
Multiple careful studies have shown no other chronic residuals

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing  
Good personal hygiene  
Physical examination of exposed personnel at regular intervals with special attention to the skin and other target organs  
Preclude from exposure those individuals with diseases of the skin, liver, nervous system, musculoskeletal and genitourinary system

May, G. 1982. Tetrachlorodibenzodioxin: A survey of subjects ten years after exposure. *Brit. J. Ind. Med.* 39:128.

Suskind, R.R. and Hertzberg, V.S. 1984. Human health effects of 2,4,5-T and its toxic contaminants. *JAMA* 251:2372.

Thiess, A.M. 1982. Mortality study of persons exposed to dioxin in a trichlorophenol process accident that occurred in the BASF AG on November 17, 1953. *Am. J. Ind. Med.* 3:179.

## DIPHENYL

### Synonyms:

Bibenzene • Biphenyl • Diphenyl methane • Phenyl benzene

## DIPHENYL (*cont'd.*)

### Description:

Yellow liquids and crystals

### Occupational Exposure:

Chemical synthesis • Dyes • Fungistat (applied to wrappers and containers) • Heat transfer agents • Pharmaceuticals

### Threshold Limit Value:

0.2 ppm • 1.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Neurotoxin • Liver damage

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Dermatitis and skin burns

Headache • Dizziness • Fatigue

Nausea • Abdominal pain

Polyneuritis manifested as numbness and aching of the extremities

#### DIAGNOSTIC TESTS:

4-Hydroxybiphenyl in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

Permanent disability can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Physical examination of exposed personnel at periodic intervals with special attention to the central nervous system and liver function

Preclude from exposure those individuals with central nervous system and liver diseases

## DIPHENYL (*cont'd.*)

Häkkinen, I. et.al. 1973. Diphenyl poisoning in fruit paper production.  
*Arch. Environ. Hlth.* 26:70.

## DIPHENYLAMINE

### Synonyms:

DPA • N-phenyl aniline • N-phenyl benzeneamine

### Description:

Colorless crystals, floral odor

4-Aminodiphenyl may be present as an impurity

### Occupational Exposure:

Chemical indicator • Dyes • Explosives • Pesticides • Pharmaceuticals • Rubber industry

### Threshold Limit Value:

10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Methemoglobin formation is possible but has not occurred in industry

#### SIGNS AND SYMPTOMS:

Dermatitis • Headache and fatigue • Anorexia and vomiting

#### DIAGNOSTIC TESTS:

Methemoglobin determination

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## DIPHENYLAMINE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## DIPROPYLENE GLYCOL METHYL ETHER

### Synonyms:

None

### Description:

Colorless liquid

### Occupational Exposure:

Solvent

### Threshold Limit Value:

100 ppm • 600 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Mild irritant

#### SIGNS AND SYMPTOMS:

Has not been a significant health hazard

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Exercise general care

## DITHIOCARBAMATES

### Synonyms:

Amobam • Ferbam • Maneb • Nabam • Vapam • Zineb • Ziram •  
Others

### Description:

White, tan, brown to black crystals and powders

### Occupational Exposure:

Fungicides

### Threshold Limit Value:

Ferbam — 10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Cholinesterase inhibition is slight

Interacts with sulfhydryl bonds and also demonstrates metal  
chelating properties

Metabolized to carbon disulfide and ethylene diamine

#### SIGNS AND SYMPTOMS:

Irritation of the eyes, upper respiratory tract, and skin

Headache • Dizziness • Weakness • Convulsions

Anorexia • Nausea • Vomiting

Thiram has caused an antabuse-like flushing, erythema, and  
pruritis when exposed individuals consume alcohol

Sensitization has been reported

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Oxygen

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## DITHIOCARBAMATES (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Israeli, R. et.al. 1983. Acute intoxication due to exposure to maneb and zineb. A case with behavioral and central nervous system changes. *Scand. J. Work Environ. Hlth.* 9(1):47.

Miller, D.B. 1982. Neurotoxicity of the pesticidal carbamates. *Neurobehav. Toxicol. Teratol.* 4(6):779.

## EARTH METALS, RARE

### Synonyms:

Cerium • Lanthanum • Yttrium • Others

### Description:

Metals are generally gray

Salts are crystals and powders

### Occupational Exposure:

Abrasives • Alloys • Catalysts • Electronics • Gas mantles • Glass and ceramics • Pharmaceuticals • Phosphors • Refractories

### Threshold Limit Value:

Yttrium — 1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Almost none

#### DIAGNOSTIC TESTS:

Chest x-ray may show evidence of pneumoconiosis

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No pulmonary impairment reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Annual examination of exposed personnel including chest x-ray and spirometry

Izraelson, Z.I. 1963. Toxicology of the Rare Metals. Moscow, translated by Irene Campbell.

Nappée, J. et.al. 1972. Pneumoconiose au cérium. *Arch. Med. Profess. Med. Travail Sec. Soc.* 33:13.



# EPICHLOROHYDRIN

## Synonyms:

1-Chloro-2,3-epoxy propane • Chloromethyl oxirane • Chloropropylene oxide • 3-Chloro-1,2-propylene oxide • 1,2-Epoxy-3-chloropropane

## Description:

Colorless liquid, chloroform-like odor

## Occupational Exposure:

Adhesives • Agricultural chemicals • Chemical synthesis • Epoxy resins • Pharmaceuticals • Solvent

## Threshold Limit Value:

2 ppm • 10 mg/m<sup>3</sup>

## Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Sensitizer

Liver damage is possible

### SIGNS AND SYMPTOMS:

#### *Acute:*

Effects may be delayed several hours

Irritation of the eyes and respiratory tract

Skin burns are severe and associated with deep pain sensations

#### *Chronic:*

Fatigue and headache

Irritation of eyes, nose, and skin

Nausea, vomiting, and abdominal discomfort

Dyspnea, cough, cyanosis, and chemical pneumonitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns as usual

Symptomatic and supportive

## EPICHLOROHYDRIN (*cont' d.*)

### DISABILITY:

Sensitization appears to be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Preclude from exposure those individuals with allergies or diseases of the skin and lungs

Remove from further exposure those who become sensitized

## EPOXY RESINS

### Synonyms:

Epon resins • Epoxide resins • Epoxies • Ethyloxyline resins

### Description: The epoxy resin system consists of:

RESIN—Polymers produced as condensation products of *epichlorohydrin* and a *polyhydroxy compound*; e.g., bisphenol A

Resins may be:

Solids—which are virtually innocuous

Liquids—which may be moderate irritants

Diluted—commonly with *glycidyl ethers* and *styrene oxide* which act as irritants and sensitizers

HARDENER—The curing agent, commonly a polyamino compound

Aliphatic: *Ethylene diamine, diethylene triamine, triethylene tetramine*

Aromatic: *Diaminodiphenyl methane, metaphenylene diamine, dicyandiamine*

Acid anhydrides: *Phthalic acid anhydride, trimellitic anhydride*

Polyamides: Usually nontoxic

DILUENTS—Utilized to reduce the viscosity of uncured resin systems; e.g., *glycidyl ethers, styrene, styrene oxide*, others

### OTHER ADDITIVES—

Solvents; e.g., *glycol ethers, MEK, methyl isobutyl ketone, toluene, xylene*

Fillers, e.g., *diatomaceous earth, silica flour*

Catalysts help perform a curing action but do not act as cross-link agents

## EPOXY RESINS (*cont'd.*)

### Occupational Exposure:

Adhesives • Laminating • Molding compounds • Surface coatings •  
Reinforced plastics

**Threshold Limit Value:** *See specific compound*

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

**MODE OF ACTION:** *See specific compound*

Irritants • Sensitizers

#### SIGNS AND SYMPTOMS:

Liquid resins tend to produce:

Contact dermatitis with erythema, edema, and weeping

Sensitization dermatitis characterized by itchy papulo-vesicular lesions

Hyperpigmentation and lichenification in chronic cases

Photosensitization has also been reported

Hardening agents in general are irritants and sensitizers and  
cause severe eye damage and asthma in some instances

Diluents tend to be sensitizers

Additives generally are irritants

#### DIAGNOSTIC TESTS:

Patch tests for sensitization

**TREATMENT:** *See specific compound*

Symptomatic and supportive

#### DISABILITY:

Sensitization and photoallergic reactions can be permanent

### Preventive Measures:

Adequate ventilation

Chemical goggles or face shield as appropriate

Approved respiratory protection (if air-fed hoods are used, noise  
levels within the hood should be checked)

Gloves, sleeves, or aprons as appropriate

Good personal hygiene

No eating or smoking in work areas

## EPOXY RESINS (*cont'd.*)

### Preventive Measures (*cont'd.*):

Discourage use of solvents for skin cleansing

Preclude from exposure those individuals with skin and respiratory diseases and allergies

Allen, H. and Kaidbey, R. 1979. Persistent photosensitivity following occupational exposure to epoxy resin. *Arch. Derm.* 115:1307.

Fawcett, I.W. et.al. 1977. Asthma due to inhaled chemical agents—Epoxy resin systems containing phthalic acid anhydride, trimellitic acid anhydride and triethylene tetramine. *Clin. Allergy* 7:1.

Hosein, H.R. 1980. Some experiences with epoxy resin grouting compounds. *Am. Ind Hyg. Assoc. J.* 41:523.

Lemon, R.C. 1972. Epoxy resins in surface coatings. *Ann. Occup. Hyg.* 15:131.

## ETHANE

### Synonyms:

Bimethyl • Dimethyl • Ethyl hydride • Methyl methane

### Description:

Colorless, odorless gas

### Occupational Exposure:

Chemical synthesis • Fuel gas • Oil and gas wells • Refrigerant

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Asphyxiant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Narcosis

## ETHANE (*cont'd.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Oxygen

Cardiorespiratory support

Symptomatic

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

## ETHANOLAMINE

### Synonyms:

2-Aminoethanol • Colamine • Ethylolamine • 2-Hydroxyethylamine

### Description:

Colorless liquid, ammoniacal odor

### Occupational Exposure:

Chemical synthesis • Detergents • Hair waving solutions •  
Pharmaceuticals • Polishes

### Threshold Limit Value:

3 ppm • 8 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Mild skin irritation has been reported

## ETHANOLAMINE (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles when appropriate • Approved respiratory protection

## ETHOXYQUIN

### Synonyms:

6-Ethoxy-1,2-dihydro-2,2,4-trimethyl quinoline

### Description:

Yellow liquid

### Occupational Exposure:

Antioxidant food preservative (apples, canned and frozen foods, animal feeds, etc.)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

None

#### MODE OF ACTION:

Sensitizer

#### SIGNS AND SYMPTOMS:

Contact and generalized dermatitis

## ETHOXYQUIN (*cont' d.*)

### DIAGNOSTIC TESTS:

Patch test

### TREATMENT:

Symptomatic

### DISABILITY:

Sensitization appears permanent

### Preventive Measures:

Rubber gloves

Education of employees

Burrows, D. 1975. Contact dermatitis in animal feed mill workers. *Brit. J. Dermatol.* 92:167.

## ETHYL ACETATE

### Synonyms:

Acetic ether • Vinegar naphtha

### Description:

Clear liquid, fruity odor

### Occupational Exposure:

Artificial fruit essence • Artificial leather • Chemical synthesis •  
Perfumes • Pharmaceuticals • Photography • Smokeless powder •  
Solvent

### Threshold Limit Value:

400 ppm • 1400 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Sensitization has been reported

Narcosis possible

## ETHYL ACETATE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis  
Irritation of nose and upper respiratory tract  
Dermatitis  
Headache and drowsiness

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

Sensitization could be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## ETHYL ALCOHOL

### Synonyms:

Ethanol • Grain alcohol

### Description:

Colorless liquid

### Occupational Exposure:

Antifreeze • Antiseptics • Beverages • Chemical synthesis • Cosmetics • Detergents • Extractant • Fuel additive • Pharmaceuticals  
• Solvent

### Threshold Limit Value:

1000 ppm • 1900 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation



## ETHYL ALCOHOL (*cont' d.*)

### MODE OF ACTION:

Irritant  
Central nervous system depressant  
Liver damage is possible  
Denaturants may cause other effects

### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract  
Dermatitis  
Headache • Drowsiness • Dizziness • Mental confusion •  
Fatigue  
Anorexia • Nausea  
Narcosis

### DIAGNOSTIC TESTS:

Alcohol in expired air or blood

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## ETHYLAMINE

### Synonyms:

Aminoethane • Ethanamine • Monoethylamine

### Description:

Colorless liquid, ammoniacal odor

### Occupational Exposure:

Chemical synthesis • Detergents • Dyestuffs • Oil refining • Pharmaceuticals • Rubber industry

## ETHYLAMINE (*cont' d.*)

### Threshold Limit Value:

10 ppm • 18 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Dermatitis

#### DIAGNOSTIC TESTS:

Ethylamine in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## ETHYL AMYL KETONE

### Synonyms:

Amyl ethyl ketone • EAK • 5-Methyl-3-heptanone

### Description:

Colorless liquid, fruity odor

### Occupational Exposure:

Perfumes • Solvent

## ETHYL AMYL KETONE (*cont'd.*)

### Threshold Limit Value:

25 ppm • 130 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

Headache • Nausea • Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves if indicated

## ETHYL BENZENE

### Synonyms:

Phenylethane

### Description:

Colorless liquid, aromatic odor

### Occupational Exposure:

Fuel additive • Solvent • Synthetic rubber

### Threshold Limit Value:

100 ppm • 435 mg/m<sup>3</sup>

## ETHYL BENZENE (*cont'.d*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Blood and liver changes have been reported

#### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis  
Irritation of respiratory tract  
Dermatitis  
Dizziness • Drowsiness  
Menstrual disorders have been reported

#### DIAGNOSTIC TESTS:

Ethyl benzene in blood  
Mandelic acid in urine

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves  
Physical examination of exposed personnel at regular intervals with special attention to hematopoietic changes and liver function

## ETHYL BROMIDE

### Synonyms:

Bromic ether • Bromoethane • Monobromoethane

### Description:

Colorless liquid, ethereal odor

## ETHYL BROMIDE (*cont'd.*)

### Occupational Exposure:

Chemical synthesis • Fumigant • Pharmaceuticals • Refrigerant • Solvent

### Threshold Limit Value:

200 ppm • 890 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Liver and kidney damage are possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin  
Headache • Dizziness • Weakness • Ataxia

#### DIAGNOSTIC TESTS:

Bromine in urine

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

#### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

## ETHYL BUTYL KETONE

### Synonyms:

3-Heptanone

### Description:

Clear liquid

## ETHYL BUTYL KETONE (*cont' d.*)

### Occupational Exposure:

Chemical synthesis • Solvent

### Threshold Limit Value:

50 ppm • 230 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles if appropriate • Approved respiratory protection if indicated

## ETHYL CHLORIDE

### Synonyms:

Chloroethane • Hydrochloric ether • Monochloroethane

### Description:

Colorless gas, ethereal odor

### Occupational Exposure:

Anesthetic • Chemical synthesis • Laboratory reagent • Manufacture of tetraethyl lead • Refrigerant • Solvent

### Threshold Limit Value:

1000 ppm • 2600 mg/m<sup>3</sup>

## ETHYL CHLORIDE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous (slight)

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Liquid ethylene chloride could produce cryogenic damage to the eyes and skin

Conjunctivitis and corneal erosions

Respiratory tract irritation

Dermatitis

Headache • Dizziness • Incoordination and narcosis

Cardiac arrest has been reported (among abusers)

#### DIAGNOSTIC TESTS:

Ethyl chloride in expired air

#### TREATMENT:

Irrigate eyes with water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles and skin protection if indicated • Approved respiratory protection when indicated

Parker, J.C. et.al. 1979. Chloroethanes: Review of toxicity. *Am. Ind. Hyg. Assoc. J.* 40:A46.

## ETHYLENE

### Synonyms:

Elayl • Ethene • Olefiant gas

### Description:

Colorless gas, sweet odor

### Occupational Exposure:

Agriculture • Anesthetic • Chemical synthesis • Plastics • Refrigerant  
• Welding

## ETHYLENE (*cont' d.*)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Asphyxiant • Cardiac arrhythmias

#### SIGNS AND SYMPTOMS:

Liquid ethylene can cause cryogenic burns

Irregular heart action

Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Oxygen

Cardiorespiratory support

Symptomatic

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation

Eye and skin protection if liquid ethylene is handled

## ETHYLENE CHLOROHYDRIN

### Synonyms:

2-Chloroethanol • 2-Chloroethyl alcohol • Glycol chlorohydrin

### Description:

Colorless liquid, ethereal odor

### Occupational Exposure:

Agriculture • Chemical synthesis • Insecticides • Refining mineral oil and rosin • Solvent • Textiles

### Threshold Limit Value:

1 ppm • 3 mg/m<sup>3</sup>



# ETHYLENE CHLOROHYDRIN (*cont' d.*)

Toxicity: *HIGHLY TOXIC*

## ROUTE OF ENTRY:

Inhalation • Percutaneous

## MODE OF ACTION:

Metabolized to chloroacetaldehyde and chloroacetic acid

Irritant

Liver and kidney damage

Pulmonary edema

## SIGNS AND SYMPTOMS:

Irritation of the eyes including corneal burns

Respiratory tract irritation

Headache • Dizziness • Weakness • Incoordination • Pares-  
thesias

Nausea • Vomiting

Hypotension • Cyanosis • Shock • Collapse

Hematuria and albuminuria

## DIAGNOSTIC TESTS:

None established

## TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen and cardiorespiratory support

Symptomatic and supportive

## DISABILITY:

No permanent residual effects anticipated

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Protective clothing must be monitored (ordinary rubber gloves and protective cloth become saturated and penetration occurs)

Physical examination of exposed personnel on a regular basis with special attention to the central nervous system and including liver and kidney studies

Preclude from exposure those individuals with diseases of liver, kidney, and lungs

# ETHYLENE DIAMINE

## Synonyms:

1,2-Diamino ethane • 1,2-Ethane diamine

## Description:

Colorless liquid, ammoniacal odor

## Occupational Exposure:

Antifreeze inhibitor • Chemical synthesis • Dyes • Emulsifier •  
Fungicides • Insecticides • Solvent • Stabilizer • Textile lubricant

## Threshold Limit Value:

10 ppm • 25 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Irritation of the eyes and respiratory tract with a late asthmatic  
reaction 4 hours after exposure

Vesicular dermatitis and skin burns; exfoliative erythroderma  
has also been reported

Headache • Dizziness

Vomiting • Abdominal cramps • Diarrhea

### DIAGNOSTIC TESTS:

Skin test may be positive

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in usual manner

Symptomatic and supportive

### DISABILITY:

Sensitization may be permanent

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory pro-  
tection • Rubber gloves and protective clothing

Preclude from exposure those individuals with asthma and chronic  
skin diseases

Remove from exposure those who become sensitized

## ETHYLENE DIAMINE (*cont'd.*)

- Lam, S. and Chan Young, M. 1980. Ethylene diamine induced asthma. *Am. Rev. Resp. Dis.* 121:151.  
Niveau, J. and Painchaux, J. 1973. Fatal poisoning by ethylene diamine. *Arch. Mal. Prof.* 34(9):523.

## ETHYLENE DIBROMIDE

### Synonyms:

1,2-Dibromoethane • EDB • Ethylene bromide

### Description:

Colorless liquid, sweetish odor

### Occupational Exposure:

Chemical synthesis • Fire extinguishers • Fuels • Fumigant • Solvent • Waterproofing preparations

### Threshold Limit Value:

OSHA — 20 ppm

Suspect carcinogen

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer • Central nervous system depressant  
Renal and hepatic damage

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis  
Pharyngitis • Cough • Dyspnea • Cyanosis • Pneumonitis • Pulmonary edema  
Erythema, edema and blistering ulceration that may be delayed 24–48 hours  
Headache • Tinnitus • Weakness • Confusion • Coma  
Anorexia • Nausea • Vomiting • Abdominal cramps • Diarrhea  
Oliguria • Metabolic acidosis

#### DIAGNOSTIC TESTS:

Bromine in serum

## ETHYLENE DIBROMIDE (*cont' d.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water; it has been suggested this be done in three stages, once with cold water then in turn with warm and finally with hot water to reduce dermal absorption and thoroughly cleanse the skin

Gastric lavage, if ingested, with charcoal and followed by saline catharsis

Careful monitoring of fluid and electrolyte balance

Correct metabolic acidosis

Cardiorespiratory support

Treat burns in usual manner

Symptomatic and supportive

### DISABILITY:

Impairment can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Neoprene or rubber protective clothing (chemical will ultimately penetrate these)

Physical examination of exposed personnel on a regular basis including evaluation of liver and kidney function

Preclude from exposure those individuals with pulmonary, liver, and kidney diseases

NIOSH has suggested that employees using disulfiram for medical purposes or exposed to disulfiram in the workplace (e.g., rubber accelerator) should not be simultaneously exposed to EDB because of enhanced toxic effects

Jacobs, R.S. 1985. Ethylene dibromide poisoning. *JAMA* 253(20):2961.

Letz, G.A. et.al. 1984. Two fatalities after acute occupational exposure to ethylene dibromide. *JAMA* 252(7):2428.

## ETHYLENE GLYCOL

### Synonyms:

1,2-Ethanediol • Glycol

### Description:

Colorless liquid

# ETHYLENE GLYCOL (*cont'd.*)

## Occupational Exposure:

Antifreeze • Chemical synthesis • Explosives • Foam stabilizer •  
Heat transfer agent • Humectant • Hydraulic fluids • Inks •  
Lacquers • Leather dyeing • Solvent

## Threshold Limit Value:

50 ppm • 125 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation ? • Percutaneous ?

### MODE OF ACTION:

Metabolized to glycolic, glyoxylic and oxalic acid  
Central nervous system depressant  
Renal and liver damage

### SIGNS AND SYMPTOMS:

*Inhalation:* Marked irritation of respiratory tract with dyspnea, cough, and burning in chest • It seems likely that aerosolized EG is not absorbed by this route

*Ingestion:* Central nervous system effects in 30 minutes to 12 hours—Nystagmus, ophthalmoplegia, papilledema, diminished reflexes, focal or general seizures and coma

*Cardiopulmonary effects* after 12–24 hours—tachypnea, tachycardia, mild hypertension, cyanosis, and cardiac failure with pulmonary edema

*Renal effects:* Flank pain, oliguria and anuria, azotemia

### DIAGNOSTIC TESTS:

Ethylene glycol in blood  
Oxalic acid in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Monitor fluids and electrolytes carefully  
Forced diuresis to prevent oxalate deposition  
Correct metabolic acidosis  
Ethanol to maintain blood levels above 100 mg/dl helps block EG metabolism

## ETHYLENE GLYCOL (*cont' d.*)

### TREATMENT (*cont' d.*):

Hemodialysis

Symptomatic and supportive

### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Approved respiratory protection • Protective clothing where indicated

No smoking or eating in work area

Physical examination of exposed personnel at periodic intervals with special attention to the central nervous system and including studies of liver and kidney function

Preclude from exposure those individuals with diseases of the liver, kidney, lungs, and central nervous system

Frommer, J.P. and Ayns, J.C. 1982. Acute ethylene glycol intoxication. *Am. J. Nephrol.* 2:1.

Peterson, C.D. et.al. 1981. Ethylene glycol poisoning. *NEJM* 304(1):21.

Wills, J.H. et.al. 1974. Inhalation of aerosolized ethylene glycol in man. *Clin. Toxicol.* 7(5):463.

## ETHYLENE GLYCOL MONOBUTYL ETHER

### Synonyms:

2-Butoxy ethanol • *n*-Butyl-beta-hydroxyethyl ether • Butyl Cello-solve

### Description:

Colorless liquid

### Occupational Exposure:

Drycleaning compounds • Lacquers and varnishes • Paints • Solvent • Textile dyeing

### Threshold Limit Value:

25 ppm • 120 mg/m<sup>3</sup>

# ETHYLENE GLYCOL MONOBUTYL ETHER

(cont' d.)

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Metabolized to butoxyacetic acid which increases red blood cell fragility?

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis • Headache • Irritation of the upper respiratory tract

### DIAGNOSTIC TESTS:

EGME in expired air

Butoxyacetic acid in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Physical examination of exposed personnel at regular intervals with special attention to blood findings and renal function

Preclude from exposure those individuals with hematologic disorders and kidney disease

# ETHYLENE GLYCOL MONOETHYL ETHER

## Synonyms:

Cellosolve • 2-Ethoxy ethanol

## Description:

Colorless liquid, no odor



# ETHYLENE GLYCOL MONOETHYL ETHER

(*cont' d.*)

## Occupational Exposure:

Antiicing additive • Cleansing solution • Dye baths • Emulsion stabilizer • Solvent • Varnish removers

## Threshold Limit Value:

5 ppm • 19 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

Possible liver and kidney damage

### SIGNS AND SYMPTOMS:

Irritation of the eyes and respiratory tract

Bilirubinemia and albuminuria have been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel at periodic intervals including studies of liver and kidney function

Preclude from exposure those individuals with liver and kidney diseases



# ETHYLENE GLYCOL MONOETHYL ETHER ACETATE

## Synonyms:

Cellosolve acetate • 2-Ethoxyethyl acetate

## Description:

Colorless liquid, ester-like odor

## Occupational Exposure:

Lacquers • Leather • Solvent • Textiles • Varnish removers • Wood stains

## Threshold Limit Value:

5 ppm • 25 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

Central nervous system depression and kidney damage are possible

### SIGNS AND SYMPTOMS:

Irritation of the eyes and respiratory tract • Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel at regular intervals with special attention to the central nervous system and kidney function

Preclude from exposure those individuals with central nervous system and kidney diseases

# ETHYLENE GLYCOL MONOMETHYL ETHER

## Synonyms:

2-Methoxy ethanol • Methyl Cellosolve

## Description:

Colorless liquid, pleasant odor

## Occupational Exposure:

Deicing additive • Dyeing leather • Nail polishes • Perfume fixative • Solvent • Textile printing • Varnishes and enamels • Wood stains

## Threshold Limit Value:

5 ppm • 16 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

Encephalopathy

Liver and kidney damage are possible

Bone marrow depression

### SIGNS AND SYMPTOMS:

Conjunctivitis and blurred vision

Respiratory tract irritation with cough and dyspnea

Anorexia • Nausea • Vomiting • Weight loss

Headache • Drowsiness • Lethargy • Slurred speech • Confusion

• Tremors • Ataxia • Stupor

Macrocytic anemia

### DIAGNOSTIC TESTS:

Oxalic acid and methanol in urine

Methyl Cellosolve in expired air

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Serious intoxications should be treated in much the same manner as ethylene glycol

Symptomatic and supportive

# ETHYLENE GLYCOL MONOMETHYL ETHER

(cont'd.)

## DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel at regular intervals with special attention to the central nervous system and including a blood count as well as studies of liver and kidney function

Preclude from exposure those individuals with diseases of the blood, liver, kidneys, and central nervous system

Cohen, R. 1984. Reversible subacute ethylene glycol monomethyl ether toxicity associated with microfilm production: A case report. *Am. J. Ind. Med.* 6:441.

Ohi, G. and Wegman, D.H. 1978. Transcutaneous ethylene glycol monomethyl ether poisoning in the work setting. *JOM* 20(10):675.

# ETHYLENE GLYCOL MONOMETHYL ETHER ACETATE

## Synonyms:

2-Methoxyethyl acetate • Methyl Cellosolve acetate

## Description:

Colorless liquid, pleasant odor

## Occupational Exposure:

Lacquers and dopes • Photographic film • Solvent • Textile printing

## Threshold Limit Value:

25 ppm • 120 mg/m<sup>3</sup> OSHA

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

Central nervous system depression is possible

# ETHYLENE GLYCOL MONOMETHYL ETHER ACETATE (*cont'd.*)

## SIGNS AND SYMPTOMS:

Irritation of the eyes • Headache • Nausea

## DIAGNOSTIC TESTS:

None established

## TREATMENT:

Irrigate eyes with water  
Symptomatic and supportive

## DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# ETHYLENEIMINE

## Synonyms:

Azacyclopropane • Aziridine • Dimethylene imine • Ethylenimine

## Description:

Colorless liquid, ammoniacal odor

## Occupational Exposure:

Adhesives • Chemical synthesis • Coatings • Ion exchange •  
Lubricant refining • Pharmaceuticals • Polymers • Surfactant

## Threshold Limit Value:

0.5 ppm • 1 mg/m<sup>3</sup>  
Specific OSHA regulations apply

## Toxicity: *HIGHLY TOXIC*

## ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous (very rapid)

## MODE OF ACTION:

Corrosive irritant • Sensitizer

## ETHYLENEIMINE (*cont' d.*)

SIGNS AND SYMPTOMS: *May be delayed one or more hours*

Conjunctivitis and keratitis

Nasal congestion with sneezing and rhinorrhea

Pharyngitis, laryngitis with edema and corrosion of vocal cords  
accompanied by dysphonia

Cough, rales, tracheitis, bronchitis, chemical pneumonitis,  
pulmonary edema, and cyanosis

Necrotizing deep skin burns

Anorexia, nausea, vomiting, liver function abnormalities, and  
albuminuria

DIAGNOSTIC TESTS:

None established

TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in usual manner

Energetic cardiorespiratory support

Careful fluid and electrolyte management

Symptomatic and supportive

DISABILITY:

Permanent impairment is possible

**Preventive Measures:**

Adequate ventilation with regular monitoring of work environment

Chemical goggles

Approved respiratory protection

Rubber gloves, aprons and boots (special indicator gloves are  
available to help detect saturation)

Physical examination of exposed personnel at regular intervals  
including liver and kidney function studies

Preclude from exposure those individuals with liver, kidney, and  
pulmonary diseases

Remove from further exposure those who become sensitized

Jones, R.M. and Farman, J.F. 1976. Ethylene imine poisoning. A case  
report. *Europ. J. Intens. Care Med.* 2:181.

# ETHYLENE OXIDE

## Synonyms:

Anprolene • 1,2-Epoxy ethane • Oxirane

## Description:

Colorless gas, sweetish odor

## Occupational Exposure:

Chemical synthesis • Fumigant • Fungicide • Rocket propellant • Sterilant • Surfactant

## Threshold Limit Value:

1 ppm • 2 mg/m<sup>3</sup>

Specific OSHA regulations apply

Suspect carcinogen

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Sensitizer

By-products are ethylene chlorohydrin and ethylene glycol

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

Irritation of respiratory tract with cough, bronchitis, and pulmonary edema

Skin burns occur from rapid evaporation of liquid, direct chemical irritation and a delayed scalded response which may be followed by hyperpigmentation when healing is complete

Headache, nausea and vomiting may precede more serious central nervous system effects

Mental confusion, fatigue, disorientation, memory difficulties, unconsciousness, and seizures

Sensorimotor polyneuropathy with weakness and sensory disturbance in distal extremities, decreased tendon reflexes, diminished vibratory sense and ataxia

### DIAGNOSTIC TESTS:

None established

Nerve conduction is diminished in the neuropathies

## ETHYLENE OXIDE (*cont' d.*)

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Treat burns in usual manner
- Symptomatic and supportive

### DISABILITY:

- Skin burns and hyperpigmentation can be disabling

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing exercising care that saturation or penetration does not occur
- Proper waiting period must be observed before using articles that have been sterilized with ethylene oxide

- Alomar, A. et.al. 1981. Ethylene oxide dermatitis. *Contact Derm.* 7:205.
- Finelli, PF. et.al. 1983. Ethylene oxide-induced polyneuropathy. A clinical and electrophysiologic study. *Arch. Neurol.* 40(7):419.
- Kuzuhara, S. et.al. 1982. Ethylene oxide polyneuropathy. Report of 2 cases with biopsy studies of nerve and muscle. *Clin. Neurol.* 22:707.
- Taylor, J.S. 1977. Dermatologic hazards from ethylene oxide. *Cutis* 19:189

## ETHYL ETHER

### Synonyms:

- Anesthetic ether • Diethyl ether • Ethoxy ethane • Ethyl oxide • Sulfuric ether

### Description:

- Colorless liquid, aromatic odor

### Occupational Exposure:

- Anesthetic • Chemical synthesis • Extractant • Fuels • Gun powder • Perfumes • Solvent



## ETHYL ETHER (*cont' d.*)

### Threshold Limit Value:

400 ppm • 1200 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant; metabolized to acetaldehyde

Central nervous system depressant

Kidney damage can occur

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Conjunctivitis

Irritation of nose and respiratory tract

Dermatitis

Headache and dizziness

Anorexia, nausea and vomiting

Narcosis

##### *Chronic:*

Headache, dizziness, lassitude

Anorexia and nausea

Psychic disturbances

#### DIAGNOSTIC TESTS:

Ether in expired air

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects anticipated

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Aune, H. et.al. 1978. Metabolism of diethyl ether to acetaldehyde in man. *Lancet* II:97.



# ETHYL FORMATE

## Synonyms:

Ethyl methanoate • Formic acid ethyl ester • Formic ether

## Description:

Clear liquid, pleasant odor

## Occupational Exposure:

Chemical synthesis • Fumigant • Larvicide • Pharmaceuticals • Solvent • Synthetic flavors

## Threshold Limit Value:

100 ppm • 300 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Central nervous system depression is possible

### SIGNS AND SYMPTOMS:

Irritation of eyes and upper respiratory tract

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Sodium bicarbonate, 5% aerosol, may be used for upper respiratory tract irritation

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection as indicated • Rubber protective clothing

# ETHYLIDENE CHLORIDE

## Synonyms:

1,1-Dichloroethane

## Description:

Colorless liquid, chloroform-like odor

## Occupational Exposure:

Adhesives • Chemical synthesis • Fumigant • Solvent

## Threshold Limit Value:

200 ppm • 810 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Central nervous system depressant  
Kidney and liver damage are possible

### SIGNS AND SYMPTOMS:

Conjunctival irritation  
Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Parker, J.C. et. al. 1979. Chlorethanes: Review of toxicity. *Am. Ind. Hyg. Assoc. J.* 40:A46.

# ETHYL ISOTHIOCYANATE

## Synonyms:

Ethyl mustard oil • Ethyl thiocarbimide

## Description:

Colorless liquid, pungent odor

## Occupational Exposure:

A decomposition product from diethyl thiourea used in synthetic rubber (diethyl thiourea evolves ethyl isothiocyanate and ethylamine)

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

None

### MODE OF ACTION:

Irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal erosions which can mimic dendritic ulcers in appearance

Erythematous rash of face and upper extremities

### DIAGNOSTIC TESTS:

Positive patch test to diethyl thiourea

### TREATMENT:

Symptomatic

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Remove from exposure those who become hypersensitive

## *n*-ETHYL MORPHOLINE

### Synonyms:

4-Ethyl morpholine

### Description:

Colorless liquid, ammoniacal odor

### Occupational Exposure:

Catalyst • Dyestuff intermediate • Emulsifier • Pharmaceuticals •  
Rubber accelerator • Solvent

### Threshold Limit Value:

5 ppm • 23 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal edema  
Irritation of nose and throat

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing if indicated

# ETHYL OXALATE

## Synonyms:

Diethyl ethanedioate • Diethyl oxalate • Oxalic acid diethyl ester

## Description:

Colorless liquid, aromatic odor

## Occupational Exposure:

Chemical synthesis • Dyestuff intermediate • Perfumes •  
Pharmaceuticals • Solvent • Synthetic resins

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Hydrolyzes to oxalic acid

### SIGNS AND SYMPTOMS:

Headache • Nausea • Malaise

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles if indicated • Approved  
respiratory protection when necessary

# ETHYL SILICATE

## Synonyms:

Silicic acid tetraethyl ester • Tetraethyl orthosilicate • Tetraethyl silicate

## Description:

Colorless liquid, pleasant odor

## Occupational Exposure:

Bonding agent • Coatings for buildings • Chemical-resistant paints • Lacquers • Refractory bricks • Weather-proof and acid-proof mortars and cements

## Threshold Limit Value:

10 ppm • 85 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Liver, kidney, and pulmonary damage are possible

### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing when indicated

# FELDSPARS

## Synonyms:

Albite (aluminum feldspar) • Anorthite (lime feldspar) • Anorthoclase (soda-potash feldspar) • Hyalophane (baryta feldspar) • Labradorite (calcium sodium feldspar) • Orthoclase (potash feldspar)

## Description:

White, red, blue, or green mineral masses

## Occupational Exposure:

Abrasives • Fertilizer • Glass and ceramics • Insulation compositions  
• Roofing materials • Soaps

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Pneumoconiosis

### SIGNS AND SYMPTOMS:

Dyspnea • Cough • Hemoptysis

Some decrease in ventilatory capacity

### DIAGNOSTIC TESTS:

X-ray reveals pneumoconiosis

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Seldom occurs

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel at regular intervals including chest x-ray and pulmonary function testing

Preclude from exposure those with pulmonary diseases

Barrie, H. J. and Hosselin, L. 1960. Massive pneumoconiosis from a rock dust containing no free silica: Nepheline lung. *Arch. Environ. Hlth.* 1:109.

## FERRIC CHLORIDE

### Synonyms:

Ferric trichloride • Iron trichloride

### Description:

Brown-black crystals

### Occupational Exposure:

Catalyst • Deodorizing sewage • Disinfectant • Mordant • Oxidizing agent • Photoengraving

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

Permanent staining may follow contact with eroded skin areas

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis and then demulcents

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Rubber gloves



# FLUORIDES

## Synonyms:

Numerous

## Description:

Liquids, crystals, and powders

## Occupational Exposure:

Anesthetics • Bleaching agents • Catalysts • Dentifrices • Electrolyte in aluminum manufacture • Fermentation inhibitor • Fluoridation agents • Flux in ore smelting • Glass and ceramic manufacture • Pesticides • Welding rods • Wood preservative

## Threshold Limit Value:

2.5 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Irritant • Fluorosis of skeleton

## SIGNS AND SYMPTOMS:

### *Acute:*

Irritation of the eyes and nose

Dermatitis

Anorexia, nausea, and vomiting are associated with most compounds

Insoluble particulate fluorides accumulate in lung resulting in interstitial fibrosis but no disability although dyspnea and wheezing are sometimes seen

### *Chronic:*

There appears to be a nonskeletal phase in which the following may occur: Synovitis, back stiffness, vague joint pains, anorexia, dyspepsia, nausea, headache, vertigo, and other symptoms

Bony fluorosis is seen after prolonged exposure:

Early signs may be nocturnal back pain, restricted trunk rotation, and slight enlargement of the trabeculae in lumbar spine

## FLUORIDES (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

#### *Chronic (cont' d.):*

Commonly the vertebrae, pelvis, and ribs exhibit exostosis, osteophyte formation, increased thickness of the long bones, and ligamentous calcifications

### DIAGNOSTIC TESTS:

Urinary fluoride (normal < 1 mg/l)

Bone biopsy

Chest x-ray may show irregular opacities and reticulation evenly distributed through lung fields

### TREATMENT:

For acute soluble compounds:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

For massive exposures see *Hydrofluoric Acid*

Symptomatic and supportive

Skeletal fluorosis requires symptomatic care

### DISABILITY:

Soluble compounds can produce permanent impairment

Some reversibility of skeletal fluorosis does occur

Pneumonconiosis is nondisabling

### Preventive Measures:

Adequate ventilation with regular monitoring of work environment

Chemical goggles where indicated

Approved respiratory protection

Good personal hygiene

No eating in work areas

Physical examination of exposed personnel at regular intervals with special attention to relevant complaints as outlined above

Monitoring of urine fluoride level (if these remain at or below 4 ppm no toxicity is anticipated)

Grandjean, P. and Thomsen, G. 1983. Reversibility of skeletal fluorosis. *Brit. J. Ind. Med.* 40:456.

## FLUORIDES (*cont' d.*)

- Grandjean, P. 1982. Occupational fluorosis through 50 years: Clinical and epidemiological experiences. *Am. J. Ind. Med.* 3:227.  
Hodge, H.C. and Smith, F.A. 1977. Occupational fluoride exposure. *JOM* 19:12.  
Weldbott, G.L. 1980. Fluoride intoxication. *JAMA* 244:331.

## FLUOROCARBON POLYMERS

### Synonyms:

Fluoropolymers • Polychlorotrifluoroethylene • Polytetrafluoroethylene • Polyvinyl fluoride • Polyvinylidene fluoride • Others

### Description:

Fluorinated straight-chain carbon polymers  
Powders, fibers, films, sheets, and rods

### Occupational Exposure:

Cooking utensils • Electrical equipment • Gaskets • Insulation •  
Nonstick coatings

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation of decomposition products (frequently from contaminated cigarettes)

#### MODE OF ACTION:

Between 315–375°C PTFE releases a sublimate or gas capable of causing pulmonary leucocytes to release endogenous pyrogens

At 500–800°C carbonyl fluoride is produced which then yields HF and CO<sub>2</sub>

#### SIGNS AND SYMPTOMS:

Polymer fume fever follows the inhalation of PTFE fumes—characteristically several hours after exposure the patient develops chest constriction, cough, dyspnea, chills, and fever which usually clear spontaneously within 48 hours

## FLUOROCARBON POLYMERS (*cont' d.*)

### DIAGNOSTIC TESTS:

Urinary fluorides may be increased

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

No smoking in work area

Good personal hygiene

Preclude from exposure to fumes those with chronic pulmonary disease

Brubaker, R.E. 1977. Pulmonary problems associated with the use of polytetrafluoroethylene. *JOM* 19:693.

Evans, E. 1973. Pulmonary edema after inhalation of fumes from polytetrafluoroethylene. *JOM* 15:599.

## FORMALDEHYDE

### Synonyms:

Formic aldehyde • Methanal • Methyl aldehyde • Oxomethane • Oxymethylene

### Description:

Colorless gas, pungent odor

Formalin is a 37% solution of formaldehyde and 10–15% methanol

### Occupational Exposure:

Adhesives • Corrosion inhibitor • Cosmetics • Dyeing • Embalming  
• Fungicide • Glues • Hardening agent • Insulation materials •  
Leather tanning • Paints • Papers • Particle board • Plywood •  
Preservative • Reducing agent • Solders • Textiles

### Threshold Limit Value:

1 ppm • 1.5 mg/m<sup>3</sup>

Suspect carcinogen

# FORMALDEHYDE (*cont'd.*)

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Sensitizer

When combined with hydrogen chloride under correct atmospheric conditions, formaldehyde will react to form bis (chloromethyl) ether

### SIGNS AND SYMPTOMS:

Irritation of eyes, conjunctivitis, and corneal damage  
Burning of nose and throat, cough, dyspnea, chest tightness, pneumonitis and pulmonary edema; allergic asthma has been reported  
Irritant and sensitizing dermatitis  
Headache and fatigue

### DIAGNOSTIC TESTS:

Formaldehyde in blood and expired air  
Formic acid in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, using 1% ammonium carbonate and followed by saline catharsis (because of the rapid metabolism to formic acid these patients require care for metabolic acidosis and dialysis to remove formic acid)  
Symptomatic and supportive

### DISABILITY:

Sensitization is permanent  
Corneal damage has been reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing  
Physical examination of exposed personnel on a regular basis with special attention to skin and including pulmonary function tests  
Remove from exposure those who become sensitized

## FORMALDEHYDE (*cont' d.*)

- Clark, R.P. 1983. Formaldehyde in pathology departments. *J. Clin. Pathol.* 36:839.
- Ells, J.T. et.al. 1981. Formaldehyde poisoning. Rapid metabolism to formic acid. *JAMA* 246:1237.
- Main, D.M. and Hogan, T.J. 1983. Health effects of low-level exposure to formaldehyde. *JOM* 25:896.
- Niemelä, R. and Vainio, H. 1981. Formaldehyde exposure in work and the general environment. *Scand. J. Work Environ. Hlth.* 7:95.

## FORMIC ACID

### Synonyms:

Hydrogen carboxylic acid • Methanoic acid

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Analytic reagent • Dehairing agent • Dyeing • Electroplating • Ore flotation • Silage making • Silvering glass • Solvent

### Threshold Limit Value:

5 ppm • 9 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Corrosive irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Rhinitis, throat discomfort, cough, dyspnea, bronchitis, and pneumonitis

Skin burns

Corrosive effects in the gastrointestinal tract, and shock, if ingested

Metabolic acidosis

## FORMIC ACID (*cont'd.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage with lime water, if ingested, followed by demulcents

Inhalation of 5% sodium bicarbonate aerosol if respiratory tract is involved

Treat skin burns in normal manner

Severe exposures should be hospitalized in order to manage fluid and electrolyte balance and treat metabolic acidosis

### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Jeffreys, D.B. and Wiseman, H.M. 1980. Formic acid poisoning. *Postgrad. Med. J.* 56:761.

Liesivuori, J. and Kettunen, A. 1983. Farmers exposure to formic acid vapors in silage making. *Ann. Occup. Hyg.* 27(3):327.

## FURFURAL

### Synonyms:

2-Furaldehyde • 2-Furan carboxy aldehyde • Furfuraldehyde • Artificial oil of ants

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Analytic reagent • Chemical synthesis • Fungicide • Germicide • Insecticide • Petroleum refining • Plastic manufacture • Solvent • Varnishes • Wetting agent



## FURFURAL (*cont' d.*)

### Threshold Limit Value:

2 ppm • 8 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Headache • Dizziness • Fatigue

Numbness of tongue and oral mucosa with loss of taste

Sensitization dermatitis • Photosensitivity has been reported

#### DIAGNOSTIC TESTS:

Furoic acid in urine (normal < 65 mg/g creatinine)

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Preclude from exposure those individuals with chronic skin disease

Remove from exposure those who become sensitized

Flek, J. and Sedivec, V. 1978. The absorption, metabolism and excretion of furfural in man. *Int. Arch. Occup. Environ. Hlth.* 41:159.

## FURFURYL ALCOHOL

### Synonyms:

2-Furan carbinol • 2-Furan methanol



# FURFURYL ALCOHOL (*cont'd.*)

## Description:

Colorless to brown liquid

## Occupational Exposure:

Corrosion-resistant sealants • Foundry core resins • Furan polymers •  
Penetrant • Solvent • Wetting agent

## Threshold Limit Value:

10 ppm • 40 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Central nervous system depression is possible

### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Virtamo, M. and Tossavainen, A. 1976. Gases formed from furan binding agents. *Scand. J. Work Environ. Hlth.* 2(suppl. 1):50.

## GALLIUM AND SALTS

### Synonyms:

Gallium fluoride • Gallium nitrate • Others

### Description:

Metal is gray-blue

Salts are crystalline powders

### Occupational Exposure:

Catalysts • Coatings • Diodes • Electronics manufacture • Fillers •  
Lubricants • Microwave devices

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous?

#### MODE OF ACTION:

Element is considered nontoxic

Irritant

Neurotoxin?

#### SIGNS AND SYMPTOMS:

Metallic taste

Petechial rash

Neuralgia and palsy have been reported

#### DIAGNOSTIC TESTS:

Gallium in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Rubber  
gloves

## GALLIUM AND SALTS (*cont'd.*)

Meigs, J.W. 1972. Gallium fluoride poisoning: A probable case with skin effects and neurological sequelae. *JOM*14:925.

## GASOLINE (NONLEADED)

### Synonyms:

Motor spirits • Petrol • Petroleum benzine

### Description:

Liquid, characteristic odor

Composition varies but usually aliphatics (C<sub>4</sub>-C<sub>12</sub>), cyclic olefins and aromatics with additives

### Occupational Exposure:

Fuel, widely used

### Threshold Limit Value:

300 ppm • 900 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant

Liver, kidney, lung, and brain damage can occur

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Irritation of nose and throat

Acute inhalation produces flushing of the face, mental confusion, staggering gait, slurred speech, and loss of consciousness sometimes with convulsions

Chronic inhalation results in anorexia, nausea, weight loss, insomnia, hyperesthesias of distal extremities followed by motor weakness and muscular atrophy, diminished tendon reflexes and ataxia

Aspiration causes choking, cough, dyspnea, tachypnea, tachycardia, fever, bronchitis, and pneumonitis

## GASOLINE (NONLEADED) (*cont' d.*)

### DIAGNOSTIC TESTS:

Chest x-ray will usually show evidence of pneumonitis within 2-18 hours

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage is still advocated by some, but must be done with extreme caution to avoid aspiration; alternatively, watchful waiting or induction of vomiting using ipecac may be advantageous

Pulmonary findings on physical examination or x-ray warrant hospitalization for observation, including serial blood gases, and cardiorespiratory support as indicated

Treat burns in normal manner

Symptomatic and supportive

### DISABILITY:

Recovery usually complete in several days

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Knave, B. et.al. 1978. Long term exposure to jet fuel. *Scand. J. Work Environ. Hlth.* 4:19.

Takeuchi, Y. et.al. 1975. Polyneuropathy caused by petroleum benzine. *Int. Arch. Arbeitsmed.* 34:185.

Walsh, W.A. et.al. 1974. Gasoline immersion burn. *NEJM* 291:830.

## GENTIAN VIOLET

### Synonyms:

Aniline violet • Crystal violet • Methyl rosaniline chloride • Methyl violet

### Description:

Dark green powder

## GENTIAN VIOLET (*cont'd.*)

### Occupational Exposure:

Acid-base indicator • Biological stain • Dye • Indelible pencils • Inks  
• Pesticide • Pharmaceutical

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Dust can be inhaled or ingested (small amounts)

#### MODE OF ACTION:

Irritant • Stain

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Itching of nose, sneezing, rhinorrhea, epistaxis, and septal perforation

Pharyngitis, laryngitis, bronchitis

Staining of teeth and gums

Local irritation if embedded in tissue

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Excise any embedded material (indelible inks)

Symptomatic and supportive

#### DISABILITY:

Perforation of nasal septum is permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Quinby, G.E. 1968. Gentian violet as a cause of epidemic occupational nose bleeds. *Arch. Environ. Hlth.* 16:485.

# GLYCIDOL

**Synonyms:**

2,3-Epoxy-1-propanol • 3-Hydroxy propylene oxide

**Description:**

Colorless liquid

**Occupational Exposure:**

Chemical synthesis • Pharmaceuticals • Stabilizer • Surface coatings

**Threshold Limit Value:**

25 ppm • 75 mg/m<sup>3</sup>

**Toxicity:****ROUTE OF ENTRY:**

Inhalation • Percutaneous

**MODE OF ACTION:**

Irritant

Central nervous system depression is possible

**SIGNS AND SYMPTOMS:**

Irritation of eyes and respiratory tract

Dermatitis

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

# GLYCIDYL ETHERS

## Synonyms:

Allyl glycidyl ether (AGE) • *n*-Butyl glycidyl ether (BGE) • Diglycidyl ether (DGE) • Isopropyl glycidyl ether (IGE) • Phenyl glycidyl ether (PGE)

## Description:

Colorless liquids and solids

## Occupational Exposure:

Chemical synthesis • Electrical equipment • Reactive agents in epoxy resin systems • Rubber and plastic products • Stabilizer for chlorinated solvents • Viscosity reducing agents

## Threshold Limit Value:

Allyl glycidyl ether — 5 ppm • 22 mg/m<sup>3</sup>

*n*-Butyl glycidyl ether — 25 ppm • 135 mg/m<sup>3</sup>

Diglycidyl ether — 0.1 ppm • 0.5 mg/m<sup>3</sup>

Isopropyl glycidyl ether — 50 ppm • 240 mg/m<sup>3</sup>

Phenyl glycidyl ether — 1 ppm • 6 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Sensitizer • Central nervous system depressant (BGE)

### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

Rhinorrhea and cough

Anorexia, nausea, and vomiting

Headache, diplopia, inability to concentrate, ataxia, lethargy (BGE)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## GLYCIDYL ETHERS (*cont' d.*)

### DISABILITY:

Central nervous system effects can last for months

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Remove from exposure those who become sensitized

Wallace, E. 1979. Effects of *n*-butyl glycidyl ether exposure. *J. Soc. Occup. Med.* 29:142.

## GLYCOLIC ACID

### Synonyms:

Hydroxyacetic acid

### Description:

Colorless crystals

### Occupational Exposure:

Adhesives • Cleaner • Copper pickling • Dyeing • Electroplating •  
Leather tanning • Soldering compounds • Textiles

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

#### DIAGNOSTIC TESTS:

None established



## GLYCOLIC ACID (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Rubber protective clothing if indicated

## GRAPHITE

### Synonyms:

Black lead • Mineral carbon • Plumbago

### Description:

Soft, black mineral

Natural graphite is elemental crystalline carbon with mineral impurities including free silica

Artificial graphite is crystalline carbon made from anthracite culm or petroleum coke and has only very small quantities of free silica

### Occupational Exposure:

Carbon electrodes • Electroplating • Fibers • Foundry facings • Ladle linings • Lubricant • Motor and generator brushes • Nuclear reactors • Pencil "lead" • Pigment • Steel manufacturing

### Threshold Limit Value:

2.5 mg/m<sup>3</sup> respirable dust

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Pneumoconiosis (graphitosis)

#### SIGNS AND SYMPTOMS:

Usually after many years exposure

Cough • Dyspnea • Chest pain • Malaise

## GRAPHITE (*cont'd.*)

### DIAGNOSTIC TESTS:

X-ray follows a pattern similar to coal workers pneumoconiosis

Vital capacity may be reduced

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Usually not severe

### Preventive Measures:

Adequate ventilation with regular monitoring of work environment •

Approved respiratory protection

Physical examination of exposed personnel at regular intervals including chest x-ray and pulmonary function studies

Preclude from exposure those individuals with pulmonary diseases

Hanao, R. 1983. Graphite pneumoconiosis. A review of etiologic and epidemiologic aspects. *Scand. J. Work Environ. Hlth.* 9:303.

Lister, W.B. and Wimborne, D. 1972. Carbon pneumoconiosis in a synthetic graphite worker. *Brit. J. Ind. Med.* 29:108.

## GUM ARABIC

### Synonyms:

Acacia gum • African gum • Mimosa gum

### Description:

White to yellow flakes or powder

### Occupational Exposure:

Adhesives • Color printing industry • Cosmetics • Emulsifiers •  
Food products • Inks • Pharmaceuticals • Textile printing •  
Thickening agent

### Threshold Limit Value:

None established

## **GUM ARABIC** (*cont'd.*)

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Sensitizer

#### **SIGNS AND SYMPTOMS:**

Conjunctivitis

Rhinitis • Pharyngitis • Bronchitis • "Printers asthma" with  
dyspnea

Urticaria • Pruritis • Eczema

#### **DIAGNOSTIC TESTS:**

Positive prick test

#### **TREATMENT:**

Symptomatic and supportive

#### **DISABILITY:**

Sensitization tends to be permanent

### **Preventive Measures:**

Adequate ventilation • Approved respiratory protection

Preclude from exposure those individuals with chronic skin and  
pulmonary diseases

Remove from exposure those who become sensitized

# HALOGENATED PESTICIDES

## Synonyms:

Cyclodienes: Aldrin • Chlordane • Endrin • Heptachlor • Kepone • Others

Bischlorophenyls: DDT • Kelthane • Methoxychlor • Others

Cycloparaffins: Benzene hexachloride • Lindane • Others

Chlorinated terpenes: Strobane • Toxaphene • Others

## Description:

Liquids, crystals, and solids

## Occupational Exposure:

Widely used

## Threshold Limit Value:

Aldrin — 0.25 mg/m<sup>3</sup>

Chlordane — 0.5 mg/m<sup>3</sup>

DDT — 1 mg/m<sup>3</sup>

Endrin — 0.1 mg/m<sup>3</sup>

Heptachlor — 0.5 mg/m<sup>3</sup>

Methoxychlor — 10 mg/m<sup>3</sup>

Toxaphene — 0.5 mg/m<sup>3</sup>

## Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Neurotoxin • Liver and kidney damage

### SIGNS AND SYMPTOMS:

#### *Acute:*

Eye and skin irritation

Nausea • Vomiting • Abdominal pain • Diarrhea

Headache • Dizziness • Ataxia • Paresthesias

Tremors, often beginning about the face and spreading to the extremities culminating in convulsions

Hepatitis and nephropathy

Late toxic polyneuritis

Impaired thrombocytopoiesis

# HALOGENATED PESTICIDES (*cont'd.*)

## SIGNS AND SYMPTOMS (*cont'd.*):

### *Chronic:*

- Dermatitis
- Peripheral paresthesias, tremors, and convulsions
- Liver and kidney damage
- Agranulocytosis has been reported
- Spermatic effects have been reported for kepone

## DIAGNOSTIC TESTS:

- Blood determination of specific compound

## TREATMENT: *TREAT AS AN EMERGENCY*

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Gastric lavage, if ingested, using charcoal and followed by saline catharsis
- Anticonvulsants
- Monitor fluid and electrolyte balance
- Cardiorespiratory support, but avoid epinephrine
- Cholestyramine enhances the excretion of kepone and may be helpful in other halogenated pesticide intoxications
- Symptomatic and supportive

## DISABILITY:

- Permanent sequelae occur

## Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective coveralls, laundered daily • Neoprene gloves and aprons
- No eating or smoking in work area
- Good personal hygiene
- Physical examination of exposed personnel at regular intervals including liver and kidney function tests and with special attention to the central nervous system

Kimbrough, R.D. 1982. Disposition and body burdens of halogenated aromatic compounds: Possible association with health effects in humans. *Drug Metab. Rev.* 13:485.

Runhaar, E.A. et. al. 1985. A case of fatal endrin poisoning. *Human Toxicol.* 4:241.

# HEPTANE

**Synonyms:**

Dipropyl methane • *n*-Heptane

**Description:**

Colorless liquid

**Occupational Exposure:**

Chemical synthesis • Fuel • Solvent

**Threshold Limit Value:**

400 ppm • 1600 mg/m<sup>3</sup>

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Irritant • Central nervous system depressant

**SIGNS AND SYMPTOMS:**

Eye irritation

Defatting dermatitis

Dizziness • Incoordination • Narcosis

Anorexia • Nausea

Numbness and paresthesias of limbs of a glove/stocking type  
with minimal polyneuropathy

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel at regular intervals with special attention to the nervous system

## HEPTANE (*cont'd.*)

### Preventive Measures (*cont'd.*):

Preclude from exposure those individuals with central nervous system disorders

Crespi, V. et.al. 1979. Electrophysiological findings in workers exposed to N-heptane fumes. *J. Neurol.* 222:135.

## HEXACHLORO ETHANE

### Synonyms:

Carbon hexachloride • Carbon trichloride • Perchloroethane

### Description:

Colorless crystals, camphor-like odor

### Occupational Exposure:

Camphor substitute • Chemical synthesis • Explosives • Pyrotechnics • Solvent

### Threshold Limit Value:

10 ppm • 100 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Central nervous system depression is possible

#### SIGNS AND SYMPTOMS:

Conjunctivitis with lacrimation and photophobia

Dermatitis

#### DIAGNOSTIC TESTS:

None established

## HEXACHLOROETHANE (*cont' d.*)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Impervious gloves if indicated

Parker, J.C. et.al. 1979. Chlorethanes: Review of toxicity. *Am. ind. Hyg. Assoc. J.* 40:A46.

## HEXAMETHYLENE DIAMINE

### Synonyms:

1,6-Diamino hexane • 1,6-Hexane diamine

### Description:

Colorless leaflets

### Occupational Exposure:

Synthetic fiber manufacture

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal edema  
Irritation of the upper respiratory tract



## HEXAMETHYLENE DIAMINE (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

Headache • Nausea • Faintness  
Dermatitis • Skin burns

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## HEXANE

### Synonyms:

*n*-Hexane

### Description:

Colorless liquid

### Occupational Exposure:

Cleaning agent • Chemical synthesis • Gasoline • Glues • Oil extraction • Perfumes • Pharmaceuticals • Solvent • Thinner

### Threshold Limit Value:

50 ppm • 180 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

## HEXANE (*cont' d.*)

### MODE OF ACTION:

Irritant • Central nervous system depressant  
Neurotoxin (oxidizes to 2,5-hexanedione)

### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and upper respiratory tract  
Dermal erythema, edema, and vesiculation  
Acute inhalation causes headache, dizziness, nausea, narcosis, and coma  
Chronic inhalation results in:  
    Anorexia, nausea, weight loss, and malaise  
    Dyesthesias and cold sensation of lower extremities  
    Hyperhidrosis of hands and feet  
    Muscular weakness, pain, and spasms in extremities  
    Symmetrical sensorimotor neuropathy with decreased vibratory, temperature, position, and touch sensation associated with progressive flaccid paralysis  
    Defective color vision and maculopathy has also been reported

### DIAGNOSTIC TESTS:

Hexane in expired air  
2,5-Hexanedione and 2-hexanol in urine  
Decreased nerve conduction velocity

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

Recovery from neuropathy is generally complete in 12 months

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing  
Physical examination of exposed personnel at regular intervals with special attention to nervous system complaints or findings  
Preclude from exposure those individuals with disorders of the nervous system

## HEXANE (*cont' d.*)

Jorgensen, N.K. and Cohr, K.H. 1981. *n*-Hexane and its toxicologic effects: A review. *Scand. J. Work Environ. Hlth.* 7:157.

Krasavage, W.J. et.al. 1980. The relative neurotoxicity of methyl *n*-butyl ketone, *n*-hexane and their metabolites. *Toxicol. Appl. Pharmacol.* 52:433.

## *sec*-HEXYL ACETATE

### Synonyms:

Methyl amyl acetate • Methyl isobutyl carbinol acetate • 4-Methyl-2-pentanol acetate

### Description:

Colorless liquid

### Occupational Exposure:

Solvent

### Threshold Limit Value:

50 ppm • 300 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Central nervous system depression is possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## *sec*-HEXYL ACETATE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## HEXYLENE

### Synonyms:

1-Hexene

### Description:

Colorless liquid

### Occupational Exposure:

Dyes • Flavors • Perfumes • Resins

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Dizziness and nausea

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## HEXYLENE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Goggles and respirator if required

## HYDRAZINES

### Synonyms:

Dimethyl hydrazine • N,N-dimethyl hydrazine • Hydrazine diamine •  
Hydrazino benzene • Phenyl hydrazine • UDMH • Others

### Description:

Colorless, oily liquids or crystalline solid, ammoniacal odor  
Aerozine-50 is a mixture of equal parts by weight of dimethyl hydrazine and hydrazine

### Occupational Exposure:

Antioxidant • Agricultural chemical • Catalyst • Chemical synthesis  
• Dyes • Explosives • Fuel cells • Laboratory reagent • Metallurgy  
• Pharmaceuticals • Photographic developer • Rocket fuels •  
Solder fluxes

### Threshold Limit Value:

0.1–0.5 ppm • 1 mg/m<sup>3</sup>  
1,1-Dimethyl hydrazine and phenyl hydrazine are suspect carcinogens

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Caustic irritant • Sensitizer  
Liver and kidney damage

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage  
Irritation of nose and respiratory tract with chest pain and  
dyspnea

## HYDRAZINES (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

- Skin burns and sensitization dermatitis
- Headache, dizziness, nausea, lethargy
- Central nervous system excitability, tremors, and convulsions
- Methemoglobinemia and anemia are possible

### DIAGNOSTIC TESTS:

- Specific hydrazine in blood
- p*-Aminophenols in urine

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Treat skin burns in usual manner
- Anticonvulsants
- Maintain hydration and monitor electrolytes
- Pyridoxine hydrochloride in high doses has been suggested for treating methylated compound intoxication
- Symptomatic and supportive

### DISABILITY:

- No permanent effects reported

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Vinyl or neoprene gloves, aprons, boots, or suits
- Physical examination of exposed personnel at regular intervals including blood count, urinalysis, and studies of liver function
- Preclude from exposure those individuals with central nervous system, liver, and blood disorders

Azar, A. et.al. 1970. Pyridoxine and phenobarbital as treatment for Aerozine-50 toxicity. *Aerospace Med.* 41:1.

Petersen, P. et.al. 1970. Examination of the liver in personnel working with liquid rocket propellant. *Brit. J. Ind. Med.* 27:141.

# HYDROCHLORIC ACID

## Synonyms:

Chlorohydric acid • HCl • Muriatic acid

## Description:

Colorless liquid, pungent odor

## Occupational Exposure:

Acidifying agent • Catalyst • Chemical synthesis • Laboratory reagent • Metal pickling • Ore refining

## Threshold Limit Value:

5 ppm • 7 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal burns

Dermatitis, skin burns and ulceration

Rhinitis, laryngitis, tracheitis, bronchitis, and pulmonary edema

Dental erosion

Ingestion results in severe burns of the gastrointestinal tract with nausea, vomiting, and abdominal pain

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in usual manner

Gastric lavage, if ingested, with 5% sodium bicarbonate solution, followed by installation of aluminum hydroxide gel

Respiratory effects may be helped by the use of a 5% sodium bicarbonate solution as an aerosol

Symptomatic and supportive

## HYDROCHLORIC ACID (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## HYDROFLUORIC ACID

### Synonyms:

HF

### Description:

Colorless liquid (aqueous solution of fluorine)

### Occupational Exposure:

Analytic reagent • Beer brewing • Dyes • Electropolishing • Germicides • Glass etching • Metallurgy • Ore digestion • Photographic processing • Plastic manufacture • Pottery glazing • Rust removers • Semiconductor industry • Solvents • Tanning agents

### Threshold Limit Value:

3 ppm • 2.5 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Denatures tissue by liquefaction necrosis which then frees the fluorine ion to repeat the same cycle until it has been converted to insoluble calcium or magnesium fluoride  
Depletes tissue calcium

#### SIGNS AND SYMPTOMS:

Corrosive burns of the conjunctiva and cornea  
Severe irritation and burns of the nose, pharynx, larynx, and bronchi with the potential for pulmonary edema  
Skin burn classification:

Up to 20% HF solution may not cause erythema and pain for up to 24 hours



## HYDROFLUORIC ACID (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

20–50% HF solution produces symptoms in 1–8 hours  
> 50% HF solution causes immediate intense pain and severe tissue destruction

Erythema is followed by an edematous yellow-white appearance of tissue before vesicles and bullae form; ulceration occurs later—pain is intense

Anorexia, nausea, and vomiting may arise from the formation of quantities of HF in the gastrointestinal tract

Hypocalcemia and hypomagnesemia may be severe and accompanied by shock

### DIAGNOSTIC TESTS:

Fluorine in blood and urine

### TREATMENT: *TREAT AS AN EMERGENCY*

(It is important that first aid and health care personnel avoid personal contamination.)

Remove clothing as rapidly as possible

*Eye*—Irrigate thoroughly with water or isotonic saline

*Skin*—Immediately flush well with water

Inject 10% calcium gluconate beneath and around burned areas

Iced soaks or wet dressings using 25% magnesium sulfate or a quaternary ammonium compound (benzalkonium) for up to 4 hours

Nails may be split or removed if necessary for adequate treatment

Follow by debridement

Dress with 20% magnesium oxide in glycerol paste, 2.5% calcium gluconate gel, A&D ointment or topical steroids

Hospitalize for follow-up care in severe cases

*Pulmonary*—Calcium gluconate 2.5–3% solution by nebulizer with 100% oxygen using IPPB, if available

Hospitalize early if airway edema and obstruction threaten as might be anticipated with burns involving the head, face, and neck

## HYDROFLUORIC ACID (cont'd.)

### TREATMENT (cont'd.):

Hospitalized patients require careful observation:

Pulmonary status must be monitored

Arrhythmias are associated with abnormal calcium levels

Monitor fluid balance and electrolytes

Hypocalcemia and hypomagnesemia require careful management

Liver and kidney effects have been reported

### DISABILITY:

Keratoconjunctivitis sicca and impaired vision

Pulmonary impairment could be severe

Skin burn scars and contractures can be disabling

### Preventive Measures:

Adequate ventilation • Chemical goggles or full face shield • Approved respiratory protection • Neoprene gloves, aprons, and boots

Physical examination of exposed personnel at regular intervals including urine fluoride determination, studies of liver and kidney function, and pulmonary function testing

Preclude from exposure those individuals with diseases of the lungs, kidney, and liver

Tepperman, P.B. 1980. Fatality due to acute systemic fluoride poisoning following a hydrofluoric acid skin burn. *JOM* 22:691.

Treviño, M.A. et.al. 1983. Treatment of severe hydrofluoric acid exposures. *JOM* 25(12):861.

## HYDROGEN BROMIDE

### Synonyms:

Anhydrous hydrobromic acid

### Description:

Colorless gas

## HYDROGEN BROMIDE (*cont'd.*)

### Occupational Exposure:

Catalyst • Chemical synthesis • Pharmaceuticals • Reducing agent •  
Synthesis of bromides

### Threshold Limit Value:

3 ppm • 10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Corrosive

#### SIGNS AND SYMPTOMS:

Burns and brownish discoloration of tissues including eyes,  
skin, and upper respiratory tract  
Severe exposures can be fatal

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat burns in usual manner  
Use 5% sodium bicarbonate aerosol for respiratory involve-  
ment  
Hospitalize serious exposures for care and monitoring

#### DISABILITY:

Impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory pro-  
tection • Protective clothing

# HYDROGEN PEROXIDE

## Synonyms:

Hydrogen dioxide • Hydroperoxide

## Description:

Colorless liquid (90% solution)

## Occupational Exposure:

Antiseptic • Bleaching agent • Dyeing • Electroplating • Laboratory reagent • Plasticizers • Pulp and paper industry • Rocket fuel • Water treatment

## Threshold Limit Value:

1 ppm • 1.5 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant; decomposes to release oxygen and produce heat

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal burns which are sometimes delayed in appearing

Irritation of nose and throat with a potential for bronchitis and pulmonary edema

Skin blanching followed by erythema and blistering

Bleaching of body hair

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Symptomatic and supportive

### DISABILITY:

Burns have produced permanent damage

## Preventive Measures:

Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

# HYDROGEN SULFIDE

## Synonyms:

Hydrosulfuric acid • Sulfuretted hydrogen

## Description:

Colorless gas, odor of rotten eggs

## Occupational Exposure:

Hydrogen sulfide is found wherever sulfur containing organic matter undergoes putrefaction

Analytic reagent • Carbon disulfide production • Fermenting manure • Manufacture of coke • Metal refining • Mines (stinkdamp) • Natural gas and petroleum production • Paper industry • Tanning industry • Viscose rayon production • Volcanic gases

## Threshold Limit Value:

10 ppm • 14 mg/m<sup>3</sup>

## Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Inhibits cytochrome oxidase

### SIGNS AND SYMPTOMS:

Extremely high concentrations are capable of causing syncope, apnea, cyanosis, unconsciousness, convulsions, coma, and death

Lesser exposures produce variable symptoms:

Conjunctivitis and keratitis with photophobia ("gas eye")

Headache, dizziness, mental confusion, weakness of the extremities, and leg pains

Nausea, vomiting, and sometimes diarrhea

Chest pain, dyspnea, cough, rhinitis, bronchitis, and pulmonary edema

### DIAGNOSTIC TESTS:

None established

## HYDROGEN SULFIDE (*cont' d.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

Remove patient to a well-ventilated area

Oxygen

Cardiopulmonary resuscitation

Anticonvulsants

Sodium nitrite to induce methemoglobinemia has also been used

Hospitalization of the more serious cases to better manage pulmonary edema, lactic acidosis, and electrolyte balance

### DISABILITY:

Those who survive the immediate effects seem to recover completely

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Employees should work in pairs when possible, observing safety precautions

Preclude from exposure those individuals with diseases of the eyes, heart, lungs, and central nervous system

Arnold, I.M.F. et.al. 1985. Health implication of occupational exposures to hydrogen sulfide. *JOM* 27:373.

Burnett, W.W. et.al. 1977. Hydrogen sulfide poisoning: Review of 5 years experience. *CMAJ* 177:1277.

Smith, R.P. and Gosselin, R.E. 1979. Hydrogen sulfide poisoning. *JOM* 21(2):93.

## HYDROQUINONE

### Synonyms:

1,4-Benzenediol • *p*-Dihydroxy benzene • Hydroquinol • Quinol

### Description:

White crystals

### Occupational Exposure:

Antioxidant • Bone cement • Dye intermediate • Motor fuels • Paints and varnishes • Photography

# HYDROQUINONE (*cont'd.*)

## Threshold Limit Value:

2 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

Prolonged exposure results in brown staining of the conjunctiva along with corneal opacification

Eczematous dermatitis

Vitiligo

Ingestion produces tinnitus, headache, nausea and vomiting, dyspnea, cyanosis, and delirium

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### DISABILITY:

Corneal changes and vitiligo are permanent

## Preventive Measures:

Adequate ventilation • Chemical goggles • Protective clothing

Physical examination of exposed personnel on a regular basis with special attention to the eyes and skin

Remove from exposure those who develop corneal degenerative changes

Kersey, P. and Stevenson, C.J. 1981. Vitiligo and occupational exposure to hydroquinone from servicing self-photographing machines. *Contact Derm.* 7:285.

Nissen, J.N. and Corydon, L. 1985. Corneal ulcer after exposure to vapours from bone cement (methyl methacrylate and hydroquinone). *Int. Arch. Occup. Environ. Hlth.* 56:161.



# HYDROXYLAMINE

**Synonyms:**

Oxammonium

**Description:**

White flakes

**Occupational Exposure:**

Chemical synthesis • Dyes • Perfumes • Photographic industry •  
Reducing agent

**Threshold Limit Value:**

None established

**Toxicity:****ROUTE OF ENTRY:**

Percutaneous

**MODE OF ACTION:**

Irritant • Sensitizer

Methemoglobinemia is possible

**SIGNS AND SYMPTOMS:**

Irritation of eyes, skin, and respiratory tract

**DIAGNOSTIC TESTS:**

Monitor for methemoglobin in major exposures

**TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Chemical goggles • Approved respiratory protection • Rubber gloves  
Remove from exposure those who become sensitized



# IODINE

## Synonyms:

None

## Description:

Blue-black plates

## Occupational Exposure:

Analytic reagent • Antiseptic • Catalyst • Dyes • Lithography •  
Lubricant • Pharmaceuticals • Soaps

## Threshold Limit Value:

0.1 ppm • 1 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Corrosive irritant • Sensitizer

### SIGNS AND SYMPTOMS:

*Local:* Corrosive effect with brown staining of tissues •  
Conjunctivitis and keratitis • Skin irritation and burns  
Respiratory tract irritation with rhinitis, pharyngitis and  
bronchitis associated with dyspnea, cough, and chest pain;  
pulmonary edema is possible  
Ingestion causes burning in the mouth and pharynx; a metallic  
taste; nausea, vomiting, and abdominal pain with diarrhea;  
fever; hematuria, albuminuria and anuria; vascular collapse  
Chronic intoxication results in iodism

### DIAGNOSTIC TESTS:

Iodine in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with 5% sodium thiosulfate  
solution  
Gastric lavage, if ingested, with 5% solution of sodium thio-  
sulfate, followed by saline catharsis  
Oxygen, with IPPB, for respiratory symptoms  
Hospitalize severe exposures for further care and monitoring

## IODINE (*cont' d.*)

### TREATMENT (*cont' d.*):

Treat burns in normal manner  
Symptomatic and supportive

### DISABILITY:

Burns may produce permanent impairment

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved respiratory protection • Rubber gloves and protective clothing  
Preclude from exposure those individuals with diseases of the lungs and skin  
Remove from exposure those who become sensitized

## IRON OXIDES

### Synonyms:

Ferric oxide • Ferrous oxide

### Description:

Black to red-brown powder

### Occupational Exposure:

Catalyst • Electrical resistors • Enamels • Magnets • Metallurgy • Mining • Mordant • Pigment • Polishing agent • Welding

### Threshold Limit Value:

Fume — 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Siderosis—a benign pneumoconiosis occurs after 5–10 years exposure

## IRON OXIDES (*cont' d.*)

### SIGNS AND SYMPTOMS:

Mild conjunctival irritation

Cough

Metal fume fever may occur

Hyperpigmentation of the skin from traumatic penetration of sparks

### DIAGNOSTIC TESTS:

Chest x-ray shows reticulation or fine nodulation throughout the lung fields

No significant change in pulmonary function

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel regularly including chest x-ray and pulmonary function testing

Keimig, D.G. et.al. 1983. Respiratory symptoms and pulmonary function in welders of mild steel: A cross-sectional study. *Am. J. Ind. Med.* 4:489.

Morgan, W.K.C. 1978. Magnetite pneumoconiosis. *JOM* 20:762.

## ISOBUTYL ACETATE

### Synonyms:

2-Methyl propyl acetate • Methyl propyl ethanoate

### Description:

Colorless liquid, fruity odor

### Occupational Exposure:

Flavoring agent • Lacquers • Perfumes • Sealants • Solvent • Thinner

### Threshold Limit Value:

150 ppm • 700 mg/m<sup>3</sup>

## ISOBUTYL ACETATE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and nose

Headache • Vertigo • Drowsiness • Weakness

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## ISOPHORONE

### Synonyms:

Isoacetophorone • Trimethyl cyclohexanone

### Description:

Clear liquid

### Occupational Exposure:

Ink thinner • Lacquers • Pesticides • Solvent

### Threshold Limit Value:

5 ppm • 25 mg/m<sup>3</sup>

## ISOPHORONE (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose and throat

Headache • Nausea • Dizziness • Faintness • Malaise

Defatting dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Samimi, B. 1982. Exposure to isophorone and other organic solvents in a screen printing plant. *Am. Ind. Hyg. Assoc. J.* 43:43.

## ISOPROPANOLAMINE

### Synonyms:

2-Hydroxy propylamine • MIPA (monoisopropanolamine)

### Description:

Liquid, ammoniacal odor

## ISOPROPANOLAMINE (*cont' d.*)

### Occupational Exposure:

Cosmetics • Cutting oils • Drycleaning soaps • Emulsifying agent •  
Insecticides • Paints • Plasticizers • Wax removers

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract  
Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation  
Eye and respiratory protection as indicated

Hervin, R.L. and Lucas, J.B. 1974. Occupational health case report no.  
8: Monoisopropanolamine. *JOM* 16:355.

## ISOPROPYL ACETATE

### Synonyms:

Acetic acid, isopropyl ester • 2-Propyl acetate

### Description:

Colorless liquid

## ISOPROPYL ACETATE (*cont'd.*)

### Occupational Exposure:

Chemical synthesis • Inks • Paints and lacquers • Perfumes • Solvent

### Threshold Limit Value:

250 ppm • 950 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Chest constriction and cough

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing as indicated

## ISOPROPYL ALCOHOL

### Synonyms:

Dimethyl carbinol • Isopropanol • 2-Propanol • *sec*-Propyl alcohol

### Description:

Colorless liquid

## ISOPROPYL ALCOHOL (*cont' d.*)

### Occupational Exposure:

Antifreeze • Body rubs • Chemical synthesis • Cosmetics •  
Denaturant • Preservatives • Quick-dry oils and inks • Solvent •  
Window cleaner

### Threshold Limit Value:

400 ppm • 980 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Metabolized to acetone

Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal edema

Irritation of upper respiratory tract

Headache, dizziness, and drowsiness with narcosis

Dermatitis

#### DIAGNOSTIC TESTS:

Isopropyl alcohol in blood and expired air

Acetone in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing as indicated

Brugnone, F. et.al. 1983. Isopropanol exposure: Environmental and biological monitoring in a printing works. *Brit. J. Ind. Med.* 40:160.



# ISOPROPYLAMINE

## Synonyms:

2-Aminopropane

## Description:

Colorless liquid, ammoniacal odor

## Occupational Exposure:

Dehairing agent • Dyes • Insecticides • Pharmaceuticals • Solvent •  
Textile industry

## Threshold Limit Value:

5 ppm • 12 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis; corneal burns can occur  
Dermatitis and skin burns  
Rhinitis and bronchitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

Burns can cause permanent impairment

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# ISOPROPYL ETHER

**Synonyms:**

Diisopropyl ether • 2-Isopropoxy propane

**Description:**

Colorless liquid, ethereal odor

**Occupational Exposure:**

Paint and varnish removers • Rubber cements • Solvent

**Threshold Limit Value:**

250 ppm • 1050 mg/m<sup>3</sup>

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Irritant

Central nervous system depression is possible

**SIGNS AND SYMPTOMS:**

Conjunctivitis

Irritation of the nose and respiratory tract

Headache and nausea

Dermatitis

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

# ISOPROPYL PERCARBONATE

## Synonyms:

Diisopropyl peroxy dicarbonate • IPP

## Description:

Colorless crystals

## Occupational Exposure:

Catalyst

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Metal fume fever-type response has occurred

Dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and shoes

## ISOCYANATES

### Synonyms:

4,4'-Diphenyl methane diisocyanate (MDI) • Hexamethylene diisocyanate (HDI) • Methyl isocyanate (MCI) • 1,5-Naphthalene diisocyanate (NDI) • Toluene diisocyanate (TDI) • Others

### Description:

Most are liquids

### Occupational Exposure:

Adhesives • Coatings • Elastomers • Fibers • Polyurethane foams • Varnishes and lacquers

### Threshold Limit Value:

4,4'-Diphenyl methane diisocyanate — 0.02 ppm • 0.2 mg/m<sup>3</sup>  
Toluene diisocyanate — 0.005 ppm • 0.04 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Corrosive irritant • Sensitizer

Generally the lower molecular weight compounds are more toxic and produce more skin reactions

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Skin erythema and burns, as well as eczematous allergic reactions

Airway irritant response varies from a slight drop in FEV<sub>1</sub> without signs or symptoms, to increased secretions, cough, chest pain, dyspnea, bronchitis, and pulmonary edema (dose-related)

Airway hypersensitivity response occurring after 1–8 weeks exposure time varies from an immediate, late or dual asthmatic reaction to allergic alveolitis

#### DIAGNOSTIC TESTS:

Positive skin test

## ISOCYANATES (*cont'd.*)

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Treat burns in normal manner
- Symptomatic and supportive

### DISABILITY:

- Eye damage and skin burns have resulted in permanent impairment
- Sensitization is permanent
- Pulmonary impairment has occurred

### Preventive Measures:

- Adequate ventilation with regular monitoring of work environment • Chemical goggles • Approved respiratory protection • Butyl rubber gloves, aprons, and boots
- Physical examination of exposed personnel at regular intervals including chest x-rays and tests of pulmonary function
- Preclude from exposure those individuals with allergies and chronic diseases of skin and respiratory tract
- Remove from exposure those who become sensitized

Smirnov, V. et.al. 1981. Acute intoxication by organic isocyanates. *Harefuah* 100:520 and 551.

Weill, H. et.al. 1981. Respiratory and immunologic evaluation of isocyanate exposure in a new manufacturing plant. NIOSH Pub. No. 81-125. NIOSH Technical Report on Contract No. 210-75-0006. Washington, D.C. U.S. Gov't. Print. Office.

# KAOLIN

## Synonyms:

Argilla • China clay • Porcelain clay • White bole

## Description:

Yellowish powder; kaolinite, a hydrated aluminum silicate, contains oxides of iron, magnesium, copper, sulfur, and silicon

## Occupational Exposure:

Cosmetics • Emollient • Filler in paints and paper • Insulators •  
Manufacture of porcelain, pottery, and bricks • Plaster •  
Pharmaceuticals • Portland cement • Refractory mortar

## Threshold Limit Value:

5 mg/m<sup>3</sup> respirable dust

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Pneumoconiosis—kaolinosiis does occur in the absence of free silica

### SIGNS AND SYMPTOMS: After many years exposure

Cough • Dyspnea • Chronic bronchitis

### DIAGNOSTIC TESTS:

Chest x-rays show fine nodules and diffuse reticular infiltrates  
Pulmonary function testing reveals restrictive effects

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Pulmonary impairment can be permanent

## Preventive Measures:

Wet methods where possible  
Approved respiratory protection  
Physical examination of exposed personnel on a regular basis including chest x-rays and pulmonary function measurements  
Preclude from exposure those individuals with pulmonary disease  
Remove from exposure those who develop pneumoconiosis

## KAOLIN (*cont'd.*)

- Altekruse, E.B. et.al. 1984. Kaolin dust concentrations and pneumoconiosis at a kaolin mine. *Thorax* 39(6):436.  
Lesser, M. et.al. 1978. Silicosis in kaolin workers and firebrick makers. *So. Med. J.* 71:1242.

## KEROSINE

### Synonyms:

Fuel oil No. 1 • Kerosene

### Description:

Colorless to yellow petroleum derivative composed of aliphatics (C<sub>10</sub>-C<sub>16</sub> range), olefinics, naphthenic and aromatic hydrocarbons

### Occupational Exposure:

Degreasing • Fuel • Insecticide • Solvent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Defatting dermatitis

Headache • Dizziness • Nausea • Fatigue

Ingestion results in burning of mouth and gastrointestinal tract with nausea, vomiting, and lethargy

Aspiration provokes choking, cough, dyspnea, fever, tachycardia, bronchitis, and pneumonia

#### DIAGNOSTIC TESTS:

Blood hydrocarbon levels are not helpful

Chest x-ray changes appear after 6-8 hours

## KEROSINE (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

There is growing evidence that induced vomiting or gastric lavage offer little advantage unless the quantity has been large or other toxins are involved

Pulmonary findings on physical examination or by x-ray warrant hospitalization for observation, serial blood gases, and cardiorespiratory support as indicated

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing when indicated

Anas, N. 1981. Criteria for hospitalizing children who have ingested products containing hydrocarbons. *JAMA* 246:840.

Knave, B. et.al. 1979. Neurasthenic symptoms in workers occupationally exposed to jet fuel. *Acta. Psychiatr. Scand.* 60:39.

## KETENE

### Synonyms:

Carbomethene • Ethenone

### Description:

Colorless gas

### Occupational Exposure:

Chemical synthesis

### Threshold Limit Value:

0.5 ppm • 0.9 mg/m<sup>3</sup>



## KETENE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes

Throat irritation and cough

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## LACTIC ACID

### Synonyms:

2-Hydroxypropanoic acid • alpha-Hydroxypropionic acid • Milk acid

### Description:

Yellowish syrupy liquid

### Occupational Exposure:

Catalyst • Dehairing agent • Food manufacture • Mordant • Plasticizer • Solder flux • Solvent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

None

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal edema  
Dental corrosion  
Eczema

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, using limewater followed by demulcents  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles or face shield • Rubber gloves

# LEAD ARSENATE

## Synonyms:

Lead orthoarsenate

## Description:

White crystals; a mixture of arsenate of soda and acetate of lead

## Occupational Exposure:

Herbicide • Insecticide • Veterinary medicine

## Threshold Limit Value:

0.15 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation

### MODE OF ACTION:

Dual toxicity of lead and arsenic, although generally arsenical symptoms predominate

### SIGNS AND SYMPTOMS:

#### *Acute:*

Contact dermatitis

Nausea • Vomiting • Abdominal pain • Diarrhea

Muscular cramps • Nervous excitation • Disorientation

#### *Chronic:*

Anorexia • Weight loss • General weakness • Pallor • Abdominal colic

Hepatitis and nephritis can occur

Perforation of nasal septum

Diffuse pigmentation of the skin after several years exposure with hyperkeratoses of the palms and soles

Pulmonary cancer has been reported

### DIAGNOSTIC TESTS:

Urinary lead and arsenic levels

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Follow therapy schedule for arsenical and lead intoxications

Symptomatic and supportive

## LEAD ARSENATE (*cont' d.*)

### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

No eating or smoking in work area

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to target organs and including chest x-ray and urine lead and arsenic levels

Preclude from exposure those individuals with diseases of the skin, lungs, liver, kidney, and nervous system

Horiguchi, S. 1979. A case of lung cancer due to exposure to arsenical compounds in an insecticide factory (Studies on lead arsenate poisoning). *Osaka City Med. J.* 25:45.

## LEAD, INORGANIC

### Synonyms:

Plumbum

### Description:

Metal is blue-gray

Salts are variable colored crystals and masses

### Occupational Exposure:

Alloys • Batteries • Corrosion-resistant surfaces • Fingerprint detection powders • Glass making • Manufacture of tetraethyl lead • Metallurgy • Pigment • Plastics • Solder • X-ray shields

### Threshold Limit Value:

Fume and dust — 0.15 mg/m<sup>3</sup>

Compounds — 50 µg/m<sup>3</sup> OSHA

Specific OSHA regulations apply

## LEAD, INORGANIC (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Interferes with heme synthesis at two levels by interrupting delta-amino levulinic acid dehydratase (ALA-D) and ferro-chelatase

Interferes with neurotransmitters

Causes nephropathy

Direct irritative action on gastrointestinal muscle

Gonadotoxic

#### SIGNS AND SYMPTOMS:

Acute stress such as injury, severe illness, dietary indiscretions, and emotional stress may precipitate symptoms of lead intoxication in persons whose metabolism of lead is in delicate balance

Lead intoxication tends to be a chronic disease covering a broad spectrum of adverse effects

*General:* Pallor • Weakness • Weight loss • Lassitude

*Gastrointestinal:* Metallic taste • Burton's lead line if oral hygiene is poor • Anorexia • Nausea • Vomiting • Constipation • Abdominal colic may occur

*Genitourinary:* Chronic nephritis and nephrosclerosis have been reported

*Central nervous system:* Impaired psychomotor performance • Irritability • Impaired concentration • Sleep disturbances • Depressed deep tendon reflexes • Peripheral neuropathy • Encephalopathy is now almost entirely confined to children

*Musculoskeletal:* Muscular aches and pains along with arthralgia do occur • Lead may be associated with gout nephropathy—"saturnine gout"

*Hematopoietic:* Normocytic, normochromic anemia with erythrocyte stippling and short red cell life

*Reproductive:* Hypospermia and oligospermia, increased incidence of abortions, miscarriages, and stillbirths

## LEAD, INORGANIC (*cont' d.*)

### DIAGNOSTIC TESTS:

Blood lead (normal < 35 µg/g creatinine)

Urine lead (normal < 50 µg/g creatinine)

Urine delta-amino levulinic acid and coproporphyrin are also useful

### TREATMENT:

Remove patient from exposure

Therapy may not need to be dramatic

Chelation when indicated is done with CaEDTA using 50 mg/kg intravenously each day in divided doses up to 5 days—the course may be repeated after several days rest; renal status must be checked before and during therapy

Prophylactic chelation is contraindicated

Symptomatic and supportive

### DISABILITY:

Encephalopathy, paralyses, and nephropathy can result in permanent impairment

### Preventive Measures:

Adequate ventilation with regular monitoring of work environment • Approved respiratory protection • Protective clothing where indicated

No eating or smoking in work area • Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to target organ systems and including blood lead determinations

Preclude from exposure those with elevated lead levels, those with diseases of the central nervous system, kidneys, and blood

Special review should be made of those who are in the reproductive age group

Ashby, J.A.S. 1980. A neurological and biochemical study of early lead poisoning. *Brit. J. Ind. Med.* 37:133.

Baker, E.L. et.al. 1979. Occupational lead poisoning in the U.S.: Clinical and biochemical findings related to blood lead levels. *Brit. J. Ind. Med.* 36:314.

Jeyaratnam, J. et.al. 1985. Neurophysiological studies on workers exposed to lead. *Brit. J. Ind. Med.* 42:173.

Lancranjan, J. et.al. 1975. Reproductive ability of workmen occupationally exposed to lead. *Arch. Environ. Hlth.* 30:396.

# LEAD, ORGANIC

## Synonyms:

Tetraethyl lead • Tetramethyl lead

## Description:

Colorless, oily liquid, pleasant odor

## Occupational Exposure:

Antiknock agent in gasoline

## Threshold Limit Value:

Tetraethyl lead — 0.1 mg/m<sup>3</sup>

Tetramethyl lead — 0.15 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Primarily neurotoxic

### SIGNS AND SYMPTOMS:

Mild intoxication characterized by headache, anorexia and nausea, abdominal discomfort, lassitude or irritability

Encephalopathy usually associated with anxiety, restlessness, insomnia, hyper reflexia and tremors, spasmodic muscle contractions, hallucinations, convulsions, and acute psychosis

Decreased spermatogenesis and impotence have been reported

No human intoxication to tetramethyl lead has been reported

### DIAGNOSTIC TESTS:

Urine lead levels (normal < 50 µg/g creatinine)

Urine diethyl lead level above 8 µg is considered hazardous

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Remove patient from further exposure if systemic intoxication threatens

Symptomatic and supportive

CaEDTA has been used but its value is questionable



## LEAD, ORGANIC (*cont'd.*)

### DISABILITY:

No permanent central nervous system effects are reported but recovery from encephalopathy may require months

### Preventive Measures:

Regular monitoring of work environment • Protective goggles and clothing • Approved respiratory protection

Good personal hygiene • No eating or smoking in work areas

Physical examination of exposed personnel on a regular basis with special attention to the nervous system and lead urine determinations

Preclude from exposure those individuals with diseases of the central nervous system

Gething, J. 1975. Tetramethyl lead absorption: A report of human exposure to a high level of tetramethyl lead. *Brit. J. Ind. Med.* 32:329.

Turlakiewicz, Z. and Chmielnicka, J. 1985. Diethyl lead as a specific indicator of occupational exposure to tetraethyl lead. *Brit. J. Ind. Med.* 42:682.

Yamamura, Y. et.al. 1975. Tetraethyl lead poisoning caused by cleaning work in the aviation fuel tank. *Jpn. J. Ind. Hlth.* 17:223.

## LITHIUM AND COMPOUNDS

### Synonyms:

Lithium chloride • Lithium hydride • Lithium oxide • Others

### Description:

Metal is silver-gray; compounds are crystals and powders

### Occupational Exposure:

Alloys • Catalysts • Hydrogen source • Metallurgy • Reducing agents

### Threshold Limit Value:

Lithium hydride — 0.025 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation



## LITHIUM AND COMPOUNDS (*cont'd.*)

### MODE OF ACTION:

Irritant

Lithium hydride forms lithium hydroxide on moist surfaces

### SIGNS AND SYMPTOMS:

Conjunctivitis and eye burns

Nasal irritation and sneezing and nasal septal perforation

Skin burns

Cough • Dyspnea • Tracheitis • Bronchitis

No systemic intoxication from industrial exposures

### DIAGNOSTIC TESTS:

Lithium in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in normal manner

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Iluna, V.A. 1970. Problems of occupational hygiene in production and processing of magnesium lithium alloys. *Gig. San.* 35:24.

# MAGNESIUM AND COMPOUNDS

## Synonyms:

Calcined magnesium • Magnesia • Magnesium oxide • Others

## Description:

Metal is silver white; compounds are crystals and powders

## Occupational Exposure:

Casein glue • Catalyst • Cosmetics • Food additives • Insulator •  
Magnesia cements • Paper • Pharmaceuticals • Refractory materials • Rubber accelerator

## Threshold Limit Value:

Magnesium oxide fume — 10 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous (by trauma)

### MODE OF ACTION:

Oxide is an irritant

Other compounds assume toxic characteristics of their constituents (e.g., arsenate, chromate, iodate, selenate, etc.)

### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Small particles embedded in skin or sebaceous tissue cause localized inflammatory reactions

Magnesium oxide fumes may cause metal fume fever: 4–6 hours after exposure patient experiences chest tightness, cough, fever, and chills lasting less than 24 hours

### DIAGNOSTIC TESTS:

Magnesium may be detected in blood

### TREATMENT:

Irrigate eyes with water

Remove any material embedded in skin

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## MAGNESIUM AND COMPOUNDS (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Protective goggles or face shield • Approved respiratory protection

Hartman, A.L. et.al. 1983. Magnesium oxide as cause of metal fume fever. *Schweiz. Med. Wochenschr.* 113:766.

## MALEIC ACID

### Synonyms:

*cis*-Butenedioic acid • Maleinic acid

### Description:

Colorless crystals

### Occupational Exposure:

Chemical synthesis • Dyeing • Preservative • Synthetic resin manufacture

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Irritation of respiratory tract

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

## MALEIC ACID (*cont' d.*)

### TREATMENT (*cont' d.*)

Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## MALEIC ANHYDRIDE

### Synonyms:

*cis* -Butenedioic anhydride • 2,5-Furandione • Toxilic anhydride

### Description:

Colorless needles, pungent odor

### Occupational Exposure:

Agricultural chemicals • Chemical synthesis • Dye intermediates • Permanent press resins • Pesticides • Pharmaceuticals

### Threshold Limit Value:

0.25 pm • 1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage  
Irritation of nose and throat, cough, and bronchitis or pneumonitis  
Asthma has been reported  
Headache, nausea and epigastric pain  
Vesicular dermatitis and skin burns

## MALEIC ANHYDRIDE (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Oxygen, with IPPB, as needed

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots

Preclude from exposure those individuals with allergies and pulmonary diseases

Guerin, J.C. et.al. 1980. A case of asthma due to maleic anhydride.  
*Poumon. Coeur* 36:393.

## MANGANESE AND COMPOUNDS

### Synonyms:

Manganese dioxide • Potassium permanganate • Pyrolusite

### Description:

Metal is red-gray; compounds are multicolored

### Occupational Exposure:

Alloys • Batteries • Bleaches • Chemical synthesis • Gasoline additives • Glass and ceramics • Mining and smelting • Steel manufacture

### Threshold Limit Value:

Dusts and compounds — 5 mg/m<sup>3</sup>

Fume — 1 mg/m<sup>3</sup>

## MANGANESE AND COMPOUNDS (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous (antiknock gasoline additive)

#### MODE OF ACTION:

Irritant • Central nervous system damage

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage from irritant salts

Papuloerythematous dermatitis

Acute pulmonary effects, consisting of dyspnea, shallow respiration and fever mimic metal fume fever

*Central nervous system:* Usually after 1–2 years exposure

Stage I—subclinical, reversible—Asthenia, indifference, irritability, headache, anorexia, sleep disturbance, decreased libido, arthralgia, muscular spasm and diminished fine motor coordination • Emotional and behavioral disorders called “manganic psychosis” are more frequently seen among miners at this stage

Stage II—clinical or intermediate—Speech becomes slow and stammering with monotonous voice; mask-like facies; excessive salivation; awkward gestures; tremors of tongue, arms, and legs; gait disturbances

Stage III—late—Muscular rigidity, bradykinesia with slow spasmodic gait, emotional instability, postural instability and imbalance, diminished mental ability

#### DIAGNOSTIC TESTS:

Blood and urine manganese levels do not correlate with symptoms

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Chronic intoxications have been treated with edetic acid and levodopa with mixed results

Symptomatic and supportive

#### DISABILITY:

Local damage from irritant salts can be permanent

Recovery from stage III manganism is unexpected

## MANGANESE AND COMPOUNDS (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

No eating or smoking in work areas • Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to neurologic and psychologic findings

Preclude from exposure those individuals with neurologic and psychologic disorders

Remove from exposure those who exhibit stage I symptoms

Bergstrom, R. 1977. Acute pulmonary toxicity of manganese dioxide. *Scand. J. Work Environ. Hlth* (suppl.)3:1.

Cook, D.G. et.al. 1974. Chronic manganese intoxication. *Arch. Neurol.* 30:59.

Sano, S. et.al. 1982. An epidemiological survey and clinical investigations on retired workers from manganese mines and ore grinders in Kyoto Prefecture. *Jpn. J. Hyg.* 37:566.

Saric, M. et.al. 1977. Occupational exposure to manganese. *Brit. J. Ind Med.* 34:114.

## MERCAPTANS

### Synonyms:

Alkyl mercaptans: butyl-, ethyl-, methyl-, perchloromethyl-

Butanethiol • Ethanethiol • Methanethiol • Other

### Description:

Organic thio-alcohols in which sulfur replaces oxygen in the hydroxy group

Gases and liquids with unpleasant odors

### Occupational Exposure:

Adhesives • Anticorrosives • Dehairing agents • Fungicide • Jet fuel •

Olfactory warning agent • Pesticides • Pharmaceuticals • Pickling of steel • Plastics • Synthetic rubber

### Threshold Limit Value:

Butyl — 0.5 ppm • 1.5 mg/m<sup>3</sup>

Ethyl — 0.5 ppm • 1 mg/m<sup>3</sup>

Methyl — 0.5 ppm • 1 mg/m<sup>3</sup>

Perchloromethyl — 0.1 ppm • 0.8 mg/m<sup>3</sup>



## MERCAPTANS (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of the eyes, skin, and respiratory tract

Headache • Dizziness • Ataxia • Narcosis

Nausea • Vomiting

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Cardiorespiratory support

Symptomatic and supportive

#### DISABILITY:

Recovery from acute exposure has not been followed by any impairment

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Shults, W.T. et.al. 1970. Methanethiol poisoning. *JAMA* 211:2153.

## MERCURY AND COMPOUNDS (INORGANIC)

### Synonyms:

Mercuric compounds (multiple) • Mercurous compounds (multiple) • Quicksilver



# MERCURY AND COMPOUNDS (INORGANIC)

(*cont' d.*)

## Description:

Metal is silver liquid

Compounds vary in texture and color

## Occupational Exposure:

Amalgams • Batteries • Catalyst • Electrical switches and lights •

Laboratory apparatus • Metal plating • Paints and pigments •

Photography • Rectifiers • Vapor tubes • X-ray tubes

## Threshold Limit Value:

Aryl and inorganic compounds — 0.1 mg/m<sup>3</sup>

Vapor — 0.05 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Reacts with thiol groups and inhibits multiple enzyme systems

Kidney and liver damage (especially inorganic salts)

Brain is critical organ in chronic exposures

Gastrointestinal and pulmonary damage

### SIGNS AND SYMPTOMS:

*Acute ingestion* (soluble compounds):

Burning in mouth and throat • Thirst • Shock • Cardiac arrhythmias • Nausea, vomiting, and abdominal pain with bloody diarrhea • Oliguria, hematuria, albuminuria, and casts

*Acute inhalation:*

Headache • Dyspnea • Chest tightness • Cough • Chills and fever • Nausea and vomiting, sometimes accompanied by abdominal colic and diarrhea • Later the patient may complain of soreness of mouth and throat, gingivitis, myalgia, weakness, and tremor • Pneumonitis may develop

## MERCURY AND COMPOUNDS (INORGANIC)

(cont'd.)

### *Chronic:*

*Central nervous system*—Headache, vertigo, vasomotor disturbances, restlessness, irritability, and sleep disturbances • ERETHISM—anxiety, timidity, depression • Tremor, both static and intentional, varying from very fine to intense and episodic • Ataxia, increased reflexes, and gait disturbance • Intellectual deterioration, memory loss, and emotional instability

*Gastrointestinal*—Increased salivation • Stomatitis • Gingivitis • Anorexia, nausea, vomiting, and diarrhea • Fatigue and weight loss

*Genitourinary*—Proteinuria, hematuria, oliguria

*Eye*—Mercurialentis (mercurial deposits in the lens) • Visual disturbances

*Skin*—Dermatitis may occur • Traumatic subcutaneous deposits may result in local inflammation and systemic signs • ACRODYNIA (pink disease) is not confined to infants and may be associated with nervous system and gastrointestinal complaints

### DIAGNOSTIC TESTS:

Urine mercury levels above 150  $\mu\text{g/L}$  indicate significant absorption

Electronic measurement of tremors may be helpful in screening

X-rays of chest will detect pneumonitis

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Remove embedded metallic mercury, surgically if necessary, then monitor biologic levels and chelate if necessary

Gastric lavage if mercuric salts are ingested, using activated charcoal and follow by monitoring biologic levels

Dimercaprol and penicillamine have both been used

Severe intoxications will require hospitalization and extreme care

### DISABILITY:

Permanent impairment does occur

## MERCURY AND COMPOUNDS (INORGANIC)

(cont'd.)

### Preventive Measures:

- Adequate ventilation with regular monitoring of work area
- Meticulous plant housekeeping
- Education of all employees regarding hazards and safe handling procedures
- No eating or smoking in work area
- Chemical goggles when indicated
- Approved respiratory protection
- Protective clothing
- Good personal hygiene
- Physical examination of exposed personnel at regular intervals with special attention to the nervous system and including urine mercury determinations
- Remove from exposure those with a urine level above 0.1 mg/L
- Preclude from exposure those individuals with diseases of the target organ systems
- Special arrangements should be made for those in the reproductive age groups

- Battigelli, M.C. 1983. Mercury in Wm. N. Rom (ed.), *Environmental and Occupational Medicine*. Boston: Little, Brown & Co.
- McNeil, N.I. et. al. 1984. Domestic metallic mercury poisoning. *Lancet* I:269.
- Seaton, A. and Bishop, C.M. 1978. Acute mercury pneumonitis. *Brit. J. Ind. Med.* 35:258.
- Snodgrass, W. et.al. 1981. Mercury poisoning from home gold ore processing, use of penicillamine and dimercaprol. *JAMA* 246:1929.
- Symington, I.S. et.al. 1980. Mercury poisoning in dentists. *J. Soc. Occup. Med.* 30:37.

## MERCURY ORGANIC COMPOUNDS

### Synonyms:

- Alkyl: Ethyl mercury chloride • Methyl mercury
- Aryl (phenyl): Phenyl mercuric acetate • These appear to be no more hazardous than inorganic compounds

## MERCURY ORGANIC COMPOUNDS (*cont' d.*)

### Description:

Colorless liquids

### Occupational Exposure:

Antifouling paints • Antiseptics • Catalysts • Chemical synthesis •  
Contraceptives • Diuretics • Fungus proofing • Germicides

### Threshold Limit Value:

Aryl compounds — 0.1 mg/m<sup>3</sup>

Alkyl compounds — 0.01 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Sensitizer (aryl compounds)

Atrophic lesions in central and cerebellar hemispheres and  
basal ganglia

Axonal necrosis and myelin sheath derangement in sensory and  
posterior peripheral nerve roots

Nephrosis

Genetic damage has been reported

**SIGNS AND SYMPTOMS:** Systemic symptoms may be delayed  
for weeks

Irritation of eyes and skin • Blistering may be delayed several  
hours

Paresthesias of the mouth, lips, and distal extremities

Fine tremors of the hands, arms, and face increase as the  
intensity of intoxication

Slurred, indistinct speech

Myalgia and dysarthria

Contraction of visual fields and impairment of hearing

Altered gait and ataxia

Emotional disturbances

*In more severe cases:* Spasticity with jerky movements of the  
head, extremities, and torso • Nausea, vomiting, diarrhea •  
Incontinence

## MERCURY ORGANIC COMPOUNDS (*cont' d.*)

### DIAGNOSTIC TESTS:

Blood mercury

Hair values when carefully done may help estimate exposure

Urine mercury levels

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner after carefully evacuating blister material

Gastric lavage, if ingested, with a 5% solution of sulfoxylate, then a 2% solution of sodium bicarbonate

Penicillamine has been widely used and mercaptopropionyl glycine has been used by Japanese physicians

There is some evidence that BAL may redistribute alkyl mercury to the nervous system and thereby increase toxicity

Symptomatic and supportive

### DISABILITY:

Central nervous system effects are severe and permanent

### Preventive Measures:

Adequate ventilation with regular monitoring of work area

Meticulous plant housekeeping

Education of all employees regarding hazards and safe handling procedures

No eating or smoking in work area

Chemical goggles as indicated

Approved respiratory protection

Protective clothing

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the nervous system and visual fields and including urine mercury determination

Remove from exposure those with a urine level above 0.1 mg/L

Preclude from exposure those individuals with diseases of the skin, kidneys, and central nervous system

Special arrangements should be made for those in the reproductive age groups

## MERCURY ORGANIC COMPOUNDS (*cont'd.*)

Battigelli, M.C. 1983. Mercury in Wm. N. Rom (ed.), *Environmental and Occupational Medicine*. Boston: Little, Brown & Co.

Goldwater, L.J. and Stopford, W. 1977. Mercury in J.M.A. Lenihan and W.W. Fletcher (eds.), *The Chemical Environment*. Glasgow: Blackie.

Tsubaki, T. and Trukayama, K. 1977. *Minimata Disease*. Tokyo-Amsterdam: Kodansha-Elsevier.

## MESITYL OXIDE

### Synonyms:

Isopropylidene acetone • Methyl isobutenyl ketone • 4-Methyl-3-penten-2-one

### Description:

Colorless, oily liquid

### Occupational Exposure:

Insect repellent • Lacquers • Ore flotation • Paint and varnish removers • Solvent • Stains

### Threshold Limit Value:

15 ppm • 60 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Irritation of respiratory tract • Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive



## MESITYL OXIDE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## METAL FUME FEVER

### Synonyms:

Brass fever • Brass founder's ague • Copper colic • Zinc shakes • Others

### Description:

An acute, self-limited syndrome following the inhalation of minute particles of metal oxides

### Occupational Exposure:

Occupations where fumes are generated by cutting, welding, smelting, or galvanizing metals

Metals known to be involved include:

Antimony • Arsenic • Beryllium • Cadmium • Cobalt • Copper  
• Iron • Lead • Magnesium • Manganese • Mercury • Nickel  
• Selenium • Tin • Zinc

### Threshold Limit Value:

See TLV for specific metal

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

It is believed that inhalation of particles at or below 1.5 microns result in an alveolar or lymphocyte pyrogen release which is responsible for the symptoms

## METAL FUME FEVER (*cont' d.*)

**SIGNS AND SYMPTOMS:** May follow exposure by 4–6 hours

Metallic taste, chest tightness, cough, and dyspnea

Headache, chills, fever, sweating, and myalgia follow

Nausea, vomiting, and weakness are not uncommon

Entire cycle is usually complete in 24–36 hours

**DIAGNOSTIC TESTS:**

Leucocytosis

Increased lactic dehydrogenase

**TREATMENT:**

Symptomatic and supportive

Sequence is self-limiting

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Approved respiratory protection

Anseline, P. 1972. Zinc-fume fever. *Med. J. Australia* 2:316.

Armstrong, C.W. et.al. 1983. An outbreak of metal fume fever. *JOM* 25:886.

## METHANE

**Synonyms:**

Marsh gas • Methyl hydride

**Description:**

Colorless gas, no odor

**Occupational Exposure:**

Chemical synthesis • Coal mines • Fuel • Source of carbon black

**Threshold Limit Value:**

None established

**Toxicity:**

**ROUTE OF ENTRY:**

Inhalation



## METHANE (*cont'd.*)

### MODE OF ACTION:

Asphyxiant

### SIGNS AND SYMPTOMS:

Dyspnea • Unconsciousness

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Remove patient to fresh air  
Cardiorespiratory support  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Airline respirator, if necessary

## METHYL ACETATE

### Synonyms:

Acetic acid, methyl ester

### Description:

Colorless liquid, fragrant odor

### Occupational Exposure:

Manufacture of artificial leather • Paint remover • Solvent •  
Synthetic flavors

### Threshold Limit Value:

200 ppm • 610 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

## METHYL ACETATE (*cont' d.*)

### MODE OF ACTION:

Metabolized to methyl alcohol  
Cerebral edema  
Central nervous system depressant  
Optic atrophy

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal edema  
Headache • Dizziness • Drowsiness  
Chest constriction • Dyspnea • Palpitation  
Dermatitis

### DIAGNOSTIC TESTS:

Methyl alcohol in blood and urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, with a 4% solution of sodium bicarbonate, followed by saline catharsis  
Treat methyl alcohol intoxication if indicated  
Symptomatic and supportive

### DISABILITY:

Blindness has been reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## METHYL ACETYLENE

### Synonyms:

Allylene • Propyne

### Description:

Colorless gas, pleasant odor

### Occupational Exposure:

Aerosol propellant • Chemical synthesis • Welding

## METHYL ACETYLENE (*cont'd.*)

### Threshold Limit Value:

1000 ppm • 1650 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of respiratory tract • Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

## METHYLAL

### Synonyms:

Dimethoxy methane • Formal

### Description:

Colorless liquid, chloroform-like odor

### Occupational Exposure:

Adhesives • Artificial resins • Chemical synthesis • Coatings • Fuel •  
Perfumes • Solvent

### Threshold Limit Value:

1000 ppm • 3100 mg/m<sup>3</sup>

## METHYLAL (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Dermatitis

Narcosis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Cardiorespiratory support as indicated

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## METHYL ALCOHOL

### Synonyms:

Carbinol • Methanol • Wood alcohol • Wood spirit

### Description:

Clear liquid

### Occupational Exposure:

Antifreeze • Chemical synthesis • Denaturant • Fuel additive • Solvent

# METHYL ALCOHOL (*cont' d.*)

## Threshold Limit Value:

200 ppm • 260 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Severe metabolic acidosis

Evidence exists that the metabolic route may be to formate

Central nervous system depressant

### SIGNS AND SYMPTOMS: May be delayed up to 24 hours

Conjunctivitis and corneal irritation

Dermatitis, erythematous and defatting

*Inhalation:* Headache, dizziness, unsteady gait, and inebriation

• Nausea, vomiting, and weakness • Blurred vision and altered color perception

*Ingestion:* Nausea, vomiting, and abdominal pain • Headache,

dizziness, narcosis, and coma • Blurred or double vision

with constriction of visual fields and blindness • Evidence

of metabolic acidosis—severity is unrelated to amount consumed

### DIAGNOSTIC TESTS:

Methanol in blood and urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by activated charcoal

Combat shock and acidosis

Monitor fluids and electrolytes

Use 10% ethanol in D5W intravenously to maintain ethyl alcohol blood level at 100 mg/dl

Hemodialysis may be indicated

### DISABILITY:

Blindness and impaired renal function may be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves, aprons, and boots as required

## METHYL ALCOHOL (*cont' d.*)

### Preventive Measures (*cont' d.*):

Physical examination of exposed personnel on a regular basis including tests of visual function, neurologic evaluation, and kidney and liver function studies

Urinary methanol concentration above 10 µg/ml suggests excessive exposure

Preclude from exposure those individuals with diseases of the eyes, liver, kidneys, and lungs

Ferry, D.G. 1980. Methanol monitoring. Comparison of urinary methanol concentration with formic acid excretion rate as a measure of occupational exposure. *Int. Arch. Occup. Environ. Hlth.* 47:155.

Martin-Amat, G. et.al. 1978. Methanol poisoning: Ocular toxicity produced by formate. *Toxicol. & Appl. Pharmacol.* 45:201.

## METHYLAMINE

### Synonyms:

Aminomethane • Monomethylamine

### Description:

Colorless gas, ammoniacal odor

### Occupational Exposure:

Chemical intermediate • Dyeing • Fuel additive • Paint removers •  
Pharmaceuticals • Photographic developer • Rocket propellant •  
Tanning

### Threshold Limit Value:

10 ppm • 12 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Irritation of respiratory tract

Dermatitis

## METHYLAMINE (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves if indicated

## METHYL AMYL ALCOHOL

### Synonyms:

Methyl isobutyl carbinol • 4-Methyl-2-pentanol

### Description:

Colorless liquid

### Occupational Exposure:

Brake fluids • Chemical synthesis • Solvent

### Threshold Limit Value:

25 ppm • 100 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

## METHYL AMYL ALCOHOL (*cont'd.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## METHYL BROMIDE

### Synonyms:

Bromomethane • Monobromomethane

### Description:

Colorless gas

### Occupational Exposure:

Chemical synthesis • Dyes • Fumigant • Insecticide • Methylating agent • Refrigerant • Solvent

### Threshold Limit Value:

5 ppm • 20 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

Whether toxicity is related to bromine, methyl alcohol, or sulfhydryl group attack is not clear

Damage occurs in brain, heart, lungs, liver, and kidneys



## METHYL BROMIDE (*cont'd.*)

**SIGNS AND SYMPTOMS:** May be delayed for days

*Local:* Conjunctivitis and chemosis • Erythematous papulovesicular lesions and second-degree skin burns

*Acute inhalation:* Anorexia, nausea, vomiting, and abdominal pain • Headache, vertigo, lethargy, faintness, and visual disturbance, numbness of arms and hands, convulsions • Pulmonary irritation with pneumonitis and edema

*Chronic effects:* Cerebral irritation with jerky motions, gait disturbance, speech difficulty, ataxia, and neuropathy • Lethargy, mental confusion, visual disturbances, hallucinations, delirium, and mania • Chronic acneiform eruption • Hepatomegaly with jaundice; proteinuria, oliguria, and anuria

**DIAGNOSTIC TESTS:**

Blood bromide

S-methyl cysteine in urine

**TREATMENT:** *TREAT AS AN EMERGENCY*

Remove all clothing immediately

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Hospitalize for careful observation

Oxygen as required

Monitor blood gases, fluids, and electrolytes

Anticonvulsants as required

Treat skin burns in normal manner

Symptomatic and supportive

**DISABILITY:**

Psychiatric and neurologic recovery may take several years

Permanent impairment is reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Impervious clothing

No eating or smoking in work area

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the nervous system and including tests of liver, kidney, and pulmonary function and including blood bromide determination

## METHYL BROMIDE (*cont'd.*)

### Preventive Measures (*cont'd.*):

Preclude from exposure those individuals with psychiatric and neurologic disorders as well as diseases of the skin, liver, lungs, and kidneys

Kameyama, K. et.al. 1978. Ocular manifestations of chronic methyl bromide intoxication. *Jpn. J. Clin. Opth.* 32:437.

Shield, L.K. et.al. 1977. Methyl bromide intoxication: Neurologic features, including simulation of Reye syndrome. *Neurology* 27:959.

Van den Oever, R. et.al. 1982. Actual hazard of methyl bromide fumigation in soil disinfection. *Brit. J. Ind. Med.* 39:140.

## METHYL BUTYL KETONE

### Synonyms:

2-Hexanone • MBK • Propyl acetone

### Description:

Colorless liquid, sweetish odor

### Occupational Exposure:

Adhesives • Coating manufacture • Solvent

### Threshold Limit Value:

5 ppm • 20 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Central nervous system depressant

Metabolized to 2,5 hexanedione (neurotoxin)

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Narcosis

## METHYL BUTYL KETONE (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

Dermatitis

Peripheral neuropathy characterized by paresthesias in fingers and toes with a proximal spread; weakness of hands and feet; loss of sense of touch, pain, and position; muscular fibrillation and paralysis

### DIAGNOSTIC TESTS:

2,5 Hexanedione in urine

Impaired nerve conduction velocity

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

Recovery from neuropathy can be delayed a year or more

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Physical examination of exposed personnel at regular intervals with special attention to the nervous system

Preclude from exposure those individuals with central nervous system disorders

Allen, N. et.al. 1975. Toxic polyneuropathy due to methyl *n*-butyl ketone. *Arch. Neurol.* 32:209.

Davenport, J.G. et.al. 1976. Giant axonal neuropathy caused by industrial chemicals: Neurofilamentous axonal masses in man. *Neurology* 26:919.

Mallov, J.S. 1976. MBK neuropathy among spray painters. *JAMA* 235:1455.

## 2-METHYL BUTYRALDEHYDE

### Synonyms:

2-Methyl butanal

### Description:

Colorless liquid, pungent odor

## 2-METHYL BUTYRALDEHYDE (*cont' d.*)

### Occupational Exposure:

Chemical synthesis

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Headache and dizziness

Nausea and vomiting

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## *n*-METHYL CARBAMATES

**Synonyms:** Do not confuse with the dithiocarbamates

Baygon • Carbaryl • Furadan • Isolan • Pyrolan • Zectran • Others

### Description:

Crystals and powders

## *n*-METHYL CARBAMATES (*cont' d.*)

### Occupational Exposure:

Pesticides

### Threshold Limit Value:

Baygon — 0.5 mg/m<sup>3</sup>

Carbaryl (Sevin) — 5 mg/m<sup>3</sup>

Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Direct cholinesterase inhibitor

### SIGNS AND SYMPTOMS:

Quite similar to organic phosphate intoxication but of shorter duration and apparently not associated with delayed neuropathies

Onset is usually within one-half hour after absorption

Miosis, blurred vision, lacrimation

Rhinorrhea and hypersalivation

Sweating and weakness

Nausea, vomiting, abdominal cramps, and diarrhea

Dizziness, lassitude, incoordination, tremors, and convulsions

### DIAGNOSTIC TESTS:

Marked inhibition of both red blood cell and plasma cholinesterase levels (venous blood is recommended)

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Atropine 2–4 mg intravenously, repeated at 15–30 minute intervals as required

Pralidoxime is not used

Symptomatic and supportive

## ***n*-METHYL CARBAMATES (cont' d.)**

### **DISABILITY:**

Cholinesterase levels usually return to normal within 48 hours  
after cessation of exposure

No permanent effects anticipated

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber coverall clothing

Compulsory bathing at end of workday

No eating or smoking in work area

Examination of exposed personnel at appropriate intervals with regular monitoring of cholinesterase levels as indicated

Simpson, G.R. and Bermingham, S. 1977. Poisoning by carbamate pesticides. *Med. J. Australia* 1:148.

Tobin, J.S. 1970. Carbofuran—A new carbamate insecticide. *JOM* 12:16.

## **METHYL CHLORIDE**

### **Synonyms:**

Chloromethane • Monochloromethane

### **Description:**

Colorless gas, ethereal odor

### **Occupational Exposure:**

Catalyst • Chemical synthesis • Herbicide • Methylating agent • Refrigerant • Silicones • Topical anesthetic

### **Threshold Limit Value:**

50 ppm • 105 mg/m<sup>3</sup>

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Irritant • Central nervous system depressant

# METHYL CHLORIDE (*cont' d.*)

## SIGNS AND SYMPTOMS:

Contact with liquid form may result in cryogenic injury

Systemic symptoms may be delayed several hours

### *Acute:*

Headache, dizziness, drowsiness, mental confusion, weakness, blurred vision, anorexia and nausea, incoordination

Original episode may be followed by an apparent recovery then recurrence of symptoms

Severe exposures may exhibit vomiting, fever, oliguria, acidosis, and coma

### *Chronic:*

Anorexia, diminished vision, vertigo, tremor, incoordination, nervousness, emotional instability and insomnia

## DIAGNOSTIC TESTS:

S-methyl cysteine in urine

## TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in normal manner

Symptomatic and supportive

Severe exposures require hospitalization, monitoring, and treatment for acidosis

## DISABILITY:

Recovery may be prolonged and permanent neurologic impairment has been reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Physical examination of exposed personnel at regular intervals with special attention to the nervous system

Preclude from exposure those individuals with psychologic and neurologic diseases



## METHYL CHLORIDE (*cont' d.*)

- Repko, J.D. 1981. Neurotoxicity of methyl chloride. *Neurobehav. Toxicol. Teratol.* 3:425.
- Schamweber, H.C. et.al. 1974. Chronic methyl chloride intoxication in six industrial workers. *JOM* 16:112.
- Van Doorn, R. et.al. 1980. Detection and identification of S-methyl cysteine in urine of workers exposed to methyl chloride. *Int. Arch. Occup. Environ. Hlth.* 46(2):99.

## METHYL CYCLOHEXANE

### Synonyms:

Hexahydrotoluene

### Description:

Colorless liquid

### Occupational Exposure:

Chemical synthesis • Solvent

### Threshold Limit Value:

400 ppm • 1600 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

Narcosis is possible

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive



## METHYL CYCLOHEXANE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## METHYL CYCLOHEXANOL

### Synonyms:

Hexahydro cresol • Hexahydromethyl phenol

### Description:

Colorless liquid

### Occupational Exposure:

Antioxidant • Blending agent • Solvent

### Threshold Limit Value:

50 ppm • 235 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Central nervous system depression is possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Headache

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## METHYL CYCLOHEXANOL (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves if indicated

## METHYL CYCLOHEXANONE

### Synonyms:

2-Methyl cyclohexanone

### Description:

Pale yellow liquid, acetone-like odor

### Occupational Exposure:

Lacquers • Solvent

### Threshold Limit Value:

50 ppm • 230 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## METHYL CYCLOHEXANONE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves if indicated

## METHYLENE CHLORIDE

### Synonyms:

Dichloromethane • Methylene dichloride

### Description:

Colorless liquid, sweetish odor

### Occupational Exposure:

Degreaser • Extractant • Fumigant • Paint removers • Plastic processing • Solvent

### Threshold Limit Value:

100 ppm • 350 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Central nervous system depressant

Metabolized to CO which then forms carboxyhemoglobin

#### SIGNS AND SYMPTOMS:

Irritation of eyes

Dermatitis and skin burns

Cough, dyspnea, pulmonary edema

Headache, anorexia, and nausea

Dizziness, drowsiness, irritability, poor concentration, numbness and tingling of extremities, unconsciousness

## METHYLENE CHLORIDE (*cont'd.*)

### DIAGNOSTIC TESTS:

Methylene chloride in expired air and blood

Carboxyhemoglobin (because methylene chloride is metabolized slowly, the COHb level remains high for a long time)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Carbon monoxide intoxication may require special care

Symptomatic and supportive

### DISABILITY:

Permanent cerebral effects secondary to CO poisoning have been reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Cherry, N. et.al. 1981. Some observations on workers exposed to methylene chloride. *Brit. J. Ind. Med.* 38:351.

Memon, N.A. and Davidson, A.R. 1981. Multisystem disorder after exposure to paint stripper (Nitromors). *Brit. Med. J.* 282:1033.

Skrabalak, D.S. and Babish, J.G. 1983. Safety standards for occupational exposure to dichloromethane. *Regul. Toxicol. Pharmacol.* 3:139.

## METHYLENE DIANILINE

### Synonyms:

Amino phenyl methane • DDM • Diaminodiphenyl methane • 4,4-Diamino diphenyl methane • Dianilino methane • 4,4'-Methylene dianiline • *p,p'*-Methylene dianiline

### Description:

Amber flakes, amine odor

# METHYLENE DIANILINE (*cont'd.*)

## Occupational Exposure:

Antioxidant • Epoxy resin hardener • Polyurethane manufacture •  
Synthetic fiber production

## Threshold Limit Value:

0.1 ppm • 0.8 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant and sensitizer  
Optic neuritis and retinopathy  
Toxic hepatitis is possible

### SIGNS AND SYMPTOMS:

Abrupt onset of upper abdominal pain and fever accompanied  
by jaundice  
Anorexia • Nausea • Vomiting • Headache • Fever • Chills •  
Weakness  
Loss of central visual acuity, color discrimination, and dark  
adaptation  
Pruritic erythematous papulovesicular eruption of exposed skin  
surfaces  
Transitory peripheral neuropathy has been reported

### DIAGNOSTIC TESTS:

Positive patch tests

### TREATMENT:

Irrigate eyes with water  
Cleanse contaminated areas of skin with isopropyl alcohol and  
then wash with soap and water  
Symptomatic and supportive

## METHYLENE DIANILINE (*cont' d.*)

### DISABILITY:

Recovery usually occurs within 2-4 weeks

Sensitization and visual changes may be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Butyl gloves and aprons as required

Good personal hygiene

Preclude from exposure those individuals with liver disease

Regular physical examinations of exposed personnel with special attention to studies of liver function

Emmett, E.A. 1976. Allergic contact dermatitis in polyurethane plastic Moulders. *JOM* 18:802.

McGill, D.B. and Motto, J.D. 1974. An industrial outbreak of toxic hepatitis due to methylene dianiline. *NEJM* 291:278.

Roy, C.W. et.al. 1985. Methylene dianiline: A new toxic cause of visual failure with hepatitis. *Hum. Toxicol.* 4:61.

Williams, S.V. et.al. 1974. Toxic hepatitis and methylene dianiline. *NEJM* 291:1256.

## METHYLENE SUCCINIC ACID

### Synonyms:

Itaconic acid

### Description:

White crystals, odorless

### Occupational Exposure:

Chemical synthesis • Oil additive • Synthetic resins

### Threshold Limit Value:

None established

## METHYLENE SUCCINIC ACID (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

None

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

#### DIAGNOSTIC TESTS:

None

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles and gloves as required

## METHYL ETHER

### Synonyms:

Dimethyl ether

### Description:

Colorless gas, ethereal odor

### Occupational Exposure:

Catalyst • Extracting agent • Propellant • Refrigerant • Solvent

## METHYL ETHER (*cont' d.*)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## METHYL ETHYL KETONE

### Synonyms:

2-Butanone • MEK

### Description:

Colorless liquid, acetone-like odor



# METHYL ETHYL KETONE (*cont'd.*)

## Occupational Exposure:

Adhesives • Chemical synthesis • Cleaning fluids • Lacquers • Paint removers • Rubber industry • Smokeless powder manufacture • Solvent

## Threshold Limit Value:

200 ppm • 590 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Central nervous system depressant  
Metabolism to methanol has been suggested  
Acidosis

### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat  
Dermatitis  
Headache • Nausea • Vomiting • Paresthesias of extremities •  
Diminished vision  
Acidosis

### DIAGNOSTIC TESTS:

MEK in expired air and urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat acidosis  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## METHYL ETHYL KETONE (*cont'd.*)

- Berg, E.F. 1971. Retrobulbar neuritis: A case of presumed solvent toxicity. *Ann. Ophthalmol.* 3:1351.
- Kopelman, P.G. and Kalfayan, P.Y. 1983. Severe metabolic acidosis after ingestion of butanone. *Brit. Med. J.* 286:21.
- Saida, K. et.al. 1976. Peripheral nerve changes induced by methyl *n*-butyl ketone and potentiation by methyl ethyl ketone. *J. Neuropathol. Exp. Neurol.* 35:207.

## METHYL FORMATE

### Synonyms:

Formic acid, methyl ester • Methyl methanoate

### Description:

Colorless liquid, pleasant odor

### Occupational Exposure:

Chemical synthesis • Fumigant • Larvicide • Solvent

### Threshold Limit Value:

100 ppm • 250 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Hydrolyzes to methyl alcohol and formic acid?

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Respiratory tract irritation with chest constriction, cough, and dyspnea

Anorexia and nausea

#### DIAGNOSTIC TESTS:

None established

## METHYL FORMATE (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Sodium bicarbonate, 5% solution, as an aerosol for respiratory symptoms

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## METHYL IODIDE

### Synonyms:

Iodomethane

### Description:

Colorless to brownish liquid

### Occupational Exposure:

Chemical synthesis

### Threshold Limit Value:

2 ppm • 10 mg/m<sup>3</sup>

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Neurotoxin • Renal damage

Inactivation of sulfhydryl groups?

## METHYL IODIDE (*cont' d.*)

### SIGNS AND SYMPTOMS:

- Latency period between exposure and symptoms may be several days
- Severe effects seem related to repeated exposures
- Irritation of eyes and skin
- Lethargy, dizziness, confusion, slurred speech, blurred vision, ataxia, irritability, and somnolence
- Nausea and vomiting
- Pulmonary edema, oliguria and renal failure and cardiovascular shock may be seen
- Convulsions and coma have also been reported
- Recovery from these systemic effects may be followed by psychiatric disturbances such as hallucinations, delusions, depression, etc.

### DIAGNOSTIC TESTS:

- None established

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Treat burns in normal manner
- Hospitalize seriously exposed patients
- Symptomatic and supportive

### DISABILITY:

- Psychiatric impairment may be permanent

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing
- Physical examination of exposed personnel at regular intervals with special attention to central nervous system
- Preclude from exposure those individuals with nervous system disorders

Appel, G.B. et.al. 1975. Methyl iodide intoxication—A case report. *Ann. Intern. Med.* 82:534.

# METHYL ISOBUTYL KETONE

## Synonyms:

Hexone • Isopropyl acetone • 4-Methyl-2-pentanone

## Description:

Colorless liquid, pleasant odor

## Occupational Exposure:

Chemical synthesis • Extraction processes • Solvent

## Threshold Limit Value:

50 ppm • 205 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Central nervous system depressant

### SIGNS AND SYMPTOMS:

Headache and dizziness

Anorexia and nausea

Irritation of eyes and skin

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# METHYL NITRITE

**Synonyms:**

None

**Description:**

Colorless gas, sweetish odor

**Occupational Exposure:**

Chemical intermediate

**Threshold Limit Value:**

None established

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Mild irritant • Hypotension

Methemoglobin former?

**SIGNS AND SYMPTOMS:**

Conjunctivitis and lacrimation

Headache and nausea

Dizziness, weakness, and incoordination

Cyanosis

**DIAGNOSTIC TESTS:**

None established

Methemoglobin should be measured

**TREATMENT:**

Irrigate eyes with water

Oxygen, if required

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection

Slovak, A.J.M. and Hill, R.N. 1981. Human exposure to methylnitrite gas. *JOM* 23(12):857.

# METHYL OCTYL BENZENE SULFONATE

## Synonyms:

None

## Description:

White powder

## Occupational Exposure:

Antistatic lubricant

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

None

### MODE OF ACTION:

Irritant • Sensitizer

### SIGNS AND SYMPTOMS:

Lacrimation and eyelid edema

Dermatitis

### DIAGNOSTIC TESTS:

Patch test may be positive

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Chemical goggles • Rubber gloves

# METHYL PROPYL KETONE

## Synonyms:

Ethyl acetone • MPK • 2-Pentanone

## METHYL PROPYL KETONE (*cont'd.*)

### Description:

Clear liquid

### Occupational Exposure:

Flavorings • Solvent

### Threshold Limit Value:

200 ppm • 700 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Depressant for central nervous system

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and skin

Narcosis is possible

#### DIAGNOSTIC TESTS:

MPK in expired air

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## alpha-METHYL STYRENE

### Synonyms:

Isopropenyl benzene • 1-Methyl-1-phenyl ethylene • beta-Phenyl propylene



## **alpha-METHYL STYRENE** (*cont'd.*)

### **Description:**

Colorless liquid

### **Occupational Exposure:**

Polymerization monomer

### **Threshold Limit Value:**

50 ppm • 240 mg/m<sup>3</sup>

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Irritant • Central nervous system depressant

#### **SIGNS AND SYMPTOMS:**

Irritation of eyes and respiratory tract

Narcosis is possible

#### **DIAGNOSTIC TESTS:**

Atrolactic acid in urine

#### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### **DISABILITY:**

No permanent effects reported

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection

## **MICA**

### **Synonyms:**

Biotite • Lepidolite (lithia mica) • Muscovite (isinglass) • Paragonite  
• Pegmatite • Phlogopite (amber mica) • Roscoelite • Sericite •  
Vermiculite • Others

**Description:**

Nonfibrous complex silicates of aluminum with alkaline metals or iron and magnesium occurring in sheet formation

**Occupational Exposure:**

Ceramic flux • Cosmetics • Drilling muds • Dusting agent • Electrical equipment • Incandescent lamps • Lubricants • Mold release agent • Roofing • Windows in high-temperature equipment

**Threshold Limit Value:**

20 mppcf

**Toxicity:**

ROUTE OF ENTRY:

Inhalation

MODE OF ACTION:

Mechanical irritant • Pneumoconiosis • Hepatic granulomas

SIGNS AND SYMPTOMS:

Irritation of skin (mechanical)

Cough, dyspnea, rales, etc.

DIAGNOSTIC TESTS:

Restrictive ventilatory impairment and reduced transfer factor

Chest x-ray may show fine nodular and linear shadows

TREATMENT:

Symptomatic and supportive

DISABILITY:

Pulmonary impairment occurs and may worsen even after cessation of exposure

**Preventive Measures:**

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel on a regular basis including chest x-rays and pulmonary function testing

Preclude from exposure those individuals with chronic pulmonary disease

## MICA (*cont'd.*)

- Davies, D. and Cotton, R. 1983. Mica pneumoconiosis. *Brit. J. Ind. Med.* 40(1):22.
- Pimental, J.C. and Menzes, A.P. 1978. Pulmonary and hepatic granulomatous disorders due to the inhalation of cement and mica dusts. *Thorax* 33:219.
- Skulberg, K.R. et. al. 1985. Mica pneumoconiosis—A literature review. *Scand. J. Work Environ. Hlth.* 11:65.

## MINERAL FIBERS, SYNTHETIC

### Synonyms:

Fiberglass • Glass fiber • Glass wool • Man-made mineral fibers (MMMF)

### Description:

Fibers made from ceramics, fusible slag, glass or natural rock—essentially amorphous silicates

### Occupational Exposure:

Textiles (electrical insulation, fabrics, plastic reinforcement, rubber, paper, others) • Wool (insulation, acoustic panels, mat products, others)

### Threshold Limit Value:

10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Mechanical irritation

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Punctate itching erythema of exposed skin surfaces; occasionally “fiberglass warts”

Nasopharyngeal irritation

## MINERAL FIBERS, SYNTHETIC (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic

### DISABILITY:

No permanent effects reported

Long-term pulmonary exposure effects are under investigation

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective cotton coveralls

Barrier creams have been used

Hill, J.W. 1978. Man-made mineral fibres. *J. Soc. Occup. Med.* 28:134.

Muittari, A. and Veneskoski, T. 1978. Natural and synthetic fibers as causes of asthma and rhinitis. *Ann. Allergy* 41:48.

Sixt, R. et.al. 1983. Lung function of sheet metal workers exposed to fiber glass. *Scand. J. Work Environ. Hlth.* 9:9.

## MOLYBDENUM AND COMPOUNDS

### Synonyms:

Ammonium molybdate • Calcium molybdate • Molybdenum-disulfide, -halides, -oxides, -trioxide • Sodium molybdate

### Description:

Metal is silver white, compounds are powders

### Occupational Exposure:

Analytic reagent • Alloys • Catalyst • Ceramic glazes • Electrical industry • Enamels • Pigments • Solid lubricants

### Threshold Limit Value:

Soluble compounds — 5 mg/m<sup>3</sup>

Insoluble compounds — 10 mg/m<sup>3</sup>

## MOLYBDENUM AND COMPOUNDS (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Elevated serum uric acid levels reported

#### DIAGNOSTIC TESTS:

Molybdenum in plasma and urine

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles and respirator as indicated

Walravens, P.A. et al. 1979. Biochemical abnormalities in workers exposed to molybdenum dust. *Arch. Environ. Hlth.* 34:302.

## MONOBENZENE

### Synonyms:

Benzyl hydroquinone • *p*-Benzyloxy phenol • Hydroquinone monobenzyl ether

### Description:

White crystals—tan powder

### Occupational Exposure:

Chemical intermediate • Rubber antioxidant

### Threshold Limit Value:

None established

## MONOBENZONE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

None

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis and eczematoid dermatitis

Hyperpigmentation and depigmentation of skin (may occur at sites distant to exposed areas)

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

Pigmentation changes are permanent

### Preventive Measures:

Encourage personal cleanliness

Remove from exposure those who become sensitized

Preclude from exposure those individuals with chronic skin diseases

## MORPHOLINE

### Synonyms:

Diethylene imidoxide • Diethylene oximide • Tetrahydro-1,4-oxazine

### Description:

Colorless liquid, amine odor

### Occupational Exposure:

Bactericides • Catalyst • Corrosion inhibitor • Optical brightener in detergents • Pharmaceuticals • Plasticizer • Rubber accelerator • Solvent • Waxes and polishes

## MORPHOLINE (*cont'd.*)

### Threshold Limit Value:

20 ppm • 70 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and corneal edema

Dermatitis

Respiratory tract irritation

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## NAPHTHALENE

### Synonyms:

Moth flakes • Naphthene • Tar camphor

### Description:

White flakes, mothball odor

### Occupational Exposure:

Chemical synthesis • Cutting fluid • Fungicide • Lampblack •  
Lubricant • Moth repellant • Preservative • Synthetic resins

### Threshold Limit Value:

10 ppm • 50 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer  
Metabolites are hemolytic  
Liver and kidney damage  
Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage • Lenticular opacities after  
prolonged exposure  
Irritant and allergic dermatitis  
Headache • Confusion • Excitement • Malaise • Unconscious-  
ness • Coma  
Nausea • Vomiting • Abdominal pain • Diarrhea  
Hepatomegaly and jaundice • Splenomegaly  
Hemolysis • Anemia  
Hematuria • Albuminuria • Oliguria • Casts • Tenesmus •  
Renal shutdown

#### DIAGNOSTIC TESTS:

Naphthols and naphthoquinones in urine

#### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis



## NAPHTHALENE (*cont' d.*)

### TREATMENT (*cont' d.*):

- Monitor fluid balance and electrolytes
- Blood transfusions for severe hemolysis
- Prednisone has been suggested
- Symptomatic and supportive

### DISABILITY:

- Corneal damage is permanent
- General recovery is anticipated

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves
- Physical examination of exposed personnel on a regular basis with special attention to the eyes and including tests of liver and kidney function and blood count
- Preclude from exposure those individuals with diseases of blood, liver, and kidneys
- It has been suggested that a G-6-PD determination may predict individuals who are hypersusceptible to hemolytic chemicals

## NAPHTHENIC ACIDS

### Synonyms:

- Hexahydrobenzoic acid

### Description:

- Light colored oily liquids (saturated higher fatty acids) that have been extracted from petroleum with caustic soda and then acidified

### Occupational Exposure:

- Detergents • Emulsifiers • Lubricants • Paint driers • Rubber reclaiming • Solvent

### Threshold Limit Value:

- None established

### Toxicity:

#### ROUTE OF ENTRY:

- None

## NAPHTHENIC ACIDS (*cont' d.*)

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Rubber gloves

## NAPHTHOL

### Synonyms:

Two isomers: alpha-, beta • a-Hydroxynaphthalene • b-Hydroxynaphthalene

### Description:

White to yellow crystals or powder

### Occupational Exposure:

Chemical synthesis • Dyes • Insecticides • Pharmaceuticals • Rubber industry • Synthetic perfumes

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Percutaneous

## NAPHTHOL (*cont' d.*)

### MODE OF ACTION:

- Irritant
- Hemolytic anemia
- Kidney and liver damage

### SIGNS AND SYMPTOMS:

- Conjunctivitis and corneal burns
- Dermatitis with subsequent hyperpigmentation
- Ingestion:* Nausea, vomiting, abdominal pain • Headache, unconsciousness, convulsions • Hepatomegaly, splenomegaly, and jaundice • Hemolytic anemia, albuminuria, and hematuria

### DIAGNOSTIC TESTS:

- Naphthol in urine

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Gastric lavage, if ingested, followed by saline catharsis
- Hospitalize serious exposures to facilitate cardiorespiratory support and control of acidosis

### DISABILITY:

- No permanent effects reported

### Preventive Measures:

- Chemical goggles • Rubber gloves and protective clothing
- Physical examination of exposed personnel at regular intervals, including blood count and studies of liver and kidney function
- Preclude from exposure those individuals with diseases of blood, liver, and kidneys
- It has been suggested that G6-PD determination may predict individuals who would be hypersusceptible to hemolytic chemicals

## NAPHTHYLAMINES

### Synonyms:

- 1-Naphthylamine: alpha-naphthylamine often contains about 4% 2-naphthylamine • 2-Naphthylamine (beta-naphthylamine)

## NAPHTHYLAMINES (*cont' d.*)

### Description:

White to reddish crystals

### Occupational Exposure:

Chemical synthesis • Dyes • Rubber industry

### Threshold Limit Value:

1-Naphthylamine — suspect carcinogen

2-Naphthylamine — carcinogen

Specific OSHA regulations apply

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

beta-Naphthylamine is a bladder carcinogen

Methemoglobinemia can occur

#### SIGNS AND SYMPTOMS:

Dermatitis

Dysuria, frequency and hematuria associated with beta-naphthylamine exposure

Tumors of the bladder occur after 15–20 years exposure

#### DIAGNOSTIC TESTS:

Naphthylamine in urine

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Bladder tumors

### Preventive Measures:

Closed system

Full body protection with supplied air

Good personal hygiene with compulsory showering at end of shift

Regular examination of exposed personnel including urine cytology and cystoscopy when indicated

## NAPHTHYLAMINES (*cont'd.*)

Johnson, W.M. and Parnes, W.D. 1979. Beta-naphthylamine and benzidine: Identification of groups at high risk of bladder cancer. *Ann. N.Y. Acad. Sci.* 329:277.

Yamaguchi, N. et.al. 1982. Periodic urine cytology surveillance of bladder tumor incidence in dyestuff workers. *Am. J. Ind. Med.* 3:243.

## NAPHTHYL THIOUREA

### Synonyms:

ANTU • alpha-Naphthyl thiocarbamide • 1-Naphthyl thiourea

### Description:

Gray powder

### Occupational Exposure:

Rodenticide

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Ingestion causes nausea and vomiting, dyspnea, cyanosis, and pulmonary changes

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Respiratory support

Symptomatic and supportive

## NAPHTHYL THIOUREA (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective gloves

No eating or smoking in work area

## NICKEL AND COMPOUNDS

### Synonyms:

Nickel • Nickel formate • Nickel nitrate • Nickel oxide • Nickelous hydroxide • Nickel sulfate • Others

### Description:

Element is silvery metal, compounds are crystals and powders

### Occupational Exposure:

Alloys • Catalyst • Ceramics • Electroplating • Mining and extraction • Nickel-cadmium batteries • Welding

### Threshold Limit Value:

Nickel — 1 mg/m<sup>3</sup>

Nickel soluble compounds — 0.1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer • Carcinogen

#### SIGNS AND SYMPTOMS:

Gingivitis • Stomatitis • Metallic taste

“Nickel itch”—pink papular erythema of finger webs which may spread to other parts of the body and be followed by pustulation and ulceration

Sensitization dermatitis also occurs

## NICKEL AND COMPOUNDS (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

Fumes are respiratory irritants and can cause metal fume fever, pneumonitis, and asthma

Anosmia has been reported along with perforation of nasal septum

Carcinoma of paranasal sinuses, larynx and lung after chronic exposure to dusts and fumes especially in refining processes

### DIAGNOSTIC TESTS:

Positive patch test

Plasma nickel (normal < 1 µg/100 mL)

Urine nickel (normal < 5 µg/g creatinine)

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Nickel itch usually clears in one week, but sensitization is permanent

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Prompt attention to all cutaneous wounds

Physical examination of exposed personnel at regular intervals with special attention to nasal sinuses, larynx and including chest x-rays along with urine nickel determinations

Remove from exposure those who become sensitized

Preclude from exposure those individuals with diseases of the skin, sinuses, and lungs

McConnell, L.H. et.al. 1973. Asthma caused by nickel sensitivity. *Ann. Int. Med.* 78:888.

Nelems, J.M.B. et.al. 1979. Detection, localization, and treatment of occult bronchogenic carcinoma in nickel workers. *J. Thorac. Cardiovasc. Surg.* 77:522.

Sunderman, F.W., Jr. 1977. A review of the metabolism and toxicology of nickel. *Ann. Clin. Lab. Sci.* 7:377.



# NICKEL CARBONYL

## Synonyms:

Nickel tetracarbonyl

## Description:

Yellow liquid

## Occupational Exposure:

Wherever carbon monoxide comes in contact with an active form of nickel

Catalyst • Chemical synthesis • Electroplating • Ore processing • Petroleum industry

## Threshold Limit Value:

0.05 ppm • 0.35 mg/m<sup>3</sup>

## Toxicity: *EXTREMELY TOXIC*

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Initial: Headache, dizziness, sweating and weakness • Cough, chest tightness, and dyspnea • Nausea and vomiting

Delayed response 12–36 hours after clearing of the above symptoms—due to pneumonitis: Retrosternal pain, chest tightness, dyspnea, cough, rapid respiration, cyanosis, and exhaustion

Eczematoid dermatitis has been described

Relation of carcinoma is still under investigation

### DIAGNOSTIC TESTS:

A urine nickel level of 5 µg/dL within the first 8 hours implies a serious exposure

Serial levels should be done during the first several days

### TREATMENT: *TREAT AS AN EMERGENCY*

There is evidence now that early treatment with dithiocarb can prevent pneumonitis

Symptomatic and supportive



## NICKEL CARBONYL (*cont'd.*)

### DISABILITY:

Recovery from pneumonitis requires months and may be followed by residual impairment  
Sensitization is permanent

### Preventive Measures:

Adequate ventilation with regular monitoring of work area  
Approved respiratory protection  
Physical examination of exposed personnel at regular intervals with special attention to sinus complaints and pulmonary function and including chest x-ray  
Regular monitoring of urine nickel levels  
Remove from exposure those who become sensitized

Sunderman, F.W., Jr. et.al. 1975. Nickel: A Report of the Committee on Medical and Biologic Effects of Environmental Pollutants. Washington, D.C.: National Academy of Sciences.

Sunderman, F.W., Jr. 1979. Efficacy of sodium diethyldithio-carbonate (Dithiocarb) in acute nickel carbonyl poisoning. *Ann. Clin. Lab. Sci.* 9:1.

## NICOTINE

### Synonyms:

1-Methyl-2(3-pyridyl) pyrrolidine • beta-Pyridyl-alpha-N-methyl pyrrolidine

### Description:

Yellow oily liquid

### Occupational Exposure:

Insecticides • Fumigant • Tobacco harvesting and dust exposure

### Threshold Limit Value:

0.5 mg/m<sup>3</sup>

## NICOTINE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system stimulant

#### SIGNS AND SYMPTOMS:

Increased salivation • Nausea • Vomiting • Abdominal pain •  
Diarrhea

Headache • Dizziness • Sweating • Tremors

Cough • Dyspnea

Generalized weakness

If ingested, symptoms may be more severe and more prolonged

#### DIAGNOSTIC TESTS:

Cotinine in urine

#### TREATMENT:

Recovery is spontaneous in 2–4 hours after exposure ceases

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing

Ghosh, S.K. et.al. 1980. Studies on occupational health problems in agricultural tobacco workers. *J. Soc. Occup. Med.* 29:113.

## NITRIC ACID

### Synonyms:

Aqua fortis • Azotic acid • Engravers acid

### Description:

Yellowish liquid, suffocating odor

## NITRIC ACID (*cont'd.*)

### Occupational Exposure:

Chemical synthesis • Dye manufacture • Explosives • Fertilizers •  
Metallurgy • Photoengraving • Steel etching

### Threshold Limit Value:

2 ppm • 5 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Corrosive—forms xanthoproteic acid  
Decomposes to oxides of nitrogen

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal ulceration  
Corrosive skin burns with yellow discoloration and ulceration  
Dental erosion may occur  
Irritation of nose and throat, sneezing, cough, chest pain,  
dyspnea, bronchitis, and pulmonary edema<sup>1</sup> as a delayed  
effect  
Ingestion produces severe burns of the mouth, throat, and  
gastrointestinal tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water  
Wash contaminated areas of body with soap and water or 5%  
solution of sodium bicarbonate  
Treat burns with wet dressings of saturated solution of sodium  
thiosulfate  
Cardiorespiratory support as indicated  
If ingested, administer orally soap solution, calcium or alu-  
minum hydroxide, or magnesium oxide (avoid alkalis that  
would produce carbon dioxide and increase the risk of intes-  
tinal perforation)  
Symptomatic and supportive

## NITRIC ACID (*cont' d.*)

### DISABILITY:

Permanent impairment can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Preclude from exposure those individuals with diseases of the eyes, skin, lungs, and kidneys

Schmid, K.O. 1974. Pathologic findings in respect of late sequelae after inhalation of nitrogenous fumes. *Pneumonologie* 150:133.

## NITROANILINE

### Synonyms:

1-Amino-2-(or 3-, or 4-) nitrobenzene • *o*-, *m*-, *p*-Nitroaniline

### Description:

Yellow to orange needles

### Occupational Exposure:

Chemical synthesis • Dyes

### Threshold Limit Value:

*p*-Nitroaniline — 3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Methemoglobin formation

#### SIGNS AND SYMPTOMS: May be delayed

Headache • Cyanosis • Dizziness • Weakness • Numbness of extremities • Dyspnea • Chest pain • Tachycardia • Nausea • Vomiting • Abdominal pain • Malaise • Syncope • Convulsions

## NITROANILINE (*cont'd.*)

### DIAGNOSTIC TESTS:

Methemoglobin determination

*p*-Aminophenol in urine

### TREATMENT:

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; decontamination may have to be repeated

Determine degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour but don't exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

### DISABILITY:

Recovery is usually complete in 24–48 hours

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Extreme cleanliness of work area and good personal hygiene

Protective clothing, laundered daily, in addition to synthetic butyl boots and gloves

Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis

Preclude from exposure those individuals with anemia, cardiovascular, liver, and pulmonary diseases

## NITROBENZENE

### Synonyms:

Nitrobenzol • Oil of mirbane

## NITROBENZENE (*cont' d.*)

### Description:

Yellow oily liquid, almond-like odor

### Occupational Exposure:

Chemical synthesis • Explosives • Manufacture of aniline • Polishes  
• Solvent

### Threshold Limit Value:

1 ppm • 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Methemoglobin formation

#### SIGNS AND SYMPTOMS: May be delayed

Headache • Cyanosis • Dizziness • Weakness • Numbness of  
extremities • Dyspnea • Chest pain • Tachycardia • Nausea •  
Vomiting • Abdominal pain • Malaise • Syncope •  
Convulsions

#### DIAGNOSTIC TESTS:

Methemoglobin determination  
*p*-Nitrophenol in urine

#### TREATMENT:

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal  
vestibules, and area beneath nails; this decontamination  
may have to be repeated

Determine degree of methemoglobin hourly until a decline is  
well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless methemo-  
globin level is above 40%: use a 1% solution in a dose of 1  
mg/kg body weight and administer intravenously, repeat in

## NITROBENZENE (*cont'd.*)

### TREATMENT (*cont'd.*):

one hour but do not exceed a total dose of 7 mg/kg  
Hyperbaric oxygen, blood transfusions, exchange transfusions,  
and hemodialysis have all been used  
Symptomatic and supportive

### DISABILITY:

Recovery is usually complete in 24–48 hours

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection  
Extreme cleanliness of work area and good personal hygiene  
Protective clothing, laundered daily, in addition to synthetic butyl gloves and boots  
Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis  
Preclude from exposure those individuals with anemia, cardiovascular, liver, and pulmonary diseases

Harrison, M.R. 1977. Toxic methemoglobinemia—A case of acute nitrobenzene and aniline poisoning treated by exchange transfusion. *Anaesthesia* 32:270.

## NITRO ETHANE

### Synonyms:

None

### Description:

Colorless oily liquid, pleasant odor

### Occupational Exposure:

Chemical synthesis • Fuel additive • Solvent

### Threshold Limit Value:

100 ppm • 310 mg/m<sup>3</sup>

## NITRO ETHANE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Mild irritation of eyes and respiratory tract

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Gloves as indicated

## NITROGEN CHLORIDE

### Synonyms:

Chlorine nitride • Nitrogen trichloride

### Description:

Yellow oily liquid, pungent odor

### Occupational Exposure:

Bleaching agent • Fumigant

### Threshold Limit Value:

None established



## NITROGEN CHLORIDE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves if indicated

## NITROGEN DIOXIDE

### Synonyms:

None

### Description:

Red-brown gas, pungent odor

### Occupational Exposure:

Wherever nitric acid acts upon organic material

Catalyst • Explosives • Metal etching • Nitrating agent • Oxidizing agent • Silage gas (silo filler's disease) • Welding

## NITROGEN DIOXIDE (*cont' d.*)

### Threshold Limit Value:

3 ppm • 6 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Nitrogen dioxide decomposes in moisture to form nitric acid, nitrous acid, and nitric oxide  
Methemoglobinemia can occur

#### SIGNS AND SYMPTOMS:

*Local:* Conjunctivitis and corneal irritation • Skin irritation; yellow staining of skin can occur • Acid taste; oral mucosal ulcerations and dental erosion have been reported

Inhalation effects may follow several patterns:

High exposures can produce bronchospasm and sudden death due to asphyxiation

More frequently after a latent period up to 24 hours—

Burning sensation in mouth and throat • Cough with yellow sputum • Dyspnea • Fever • Tracheobronchitis • Bronchopneumonia • Pulmonary edema

Recovery from acute phase followed weeks later with—  
Recurrence of chest symptoms • Progressive dyspnea and cyanosis associated with pulmonary edema and bronchiolitis fibrosa obliterans

#### DIAGNOSTIC TESTS:

Early chest x-rays may show uniformly distributed nodular shadows; later the typical confluent shadows of pulmonary edema are seen

Pulmonary function tests may reveal obstructive and restrictive defects

#### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Hospitalize exposed individual for close observation during first 2 days then close follow-up for another month

Symptomatic and supportive

## NITROGEN DIOXIDE (*cont'd.*)

### DISABILITY:

Chronic pulmonary fibrosis can be severe

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing  
Exercise great care in cleaning up nitric acid spills  
Prohibit entering silos for six weeks after filling  
Physical examination of exposed personnel on a regular basis with special attention to skin, dental care, and lungs  
Preclude from exposure those individuals with cardiac and pulmonary diseases

Fleetham, J.A. et.al. 1978. Methemoglobinemia and the oxides of nitrogen. *NEJM* 298:1130.

Fleetham, J.A. et.al. 1978. Silofillers disease. *Can. Med. Assoc. J.* 119:482.

Fleming, G.M. et.al. 1979. Dysfunction of small airways following pulmonary injury due to nitrogen dioxide. *Chest* 75:720.

## NITROGLYCERIN AND ETHYLENE GLYCOL DINITRATE

### Synonyms:

Nitroglycerin—Blasting oil • Glyceryl trinitrate • Nitroglycerol • Trinitro glycerol  
EGDN—Glycol dinitrate • Nitroglycol

### Description:

Yellow oily liquids

### Occupational Exposure:

Explosives • Manufacture of dynamite • Pharmaceuticals • Rocket propellant

### Threshold Limit Value:

Nitroglycerin — 0.05 ppm • 0.5 mg/m<sup>3</sup>

EGDN — 0.05 ppm • 0.3 mg/m<sup>3</sup>

# NITROGLYCERIN AND ETHYLENE GLYCOL DI-NITRATE (*cont' d.*)

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Vasodilator

Cardiac sensitization?

### SIGNS AND SYMPTOMS:

Headache, sweating, facial flushing, hypotension, dizziness and palpitation are noted in varying intensities especially on return to work after several days absence

Employees who have been exposed to mixtures of EGDN and nitroglycerin for 6–10 years may complain of angina-like pain and die suddenly 36–72 hours after the last exposure or early in the work week—"Monday deaths"

Alcohol intolerance has also been reported

### DIAGNOSTIC TESTS:

EGDN in urine

Nitroglycerin in blood

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Sudden death as described

## Preventive Measures:

Adequate ventilation with regular monitoring of work atmosphere

Protective clothing appropriate for dust or liquid exposure; polyethylene appears to be impervious

Approved respiratory protection

Good personal hygiene

No eating or smoking in work area

Physical examination of exposed personnel on a regular basis with special attention to the heart

Preclude from exposure those individuals with ECG changes or diseases of the heart, liver, or blood

Consider limiting total exposure period in the department to 5 years

## NITROGLYCERIN AND ETHYLENE GLYCOL DINITRATE (*cont'd.*)

- Gjesdal, K. et.al. 1985. Exposure to glyceryl trinitrate during gun powder production: Plasma glyceryl trinitrate concentration, elimination kinetics, and discomfort among production workers. *Brit. J. Ind. Med.* 42:27.
- Hogstedt, C. et.al. 1980. 48 hour ambulatory electrocardiography in dynamite workers and controls. *Brit. J. Ind. Med.* 37(3):299.
- Morton, W.E. 1977. Occupational habituation to aliphatic nitrates and the withdrawal hazards of coronary artery disease and hypertension. *JOM* 19:197.

## NITROMETHANE

### Synonyms:

Nitrocarbonyl

### Description:

Colorless oily liquid, fruity odor

### Occupational Exposure:

Coating industry • Gasoline additive • Rocket fuel • Solvent

### Threshold Limit Value:

100 ppm • 250 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## NITROMETHANE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## NITROPROPANES

### Synonyms:

Two isomers: 1- and 2-

### Description:

Colorless liquid, fruity odor

### Occupational Exposure:

Chemical synthesis • Coatings • Gasoline additive • Plastic products  
• Rocket propellant • Solvent

### Threshold Limit Value:

25 ppm • 90 mg/m<sup>3</sup>

2-Nitropropane is a suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Liver and kidney damage

#### SIGNS AND SYMPTOMS:

Irritation of eyes

Nausea • Vomiting • Abdominal pain • Diarrhea

Headache • Ataxia

Chest pain • Dyspnea

Hepatic and renal failure

#### DIAGNOSTIC TESTS:

None established

## NITROPROPANES (*cont'd.*)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects among survivors

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Hine, C. et.al. 1978. Fatalities following exposure to 2-nitropropane.  
*JOM* 20:333.

Skinner, J.B. 1974. The toxicity of 2-nitropropane. *Ind. Med.*  
16:441.

## NITROTOLUENE

### Synonyms:

Methyl nitrobenzene (3 isomers)

### Description:

Yellow liquid and crystals

### Occupational Exposure:

Chemical synthesis • Synthetic dyes

### Threshold Limit Value:

2 ppm • 11 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Methemoglobin formation is possible

#### SIGNS AND SYMPTOMS: If methemoglobinemia occurs:

Headache • Cyanosis • Dizziness • Weakness • Numbness of  
extremities • Dyspnea • Chest pain • Tachycardia • Nausea •  
Vomiting • Abdominal pain • Malaise • Syncope •  
Convulsions



## NITROTOLUENE (*cont' d.*)

### DIAGNOSTIC TESTS:

Methemoglobin determination

### TREATMENT: For methemoglobinemia

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; this decontamination may have to be repeated

Determine degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour but do not exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, exchange transfusions, and hemodialysis have all been used

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Extreme cleanliness of work area and good personal hygiene

Protective clothing, laundered daily, in addition to use of synthetic butyl gloves and boots if indicated

Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis



# OCHRE

## Synonyms:

Hematite • Limonite • Ochres

## Description:

Yellow-brown to red powders of hydrated ferric oxides mixed with clays

Some ochres have a high silica content

## Occupational Exposure:

Cosmetics • Ochre processing • Pigments

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Pneumoconiosis

**SIGNS AND SYMPTOMS:** Usually after 15–20 years exposure  
Cough and dyspnea

### DIAGNOSTIC TESTS:

Chest x-rays reveal reticular and nodular changes

Pulmonary function may show slight change

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Usually none

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel on a regular basis including a chest x-ray and pulmonary function tests

Preclude from exposure those individuals with pulmonary diseases

## ORGANIC DUSTS

### Common Designation

Air conditioner lung  
 Bagassosis  
  
 Baker's asthma  
 Bird breeder's lung  
     (Pigeon breeder's disease)  
 Byssinosis  
     (Cannabosis)  
 Cheesewasher's lung  
 Cheeseworker's illness  
 Coffee worker's lung  
 Detergents  
 Dog house disease  
 Dry rot lung  
 Farmer's lung  
  
 Feathers  
 Furrier's lung  
 Kapok  
  
 Maltworker's lung  
 Maple bark stripper's disease  
 Miller's bronchitis  
  
 Mill fever  
 Mill worker's asthma  
 Mother of pearl (nacre)  
 Mushroom picker's lung  
 Paprika splitter's lung  
 Rat handlers lung  
 Sequoiosis  
 Sisal  
 Suborosis  
 Tamarind  
 Teamaker's asthma  
  
 Tobaccosis  
 Vineyard sprayers lung

### Etiologic Agent

*Thermoactinomyces*  
*Thermoactinomyces vulgaris*, *Aspergillus fumigatus*, and *Micropolyspora sp.*  
*Alternaria?*  
 Avian proteins  
  
 Cotton, flax, and soft fiber hems  
  
*Penicillium caseii*  
*Acarus siro*  
 Chlorogenic acid?  
*B. subtilis*  
*Aspergillus versicolor*  
*Merulius lacrymans*  
*Micropolyspora faeni* and *Thermoactinomyces vulgaris*  
 Feather proteins  
 Keratinized particles of hair  
*Ceiba pentandra* (fruit) and *Eriodendron anfractuosum* (seed pod)  
*Aspergillus clavatus*  
*Cryptostoma corticale*  
*Aspergillus glaucus* and *Penicillium glaucum*  
*Corchorus capsularis* and *olitorious*  
*Sitophilus granarius*  
 Conchiolin  
 Thermophilic actinomycetes  
*Mucor stolinifer*  
 Rat protein  
*Graphium sp.*  
  
*Penicillium frequetans*  
  
*Aspergillus*, *Penicillium*, and *Chromobacteria*

Bordeaux mixture

## ORGANIC DUSTS (*cont'd.*)

### Common Designation

### Etiologic Agent

Washing powder lung

*B. subtilis*

Wheat weevil disease

*Sitophilus granarius*

Wood trimmers disease

Fungus

Woodworker's lung

*Alternaria* (?), plicatic acid in Western red cedar

### Occupational Exposure:

Self-explanatory

### Threshold Limit Value:

Check specific dust

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Local reaction in many instances as: Grain itch from flour mites • Dermatitis from detergents • Epithelioid granulomas from fur • Oil acne from jute

Extrinsic allergic alveolitis—interstitial lung disease (Type III reaction)

#### Special comments:

Chronic bronchitis can also be seen in some of these conditions

Hard hems, jute, and unretted flax do not appear to cause byssinosis

Cork bark contains some silica and cork leaves contain hyoscine

Feathers may contain *Histoplasma* spores

Mother of pearl has been reported to cause osteitis of ends of long bones

Wood is highly suspect as a cause of ethmoid sinus cancer

### SIGNS AND SYMPTOMS:

*Local:* Conjunctivitis, rhinitis, urticaria, eczema

## ORGANIC DUSTS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

*Acute:* Allergic alveolitis is characteristically caused by inhaling a 2–5  $\mu\text{m}$  antigen which is followed in 4–10 hours by breathlessness, chest tightness, cough, fever, muscular aching, and malaise; symptoms subside in 12–24 hours

*Chronic:* After 5 or more years of repeated exposures—Dyspnea and wheezing become continuous and accompanied by cyanosis and weight loss

### DIAGNOSTIC TESTS:

Serum antibodies specifically precipitate with the causative organic dust

Chest x-rays

Early there are fine reticulonodular shadows in the mid-zones which clear if exposure ceases

Late there are interstitial fibrosis, granulomas, and bronchiolitis obliterans

Restrictive ventilatory defect

### TREATMENT:

Terminate exposure to antigen source

Steroids may be helpful in the acute stages

Symptomatic and supportive

### DISABILITY:

Permanent respiratory impairment occurs

### Preventive Measures:

Adequate ventilation with regular monitoring of work area •

Protective clothing • Approved respiratory protection

Physical examination of exposed personnel on a regular basis including a chest x-ray and pulmonary function tests

Preclude from exposure those individuals with allergies and pulmonary disease

Remove from exposure those who become sensitized

Salvaggio, J.E. and Karr, R.M. 1979. Hypersensitivity pneumonitis:

State of the art. *Chest* 75(2 suppl.):270.

Weil. Bagassosis. *Ann. Int. Med.* 64:737.

Hendrick. Baker's asthma. *Clin. Allergy* 6:243.

Nash. Bird breeder's lung. *S. Afric. Med. J.* 41:191.

Barbero. Byssinosis. *Arch. Environ. Hlth.* 14:529.

Tuma. Byssinosis. *JOM* 15:409.

## ORGANIC DUSTS (*cont'd.*)

- Valic. Byssinosis. *Brit. J. Ind. Med.* 28:364.  
Schlueter. Cheesewashers lung. *Schweiz Med. Woch.* 99:872.  
Molina. Cheese worker's illness. *Nouve. Presse Med.* 3:1603.  
Uragod. Chili grinder's disease. *Brit. J. Ind. Med.* 24:162.  
van Toom. Coffee worker's lung. *Thorax* 25:399.  
Little. Detergents. *Can. Med. Assoc. J.* 108:1120.  
Rhudy. Dog house disease. *Scand. J. Resp. Dis.* 52:177.  
Warren. Farmers' lung. *Can. Med. Assoc. J.* 100:699.  
Diedrichs and Lubbers. Flour. *Zentr. Arbeitsmed v. Arbeitsschut*  
5:189.  
Warren. Furrier's lung. *Can. Med. Assoc. J.* 100:699.  
Riddle. Malt worker's lung. *Thorax* 23:271.  
Wenzel. Maple bark disease. *Arch. Environ. Hlth.* 14:385.  
Rhudy. Mill fever. *Brit. Med. J.* 1:704.  
Lunn. Millworker's asthma. *Brit. J. Ind. Med.* 23:149.  
Lunn. Mushroomworker's lung. *JAMA* 171:15.  
Lunn. Paprika splitter's lung. *Aerzt Sachverst. Ptg.* 42:297.  
Cohen. Sequois. *Am. J. Med.* 43:785.  
Munt. Sisal. *Brit. J. Ind. Med.* 22:196.  
Suberosis. *Cancella. Med. Contemp.* 73:235.  
Uragoda. Tea maker's asthma. *Brit. J. Ind. Med.* 27:181.  
Zenker. Tobaccosis. *Dtsch. Arch. klin. Med.* 2:116.  
Pimentel. Vineyard sprayer's lung. *Thorax* 24:678.  
Zenker. Vineyard sprayer's lung. *Thorax* 24:415.  
Lunn. Wheat weevil disease. *Brit. J. Ind. Med.* 24:158.  
Ishizaki. Wood. *JOM* 15:580.  
Acheson Wood. *Brit. Med. J.* 2:587.

## ORGANOPHOSPHATES

**Synonyms:** More common compounds are grouped by toxic effect

*Very toxic:* Demeton • EPN • HETP • Parathion • Schradan • TEPP •

Others

*Highly toxic:* Carbophenothion • Diazinon • Dichlorvos • Ekaton •

Methyl demeton • Others

*Moderately toxic:* DEF • Malathion • Phostex • Sumithion •

Trichlorfon • Others

*Least toxic:* Chlorothion • Dipterex • Ronnel • Ruelene • Others

**Description:**

Liquids and crystals

**Occupational Exposure:**

Widely used in agriculture

## ORGANOPHOSPHATES (*cont' d.*)

### Threshold Limit Value:

Demeton — 0.01 ppm • 0.1 mg/m<sup>3</sup>

Diazinon — 0.1 mg/m<sup>3</sup>

Dichlorvos — 0.1 ppm • 1 mg/m<sup>3</sup>

Methyl demeton — 0.05 mg/m<sup>3</sup>

Malathion — 10 mg/m<sup>3</sup>

Parathion — 0.1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Inhibition of acetyl cholinesterase at neural synapses

#### SIGNS AND SYMPTOMS: May vary with route of entry

##### *Acute:*

Mild—Malaise • Nausea • Salivation • Vomiting • Abdominal cramping • Diarrhea • Blurred vision • Lacrimation • Sweating

Moderate—Headache • Dizziness • Agitation • Insomnia • Mental confusion • Trembling • Ataxia • Speech disturbance • Substernal tightness

Severe—Apathy • Depressed respiration • Convulsions • Cyanosis • Cardiac arrhythmias • Pulmonary edema • Coma

##### *Chronic:*

Headache • Dizziness • Fatigue • Anorexia • Memory loss • Insomnia • Disorientation • Muscular twitching and trembling • Occasionally neuritis and paresis

Small amounts absorbed over a period of time may produce an unsuspected cholinesterase depression resulting in a precarious impairment

#### DIAGNOSTIC TESTS:

Depression of plasma and red blood cell cholinesterase to less than 60% normal



## ORGANOPHOSPHATES (*cont' d.*)

### TREATMENT:

- Irrigate eyes with water
- Remove all contaminated clothing
- Wash contaminated areas of body with soap and water
- Oxygen and respiratory support
- Atropine sulfate 2–4 mg intravenously at once and repeat at 5–10 minute intervals until atropinization is apparent (dilated pupils, flushing, dry mouth, tachycardia); maintain atropinization for 24–48 hours
- Pralidoxime 1 g intravenously, repeat in 30–60 minutes if required
- Anticonvulsants
- Cardiorespiratory support
- Gastric lavage, if ingested, followed by saline catharsis
- Symptomatic and supportive

### DISABILITY:

Delayed, permanent neurologic changes can occur

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Long sleeve coveralls with tight collars and cuffs, laundered daily • Rubber gloves and shoes
- No eating or smoking in work area
- Good personal hygiene
- Preplacement cholinesterase determinations with repeat examinations at appropriate intervals
- Remove from exposure those whose cholinesterase falls to 60% of normal; employees may return when the level is again above 75%

- Done, A.K. 1979. The toxic emergency—Anticholinesterases. *Emerg. Med.* 11:167.
- Fisher, J.R. 1977. Guillain-Barré syndrome following organophosphate poisoning. *JAMA* 238:1950.
- Hierous, R. and Johnson, M.K. 1978. Clinical and toxicological investigations of a case of delayed neuropathy in a man after acute poisoning by an organophosphorous pesticide. *Arch. Toxicol.* 40:279.
- Midtling, J.E. et.al. 1985. Clinical management of field worker organophosphate poisoning. *West J. Med.* 142:514.

# OSMIUM TETROXIDE

## Synonyms:

Osmic acid • Perosmic oxide

## Description:

Yellow crystals, unpleasant odor

## Occupational Exposure:

Biologic stain • Catalyst • Electrical switches • Oxidizing agent •  
Photography

## Threshold Limit Value:

0.0002 ppm • 0.002 mg/m<sup>3</sup>

## Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Dermatitis and dermal ulceration along with greenish discoloration of tissue has been reported

Headache

Tracheitis, bronchitis, and pneumonitis with dyspnea, cough, and chest pain

### DIAGNOSTIC TESTS:

Osmium in urine

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Symptomatic and supportive

### DISABILITY:

Permanent blindness has occurred

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing as indicated



## OSMIUM TETROXIDE (*cont'd.*)

Smith, I.C. 1974. Osmium: An appraisal of environmental exposure.  
*Environ. Hlth. Perspect.* 8:201.

## OXALIC ACID

### Synonyms:

Ethanedioic acid

### Description:

Colorless crystals

### Occupational Exposure:

Bleaching agent • Catalyst • Ceramics and pigments • Dyes •  
Laboratory reagent • Leather tanning • Metal cleaner • Photog-  
raphy • Printing • Purifying agent • Rubber manufacture • Wood  
cleaner

### Threshold Limit Value:

1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Corrosive irritant  
Combines with calcium ions

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage  
Skin burns can be severe and very painful  
Nails become white and brittle  
Inhalation causes inflammatory changes in respiratory tract  
with ulceration of nasal mucosa and epistaxis  
Ingestion causes burns of the gastrointestinal tract with shock,  
collapse, convulsions, and death

#### DIAGNOSTIC TESTS:

None established

## OXALIC ACID (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, using calcium solutions followed by saline catharsis

Severe intoxications require hospitalization to facilitate treatment of shock, acidosis, and renal shutdown

Symptomatic and supportive

### DISABILITY:

Eye and skin damage can result in permanent impairment

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## OZONE

### Synonyms:

O<sub>3</sub>

### Description:

Blue gas, pungent odor

### Occupational Exposure:

Arc and inert gas welding • Bleach • Chemical synthesis • Deodorizer  
• High altitude flying • High voltage electrical equipment •  
Oxidizing agent • Waste treatment • Water purification

### Threshold Limit Value:

0.1 ppm • 0.2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Pulmonary edema

## OZONE (*cont'd.*)

### SIGNS AND SYMPTOMS:

Skin burns may occur from contact with liquid ozone

Irritation of eyes

Headache • Dizziness • Weakness • Decreased visual acuity

Acrid taste • Burning in throat • Dyspnea • Cough • Chest tightness

### DIAGNOSTIC TESTS:

None established

Chest x-rays may show increased markings

### TREATMENT:

Oxygen with IPPB, if chest symptoms warrant

Symptomatic and supportive

### DISABILITY:

Symptoms may persist for months but no permanent impairment is reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Preclude from exposure those individuals with pulmonary disease

Melton, C.E. 1982. Effects of long term exposure to low levels of ozone: A review. *Aviat. Space Environ. Med.* 53:105.

Reed, D. et.al. 1980. Ozone toxicity symptoms among flight attendants. *Am. J. Ind. Med.* 1:43.

# PENTACHLORO ETHANE

**Synonyms:**

Pentalin

**Description:**

Colorless liquid, chloroform-like odor

**Occupational Exposure:**

Chemical synthesis • Solvent

**Threshold Limit Value:**

None established

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Irritant • Central nervous system depressant

**SIGNS AND SYMPTOMS:**

Irritation of the eyes and respiratory tract

Narcosis

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection

# PENTACHLORO PHENOL

## Synonyms:

PCP • PENCHLOROL • PENTA

## Description:

White crystals, phenolic odor

## Occupational Exposure:

Algicide • Antimildew agent • Fungicide • Herbicide • Insecticide •  
Lumber preservative • Molluscicide • Termite control

## Threshold Limit Value:

0.5 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Uncouples oxidative phosphorylation resulting in hypermetabolism

### SIGNS AND SYMPTOMS:

#### *Acute:*

Anorexia • Nausea • Vomiting • Abdominal pain  
Weakness • Headache • Profuse sweating • Hyperpyrexia  
• Thirst • Tachycardia • Rapid respiration  
Extremity pain • Severe terminal muscle spasm and  
tremors  
Metabolic acidosis  
Coma

#### *Chronic:*

Conjunctivitis  
Sinusitis • Bronchitis  
Contact dermatitis • Chloracne has been reported  
Polyneuritis with diminished nerve conduction velocity  
can also be seen

### DIAGNOSTIC TESTS:

Pentachloro phenol in urine

## PENTACHLORO PHENOL (*cont' d.*)

### TREATMENT:

- Remove from exposure
- Maintain body temperature
- Forced diuresis
- Combat acidosis
- Monitor fluid and electrolyte balance
- Symptomatic and supportive

### DISABILITY:

- Permanent impairment is possible

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing
- No eating or smoking in work area • Good personal hygiene

Gray, R.E. et.al. 1985. Pentachlorophenol intoxication: Report of a fatal case, with comments on the clinical course and pathologic anatomy. *Arch. Environ. Hlth.* 40(3):161.

Sato, M.M. et.al. 1978. Clinical findings in workers exposed to pentachloro phenol. Honolulu: Hawaii Epidemiologic Studies Program Pacific Biomedical Research Center, Manoa.

Wood, S. et.al. 1983. Pentachloro phenol poisoning. *JOM* 25:527.

## PENTAERYTHRITOL TETRANITRATE

### Synonyms:

- PETN

### Description:

- Solid

### Occupational Exposure:

- Explosives

### Threshold Limit Value:

- 30 mppcf • 10 mg/m<sup>3</sup>

## PENTAERYTHRITOL TETRANITRATE (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Vasodilatation is minimal

#### SIGNS AND SYMPTOMS:

Dermatitis has been reported

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles and approved respiratory protection as required • Encourage good personal hygiene

## PENTANE

### Synonyms:

Amyl hydride

### Description:

Colorless liquid, pleasant odor

### Occupational Exposure:

Laboratory use • Manufacture of artificial ice • Pesticide • Solvent • Thermometers

### Threshold Limit Value:

600 ppm • 1800 mg/m<sup>3</sup>

## PENTANE (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## PERCHLORIC ACID

### Synonyms:

Dioxonium perchlorate • Fraude's reagent • Hydronium perchlorate

### Description:

Colorless liquid

### Occupational Exposure:

Catalyst • Explosives • Laboratory reagent • Metal plating

### Threshold Limit Value:

None established



## PERCHLORIC ACID (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Corrosive irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

Irritation of respiratory tract and cough

Skin burns

Allergic dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Symptomatic and supportive

#### DISABILITY:

Sensitization is permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Remove from exposure those who become sensitized

## PERCHLORYL FLUORIDE

### Synonyms:

Chlorine fluoride oxide • Chlorine oxyfluoride

### Description:

Colorless gas or liquid, sweet odor

### Occupational Exposure:

Chemical synthesis • Oxidizing agent • Rocket fuels

## PERCHLORYL FLUORIDE (*cont' d.*)

### Threshold Limit Value:

3 ppm • 14 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Said to be a methemoglobin former

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Dermal burns

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in normal manner

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## PETROLEUM NAPHTHA

### Synonyms:

None

### Description:

Colorless liquid; a mixture of hydrocarbons with molecular weights above those of gasoline

## PETROLEUM NAPHTHA (*cont' d.*)

### Occupational Exposure:

Fuel • Petroleum industry • Solvent

### Threshold Limit Value:

400 ppm • 1600 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Irritation of nose and throat

Dyspnea, cyanosis, nausea, and tremulousness have been reported

Dermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing as indicated

## PHENOL

### Synonyms:

Carbolic acid • Hydroxy benzene • Phenyl hydroxide • Phenylic acid

## PHENOL (*cont' d.*)

### Description:

White crystalline mass

### Occupational Exposure:

Cosmetics • Disinfectant • Dyes • Fertilizer manufacture • Germicidal paints • Laboratory reagent • Pharmaceuticals • Resins • Solvent

### Threshold Limit Value:

5 ppm • 19 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Corrosive

Central nervous stimulation then depression

Metabolic acidosis

Liver and kidney damage

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Conjunctival and corneal necrosis

Severe skin burns, with early blanching

*If ingested:* Corrosion of the mouth, throat and gastrointestinal tract with perforation of the gut, shock, collapse, and convulsions

Dyspnea, cough, cyanosis, and pulmonary edema

Headache, dizziness, weakness, sweating, tremors, convulsions, and coma

Oliguria and anuria, hematuria and hemoglobinuria

Shock and acidosis

Chronic exposure causes a syndrome called *phenol marasmus* characterized by headache, fatigue and weakness, vertigo, anorexia and weight loss, salivation, nervousness, muscular aches and pains, very dark urine and ochronosis-like pigmentation of the sclerae and skin over the nose and molar eminences

#### DIAGNOSTIC TESTS:

Phenol in blood and urine

## PHENOL (*cont' d.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

Decontamination team must exercise care

Terminate exposure

Remove all clothing

Irrigate eyes and wash contaminated areas of body with a mixture of polyethylene glycol 300/industrial methylated spirits (PEG 300/IMS—2:1 by volume) or similar preparation that will absorb phenol

Special attention should be given to body areas that entrap phenol, such as matted hair, skin folds, and beneath nails, and an effort should be made to swab clear the epidermal-phenol protein complex

Hospitalize serious exposures to facilitate care for acidosis, shock, convulsions, and fluid balance

Symptomatic and supportive

### DISABILITY:

Burn scars, leucoderma, and other sequelae may cause permanent impairment

### Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved respiratory protection • Rubber gloves, aprons, and boots

Physical examination of exposed personnel on a regular basis including liver and kidney function studies

Preclude from exposure those individuals with diseases of central nervous system, liver, kidneys, and lungs

Brown, V.K.H. et.al. 1975. Decontamination procedures for skin exposed to phenolic substances. *Arch. Environ. Hlth.* 30:1.

Merliss, R.R. 1972. Phenol marasmus. *JOM* 14:55.

Pardoe, R. et.al. 1976. Phenol burns. *Burns* 3:29.

## PHENOXY HERBICIDES

### Synonyms:

2,4-Dichlorophenoxy acetic acid (2,4-D) • 4-2,4-Dichlorophenoxy butyric acid (2,4-DB) • 2-Methyl-4-chlorophenoxy acetic acid (MCPA) • 2,4,5-Trichlorophenoxy acetic acid (2,4,5-T) • Others

### Description:

White crystalline powders

Agent orange is a 1:1 mixture of 2,4-D and 2,4,5-T

As a group the compounds are often contaminated with dioxins

### Occupational Exposure:

Defoliant • Herbicide

### Threshold Limit Value:

2,4-D — 10 mg/m<sup>3</sup>

2,4,5-T — 10 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Liver damage

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Headache • Dizziness • Fever

Hypotension

Nausea • Vomiting • Abdominal pain

##### *Chronic:*

Irritation of eyes and skin

Nausea • Vomiting • Diarrhea

Cardiac arrhythmias

Peripheral neuropathy

#### DIAGNOSTIC TESTS:

Urine level of particular herbicide

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

## PHENOXY HERBICIDES (*cont'd.*)

### DISABILITY:

Permanent effects still under investigation

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Good personal hygiene

No eating or smoking in work area

Physical examination of exposed personnel at periodic intervals with special attention to heart, liver, and nervous system

## *p*-PHENYLENE DIAMINE

### Synonyms:

*p*-Diamino benzene

### Description:

White crystals, darken on exposure to light

### Occupational Exposure:

Chemical reagent • Dyeing fur and hair • Petroleum additive • Photography • Rubber vulcanization • Textiles

### Threshold Limit Value:

0.1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal ulcers • Optic neuritis • Lenticular opacities can occur

Rhinitis • Pharyngitis • Cough • Asthma ("Ursol asthma")

Sensitization dermatitis of face, neck, and forearms

Dysuria and cystitis have also been reported

## ***p*-PHENYLENE DIAMINE (cont' d.)**

### **DIAGNOSTIC TESTS:**

Positive patch test

### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### **DISABILITY:**

Sensitization is permanent

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Preclude from exposure those with allergies

Remove from exposure those who become sensitized

Jain, I.S. et.al. 1979. Cataractogenous effect of hair dyes: A clinical and experimental study. *Ann. Ophthalmol.* 11:1681.

## **PHENYLGLYCINE CHLORIDE HYDROCHLORIDE**

### **Synonyms:**

Phenylglycine acid chloride

### **Description:**

White powder

### **Occupational Exposure:**

Ampicillin synthesis

### **Threshold Limit Value:**

None established

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation



# PHENYLGLYCINE CHLORIDE HYDROCHLORIDE

(cont'd.)

## MODE OF ACTION:

Mild irritant  
Sensitizing hapten

## SIGNS AND SYMPTOMS:

Bronchitis and bronchial asthma

## DIAGNOSTIC TESTS:

Intradermal tests

## TREATMENT:

Symptomatic and supportive

## DISABILITY:

Sensitization may be permanent

## Preventive Measures:

Adequate ventilation or even a closed system • Approved respiratory protection  
Preclude from exposure those with allergies and pulmonary disease  
Remove from exposure those who become sensitized

Cirla, A.M. et.al. 1976. Occupational allergy due to phenylglycine chloride hydrochloride. *Med. Lav.* 67:416.

Kammermeyer, J.K. and Mathews, K.P. 1973. Hypersensitivity to phenylglycine acid chloride. *J. Allergy Clin. Immunol.* 52:73.

# PHOSGENE

## Synonyms:

Carbonic dichloride • Carbonyl chloride • Chloroformyl chloride

## Description:

Colorless gas, odor of fresh cut hay

## Occupational Exposure:

A combustion product of most volatile chlorine compounds (e.g.  $\text{CCl}_4$ )

Chemical synthesis • Isocyanate manufacture • Metallurgy • Military gas

## PHOSGENE (*cont' d.*)

### Threshold Limit Value:

0.1 ppm • 0.4 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Probably forms a carboxy linkage with protein and cellular enzymes

#### SIGNS AND SYMPTOMS: May be delayed up to 12 hours

Conjunctivitis • Corneal damage

Skin irritation is reported

Headache • Chest discomfort • Progressive dyspnea • Cough with viscid sputum • Thirst • Cyanosis • Asphyxiation

#### DIAGNOSTIC TESTS:

None established

Earliest x-ray change is slight hilar enlargement and ill-defined patchy infiltrates in the central lung fields

#### TREATMENT: *TREAT AS AN EMERGENCY*

(the method proposed by Diller, modified here, has merit)

Remove the patient from exposure

Decontaminate thoroughly

For the patient who has smelled or inhaled phosgene but has no symptoms:

Prednisolone 0.1 g i.m.

Aminocaproic acid 10 g p.o.

Oxygen and bed rest

Chest x-ray in 8 hours

Discharge if everything is normal

For the patient who complains of irritation of the eyes, nose, throat, or respiratory tract or who has had nausea or vomiting:

Prednisolone 0.25 g i.v.

Aminocaproic acid 10 g p.o.

Decamethasone aerosol inhalation

## PHOSGENE (*cont' d.*)

### TREATMENT (*cont' d.*):

Oxygen with PEEP (10 cm H<sub>2</sub>O pressure)

Bed rest

Serial chest x-rays at 2,4 and 8 hours post exposure

Discharge if everything is normal

For the patient showing beginning pulmonary edema:

Hospitalize

Prednisolone 1 g i.v.

Positive pressure breathing continuously

Careful monitoring of blood gases and electrolytes

Cardiorespiratory support as indicated

Symptomatic

### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel at regular intervals to assess cardiopulmonary status

Preclude from exposure those with cardiac and pulmonary diseases

Regular use of a personal phosgene dosimeter when in work area

Diller, W.F. 1978. Medical phosgene problems and their possible solution. *JOM* 20:189.

Thiess, A.M. and Tress, E. 1975. Phosgene intoxications in the chemical industry. *Therapiewoche* 25:5899.

## PHOSPHINE

### Synonyms:

Hydrogen phosphide • Phosphoretted hydrogen

### Description:

Colorless gas, garlic-like odor

## PHOSPHINE (*cont' d.*)

### Occupational Exposure:

Phosphine can evolve when metallic phosphides contact moisture

Catalyst • Chemical synthesis • Fumigant • Pickling of metals •  
Semiconductor industry

### Threshold Limit Value:

0.3 ppm • 0.4 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Pulmonary and cerebral edema

Liver and kidney damage

#### SIGNS AND SYMPTOMS:

*Gastrointestinal*—Anorexia • Nausea • Vomiting • Abdominal  
pain • Diarrhea • Thirst • Jaundice

*Respiratory*—Chest tightness • Cough • Dyspnea • Pulmonary  
edema

*Nervous system*—Fatigue • Headache • Weakness • Vertigo •  
Ataxia • Paresthesias • Convulsions

#### DIAGNOSTIC TESTS:

None established

Liver enzymes may be elevated

#### TREATMENT:

Remove patient to a well-ventilated area

Oxygen and cardiopulmonary support as indicated

Hospitalize for better management of pulmonary edema, liver  
and kidney problems

Symptomatic and supportive

#### DISABILITY:

Recovery is anticipated

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Preclude from exposure those with cardiac and pulmonary disease

## PHOSPHINE (*cont'd.*)

Wilson, R. et.al. 1980. Acute phosphine poisoning aboard a grain freighter. *JAMA* 244:148.

## PHOSPHORIC ACID

### Synonyms:

Orthophosphoric acid

### Description:

Clear crystals or syrupy liquid

### Occupational Exposure:

Animal feed • Chemical synthesis • Condensing agent • Dehydrating agent • Electroplating • Fertilizer • Fire extinguisher • Laboratory reagent • Pharmaceuticals • Phosphate salts • Photography • Soft drinks • Surfactants

### Threshold Limit Value:

1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Produces phosphorus oxide when heated to decomposition

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

Burns can occur from concentrated acid

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Symptomatic and supportive

## PHOSPHORIC ACID (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Vyskocilova, D. et.al. 1983. Observations of general health of workers in the production of phosphoric acid. *Prac. Lek.* 35:76.

## PHOSPHORUS (ELEMENTAL)

### Synonyms:

Yellow or white phosphorus (red phosphorus is relatively nontoxic)

### Description:

Yellowish crystalline solid, darkens on exposure to light and spontaneously ignites in air

### Occupational Exposure:

Explosives • Munitions • Pyrotechnics • Rodenticides • Smoke screens

### Threshold Limit Value:

0.1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Protoplasmic poison to all major organs

Irritation from fumes

Thermal damage from flammable element

#### SIGNS AND SYMPTOMS:

##### *Local:*

Element can cause serious and severe eye and skin burns  
Fume exposure produces conjunctivitis, rhinitis, and irritation of respiratory tract

## PHOSPHORUS (ELEMENTAL) (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

#### *Systemic:*

*Acute:* from accidental ingestion—Painful burns of the gastrointestinal tract with nausea, vomiting, abdominal pain, and diarrhea • Garlic odor to breath, vomitus, and feces • A symptom-free period of days to weeks, then severe deteriorating systemic toxicity involving all major organs

*Chronic:* from inhalation of fumes, 1 or more years—Ulcerative stomatitis • Periostitis with suppuration, ulceration, and necrosis of the mandible—"phossy jaw" • Leukopenia and anemia • Hepatomegaly and jaundice

### DIAGNOSTIC TESTS:

Phosphorus in vomitus or feces

### TREATMENT:

Irrigate eyes with water

Skin burns should be immersed in water if possible, then washed with a 3% solution of copper sulfate with follow-up therapy for general burns

If ingested, gastric lavage with potassium permanganate (1:5000) followed by installation of 100–200 ml liquid petrolatum

Combat shock and monitor hepatic and renal function carefully  
Sequestered bone should be removed

Symptomatic and supportive

### DISABILITY:

Permanent impairment does occur

### Preventive Measures:

Adequate ventilation • Chemical goggles or full face shield •

Approved respiratory protection • Flame-proof work clothes

Good personal hygiene • No eating or smoking in work area

Physical examination of exposed personnel at regular intervals, including blood count and liver function studies

Dental examination at regular intervals, including x-rays



## PHOSPHORUS (ELEMENTAL) (*cont' d.*)

### Preventive Measures (*cont' d.*):

Preclude from exposure those with diseases of blood, liver, kidneys, and teeth

Remove from exposure those who develop mandibular or maxillary lesions

Ben-Hur, N. et.al. 1972. Phosphorus burns: The antidote—a new approach. *Brit. J. Plastic Surg.* 25:245.

Hughes, J.P.W. et.al. 1962. Phosphorus necrosis of the jaw: A present day study. *Brit. J. Ind. Med.* 19:83.

Simon, F.A. and Pickering, L.K. 1976. Acute yellow phosphorus poisoning. *JAMA* 235:1343.

## PHOSPHORUS COMPOUNDS

### Synonyms:

Chlorides—Phosphorus trichloride (phosphorus chloride) • Phosphorus pentachloride (phosphoric chloride) • Phosphorus oxychloride (phosphoryl chloride)

Sulfides—Phosphorus pentasulfide (phosphoric sulfide) • Phosphorus sesquisulfide (tetraphosphorus trisulfide)

### Description:

Crystals and liquids

### Occupational Exposure:

Catalysts • Chemical synthesis • Chlorinating agent • Dyestuffs • Gasoline additive • Hydraulic fluid • Insecticides • Pesticides • Safety matches • Surfactants • Textile finishes

### Threshold Limit Value:

Phosphorus trichloride — 0.2 ppm • 1.5 mg/m<sup>3</sup>

Phosphorus pentachloride — 0.1 ppm • 1 mg/m<sup>3</sup>

Phosphorus oxychloride — 0.1 ppm • 0.6 mg/m<sup>3</sup>

Phosphorus pentasulfide — 1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation



## PHOSPHORUS COMPOUNDS (*cont' d.*)

### MODE OF ACTION:

Irritant and corrosive

Chloro compounds all decompose to phosphoric acid and hydrochloric acid

Phosphorus pentasulfide decomposes to hydrogen sulfide (see  $H_2S$ ) and phosphoric acid

### SIGNS AND SYMPTOMS: (except phosphorus pentasulfide)

Conjunctivitis and corneal damage

Irritation of nose and throat with hoarseness and dysphagia

Tracheitis, bronchitis, and bronchopneumonia with cough, chest tightness and dyspnea

Dermatitis and skin burns

Dental erosion has been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in usual manner

Oxygen, bronchodilators, and decongestants as indicated

Symptomatic and supportive

### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Good personal hygiene

Physical examination of exposed personnel on a regular basis including blood count, urinalysis, and chest x-ray

Preclude from exposure those with diseases of the skin, liver, kidneys, lungs, and teeth

Roshchin, A.V. and Molodkina, N.N. 1977. Chloro compounds of phosphorus as industrial hazards. *J. Hyg. Epidemiol. Microbiol. and Immunol.* 21:387.

## PHTHALATES

### Synonyms:

Diallyl phthalate • Dibutyl phthalate • Diethyl phthalate • Dimethyl phthalate • Many others

### Description:

Esters formed by the reaction of phthalic acid with a specific alcohol  
Most are colorless liquids

### Occupational Exposure:

Adhesives • Cosmetics • Inks • Insecticides • Lubricating oils • Paper coatings • Plasticizers • Safety glass • Solvent • Textile lubricant  
• Wetting agent

### Threshold Limit Value:

5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Mild irritant

Most hydrolyze to phthalic acid and the respective alcohol (although no methyl alcohol effect has been noted)

#### SIGNS AND SYMPTOMS:

Conjunctivitis and slight irritation of the respiratory tract

#### DIAGNOSTIC TESTS:

Phthalic acid in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## PHTHALATES (*cont'd.*)

Autian, J. June, 1973. Toxicity and health threats of phthalate esters:  
Review of the literature. *Environ. Hlth. Perspect.* \*

### PHTHALIC ANHYDRIDE

#### Synonyms:

1,3-Isobenzofurandione • Phthalic acid anhydride

#### Description:

White needles, pungent odor

#### Occupational Exposure:

Chemical synthesis • Dye synthesis • Laboratory reagent • Paints •  
Pharmaceuticals • Plasticizers • Resins

#### Threshold Limit Value:

1 ppm • 6 mg/m<sup>3</sup>

#### Toxicity:

##### ROUTE OF ENTRY:

Inhalation

##### MODE OF ACTION:

Irritant • Sensitizer

##### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal burns

Rhinitis with anosmia and epistaxis

Sneezing • Hoarseness • Coughing • Bronchitis • Asthma

Erythema and burning of the skin, occasionally with brown  
staining

Urticaria and eczema may also occur

##### DIAGNOSTIC TESTS:

Patch test may be positive

##### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Symptomatic and supportive

## PHTHALIC ANHYDRIDE (*cont' d.*)

### DISABILITY:

Sensitization is permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Preclude from exposure those with allergies, skin, and pulmonary diseases

Remove from exposure those who become sensitized

Maccia, C.A. et.al. 1976. In vitro demonstration of specific IgE in phthalic anhydride hypersensitivity. *Am. Rev. Resp. Dis.* 113:701.

Pauli, G. et.al. 1980. Meat wrapper's asthma: Identification of the causal agent. *Clin. Allergy* 10:263.

Ward, M.J. and Davies, D. 1983. Asthma due to grinding epoxy resin cured with phthalic anhydride. *Clin. Allergy* 13:165.

## PICRIC ACID

### Synonyms:

Carbasotic acid • Nitroxanthic acid • Picronitric acid • 2,4,6-Trinitro phenol

### Description:

Yellow crystals

### Occupational Exposure:

Chemical synthesis • Dyes • Electric batteries • Etchant • Explosives • Glass manufacture • Laboratory reagent • Matches • Mordant

### Threshold Limit Value:

0.1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

## PICRIC ACID (*cont'd.*)

### MODE OF ACTION:

Irritant • Sensitizer  
Liver and kidney damage

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal ulcers with yellow discoloration of tissue  
“Picric itch”—erythema, papulovesicular eruption of skin followed by desquamation  
Yellow staining of hair and skin  
Inhalation has caused weakness, myalgia, temporary coma, and anuria  
Ingestion results in headache; vertigo; bitter taste; nausea, vomiting and diarrhea; yellow discoloration of skin; hematuria and albuminuria  
Hemolysis, hemorrhagic nephritis, and hepatitis are reported

### DIAGNOSTIC TESTS:

Picric acid in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with alcohol, then soap and water  
Treat skin burns in normal manner  
Gastric lavage, if ingested, using 5% sodium bicarbonate, followed by saline catharsis  
Intravenous glucose is said to help reduce picric acid to the less toxic picramic acid  
Symptomatic and supportive

### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing as indicated  
Physical examination of exposed personnel on a regular basis including tests of liver and kidney function as well as blood count  
Preclude from exposure those with diseases of the skin, blood, liver, and kidneys

## PLATINUM COMPOUNDS (halide complexes)

### Synonyms:

Chloroplatinates (ammonium, sodium) • Hexachloroplatinates (ammonium, potassium) • Tetrachloroplatinates (ammonium, potassium, sodium) • Others

### Description:

Multicolored crystals

### Occupational Exposure:

Acid proofing • Catalyst • Chemical synthesis • Dentistry • Electrical equipment • Electroplating • Jewelry • Permanent magnets • Photography • Refineries • Surgery • Thermocouples

### Threshold Limit Value:

Metal — 1 mg/m<sup>3</sup>

Soluble salts — 0.002 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Sensitizers (metallic platinum is inert)

**SIGNS AND SYMPTOMS:** Most frequently after months of exposure

Allergic contact sensitivity is characterized by itching, pruritis, and urticaria, and chronic eczema

Inhalation sensitivity is also known as "platinosis":

Conjunctival irritation with lacrimation

Rhinorrhea and sneezing

Later there is cough, dyspnea, chest tightness, and wheezing respiration

Anaphylactic reactions are considered possible

#### DIAGNOSTIC TESTS:

Specific IgE antibodies (RAST)

Skin prick test

## PLATINUM COMPOUNDS (halide complexes)

(cont'd.)

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Sensitization is permanent

### Preventive Measures:

Good engineering control with closed processes where possible

Good housekeeping and good personal hygiene

Protective clothing

Approved respiratory protection

No smoking in work area

Preclude from exposure those with allergies and pulmonary disease

Remove from exposure those who become sensitized

Cromwell, O. et.al. 1979. Specific IgE antibodies to platinum salts in sensitized workers. *Clin. Allergy* 9:109.

Hughes, E.G. 1980. Medical surveillance of platinum refinery workers. *J. Soc. Occup. Med.* 30:27.

Orbaek, P. 1982. Allergy to the complex salts of platinum—A review of the literature and three case reports. *Scand. J. Work Environ. Hlth.* 8:141.

## POLYBROMINATED BIPHENYLS

### Synonyms:

Bromobiphenyls (multiple isomers) • PBBs

### Description:

Solid; halogenated aromatic hydrocarbons

### Occupational Exposure:

Coatings and lacquers • Flame retardants • Thermoplastics

### Threshold Limit Value:

None established



## POLYBROMINATED BIPHENYLS (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion of vapor or dust

#### MODE OF ACTION:

Not clear

#### SIGNS AND SYMPTOMS:

##### *Occupational:*

Chloracne and dry skin

Darkening of skin and nails

Headache, nausea, and fatigue

Decreased T and B lymphocytes

Hypothyroidism has been reported

##### *Ingestion via food chain contamination:*

Anorexia, nausea, and diarrhea

Halogenacne and hair loss

Abnormal liver function tests with hepatomegaly

Decreased T and B lymphocytes

Sensory neuropathy

#### DIAGNOSTIC TESTS:

Serum and fat PBB levels

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Ultimate health effects are not clearly defined

### Preventive Measures:

Adequate ventilation and dust control • Protective clothing

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the skin and including appropriate blood work

Preclude from exposure those with diseases of the skin and thyroid

Bahn, A.K. 1980. Hypothyroidism in workers exposed to polybrominated biphenyls. *NEJM* 302:31.

DiCarlo, F.J. et.al. 1978. Assessment of the hazards of polybrominated biphenyls. *Environ. Hlth. Perspect.* 23:351.



## POLYBROMINATED BIPHENYLS (*cont'd.*)

Landrigan, P.J. et.al. 1979. Cohort study of Michigan residents exposed to polybrominated biphenyls: Epidemiological and immunological findings. *Ann. N.Y. Acad. Sci.* 320:284.

## POLYCHLORINATED BIPHENYLS

### Synonyms:

Chlorodiphenyls (multiple isomers) • PCBs

### Description:

Clear to yellow liquids with aromatic odor

### Occupational Exposure:

Electrical transformers and capacitors • Heat transfer systems •  
Hydraulics • Lubricating and cutting oils • Plasticizers

### Threshold Limit Value:

1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant, generally toxicity increases with the degree of chlorination

All of these compounds may contain varying amounts of chlorinated dibenzofurans and polychlorinated naphthalenes

#### SIGNS AND SYMPTOMS:

##### *Occupational:*

Chloracne—comedones, sebaceous cysts and pustules on malar surface of face, ear lobes, and adjacent scalp

Erythema, swelling, dryness, and thickening of skin, often associated with hyperpigmentation of skin and nails

Eyelid swelling and excessive eye discharge

Anorexia, nausea, and abdominal pain have also been reported

Hepatomegaly

## POLYCHLORINATED BIPHENYLS (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

*Ingestion* (Japanese yusho—rice oil disease):

Enlargement and hypersecretion of the Meibomian glands and swelling of eyelids

Pigmentation of nails and mucous membranes

Fatigue, nausea, and vomiting

Hyperkeratosis and darkening of the skin, most frequently on neck and upper torso

Chloracne

Chronic bronchitis

Sensory neuropathy with numbness of arms and legs

### DIAGNOSTIC TESTS:

Blood levels of PCBs

Altered liver enzymes

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Chloracne may require antibiotic or surgical intervention

Symptomatic and supportive

### DISABILITY:

Impairment has not been severe but clinical evaluations continue

### Preventive Measures:

Adequate ventilation • Closed systems where possible • Chemical goggles • Approved respiratory protection

Coveralls, gloves, and shoes

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the skin, liver, and reproductive history and including pulmonary function tests and plasma PCB levels

Preclude from exposure fertile women and employees with skin and liver diseases

Fischbein, A. et.al. 1985. Oculodermatological findings in workers with occupational exposure to polychlorinated biphenyls (PCBs). *Brit. J. Ind. Med.* 42:426.

## POLYCHLORINATED BIPHENYLS (*cont'd.*)

- Letz, G. 1983. The toxicology of PCBs: An overview for clinicians. *West. J. Med.* 138:534.
- Seppäläinen, A.M. et.al. 1985. Reversible nerve lesions after accidental polychlorinated biphenyl exposure. *Scand. J. Work Environ. Hlth.* 11:91.
- Warshaw, R. et.al. 1979. Decrease in vital capacity in PCB exposed workers in a capacitor manufacturing facility. *Ann. N.Y. Acad. Sci.* 320:277.

## POLYVINYL CHLORIDE

### Synonyms:

Chloroethylene polymer • PVC

### Description:

White thermoplastic solid or transparent film

### Occupational Exposure:

Coatings • Construction material • Fiber manufacture • Packaging film • Pipes and conduits • Recreational items • Rubber substitutes • Synthetic turf • Wire and cable protection

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation of dust or fumes

#### MODE OF ACTION:

Irritant

Emissions from heated PVC film are di-2-ethylhexyl adipate and HCl

#### SIGNS AND SYMPTOMS:

PVC dust exposure: Dyspnea after 20+ years exposure

PVC film used in meat wrapping emits fumes which cause conjunctivitis, rhinitis, and a nonspecific bronchoconstriction often called "meat wrapper's asthma" (it has been suggested that dicyclohexyl phthalate and phthalic anhydride emissions from heated price labels may be related to the airway sensitization)

## POLYVINYL CHLORIDE (*cont' d.*)

### DIAGNOSTIC TESTS:

In pneumoconiosis the chest x-ray may show rounded opacities with diffuse fibrosis, but these tend to be slight

Minimal pulmonary function changes have been reported in both types exposure

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Preclude from exposure those with respiratory disease

Arnaud, A. et.al. 1978. Polyvinyl chloride pneumoconiosis. *Thorax* 33:19.

Soutar, C.A. et.al. 1980. Epidemiological study of respiratory disease in workers exposed to polyvinyl chloride dust. *Thorax* 35:644.

Vandevort, R. and Brooks, S.M. 1979. Polyvinyl chloride film thermal decomposition products as an occupational illness: I environmental exposures and toxicology. *JOM* 19:189.

Warweiler, R.J. et.al. (eds.). 1981. Conference to reevaluate the toxicity of vinyl chloride, poly (vinyl chloride) and structural analogs. *Environ. Hlth. Perspect.* 41:1.

## PORTLAND CEMENT

### Synonyms:

Hydraulic cement

### Description:

A gray powder containing tricalcium silicate, dicalcium silicates, tricalcium aluminate, tetracalcium alumino ferrite, and small amounts of free silica, chromium, cobalt, and nickel as contaminants

Calcium hydroxide is formed when water is added to Portland cement

# PORTLAND CEMENT (*cont'd.*)

## Occupational Exposure:

Bricklaying • Construction • Decorating • Painting • Plastering

## Threshold Limit Value:

Respirable dust — 5 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Mechanical irritation • Caustic irritation • Sensitization

### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal burns

Rhinitis • Perforation of nasal septum

Dermatitis both primary irritant in type as well as allergic sensitivity

Skin burns can be severe

Reports of chronic bronchitis and reduced pulmonary capacity cannot be ignored completely

### DIAGNOSTIC TESTS:

Patch test with contaminant sensitizers may be positive

X-rays and pulmonary function studies may be consistent with chronic bronchitis

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in usual manner

Symptomatic and supportive

### DISABILITY:

Sensitivity to allergens may be permanent

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and boots where indicated

Remove from exposure those who become sensitized

## PORTLAND CEMENT (*cont' d.*)

- Bazas, T. 1980. Effects of occupational exposure to dust on the respiratory system of cement workers. *J. Soc. Occup. Med.* 30:31.
- Peters, W.J. 1984. Alkali burns from wet cement. *Can. Med. Assoc. J.* 130(7):902.
- Pfister, R.R. 1983. Chemical injuries of the eye. *Ophthalmol.* 90(10):1246.

## POTASH

### Synonyms:

- Carnallite (a hydrous chloride of magnesium and potassium) •  
Sylvite (potassium chloride) • Other potassium ores

### Description:

- Crystalline potassium and sodium chloride with clay and other mineral impurities
- Not to be confused with potassium carbonate obtained from wood ashes

### Occupational Exposure:

- Fertilizers • Ore mining and processing • Pharmaceuticals • Soaps •  
Wool dyeing

### Threshold Limit Value:

- None established

### Toxicity:

- ROUTE OF ENTRY:  
Inhalation

- MODE OF ACTION:  
Irritant

- SIGNS AND SYMPTOMS:  
Conjunctivitis • Keratitis  
Epistaxis • Perforation of nasal septum  
Dermatitis • Skin burns  
Cough • Dyspnea

## POTASH (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

Perforation of nasal septum

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Good personal hygiene

Markham, J.W. and Tan, L.K. 1981. Concentrations and health effects of potash dust. *Am. Ind. Hyg. Assoc. J.* 42:671.

Williams, N. 1974. Potash ore and perforation of the nasal septum. *JOM* 16:383.

## POTASSIUM CHLORATE

### Synonyms:

None

### Description:

Colorless crystals

### Occupational Exposure:

Bleaching • Disinfectant • Dyeing • Explosives • Matches • Oxidizing agent • Pyrotechnics • Textile printing

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation



## POTASSIUM CHLORATE (*cont' d.*)

### MODE OF ACTION:

Irritant

Hemolysis and methemoglobin formation

### SIGNS AND SYMPTOMS:

Irritation of eyes and upper respiratory tract

Ingestion can cause nausea, vomiting, abdominal pain, diarrhea, dyspnea, methemoglobinemia, and cyanosis

### DIAGNOSTIC TESTS:

Potassium chlorate in urine

Methemoglobin determination

### TREATMENT:

Gastric lavage, if ingested, with activated charcoal afterwards

Treat methemoglobinemia if necessary

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Good housekeeping • Chemical goggles and respirator as indicated

## POTASSIUM HYDROXIDE

### Synonyms:

Caustic potash • KOH • Potassium hydrate

### Description:

White to yellow lumps

### Occupational Exposure:

Bleaches • Chemical synthesis • Dyestuffs • Electroplating • Glass •  
Herbicides • Mordant • Paint and varnish removers • Printing inks  
• Soaps



# POTASSIUM HYDROXIDE (*cont' d.*)

## Threshold Limit Value:

2 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Corrosive

Combines with tissue to form alkaline albuminates

### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal burns

Deep skin burns

Irritation of the respiratory tract and pneumonitis

*If ingested*, severe burns of the mouth, esophagous and stomach with nausea, vomiting, and hematemesis; perforation of the intestinal tract and cardiovascular collapse

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

If ingested, dilute with water or milk and hospitalize for tracheostomy, shock therapy, and endoscopy when possible under controlled conditions

Symptomatic and supportive

### DISABILITY:

All corrosive effects may result in permanent impairment

### Preventive Measures:

Adequate ventilation • Chemical goggles or full face shield • Approved respiratory protection • Rubber gloves, aprons, and boots

# POTASSIUM PERMANGANATE

## Synonyms:

Permanganic acid, potassium salt • Purple salt

## Description:

Purple-bronze crystals

## Occupational Exposure:

Antiseptic • Bleach • Chemical synthesis • Disinfectant • Dye • Pharmaceuticals • Tanning • Water treatment • Wood preservative

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Accidental ingestion

### MODE OF ACTION:

Corrosive

### SIGNS AND SYMPTOMS:

Local irritation and brownish stains in area of contact

*If ingested*, causes stomatitis, nausea, vomiting, abdominal pain, and shock

### DIAGNOSTIC TESTS:

Manganese in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, with demulcents followed by activated charcoal and saline catharsis

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Education of exposed personnel

Protective devices as indicated

# PROPANE

## Synonyms:

Dimethyl methane • Propyl hydride

## Description:

Colorless gas

## Occupational Exposure:

Fuel • Oil and gas wells • Refrigerating systems

## Threshold Limit Value:

1000 ppm • 1800 mg/m<sup>3</sup> OSHA

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Mild irritant • Asphyxiant

Liquid propane is a cryogenic hazard

### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract

Headache • Dizziness • Vomiting

Skin burns from contact with liquid propane can be severe

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Cardiorespiratory support if indicated

Treat skin burns in normal manner; deep tissue injury can result from liquid propane in close contact with the skin

Symptomatic and supportive

### DISABILITY:

Serious impairment can result from severe skin burns

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing when indicated

## PROPANE (*cont' d.*)

- Hicks, L.M. 1979. Liquid propane cold injury: A clinico-pathologic and experimental study. *J. of Trauma* 19:701.
- Santoni, R. 1979. Frost injury of both hands caused by liquid gas. *Unfallheilkunde* 82:387.

## beta-PROPIOLACTONE

### Synonyms:

Hydracrylic acid beta-lactone • 2-Oxetanone • Propionic acid

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Chemical synthesis • Disinfectant • Viricide

### Threshold Limit Value:

0.5 ppm • 1.5 mg/m<sup>3</sup>

Specific OSHA regulations apply

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant and vesicant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Dermal erythema and vesiculation

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## beta-PROPIOLACTONE (*cont'd.*)

### Preventive Measures:

Closed system

Full body protective clothing including supplied air respirator

Good personal hygiene

Physical examination of exposed personnel at regular intervals with due consideration for the carcinogenic potential

## PROPYL ACETATE

### Synonyms:

Acetic acid *n*-propyl ester

### Description:

Colorless liquid, odor of pears

### Occupational Exposure:

Chemical synthesis • Flavors • Laboratory reagent • Perfumes •  
Solvent • Synthetic resins

### Threshold Limit Value:

200 ppm • 840 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Irritation of nose and throat

Dermatitis

Narcosis is possible

#### DIAGNOSTIC TESTS:

None established

## PROPYL ACETATE (*cont' d.*)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## *n*-PROPYL ALCOHOL

### Synonyms:

1-Propanol • Propylic alcohol

### Description:

Clear liquid

### Occupational Exposure:

Antiseptic • Brake fluids • Chemical synthesis • Degreasing • Lacquers • Polishing compositions • Solvent

### Threshold Limit Value:

200 ppm • 500 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant  
Metabolized to acetone  
Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal edema  
Irritation of the upper respiratory tract

## ***n*-PROPYL ALCOHOL (cont' d.)**

### **SIGNS AND SYMPTOMS (*cont' d.*):**

Headache; narcosis is possible

Dermatitis

### **DIAGNOSTIC TESTS:**

*n*- Propyl alcohol in expired air and urine

### **TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### **DISABILITY:**

No permanent effects reported

### **Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## **PROPYLENE**

### **Synonyms:**

Methyl ethylene • Propene

### **Description:**

Colorless gas

### **Occupational Exposure:**

Chemical synthesis • Cracking of petroleum

### **Threshold Limit Value:**

None established

### **Toxicity:**

#### **ROUTE OF ENTRY:**

Inhalation

#### **MODE OF ACTION:**

Asphyxiant

## PROPYLENE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Headache • Dizziness • Dyspnea  
Tachycardia • Cyanosis  
Loss of consciousness

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Terminate exposure  
Cardiorespiratory support and oxygen  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

## PROPYLENE DICHLORIDE

### Synonyms:

1,2-D • 1,2-Dichloropropane

### Description:

Colorless liquid, chloroform-like odor

### Occupational Exposure:

Chemical synthesis • Degreasing • Dry cleaning • Pharmaceuticals •  
Soil fumigant • Solvent

### Threshold Limit Value:

75 ppm • 350 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation



## PROPYLENE DICHLORIDE (*cont'd.*)

### MODE OF ACTION:

Irritant • Central nervous system depressant  
Hepatic necrosis and renal tubular necrosis is possible  
Hemolytic anemia  
Disseminated intravascular coagulation

### SIGNS AND SYMPTOMS: May be delayed up to 24 hours

Mild irritation of eyes

Dermatitis

Epistaxis • Vomiting • Abdominal pain • Fever • Anorexia •  
Ecchymoses • Hematuria • Oliguria • Night sweats

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Physical examination of exposed personnel at regular intervals including studies of liver and kidney function

Preclude from exposure those with diseases of the liver and kidneys

## PROPYLENE GLYCOL DINITRATE

### Synonyms:

PGDN • 1,2-Propanediol dinitrate

### Description:

Red-orange liquid, disagreeable odor

### Occupational Exposure:

Torpedo propellant fuel

## PROPYLENE GLYCOL DINITRATE (*cont' d.*)

### Threshold Limit Value:

0.05 ppm • 0.3 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant

Methemoglobinemia is possible

#### SIGNS AND SYMPTOMS:

Headache • Dizziness • Incoordination

Irritation of eyes and nose (congestion)

Nausea

#### DIAGNOSTIC TESTS:

None established

PGDN is detectable in expired air if examined early after exposure

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Stewart, R.D. 1974. Experimental human exposure to propylene glycol dinitrate. *Toxicol. & Appl. Pharmacol.* 30:377.

## PROPYLENE GLYCOL MONOMETHYL ETHER

### Synonyms:

PGME • Propylene glycol methyl ether

# PROPYLENE GLYCOL MONOMETHYL ETHER

(*cont'd.*)

## Description:

Colorless liquid, ethereal odor

## Occupational Exposure:

Heat exchanger • Solvent

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Central nervous system depressant

### SIGNS AND SYMPTOMS:

Mild irritation of eyes, nose, and throat

Headache and nausea

### DIAGNOSTIC TESTS:

PGME in expired air (rapid decay time)

Methanol in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

# PROPYLENE IMINE

## Synonyms:

2-Methyl aziridine • 1,2-Propylene imine

## Description:

Clear liquid

## Occupational Exposure:

Manufacture of adhesives, coatings, paper, polymers, textiles

## Threshold Limit Value:

2 ppm • 5 mg/m<sup>3</sup>

Suspect carcinogen

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Special information should be secured from the supplier since propylene imine may behave much like ethylene imine

# PROPYLENE OXIDE

## Synonyms:

1,2-Epoxy propane • Methyl oxirane • Propene oxide

## Description:

Colorless liquid, ethereal odor

## Occupational Exposure:

Chemical synthesis • Detergents • Fumigant • Hydraulic fluids • Soil sterilant • Solvent • Surfactants • Synthetic lubricants

## Threshold Limit Value:

20 ppm • 50 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal burns

Dermatitis and skin burns

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## *n*-PROPYL NITRATE

### Synonyms:

Nitrous acid *n*-propyl ester

### Description:

Straw-colored liquid, nauseating odor

### Occupational Exposure:

Chemical synthesis • Rocket fuel

### Threshold Limit Value:

25 ppm • 105 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Methemoglobinemia is possible

#### SIGNS AND SYMPTOMS:

Headache and nausea

Yellow discoloration of the skin from chronic contact has been reported

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing as indicated

# PUMICE

## Synonyms:

None

## Description:

Gray-colored porous volcanic rock or powder consisting of complex silicates of aluminum, potassium, and sodium and containing some free silica

## Occupational Exposure:

Abrasives • Building material • Cosmetics • Dentistry • Filtering agent • Insulation

## Threshold Limit Value:

None established, would vary with quartz content

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Pneumoconiosis

**SIGNS AND SYMPTOMS:** Usually after 10–30 years exposure  
“Glass-grinder’s lung” associated with cough and dyspnea

### DIAGNOSTIC TESTS:

Chest x-ray shows primarily linear fibrosis

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Pulmonary changes are permanent but impairment is not severe

## Preventive Measures:

Adequate ventilation • Wet processes where possible • Approved respiratory protection

Physical examination of exposed personnel on a regular basis including chest x-ray and pulmonary function tests

Preclude from exposure those with chest diseases

## PYRETHRINS

### Synonyms:

*Natural pyrethrins:* Cinerin I and II • Pyrethrin I and II • Jasmolin I and II

*Synthetic pyrethrins:* Allethrin • Cyclethrin • Ethythrin • Furethrin

*Chrysanthemum cinerariae folium* and *coccineum* • Persian insect powder • Pyrethrum powder • Esters of chrysanthemumic acid

### Description:

Amber liquids

### Occupational Exposure:

Chrysanthemum cultivation and handling • Insecticides • Mosquito repellants • Scabiecidess

### Threshold Limit Value:

Pyrethrum — 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant—Chrycinnerol, a phenolic constituent is a primary irritant • Acetic acid is also present in dried pyrethrum flowers

Sensitizer—Pyrethrosin, a sesquiterpene lactone, is thought to be the allergen

Synthetic pyrethroids are mildly neurotoxic

#### SIGNS AND SYMPTOMS:

Skin irritation and allergic dermatitis

Allergic rhinitis with itching and sneezing

Asthma

Allergic alveolitis with chest pain, dyspnea, cough, and malaise

Cutaneous paresthesias characterized by a burning sensation, beginning 30 or more minutes after exposure, progressing to numbness and persisting several hours

#### DIAGNOSTIC TESTS:

Skin tests may show type 1 and 3 hypersensitivity reactions



## PYRETHRINS (*cont' d.*)

### TREATMENT:

Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

Sensitization may be permanent  
Pulmonary impairment is possible

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing  
Good personal hygiene  
Physical examination of exposed personnel on a regular basis including a chest x-ray and pulmonary function tests  
Preclude from exposure those with allergies and pulmonary disease  
Remove from exposure those who become sensitized

- Campolmi, P. et.al. 1978. Alantolactone sensitivity in chrysanthemum contact dermatitis. *Contact Derm.* 4:93.  
Carlson, J.E. and Villaveces, J.W. 1977. Hypersensitivity pneumonitis due to pyrethrum—Report of a case. *JAMA* 237:1718.  
Ebihara, I. 1976. Respiratory symptoms among cultivators of chrysanthemum. *J. Sci. Labour* 52:407.  
Tucker, S.B. and Flannigan, S.A. 1983. Cutaneous effects from occupational exposure to fenvalerate. *Arch. Toxicol.* 54:195.

## PYRIDINE

### Synonyms:

Azine

### Description:

Colorless liquid, unpleasant odor

### Occupational Exposure:

Chemical synthesis • Denaturant • Disinfectants • Dyestuffs • Explosives • Paints • Pharmaceuticals • Rubber manufacture • Solvent

## PYRIDINE (*cont' d.*)

### Threshold Limit Value:

5 ppm • 15 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer • Central nervous system depressant  
Liver and kidney damage is possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract  
Dermatitis, sensitization, and photosensitization have all been reported  
Anorexia • Nausea • Vomiting • Abdominal pain  
Headache • Dizziness • Insomnia • Nervousness • Weakness  
Urinary frequency

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported from industrial intoxication

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber and plastic gloves or clothing should be monitored for penetration

Good personal hygiene

Physical examination of exposed personnel on a regular basis with special attention to the skin and nervous system and including tests of liver and kidney function

Preclude from exposure those with diseases of the nervous system, liver, and kidneys

Remove from exposure those who become sensitized

## PYRIDINE (*cont' d.*)

Kuzelova, M. et.al. 1975. An unusual picture of acute pyridine poisoning. *Prac. Lek.* 27:207.

## PYROGALLOL

### Synonyms:

1,2,3-Benzotriol • Pyrogalllic acid • 1,2,3-Trihydroxy benzene

### Description:

White crystals

### Occupational Exposure:

Chemical synthesis • Dyes • Engraving • Laboratory reagent •  
Leather staining • Mordant • Pharmaceuticals • Photography

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer

Methemoglobinemia and hemolysis are possible

Liver and kidney damage can occur

#### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage with brown to green discoloration of tissue

Dermal irritation • Eczema

Nausea • Vomiting • Diarrhea

Dyspnea • Cyanosis • Weakness • Tremors • Incoordination •  
Coma

Hematuria • Albuminuria

#### DIAGNOSTIC TESTS:

None established

Methemoglobin determination

## PYROGALLOL (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

Serious exposures will require hospitalization for care of methemoglobinemia, liver and kidney damage

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Rubber gloves, aprons, and boots

Physical examination of exposed personnel at regular intervals including studies of liver and kidney function

Preclude from exposure those with diseases of blood, liver, and kidneys

# QUINONE

## Synonyms:

1,4-Benzoquinone • Chinone

## Description:

Yellow crystals, irritating odor

## Occupational Exposure:

Dyes • Fungicides • Laboratory reagent • Oxidizing agent •  
Photography • Tanning

## Threshold Limit Value:

0.1 ppm • 0.4 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis with green-brown staining of the tissues and sometimes followed by corneal opacification

Dermal erythema, edema, and vesicle formation which can progress to ulceration

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

Corneal opacities are permanent

## Preventive Measures:

Adequate ventilation • Chemical goggles • Rubber gloves and protective clothing

Physical examination of exposed personnel at regular intervals with special attention to eyes and skin

Preclude from exposure those with diseases of the eyes and skin

# RESORCINOL

## Synonyms:

1,3-Benzenediol • *m*-Dihydroxy benzene • Resorcin

## Description:

White crystals, aromatic odor

## Occupational Exposure:

Adhesives • Cosmetics • Dyes • Explosives • Pharmaceuticals •  
Resins • Rubber industry • Tanning

## Threshold Limit Value:

10 ppm • 45 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

### MODE OF ACTION:

Irritant, resembles phenol

Sensitizer

Liver and kidney damage

Methemoglobinemia is possible

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal damage

Dermatitis with erythema and edema

Systemic symptoms follow the pattern of phenol intoxication

### DIAGNOSTIC TESTS:

Resorcinol in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat methemoglobinemia if it occurs

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles or face shield • Approved  
respiratory protection • Rubber gloves and protective clothing as  
indicated

# RICE

## Synonyms:

None

## Description:

Straw from cereal grass • Rice husk dust

## Occupational Exposure:

Harvesting and processing rice • Manufacture of cellulose

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Local irritant • Sensitizer

There is a high content of free silica

### SIGNS AND SYMPTOMS:

*Eye:* Keratoconjunctivitis with corneal scarring

*Skin:* Erythematoporphyrpapulous type—usually occurs on the first day of work and disappears in 10–12 days; lesions are limited to parts of the body in contact with water • Erythematopapulopustulous type—due to irritant action of the rice folious; is easily transformed into impetigo, but has a longer course and appears on all body parts

*Pulmonary:* Irritation of the nose and respiratory tract with cough, chest tightness, dyspnea, and asthmatic breathing

### DIAGNOSTIC TESTS:

Chest x-ray may show hilar enlargement and reticulonodular shadows in the mid and lower lung fields

Occasionally a diffuse haziness tends to obliterate lung markings

### TREATMENT:

Symptomatic and supportive

## RICE (*cont' d.*)

### DISABILITY:

Corneal scarring is permanent

X-ray changes regress if patient is removed from exposure

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel at regular intervals with special attention to the eyes, skin, and respiratory system and including chest x-ray

Remove from exposure those with chronic skin and pulmonary disease

Lim, H.H. et.al. 1984. Rice miller's syndrome: A preliminary report. *Brit. J. Ind. Med.* 41:445.

Manferto, G. 1960. Dermatitis of rice workers. *Med. Lav.* 51:624.

## ROTENONE

### Synonyms:

Derris root • Tubatoxin

### Description:

White crystals

### Occupational Exposure:

Flea powders • Fly sprays • Grubicide • Insecticide • Moth proofing

### Threshold Limit Value:

5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant



## ROTENONE (*cont'd.*)

### SIGNS AND SYMPTOMS:

- Conjunctivitis
- Rhinitis and anosmia
- Irritation of lips and tongue
- Dermatitis

### DIAGNOSTIC TESTS:

- None established

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Symptomatic and supportive

### DISABILITY:

- No permanent effects reported

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection
- Good personal hygiene

Haley, T.J. 1978. A review of the literature of rotenone. *J. Environ. Path. Toxicol.* 1:315.

# SELENIUM AND COMPOUNDS

## Synonyms:

Hydrogen selenide • Selenium • Selenium anhydride • Selenium chloride • Selenium dioxide • Selenium disulfide • Selenium fluoride • Selenium oxide • Selenium oxychloride • Selenium trioxide • Sodium selenite

## Description:

Selenium—red amorphous powder

Hydrogen selenide and selenium fluoride—gases

Others—red, orange, or yellow powders and liquids

## Occupational Exposure:

Alloys • Catalyst • Ceramics • Electronics • Fireproofing • Lubricating oils • Metal “blueing” and etching • Pigment (inks and paints) • Pharmaceuticals • Photocells • Photography • Rubber accelerator • Solar batteries • X-ray xerography

## Threshold Limit Value:

Selenium compounds—0.2 mg/m<sup>3</sup>

**Toxicity:** *SALTS ARE HIGHLY TOXIC*; element appears harmless

## ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

## MODE OF ACTION:

Salts are irritants and vesicants

Sensitizer

Metabolite dimethyl selenide may be the toxic agent

Liver, kidney, and nervous system damage are possible

## SIGNS AND SYMPTOMS:

*General:* Headache • Dizziness • Weakness • Fatigue • Irritability • Weight loss

*Local:* Puffy, pink eyelids • Conjunctivitis • Keratitis

Reddish discoloration of hair and nails which may become brittle

Burns of the skin and painful paronychia if salts penetrate beneath nails

Red, itchy, papular dermatitis and urticaria

Photosensitivity dermatitis has been reported

## SELENIUM AND COMPOUNDS (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

*Gastrointestinal:* Metallic taste and a garlic odor of the breath (via dimethyl selenide)

Anorexia • Nausea • Vomiting • Abdominal pain • Diarrhea

Hepatomegaly has been reported

*Respiratory:* It has been suggested these symptoms may be caused by the metabolite dimethyl selenide

Pharyngitis, bronchitis and pulmonary congestion with cough, dyspnea, and chest discomfort with wheezy respiration

Metal fume fever symptoms have been reported

*Nervous system:* Amyotrophic lateral sclerosis has been suggested

Adverse reproductive effects have been reported

### DIAGNOSTIC TESTS:

Selenium in blood and urine (normal urine is < 25 µg/g creatinine)

### TREATMENT: *TREAT ACUTE EXPOSURES AS EMERGENCIES*

Irrigate eyes with water or 10% aqueous sodium thiosulfate solution

Wash contaminated areas of body with 10% aqueous sodium thiosulfate solution

Treat skin burns with a 10% sodium thiosulfate cream

Gastric lavage, if ingested, followed by saline catharsis

Respiratory support as needed

Symptomatic and supportive

If chelation is done calcium disodium edetate is the agent of choice; dimercaprol is contraindicated

### DISABILITY:

Permanent impairment can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber or plastic gloves must be checked for saturation and penetration • Cotton coveralls

Good personal hygiene • No eating or smoking in work area

## SELENIUM AND COMPOUNDS (*cont'd.*)

### Preventive Measures (*cont'd.*):

Physical examination of exposed personnel at regular intervals with special attention to skin, respiratory, and nervous system and including selenium urine determination as well as studies of liver function

Preclude from exposure those with diseases of lungs, liver, gastrointestinal tract and central nervous system

Diskin, C.J. et.al. 1979. Long-term selenium exposure. *Arch. Intern. Med.* 139:824.

Kilness, A.W. and Hochberg, F.H. 1977. Amyotrophic lateral sclerosis in a high selenium environment. *JAMA* 237:2843.

Klevay, L.M. 1976. Pharmacology and toxicology of heavy metals: Selenium. *Pharmac. Ther.* A.1:211.

Schechter, A. et.al. 1980. Acute hydrogen selenide inhalation. *Chest* 77:554.

## SHALE

### Synonyms:

Marlstone

### Description:

Gray-brown rock containing kerogen, the source of shale oil, silicates, and free silica

### Occupational Exposure:

Shale mining and retorting • Oil shale lubricants • Chemical feedstock

### Threshold Limit Value:

Variable with the quartz content

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation of dust • Direct contact with oil

#### MODE OF ACTION:

Pneumoconiosis • Irritant (oil)

## SHALE (*cont' d.*)

SIGNS AND SYMPTOMS: After many years exposure

Shalosis (oil shale pneumoconiosis) follows a course quite similar to CWP

Pulmonary squamous cell cancer has also been reported

Epithelioma of scrotum, arms, hands, and face

DIAGNOSTIC TESTS:

X-rays of lungs show pneumoconiotic changes

TREATMENT:

Symptomatic and supportive

DISABILITY:

Impairment can be permanent

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the skin and including a chest x-ray

Preclude from exposure those with diseases of the skin and lungs

Seaton, A. et.al. 1981. Pneumoconiosis of shale miners. *Thorax* 36:412.

Weaver, N.K. and Gibson, R.L. 1979. The U.S. oil shale industry: A health perspective. *Am. Ind. Hyg. Assoc. J.* 40:460.

## SILICA, AMORPHOUS

### Synonyms:

Natural amorphous silica: Diatomite • Infusorial earth • Siliceous earth • Fossil flour

Synthetic amorphous silica (by process): Fumed • Fused • Precipitated • Vaporized • Others

### Description:

Chalky material with a varying crystalline silica content

Diatomaceous earth contains quartz, cristobalite, and tridymite; calcining increases the cristobalite content

## SILICA, AMORPHOUS (*cont' d.*)

### Description (*cont' d.*):

Vaporization of crystalline silica produces an amorphous form with some free silica content

Precipitated amorphous silica is produced when sodium silicate in water is treated with carbon dioxide or calcium chloride to precipitate hydrated silica which has no crystalline form

### Occupational Exposure:

Chromatography • Clarifying agent • Dentifrices • Filtering agent • Fire brick • Insulation • Metal polishes • Paint and paper fillers • Plastics

### Threshold Limit Value:

20 mppcf

Fused amorphous — 0.1 mg/m<sup>3</sup> respirable dust

Precipitated amorphous — 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Benign pneumoconiosis

Pulmonary fibrosis appears to be directly related to the silica content

#### SIGNS AND SYMPTOMS:

Benign pneumoconiosis is generally asymptomatic

Silicosis from crystalline silica follows a normal progressive course

#### DIAGNOSTIC TESTS:

Chest x-rays may show small opacities unless silica complicates the pattern

Pulmonary function tests remain normal unless a true silicosis becomes superimposed

#### TREATMENT:

Symptomatic and supportive

## SILICA, AMORPHOUS (*cont'd.*)

### DISABILITY:

Seems to be related to crystalline silica content

### Preventive Measures:

Adequate ventilation with periodic monitoring of work environment to determine free silica contamination • Approved respiratory protection

Physical examination of exposed personnel regularly, including chest x-ray and pulmonary function study

Preclude from exposure those with known pulmonary disease

Beskow, R. 1978. Silicosis in diatomaceous earth factory workers in Sweden. *Scand. J. Resp. Dis.* 59:216.

Cooper, W.C. and Jacobson, G. 1977. A 21 year radiographic follow-up of workers in the diatomite industry. *JOM* 19:563.

Wilson, R.K. et.al. 1979. Effects of chronic amorphous silica exposure on sequential pulmonary function. *JOM* 21(6):399.

## SILICA (CRYSTALLINE)

### Synonyms:

Cristobalite • Quartz • Silica flour • Silicic anhydride • Silicon dioxide • Tridymite

### Description:

Colorless crystals or white powder

### Occupational Exposure:

Abrasives • Ceramics • Foundries • Glass manufacture • Insulation • Mining • Pottery • Quarrying • Refractories • Sand blasting • Silica flour manufacture • Stone cutting • Tunneling

### Threshold Limit Value:

30 mg/m<sup>3</sup> divided by percent of silicon dioxide + 3

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation



## SILICA (CRYSTALLINE) (*cont' d.*)

### MODE OF ACTION:

Silicotic nodule is a local fibrosis of the terminal and respiratory bronchiole

Massive fibrosis is the result of coalescence of nodules and is associated with architectural distortion and cavitation

### SIGNS AND SYMPTOMS:

Simple silicosis—occurs after 20+ years exposure

May be relatively asymptomatic and show little respiratory impairment

Coalescence of smaller opacities to progressive massive fibrosis is accompanied by cough, progressive dyspnea, weight loss, and hemoptysis

Accelerated silicosis—occurs after 5–15 years exposure

X-ray changes appear earlier and the disease progresses at a faster rate

More frequently associated with the development of PMF

Acute silicosis—occurs after 1–3 years exposure

Also known as silicoproteinosis

Characterized by progressive dyspnea, fever, cough, and weight loss

### DIAGNOSTIC TESTS:

X-rays should follow the ILO 1980 classifications

Egg shell calcification of the hilar lymph nodes is common

Accelerated forms show more rapid development and progression of lesions

Acute silicosis exhibits a greater haziness and less tendency for nodulation

Pulmonary function abnormalities become manifest at about category 3 and are of a mixed pattern; although acute silicosis is more frequently a restrictive type with decreased diffusion capacity

### TREATMENT:

Symptomatic and supportive

Control of pulmonary infections is important



## SILICA (CRYSTALLINE) (*cont' d.*)

### DISABILITY:

Lesions tend to progress even after cessation of exposure  
Tuberculosis is more common in the acute and accelerated forms and pneumothorax is more frequent in PMF  
Blood gas abnormalities do not correlate with x-ray changes or pulmonary function findings

### Preventive Measures:

Adequate ventilation with regular monitoring of the work environment • Wet methods and process enclosure when possible • Approved respiratory protection  
Physical examination of exposed personnel at least annually including a chest x-ray and pulmonary function assessment  
Preclude from exposure those with pulmonary disease  
Remove from exposure those who develop silicotic changes

- Banks, D.E. et.al. 1981. Silicosis in silica flour workers. *Am. Rev. Resp. Dis.* 124:445.  
Banks, D.E. et.al. 1981. Silicosis in the 1980s. *Am. Ind. Hyg. Assoc. J.* 42:77.  
Seaton, A. et.al. 1981. Quartz and pneumoconiosis in coal miners. *Lancet* 2:1272.

## SILICON TETRACHLORIDE

### Synonyms:

Tetrachlorosilane

### Description:

Clear liquid

### Occupational Exposure:

Fused silica glass • Metal etching • Microchips • Silicon polymers • Smoke screens • Warfare agent

### Threshold Limit Value:

None established

## SILICON TETRACHLORIDE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Reacts with water to form silicic and hydrochloric acids  
(Silicic acid particles are respirable)

#### SIGNS AND SYMPTOMS:

Conjunctivitis and blurred vision

Irritation of nose and throat with cough, dyspnea, and wheezing

Late symptoms consist of dry mouth, nausea, headache, and dizziness

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Kizer, K.W. et.al. 1984. Health effects of silicon tetrachloride—Report of an urban accident. *JOM* 26:33.

## SILOXANES

### Synonyms:

Organosiloxane

### Description:

Siloxane polymers are a group of resins, elastomers, and oils (compounds of oxygen, silicon, and various organic radicals)

## SILOXANES (*cont'd.*)

### Occupational Exposure:

Adhesives • Brake fluids • Coatings • Coolant • Dielectric fluid •  
Foam stabilizer • Gaskets • Insulation • Lubricants • Medical  
devices • Polishes • Surfactant • Textile finishes • Water repellent

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Mild irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Slight irritation of nose and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles

Vrba, J. 1956. Health of workers manufacturing silicones. *Prac. Lek.*  
8:291.

## SILVER AND COMPOUNDS

### Synonyms:

Argentum • Silver chloride • Silver nitrate • Silver oxide • Silver  
picrate

## SILVER AND COMPOUNDS (*cont' d.*)

### Description:

Metal is lustrous white, salts are various colors

### Occupational Exposure:

Alloys • Bactericides • Batteries • Catalyst • Chemical synthesis •  
Glass and ceramics • Jewelry • Mirrors • Pharmaceuticals •  
Photography • Solders • Tableware

### Threshold Limit Value:

Silver — 0.1 mg/m<sup>3</sup>

Silver compounds — 0.01 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous (by trauma)

#### MODE OF ACTION:

Metal itself is unreactive

Salts are irritants

Silver precipitates in epithelial connective and elastic tissue where it is reduced by the action of light or hydrogen sulfide resulting in argyria—blue pigmentation

#### SIGNS AND SYMPTOMS:

Corrosive salts cause:

Conjunctivitis

Respiratory tract irritation with epistaxis, cough, wheezing, and chest tightness

Skin burns

Headache, nervousness, and abdominal discomfort (local g.i. irritation?)

#### Argyria

Localized tattooing occurs when small metallic particles penetrate the skin

Ocular argyrosis may be the first indication of generalized argyria and is manifest as pigmentation of the conjunctiva and cornea; lens involvement is infrequent

“Blue men”—generalized argyria—characterized by dark slate-gray color uniformly distributed over the face, forehead, neck, hands, and forearms; fingernails may be a chocolate brown color

## SILVER AND COMPOUNDS (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

Ingested salts produce a severe gastroenteritis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water and wash contaminated areas of body with soap and water if corrosive salts are involved

Gastric lavage, if irritant salts are ingested, using sodium chloride to precipitate the silver, and followed by saline catharsis

Treat skin burns in usual manner

Symptomatic and supportive

### DISABILITY:

Eye and skin burns can result in impairment

Argyria is disfiguring

### Preventive Measures:

Adequate ventilation • Chemical goggles when indicated • Approved respiratory protection

Rosenman, K.D. et.al. 1979. Argyria: Clinical implications of exposure to silver nitrate and silver oxide. *JOM* 21:431.

Weir, F.W. 1979. Health hazard from occupational exposure to metallic copper and silver dust. *Am. Ind. Hyg. Assoc. J.* 40:245.

## SLATE

### Synonyms:

None

### Description:

Metamorphic rock composed of micas, chlorite, quartz, hematite, etc.; multiple colors

### Occupational Exposure:

Blackboards • Filler powders • Mining and processing • Roofing material

## SLATE (*cont' d.*)

### Threshold Limit Value:

Variable with quartz content

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Pneumoconiosis (from quartz)

#### SIGNS AND SYMPTOMS: After 10 or more years exposure

Slate worker's pneumoconiosis with cough, dyspnea, chest discomfort

#### DIAGNOSTIC TESTS:

Chest x-rays show irregular mid-zone opacities with increased linear markings; eggshell calcification is common

Pulmonary function tests generally do not show marked changes

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Impairment is infrequent

### Preventive Measures:

Adequate ventilation with monitoring and analysis of dust levels •  
Approved respiratory protection

Physical examination of exposed personnel at regular intervals  
including chest x-ray and testing of pulmonary function

Preclude from exposure those with pulmonary disease

Glover, J.R. et.al. 1980. Effects of exposure to slate dust in North Wales. *Brit. J. Ind. Med.* 37:152.

# SODIUM CARBONATE

## Synonyms:

Crystal carbonate • Sal soda • Soda ash

## Description:

White crystals or powder

## Occupational Exposure:

Catalyst • Chemical synthesis • Glass manufacture • Paints • Pharmaceuticals • Pulp and paper • Soaps and detergents • Water treatment

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant via sodium hydroxide formation

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal burns

Irritation of nose and respiratory tract with perforation of nasal septum, cough, and dyspnea

"Soda ulcers" of skin

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis and olive oil

Treat skin burns in usual manner

Symptomatic and supportive

### DISABILITY:

Burns can result in impairment

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

# SODIUM CHLORATE

## Synonyms:

Soda chlorate

## Description:

Colorless crystals

## Occupational Exposure:

Chemical synthesis • Dyeing • Explosives • Herbicides • Leather tanning • Matches • Pharmaceuticals • Pyrotechnics

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Methemoglobinemia is possible

### SIGNS AND SYMPTOMS:

Conjunctivitis

Dermatitis and leucomelanoderma (?)

Irritation of respiratory tract

Dizziness and nausea

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Treat methemoglobinemia if it occurs

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing as indicated



## SODIUM CHLORATE (*cont'd.*)

Matsushita, T. et.al. 1975. Skin disorders caused by herbicides sodium chlorate and sodium 2,2-dichloropropionate. *Kumamoto Med. J.* 28:164.

## SODIUM FLUOROACETATE

### Synonyms:

Compound 1080 • Fluoroacetic acid, sodium salt • Sodium monofluoroacetate

### Description:

White powder

### Occupational Exposure:

Rodenticide

### Threshold Limit Value:

0.05 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Fluoroacetate ion is converted to fluorocitric acid which blocks the tricarboxylic acid cycle via inhibition of aconitase  
Effects can be cumulative

#### SIGNS AND SYMPTOMS: Latent period may extend to 6+ hours

Salivation • Nausea • Vomiting • Epigastric pain • Paresthesias and muscle twitching about face

Apprehension and convulsions followed by coma, arrhythmias, and cardiac arrest

#### DIAGNOSTIC TESTS:

SMFA in urine

#### TREATMENT: *TREAT AS AN EMERGENCY*

Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis

## SODIUM FLUOROACETATE (*cont' d.*)

### TREATMENT (*cont' d.*):

Cardiorespiratory support  
Anticonvulsants  
Symptomatic and supportive

### DISABILITY:

If patient survives, there appear to be no permanent effects

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Rubber gloves  
No eating or smoking in work area • Good personal hygiene  
Education of exposed personnel  
Preclude from exposure those with diseases of the heart and central nervous system

Parkin, P.J. et.al. 1977. Chronic sodium monofluoroacetate (Compound 1080) intoxication in a rabbit. *New Zealand Med. J.* 85:93.

Peters, R.A. et.al. 1981. Subacute fluoroacetate poisoning. *JOM* 23:112.

## SODIUM HYDROXIDE

### Synonyms:

Caustic • Caustic soda • Lye • Sodium hydrate • White caustic

### Description:

White beads or pellets

### Occupational Exposure:

Analytic reagent • Chemical synthesis • Degreasing • Detergents and soaps • Etching • Petroleum refining • Pulp and paper • Rubber reclaiming • Textile processing

### Threshold Limit Value:

2 mg/m<sup>3</sup>

# SODIUM HYDROXIDE (*cont'd.*)

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Corrosive

Combines with tissues to form alkaline albuminates

### SIGNS AND SYMPTOMS:

Conjunctivitis and corneal burns

Deep skin burns

Irritation of the entire respiratory tract; pneumonitis is possible

*If ingested*, causes severe burns of the mouth, esophagus, and stomach with nausea, vomiting, and hematemesis; perforation of the intestinal tract and cardiovascular collapse

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in usual manner

*If ingested*, dilute with water or milk and hospitalize for tracheostomy, shock therapy, and endoscopy when possible under controlled conditions

Symptomatic and supportive

### DISABILITY:

All corrosive effects may result in permanent impairment

## Preventive Measures:

Adequate ventilation • Chemical goggles or full face shield • Approved respiratory protection • Rubber gloves, aprons, and boots

Cooper, D.W. et al. 1979. A critique of the U.S. standard for industrial exposure to sodium hydroxide aerosols. *Am. Ind. Hyg. Assoc. J.* 40:365.

# SODIUM HYPOCHLORITE

## Synonyms:

Bleach

## Description:

White crystals

## Occupational Exposure:

Bleach • Chemical synthesis • Disinfectant • Fungicide • Germicide •  
Laundering • Pharmaceuticals • Water treatment

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant—releases chlorine

### SIGNS AND SYMPTOMS:

Conjunctivitis

Irritation of respiratory tract with cough, dyspnea, laryngeal edema, and pneumonitis

Dermatitis and skin burns

Onycholysis

*If ingested*, produces severe burns of the gastrointestinal tract

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

*If ingested*, give demulcents, follow with gastric lavage if required

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## SODIUM HYPOCHLORITE (*cont' d.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective gloves or clothing as required

Coskey, R.J. 1974. Onycholysis from sodium hypochlorite. *Arch. Derm.* 109:96.

## SODIUM PENTACHLOROPHENATE

### Synonyms:

Sodium pentachlorophenolate

### Description:

White powder

### Occupational Exposure:

Disinfectant • Fungicide • Herbicide

### Threshold Limit Value:

None established

### Toxicity: *HIGHLY TOXIC*

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant

Interferes with oxidative phosphorylation

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Acne • Furunculosis with brown pigmentation • Skin burns

Dyspnea • Cough

Fever • Tachycardia • Sweating • Weakness

Convulsions • Coma

#### DIAGNOSTIC TESTS:

Pentachlorophenol in urine

## SODIUM PENTACHLOROPHENATE (*cont' d.*)

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat burns in normal manner

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber protective clothing

Good personal hygiene

## SODIUM POTASSIUM ALLOY

### Synonyms:

Nack • NaK alloy

### Description:

Silvery, soft metal

### Occupational Exposure:

Chemical processing • Heat transfer agent • Metal alloying • Nuclear reactor coolant

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Caustic—evolves sodium hydroxide and potassium hydroxide on contact with water

Radiation effects are possible from sodium potassium in reactors

## SODIUM POTASSIUM ALLOY (*cont'd.*)

### SIGNS AND SYMPTOMS:

Irritation and burns of eyes and skin  
Respiratory tract damage

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *DO NOT APPLY WATER TO THE SKIN*

Irrigate eyes with mineral oil  
Flood contaminated areas of body with 1% solution of stearic acid in mineral oil  
Remove metal by gently scraping with a spatula; do not brush or wipe away  
Follow with a 2% acetic acid solution or water flush  
Treat burns in normal manner  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and boots with protective clothing that can be removed easily

## SODIUM SESQUICARBONATE

### Synonyms:

Trona dust

### Description:

Alkaline dust

### Occupational Exposure:

Processing of trona ore to sodium carbonate

### Threshold Limit Value:

None established

## SODIUM SESQUICARBONATE (*cont'd.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis

Rhinitis, with mucosal ulcerations and pharyngitis

Dermal redness, itching, and fissuring; pustulation can occur and in chronic cases hyperpigmentation and lichenification are seen

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing

Good personal hygiene

Barrier creams have been suggested

Rom, W.N. et.al. 1983. A study of dermatitis in trona miners and millers. *JOM* 25:295.



# SODIUM SILICATE

## Synonyms:

Water glass

## Description:

White powder

## Occupational Exposure:

Adhesives • Catalyst • Detergent • Drilling fluids • Egg preservation  
• Flame retardant • Glass foam • Paints • Water proofing • Water treatment

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

None

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

Erythema and vesicular eruptions of the skin; burns can occur

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Chemical goggles • Rubber gloves

## STIBINE

### Synonyms:

Antimony hydride • Hydrogen antimonide

### Description:

Colorless gas, unpleasant odor

### Occupational Exposure:

Evolves when antimony alloys come in contact with an acid or a source of nascent hydrogen; or when antimony compounds react with steam

Fumigant • Metallurgy • Soldering • Storage batteries • Welding

### Threshold Limit Value:

0.1 ppm • 0.5 mg/m<sup>3</sup>

### Toxicity: *EXTREMELY TOXIC*

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Red blood cell hemolysis

#### SIGNS AND SYMPTOMS:

Headache • Weakness

Nausea • Epigastric pain and jaundice

Oliguria • Hemoglobinuria

#### DIAGNOSTIC TESTS:

Antimony in blood or urine

#### TREATMENT: *TREAT AS AN EMERGENCY*

Symptomatic and supportive

Early exchange transfusion has proved beneficial

Dimercaprol is recommended

Hemodialysis is indicated where the kidneys may be compromised

#### DISABILITY:

Permanent impairment is possible

## STIBINE (*cont' d.*)

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Preclude from exposure those with blood and kidney disease

It has been suggested that a glucose-6-phosphate dehydrogenase determination may predict those who would be hypersusceptible to hemolytic chemicals

## STODDARD SOLVENT

### Synonyms:

White spirits

### Description:

Petroleum distillates including paraffins, naphthenes, and alkyl aromatics and having a boiling point between 150–200°C

### Occupational Exposure:

Cleaning agent • Dry cleaning • Paint thinners • Solvent

### Threshold Limit Value:

100 ppm • 525 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant

#### SIGNS AND SYMPTOMS:

Irritation of the eyes and nose

Dizziness • Nausea

Dermal erythema • Vesiculation • Desquamation

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

## STODDARD SOLVENT (*cont'd.*)

### TREATMENT (*cont'd.*):

Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## STYRENE

### Synonyms:

Cinnamene • Phenyl ethylene • Styrol • Vinyl benzene

### Description:

Yellowish liquid, aromatic odor

### Occupational Exposure:

Chemical synthesis • Coatings • Insulator • Plastics • Resins • Synthetic rubber

### Threshold Limit Value:

50 ppm • 215 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant  
Central nervous system depressant  
Liver damage is possible  
Sensitizer?

### SIGNS AND SYMPTOMS:

Conjunctivitis and keratitis

## STYRENE (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

Irritation of respiratory tract; asthmatic respiration has been reported  
Headache, drowsiness, incoordination, and weakness; narcosis is possible  
Altered taste sensation, anorexia, nausea, and vomiting  
Disorders of menstrual cycles have been reported  
Defatting dermatitis

### DIAGNOSTIC TESTS:

Styrene in expired air and blood  
Mandelic and phenyl glyoxilic acid in urine  
Altered liver function tests may occur

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves  
Physical examination of exposed personnel on a regular basis including liver and kidney function studies  
Preclude from exposure those with diseases of the skin, liver, and kidneys

- Cherry, N. et.al. 1980. An investigation of the acute behavior effects of styrene on factory workers. *Brit. J. Ind. Med.* 37:234.  
Rosen, I. et.al. 1978. Neurophysiological derivations after chronic styrene exposure. *Scand. J. Work Environ. Hlth.* 4(suppl. 2):184.  
Sjoberg, S. et.al. 1984. Contact allergy to styrene and related chemicals. *Contact Derm.* 10:94.

## SULFUR

### Synonyms:

Brimstone • Sulfur flower

### Description:

Yellow crystals

### Occupational Exposure:

Binder • Bleaching • Chemical synthesis • Detergents • Dyes • Explosives • Fungicide • Insecticides • Manufacture of sulfuric acid • Pharmaceuticals • Pulp and paper • Rubber vulcanizing

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Sensitizer?

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal damage

Rhinitis • Sinusitis • Tracheobronchitis • Dyspnea • Cough

Dermal erythema, eczema, and ulcers

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing as indicated

# SULFUR CHLORIDE

## Synonyms:

Disulfur dichloride • Sulfur monochloride

## Description:

Amber to red oily liquid, penetrating odor

## Occupational Exposure:

Analytic reagent • Catalyst • Chemical synthesis • Military gas • Ore extraction • Pharmaceuticals • Rubber vulcanization • Sulfur dyes

## Threshold Limit Value:

1 ppm • 6 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant and caustic

Decomposes to yield hydrochloric acid and sulfur dioxide

### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis

Tracheitis • Bronchitis

Skin burns

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in usual manner

Oxygen, bronchodilators and decongestants, and cough suppression for severe respiratory exposures

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## SULFUR CHLORIDE (*cont' d.*)

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves  
Preclude from exposure those with pulmonary disease

## SULFUR DIOXIDE

### Synonyms:

Sulfurous anhydride • Sulfurous oxide

### Description:

Colorless gas, sharp odor

### Occupational Exposure:

Antioxidant • Bleaching • Chemical synthesis • Coke ovens • Disinfectant • Food additive • Foundries • Fumigant • Ore refining • Solvent

### Threshold Limit Value:

2 ppm • 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Corrosive

Forms sulfurous and sulfuric acids on contact with moisture

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Conjunctivitis and nasal irritation with rhinorrhea  
Dyspnea, cough, laryngeal spasm, and suffocation  
Exposures to high concentration and liquid can result in  
burns of the cornea and skin and pulmonary edema

##### *Chronic:*

Conjunctivitis  
Nasal irritation, epistaxis, and ulcers of the nasal septum



## SULFUR DIOXIDE (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

#### *Chronic (cont' d.):*

Gingivitis, burning, and dryness of throat  
Dyspnea, cough, chronic bronchitis, and fatigue  
Obstructive pulmonary disease

### DIAGNOSTIC TESTS:

None established  
Chest x-rays may show fibrotic changes

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat burns in normal manner  
Oxygen with IPPB, bronchodilators, and decongestants  
Symptomatic and supportive

### DISABILITY:

Corneal and skin burn damage may result in permanent impairment  
Peribronchial fibrosis with obstructive disease can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection  
Physical examination of exposed personnel on a regular basis including chest x-ray and pulmonary function assessment  
Preclude from exposure those with eye, skin, and pulmonary disease

- Charan, N.B. et.al. 1979. Pulmonary injuries associated with acute sulfur dioxide inhalation. *Am. Rev. Resp. Dis.* 119:555.  
Uragoda, C.G. 1981. Long term exposure to sulfur dioxide during bleaching of coir. *J. Soc. Occup. Med.* 31:76.  
Woodford, D.M. et.al. 1979. Obstructive lung disease from acute sulfur dioxide exposure. *Respiration* 38:238.

# SULFURIC ACID

## Synonyms:

Hydrogen sulfate • Oil of vitriol

## Description:

Colorless to brown oily liquid

## Occupational Exposure:

Catalyst • Chemical synthesis • Dyes • Electroplating • Etchant • Explosives • Fertilizers • Laboratory reagent • Metallurgy • Petroleum refining

## Threshold Limit Value:

1 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Corrosive

### SIGNS AND SYMPTOMS:

Concentrated forms produce severe burns of the eyes, skin, and, if ingested, the gastrointestinal tract

#### Fume exposure:

Dermatitis

Conjunctivitis and keratitis

Irritation of the nose with rhinorrhea and epistaxis

Pharyngitis, laryngitis, bronchitis, and pneumonitis

High concentrations can cause pulmonary edema and fibrosis

Stomatitis and brownish staining of the teeth along with enamel erosion has also been reported

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen with IPPB; a 5% solution of sodium bicarbonate as an

## SULFURIC ACID (cont'd.)

### TREATMENT (cont'd.):

aerosol may be used as well as bronchodilators and decongestants

Treat burns in normal manner

*If ingested*, administer orally soap solution, calcium or aluminum hydroxide or magnesium oxide (avoid alkalis that would produce carbon dioxide and increase the risk of intestinal perforation)

Symptomatic and supportive

### DISABILITY:

Permanent impairment can occur

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Acid-resistant gloves and protective clothing

Preclude from exposure those with pulmonary disease

El-Sadik, Y.M. et.al. 1972. Exposure to sulfuric acid in the manufacture of storage batteries. *JOM* 14:224.

## SULFURYL CHLORIDE

### Synonyms:

Chlorosulfuric acid • Sulfonyl chloride • Sulfuric chloride • Sulfuric oxychloride

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Catalyst • Chemical synthesis • Dyestuff • Military gas • Pharmaceuticals • Solvent

### Threshold Limit Value

None established

## SULFURYL CHLORIDE (*cont' d.*)

Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Decomposes to sulfuric and hydrochloric acids

### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis

Rhinitis • Tracheitis • Bronchitis

Dermal burns

### DIAGNOSTIC TESTS:

None established

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen, with IPPB; a 5% solution of sodium bicarbonate as an aerosol may be used as well as bronchodilators and decongestants

Treat skin burns in normal manner

Symptomatic and supportive

### DISABILITY:

Corneal damage may be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing as indicated

Preclude from exposure those with pulmonary disease

# TALC

## Synonyms:

French chalk • Mineral graphite • Soapstone • Steatite • Talcum

## Description:

White powder—hydrous magnesium silicate

Cosmetic talcs generally are of high purity

Commercial talc contain tremolite, serpentine, anthophyllite, and other silicates

## Occupational Exposure:

Ceramics • Cosmetics • Crayons • Dusting powder • Electrical insulation • Filler • Filtering agent • Fireproof paints • Mold lubricant • Pharmaceuticals • Pigment

## Threshold Limit Value:

Fibrous talc — asbestos TLV

Nonfibrous form — 2 mg/m<sup>3</sup> respirable dust

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Three types of lesions have been proposed:

Foreign body granulomas from pure talc

Diffuse interstitial fibrosis from the fibrous mineral contaminants

Nodular lesions associated with a high quartz content

SIGNS AND SYMPTOMS: Usually after 20+ years exposure

Cough • Dyspnea • Diminished breath sounds

### DIAGNOSTIC TESTS:

Chest x-rays show interstitial infiltration in the mid lung fields and pleural plaques may occur

Pulmonary function tests show an obstructive pattern

### TREATMENT:

Symptomatic and supportive

**DISABILITY:**

Clinical course is slow and disability is rare

Lung cancer may not be the threat that had been proposed earlier

**Preventive Measures:**

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel annually including vital capacity and chest x-ray

Preclude from exposure those with pulmonary disease

Gamble, J.F. et.al. 1979. An epidemiologic study of a group of talc workers. *Am. Rev. Resp. Dis.* 119:741.

Stille, W.T. and Tabershaw, I.R. 1982. The mortality experience of upstate New York talc workers. *JOM* 24:481.

Tukiainen, P. et.al. 1984. Pulmonary granulomatous reaction: Talc pneumoconiosis or chronic sarcoidosis? *Brit. J. Ind. Med.* 41:84.

## TELLURIUM AND COMPOUNDS

**Synonyms:**

Hydrogen telluride • Potassium tellurite • Telluric acid • Tellurium dioxide • Tellurium hexafluoride

**Description:**

Element is a gray-white solid

Compounds are gases and powders

**Occupational Exposure:**

Alloys • Catalyst • Ceramics and glass • Photography • Semiconductors • Silverware • Steel manufacture • Vulcanizing agent

**Threshold Limit Value:**

0.1 mg/m<sup>3</sup>

Tellurium hexafluoride — 0.02 ppm • 0.2 mg/m<sup>3</sup>

**Toxicity:**

**ROUTE OF ENTRY:**

Inhalation • Percutaneous (esters)

## TELLURIUM AND COMPOUNDS (*cont'd.*)

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Garlic odor to breath, probably from dimethyl telluride

Metallic taste • Anorexia • Nausea

Dry itchy dermatitis

Blue-black pigmentation of the skin has been reported following percutaneous absorption of tellurium esters

Hydrogen telluride, tellurium dioxide, and tellurium hexafluoride are known irritants to the eyes and respiratory tract and also cause malaise and weakness

### DIAGNOSTIC TESTS:

Tellurium in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

Chelation with calcium disodium edetate has been suggested

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Gloves when handling compounds • Good personal hygiene

Blackadder, E.S. and Manderson, W.G. 1975. Occupational absorption of tellurium: A report of two cases. *Brit. J. Ind. Med.* 32:59.

## TERPENES

### Synonyms:

None

### Description:

Oil or resin (C<sub>10</sub>H<sub>16</sub> hydrocarbons)

### Occupational Exposure:

Forestry and lumber mills • Multiple other uses



## TERPENES (*cont'd.*)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Dyspnea • Chest tightness • Cough • Chronic bronchitis

#### DIAGNOSTIC TESTS:

Mild obstructive airway changes

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Approved respiratory protection as indicated

Hedenstierna, G. et.al. 1983. Exposure to terpenes: Effects on pulmonary function. *Int. Arch. Occup. Environ. Hlth.* 51:191.

## TERPHENYLS

### Synonyms:

Diphenyl benzenes • Terphenyl: *o*-, *m*-, *p*-

### Description:

Yellow resins

### Occupational Exposure:

Casting waxes • Fire retardant • Hydraulic fluid • Paints • Plasticizers  
• Sealants



## TERPHENYLS (*cont' d.*)

### Threshold Limit Value:

0.5 ppm • 5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant—appears to be similar to PCBs

These compounds often contain small amounts of PCBs and residues of chlorinated dibenzofurans

#### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, throat, and respiratory tract

Headache

Dermatitis has been reported

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Closed systems where possible • Chemical goggles • Approved respiratory protection • Coveralls, gloves, and shoes

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the skin, liver, and reproductive history and including pulmonary function tests and plasma terphenyl levels

Jensen, A.A. and Jorgensen, K.F. Polychlorinated terphenyls (PCTs) use, levels and biological effects.

# TETRABROMOETHANE

## Synonyms:

Acetylene tetrabromide

## Description:

Yellow liquid, camphor-like odor

## Occupational Exposure:

Chemical synthesis • Liquid gauge fluid • Solvent

## Threshold Limit Value:

1 ppm • 15 mg/m<sup>3</sup>

## Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Hepatotoxin

### SIGNS AND SYMPTOMS:

Irritation of eyes and nose

Headache • Lassitude

Anorexia • Nausea • Abdominal pain

Hepatomegaly • Jaundice

### DIAGNOSTIC TESTS:

Bilirubinuria

Altered liver function studies

### TREATMENT: *TREAT AS AN EMERGENCY*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Good personal hygiene

Physical examination of exposed personnel annually including studies of liver function

Preclude from exposure those with liver disease

# TETRACHLOROETHANE

## Synonyms:

Acetylene tetrachloride • *sym*-Tetrachloroethane • 1,1,2,2-Tetrachloroethane

## Description:

Colorless liquid, chloroform-like odor

## Occupational Exposure:

Cements • Chemical synthesis • Crystallography • Degreasing • Insecticides • Paint and varnish remover • Photographic film • Soil sterilization • Solvent

## Threshold Limit Value:

1 ppm • 7 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Central nervous system depressant  
Damage to liver, kidneys, heart, and other organs

### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract  
Headache • Vertigo • Drowsiness • Mental confusion • Stupor • Coma  
Paresthesias of extremities • Paralysis of interossei muscles of hands and feet • Loss of gag reflex and deep tendon reflexes  
Anorexia • Nausea • Vomiting • Abdominal pain • Hematemesis • Diarrhea or constipation  
Hepatomegaly • Jaundice • Bilirubinuria  
Albuminuria • Casts  
Anemia • Thrombocytosis

### DIAGNOSTIC TESTS:

Tetrachloroethane in expired air

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

## TETRACHLOROETHANE (*cont'd.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Protective clothing as indicated

Physical examination of exposed personnel on a regular basis with special attention to the central nervous system and including studies of liver and kidney function and blood count

Preclude from exposure those with diseases of central nervous system, liver, and kidneys

## TETRACHLOROETHYLENE

### Synonyms:

Ethylene tetrachloride • Perchloroethylene

### Description:

Colorless liquid, ethereal odor

### Occupational Exposure:

Degreasing • Dry cleaning • Heat transfer medium • Pharmaceuticals  
• Vermifuge

### Threshold Limit Value:

50 ppm • 335 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous?

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Liver and kidney damage

#### SIGNS AND SYMPTOMS:

Irritation of the eyes, nose, and respiratory tract  
Dermatitis and, with prolonged exposure, blistering  
Anorexia • Nausea • Vomiting

# TETRACHLOROETHYLENE (*cont'd.*)

## SIGNS AND SYMPTOMS (*cont'd.*):

Headache • Dizziness • Drowsiness • Mental confusion •  
Slurred speech • Ataxia • Tremors  
Peripheral neuropathy has occurred  
Cardiac arrhythmias and Raynaud's phenomenon have also  
been reported

## DIAGNOSTIC TESTS:

Tetrachloroethylene in expired air and in blood  
Trichloro acetic acid in urine

## TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Symptomatic and supportive

## DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing  
Physical examination of exposed personnel at regular intervals with special attention to the nervous system and including studies of liver and kidney function  
Preclude from exposure those with central nervous system, liver, and kidney disease

- Abedin, Z. et.al. 1980. Cardiac toxicity of perchloroethylene (a dry cleaning agent). *So. Med. J.* 73:1081.  
Lanwerys, R. et.al. 1983. Health surveillance of workers exposed to tetrachloroethylene in dry cleaning shops. *Int. Arch. Occup. Environ. Hlth.* 52:69.  
Sparrow, G.P. 1977. A connective tissue disorder similar to vinyl chloride disease in a patient exposed to perchlorethylene. *Clin. & Experimental Derm.* 2:17.

## TETRACHLORO SALICYLANILIDE

### Synonyms:

3,5-Dichloro-N-(3,4-dichlorophenyl)-2-hydroxy benzamide

### Description:

White crystals

### Occupational Exposure:

Bacteriostat • Coolants • Cutting oils

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Percutaneous

#### MODE OF ACTION:

Sensitizer

#### SIGNS AND SYMPTOMS:

Photodermatitis

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Sensitization may be permanent

### Preventive Measures:

Rubber gloves

Remove from exposure those who become sensitized

## TETRAHYDROFURAN

### Synonyms:

Diethylene oxide • Tetramethylene oxide

## TETRAHYDROFURAN (*cont'd.*)

### Description:

Clear liquid, ethereal odor

### Occupational Exposure:

Adhesives • Chemical synthesis • Lacquers • Printing inks • Solvent

### Threshold Limit Value:

200 ppm • 590 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Central nervous system depression is possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

Headache • Dizziness • Nausea

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

## TETRALIN

### Synonyms:

Naphthalene tetrahydride • Tetrahydronaphthalene

## TETRALIN (*cont' d.*)

### Description:

Colorless liquid, pungent odor

### Occupational Exposure:

Chemical synthesis • Degreasing • Solvent • Turpentine substitute

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Eczematous dermatitis

Irritation of respiratory tract

Headache • Fatigue

Nausea • Vomiting

#### DIAGNOSTIC TESTS:

Tetralyl glucuronic acid in urine

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves



# TETRAMETHYL THIURAM DISULFIDE

## Synonyms:

Bis(dimethyl thiocarbamyl) disulfide • Thiram • TMTD

## Description:

White to yellow crystals, sweetish odor

## Occupational Exposure:

Animal repellent • Antioxidant • Bacteriostat • Fungicide • Synthetic rubber • Wood preservative

## Threshold Limit Value:

5 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant and sensitizer

Inhibits aldehyde dehydrogenase

When heated to decomposition yields nitrogen and sulfur oxides

Metabolized to carbon disulfide?

### SIGNS AND SYMPTOMS:

Conjunctivitis

Rhinitis with sneezing and epistaxis

Allergic dermatitis has been reported

Nausea, vomiting, and diarrhea

An exposed worker who drinks alcohol may develop flushing of the face and hands, pruritis and urticaria, tachycardia, and other symptoms of an antabuse-like reaction

### DIAGNOSTIC TESTS:

Patch test may be positive

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

## TETRAMETHYL THIURAM DISULFIDE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing

No eating or smoking in work area

Education of employees regarding the disulfiram syndrome

Hills, B.W. and Venable, H.L. 1982. The interaction of ethyl alcohol and industrial chemicals. *Am. J. Ind. Med.* 3:321.

## TETRANITRO METHANE

### Synonyms:

None

### Description:

Yellowish liquid, acrid odor

### Occupational Exposure:

Analytic reagent • Chemical reagent • Diesel fuel additive • Rocket fuel

### Threshold Limit Value:

1 ppm • 8 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

Methemoglobin formation is possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes and respiratory tract with dyspnea, cough, and chest pain

Dermal burns may occur

# TETRANITRO METHANE (*cont'd.*)

## SIGNS AND SYMPTOMS (*cont'd.*):

Methemoglobinemia is characterized by headache, cyanosis, dizziness, weakness, numbness of the extremities, dyspnea, chest pain, tachycardia, nausea, vomiting, abdominal pain, malaise, syncope, and convulsions

## DIAGNOSTIC TESTS:

Methemoglobin determination

## TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in normal manner

If methemoglobinemia occurs from inhalation:

Terminate exposure

Determine degree of methemoglobin hourly until a decline is well established

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour but do not exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, and hemodialysis have all been used

Symptomatic and supportive

## DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Routine checking of exposed personnel for signs of cyanosis

Preclude from exposure those with anemia, cardiovascular or pulmonary disease

## TETRYL

### Synonyms:

Nitramine • Tetranitro methyl aniline • 2,4,6-Trinitro phenyl-methyl nitramine

### Description:

Yellow crystals

### Occupational Exposure:

Chemical indicator • Explosives

### Threshold Limit Value:

1.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Sensitizer

Liver damage and marrow depression may occur

#### SIGNS AND SYMPTOMS:

##### *Acute:*

Conjunctivitis • Keratitis

Nasal irritation with itching, sneezing, and epistaxis;  
often associated with throat irritation and cough

Erythemato-vesicular dermatitis, especially about the  
face; massive edema has also been reported

Yellow discoloration of the skin and hair

##### *Chronic:*

Anorexia • Nausea • Vomiting • Abdominal cramps •  
Diarrhea

Headache • Malaise • Fatigue • Weight loss • Insomnia •  
Irritability

Chronic hepatitis, anemia, and menstrual disorders have  
also been reported

#### DIAGNOSTIC TESTS:

None established

## TETRYL (*cont'd.*)

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with 5% sodium sulfite, then with soap and water

Symptomatic and supportive

### DISABILITY:

Sensitization may be permanent

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

Compulsory shower at end of work shift using a sodium sulfite indicator soap

No eating or smoking in work area

Physical examination of exposed personnel on a regular basis including a blood count and studies of liver function

Preclude from exposure those with allergies, blood, skin, and liver diseases

Remove from exposure those who become sensitized

## THALLIUM AND COMPOUNDS

### Synonyms:

Thallous-acetate, -bromide, -chloride, -oxides, -sulfide

### Description:

Elemental thallium is a blue-white metal

Compounds are white, yellow, and black crystals

### Occupational Exposure:

Alloys • Catalyst • Electrodes • Insecticides • Photocells • Rodenticides

### Threshold Limit Value:

Soluble compounds — 0.1 mg/m<sup>3</sup>

### Toxicity: *HIGHLY TOXIC*

### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

## THALLIUM AND COMPOUNDS (*cont' d.*)

### MODE OF ACTION:

Thallium is a cumulative toxin

Irritant and sensitizer

Causes damage to the liver, kidneys, and central nervous system

Inhibits oxidative phosphorylation

### SIGNS AND SYMPTOMS:

Metallic taste • Abdominal pain • Weight loss

Nervous irritability and fatigue with headaches

Peripheral neuritis with pains in legs and joints

Albuminuria • Hematuria

Alopecia

When soluble salts are ingested the effects are more serious:

Nausea, vomiting, abdominal pain, hematemesis, and bloody diarrhea

Painful peripheral neuropathy with tremors that may be followed by ocular and facial paralysis

Chest pain, tachycardia, and convulsions

Alopecia doesn't occur until about the third week

### DIAGNOSTIC TESTS:

Thallium in blood, urine, and feces. It is suggested that urine levels above 50 µg/L indicate abnormal exposure.

### TREATMENT: *INGESTION REQUIRES EMERGENCY CARE*

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage within the first 4 hours followed by a colloidal solution of Prussian Blue (250 mg/kg/day in divided doses) to aid intestinal excretion

Hospitalize for maintenance of fluid and electrolyte balance, potassium chloride administration to replace thallium intracellularly, diuresis, and supportive care

Hemoperfusion and hemodialysis have been used

Dithiocarb is contraindicated

Symptomatic and supportive

### DISABILITY:

No permanent effects have been reported from occupational exposures

## THALLIUM AND COMPOUNDS (*cont'd.*)

### Preventive Measures:

- Adequate ventilation • Approved respiratory protection • Protective coveralls, changed daily
- Good personal hygiene • No eating or smoking in work areas
- Physical examination of exposed personnel on a regular basis with special attention to the nervous system and including a blood count, urinalysis, and studies of liver and kidney function
- Preclude from exposure those with diseases of the liver, kidneys, and central nervous system

Bank, W.J. et.al. 1972. Thallium poisoning. *Arch. Neurol.* 26:456.

Brockhaus, A. et.al. 1981. Intake and health effects of thallium among a population living in the vicinity of a cement plant emitting thallium containing dust. *Int. Arch. Occup. Environ. Hlth.* 48:375.

Kamerbeck, H.H. 1972. Special communication: Thallium poisoning. *Clin. Toxicol.* 5:89.

Marcus, R.L. 1985. Investigation of a working population exposed to thallium. *J. Soc. Occup. Med.* 35:4.

## THIOGLYCOLIC ACID

### Synonyms:

Mercapto acetic acid

### Description:

Colorless liquid, offensive odor

### Occupational Exposure:

Depilatories • Permanent wave solution • Pharmaceuticals • Thioglycolate manufacture

### Threshold Limit Value:

1 ppm • 4 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

None

#### MODE OF ACTION:

Irritant • Sensitizer

Evolves hydrogen sulfide on decomposition



## THIOGLYCOLIC ACID (*cont'd.*)

### SIGNS AND SYMPTOMS:

- Conjunctivitis
- Papulo-vesicular eruptions and urticaria
- Dermal burns may occur
- Anorexia

### DIAGNOSTIC TESTS:

- None established

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Treat burns in normal manner
- Symptomatic and supportive

### DISABILITY:

- No permanent effects reported

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Rubber gloves
- Remove from exposure those who become sensitized

## THIONYL CHLORIDE

### Synonyms:

- Sulfurous oxychloride • Sulfur oxychloride

### Description:

- Yellow to red liquid

### Occupational Exposure:

- Catalyst • Chemical synthesis • Chlorinating agent • Pesticide

### Threshold Limit Value:

- None established

### Toxicity:

### ROUTE OF ENTRY:

- Inhalation



## THIONYL CHLORIDE (*cont' d.*)

### MODE OF ACTION:

Corrosive

Decomposes to hydrochloric acid and sulfur dioxide

### SIGNS AND SYMPTOMS:

Conjunctivitis • Rhinitis and pneumonitis

Dermal burns

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Oxygen with IPPB; a 5% solution of sodium bicarbonate as an aerosol may be used along with bronchodilators and decongestants

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective clothing

## TIN AND INORGANIC COMPOUNDS

### Synonyms:

Sodium and potassium stannate • Stannous chloride, -oxide, -sulfate  
• Tin oxide, -peroxide, -tetrachloride

### Description:

Element is silver-white metal

Compounds are crystals and powders

### Occupational Exposure:

Metal is used in alloys, coatings, solders, and packaging

Compounds are used in ceramics and porcelain, enamels, fungicides, mordants, silk treatment, and tanning

## TIN AND INORGANIC COMPOUNDS (*cont' d.*)

### Threshold Limit Value:

2 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Compounds are irritants

#### SIGNS AND SYMPTOMS:

Inhalation of the metal produces a benign pneumoconiosis known as stannosis which is entirely asymptomatic

Compounds cause local irritation to the eyes, nose, and skin

#### DIAGNOSTIC TESTS:

Chest x-ray in stannosis reveals very dense small opacities with no fibrotic changes

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Gloves when handling irritant compounds

Physical examination of those exposed to tin dusts at regular intervals including a chest x-ray

## TIN (ORGANIC COMPOUNDS)

### Synonyms:

Dialkyl salts, e.g., Dibutyl tin chloride • Tributyl tin chloride • Others

Trialkyl salts, e.g., Trimethyl tin chloride • Triethyl tin • Triphenyl tin acetate • Others

## TIN (ORGANIC COMPOUNDS) (*cont' d.*)

### Description:

White to yellow liquids and crystals

### Occupational Exposure:

Anthelmintics • Catalysts • Dyeing • Fungicide • Heat stabilizers •  
Insecticide • Marine paints • Preservatives • Printing • Rubber  
manufacture

### Threshold Limit Value:

0.1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritants and vesicants

Hepatotoxin

Alkyl and aromatic compounds are cumulative neurotoxins

#### SIGNS AND SYMPTOMS:

Dialkyl salts in general:

Conjunctivitis and pharyngitis with cough

Dermal burns from liquid contact may be delayed several  
hours and are characterized by itchy erythema with  
blistering but little pain

Vapor exposure causes a diffuse erythematous eruption  
with pruritis; folliculitis and pustulation are unusual

Trialkyl salts in general:

Headache • Irritability • Insomnia • Malaise

Anorexia • Nausea • Vomiting • Abdominal pain •  
Diarrhea

Conjunctivitis and skin irritation can occur

Hepatomegaly and altered liver enzymes

Epileptiform seizures

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

## TIN (ORGANIC COMPOUNDS) (*cont'd.*)

### TREATMENT (*cont'd.*):

- Wash contaminated areas of body with soap and water
- Treat burns in normal manner
- Symptomatic and supportive

### DISABILITY:

- Eye damage has resulted in permanent impairment

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection • Polyvinyl gloves, aprons, and boots
- No eating or smoking in work area • Good personal hygiene
- Physical examination of exposed personnel on a regular basis with special attention to the skin and central nervous system and including studies of liver function

Fortemps, E. et.al. 1978. Trimethyl tin poisoning—Report of two cases. *Int. Arch. Occup. Environ. Hlth.* 41:1.

Piver, W.T. 1973. Organotin compounds: Industrial application and biological invertization. *Environ. Hlth. Perspect.* 4:61.

## TITANIUM AND COMPOUNDS

### Synonyms:

- Elemental titanium • Titanium dioxide (titanium white) • Titanium tetrachloride (titanic chloride)

### Description:

- Element is a dark gray metal
- Titanium dioxide is a white pigment
  - Rutile, natural  $\text{TiO}_2$  contains up to 10% iron and is red-brown
  - Anatase is the crystalline form of  $\text{TiO}_2$
- Titanium tetrachloride is a colorless liquid, pungent odor

### Occupational Exposure:

- Alloys • Ceramics • Coatings • Cosmetics • Inks • Mordants • Paint • Pharmaceuticals • Plastics • Rubber • Smoke screens • Welding rods

## TITANIUM AND COMPOUNDS (*cont'd.*)

### Threshold Limit Value:

Titanium dioxide — 5 mg/m<sup>3</sup> respirable dust

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Titanium and titanium dioxide are nontoxic

Titanium tetrachloride reacts with moisture to produce hydrochloric acid and heat

#### SIGNS AND SYMPTOMS:

Titanium dioxide reports vary from no reaction to cough, dyspnea, chest tightness, and wheezing without impairment

Titanium tetrachloride causes conjunctivitis, keratitis, rhinitis, tracheitis, bronchitis, and skin burns; a metal fume fever-type syndrome does occur

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT: For titanium tetrachloride

Irrigate eyes with water

Wipe contaminated areas of body gently with towels or cotton waste, then cleanse with soap and water

Treat skin burns in normal manner

Oxygen, with IPPB, bronchodilators, and decongestants

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection

Physical examination of exposed personnel annually including chest x-ray and pulmonary function studies

Preclude from exposure those with pulmonary disease

## TITANIUM AND COMPOUNDS (*cont' d.*)

- Daum, S. et.al. 1977. Pulmonary changes among titanium workers. *Proc. R. Soc. Med.* 70:31.
- Rode, L.E. 1981. Massive pulmonary deposition of rutile after titanium dioxide exposure. *Acta Pathol. Microbiol. Scand. Sect. A Pathol.* 89:455.

## TOLUENE

### Synonyms:

Methyl benzene • Phenyl methane • Toluol

### Description:

Colorless liquid, aromatic odor

### Occupational Exposure:

Adhesives • Chemical synthesis • Detergents • Dyes • Explosives • Fuel • Paints and lacquers • Pharmaceuticals • Printing • Solvent

### Threshold Limit Value:

100 ppm • 375 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Kidney and liver damage can occur

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis  
Defatting dermatitis • Skin paresthesias  
Respiratory tract irritation with chemical pneumonitis  
Headache, dizziness, drowsiness, mental confusion, incoordination, and ataxia followed by narcosis  
Anorexia • Nausea • Vomiting  
Liver and kidney damage in massive exposures with hepatomegaly, albuminuria, hematuria, and oliguria

## TOLUENE (*cont'd.*)

### DIAGNOSTIC TESTS:

Toluene in expired air and blood  
Hippuric acid in urine (normal < 1.5 g/g creatinine)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

Permanent central nervous system changes have been reported

### Preventive Measures:

Ascertain benzene content of all toluene used  
Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves  
Physical examination of exposed personnel on a regular basis with special attention to the eyes and nervous system and including a blood count and studies of liver and kidney function  
Preclude from exposure those with diseases of the central nervous system, liver, and kidneys

Benignus, V.A. 1981. Health effects of toluene: A review. *Neurotoxicol.* 2:567.

Cohr, K.H. and Stokholm, J. 1979. Toluene: A toxicologic review. *Scand. J. Work Environ. Hlth.* 5:71.

Magnussen, Z. and Fossan, G.O. 1983. Chronic toluene poisoning. *Tidsskr. Nor. Laege Foren.* 103:2039 and 2056.

## TOLUENE DIAMINE

### Synonyms:

Diamino toluene • *meta*-Tolylene diamine • Toluene-2,4-diamine

### Description:

Colorless crystals

### Occupational Exposure:

Dye intermediate • Plastics



## TOLUENE DIAMINE (*cont' d.*)

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Mild irritant

Central nervous system depression is possible

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

Adverse reproductive effects have been reported

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles and respiratory protection as indicated

## TOLUIDINE

### Synonyms:

Three isomers: *ortho*-, *meta*-, *para*-

### Description:

Colorless liquid or flakes

### Occupational Exposure:

Chemical synthesis • Dyes • Plastics • Printing dyes



## TOLUIDINE (*cont' d.*)

### Threshold Limit Value:

*o*-Toluidine — 2 ppm • 9 mg/m<sup>3</sup>

Suspect carcinogen

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Central nervous system depressant

Methemoglobinemia is possible

#### SIGNS AND SYMPTOMS:

Local irritaiton

Methemoglobinemia formation would be accompanied by headache, cyanosis, dizziness, weakness, numbness of the extremities, dyspnea, chest pain, tachycardia, nausea, vomiting, abdominal pain, malaise, syncope, and convulsions

#### DIAGNOSTIC TESTS:

Methemoglobin determination

#### TREATMENT:

Terminate exposure

Remove all clothing

Wash and scrub total body surface including ear canals, nasal vestibules, and area beneath nails; this decontamination may have to be repeated

Determine degree of methemoglobin hourly until a decline is well established

Gastric lavage, if ingested, followed by saline catharsis

Oxygen, using IPPB, if available

Methylene blue is usually not recommended unless methemoglobin level is above 40%: use a 1% solution in a dose of 1 mg/kg body weight and administer intravenously, repeat in one hour but do not exceed a total dose of 7 mg/kg

Hyperbaric oxygen, blood transfusions, and hemodialysis have all been used

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

## TOLUIDINE (*cont' d.*)

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing, laundered daily • Synthetic butyl gloves and boots  
Good housekeeping  
Routine checking of lips, tongue, and nail beds of exposed personnel for signs of cyanosis  
Preclude from exposure those with anemia, cardiovascular, or pulmonary disease

## TRICHLOROACETIC ACID

### Synonyms:

TCA

### Description:

Colorless crystals, pungent odor

### Occupational Exposure:

Chemical synthesis • Herbicide • Pharmaceuticals

### Threshold Limit Value:

1 ppm • 7 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant and corrosive

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal burns

Dermal burns

Respiratory tract irritation

#### DIAGNOSTIC TESTS:

None established

## TRICHLOROACETIC ACID (*cont' d.*)

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat burns in normal manner  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## TRICHLOROETHANE

### Synonyms:

1,1,1-Trichloroethane (methyl chloroform) • 1,1,2-Trichloroethane (vinyl trichloride)

### Description:

Colorless liquids, sweetish odor

### Occupational Exposure:

Degreasing • Dry cleaning • Pesticide • Propellant • Solvent  
There appears to be no report of adverse occupational exposure to 1,1,2-trichloroethane

### Threshold Limit Value:

10 ppm • 45 mg/m<sup>3</sup> (1,1,2 trichloroethane)  
350 ppm • 1900 mg/m<sup>3</sup> (methyl chloroform)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Liver and kidney damage

#### SIGNS AND SYMPTOMS:

*Neurologic:* Headache • Dizziness • Drowsiness • Incoordination • Ataxia • Paresthesias • Narcosis

## TRICHLOROETHANE (*cont' d.*)

### SIGNS AND SYMPTOMS (*cont' d.*):

*Gastrointestinal:* Nausea and vomiting • Hepatic dysfunction  
*Cardiovascular:* Hypotension • Bradycardia • Cardiac arrhythmias  
*Skin:* Defatting dermatitis with erythema  
Conjunctivitis

### DIAGNOSTIC TESTS:

Trichloroethane in expired air and blood  
Trichloroethanol and trichloroacetic acid in urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Gastric lavage, if ingested, followed by saline catharsis  
Cardiorespiratory support as indicated  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Neoprene gloves  
Physical examination of exposed personnel on a regular basis including studies of liver and kidney function  
Preclude from exposure those with diseases of the skin, liver, and kidneys

Jones, R.D. and Winter, D.P. 1983. Two case reports of deaths on industrial premises attributed to 1,1,1-trichloroethane. *Arch. Environ. Hlth.* 38:59.

Northfield, R.R. 1981. Avoidable deaths due to acute exposure to 1,1,1-trichloroethane. *J. Soc. Occup. Med.* 31:164.

Parker, J.C. et.al. 1979. Chloroethanes: A review of toxicity. *Am. Ind. Hyg. Assoc. J.* 40:A46.

# TRICHLOROETHYLENE

## Synonyms:

Ethynyl trichloride • Trichloroethene

## Description:

Colorless liquid, chloroform-like odor

## Occupational Exposure:

Adhesive solvent • Chemical synthesis • Degreasing • Dry cleaning •  
Fumigant • Lacquers and paints • Pharmaceuticals • Refrigerant •  
Textile processing

## Threshold Limit Value:

50 ppm • 270 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant • Central nervous system depressant

Cardiac sensitization

Liver and kidney damage

Decomposes at high temperature to hydrochloric acid and phosgene

On contact with soda lime decomposes to dichloro acetylene and phosgene

### SIGNS AND SYMPTOMS:

#### *Local:*

Conjunctivitis

Prolonged dermal contact can result in vesiculation and burns, but additionally paresthesias and paralysis of the digits have been reported

#### *Inhalation:*

Headache, dizziness, drowsiness, irritability, and finally unconsciousness

Respiratory tract irritation can be severe

Nausea and vomiting with abdominal cramps

Cardiac arrhythmias and ventricular fibrillation

Degreaser's flush may not occur until the individual has

## TRICHLOROETHYLENE (*cont'd.*)

### SIGNS AND SYMPTOMS (*cont'd.*):

#### *Inhalation (cont'd.):*

been exposed several weeks, but then after ingesting alcohol there is a transient vasodilation producing bright red blotches about the face, neck, shoulders, and back

Chronic exposures may result in anosmia, diplopia, altered color perception, and even blindness

Trigeminal neuralgia with anesthesia and facial weakness may also occur

### DIAGNOSTIC TESTS:

Trichloroethylene in expired air

Trichloroethanol and trichloro acetic acid in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Gastric lavage, if ingested, followed by saline catharsis

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection (canisters containing alkaline material should not be used because dichloroacetylene can be formed) • Polyvinyl gloves, aprons, and boots

Physical examination of exposed personnel at regular intervals with special attention to the nervous system and including studies of liver and kidney function

Preclude from exposure those with disease of the central nervous system, lungs, liver, and kidneys

Antti-Poika, M. 1982. Prognosis of symptoms in patients with diagnosed chronic organic solvent intoxication. *Int. Arch. Occup. Environ. Hlth.* 51:81.

Barret, L. et.al. 1982. Evoked trigeminal nerve potential in chronic trichloroethylene intoxication. *J. Toxicol.-Clin. Toxicol.* 19:419.

Hills, B.W. and Venable, H.L. 1982. The interaction of ethyl alcohol and industrial chemicals. *Am. J. Ind. Med.* 3:321.

# TRICHLOROPHENOL

## Synonyms:

2,4,5-Trichlorophenol

## Description:

Colorless liquid

## Occupational Exposure:

Fungicide • Racer gas

## Threshold Limit Value:

None established

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Could interfere with oxidative phosphorylation

### SIGNS AND SYMPTOMS:

Irritation of the eyes and nose

Bronchitis and pulmonary edema with cough, dyspnea, and wheezing

### DIAGNOSTIC TESTS:

None established

Chest x-rays may show changes

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Alexanderson, R. and Hedenstierna, G. 1982. Pulmonary function after long term exposure to trichloro phenol. *Int. Arch. Occup. Environ. Hlth.* 49:275.

# 1,2,3-TRICHLOROPROPANE

## Synonyms:

Allyl trichloride • Glycerol trichlorohydrin

## Description:

Colorless liquid, unpleasant odor

## Occupational Exposure:

Degreasing • Paint and varnish remover • Solvent

## Threshold Limit Value:

50 ppm • 300 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Central nervous system depression is possible

### SIGNS AND SYMPTOMS:

Irritation of eyes, nose, and throat

Headache

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection



# TRICRESYL PHOSPHATES

## Synonyms:

Three isomers: *ortho*-, *meta*-, *para*- • TMCP • TOCP • Tolyl phosphates: *o*-, *m*-, *p*- • TPCP

## Description:

Colorless, oily liquids

## Occupational Exposure:

Flame retardant • Heat exchange medium • Hydraulic fluid • Lubricant additive • Plasticizer • Resin binder • Solvent • Waterproofing

## Threshold Limit Value:

Tri-*o*-cresyl phosphate — 0.1 mg/m<sup>3</sup>

**Toxicity:** Outbreaks of poison have consistently followed the accidental ingestion of food and drink contaminated with these compounds, especially the very toxic *ortho* isomer

## ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

## MODE OF ACTION:

Pseudocholinesterase inhibitor

Neurotoxin involving the axis cylinders and myelin sheaths of peripheral motor nerves

**SIGNS AND SYMPTOMS:** These all relate to *ingestion*

Prodromal: Nausea, vomiting, abdominal pain, and diarrhea

Followed by an asymptomatic latent period of 3–28 days

Then: Pain and weakness of the extremities followed by progressive bilateral foot and wrist drop over a period of several days • Sensory involvement may not be severe

Severe intoxications are accompanied by more intense and more serious nerve afflictions

## DIAGNOSTIC TESTS:

None established

## TREATMENT:

Prompt decontamination of any accidental workplace contacts  
Symptomatic and supportive

## TRICRESYL PHOSPHATES (*cont' d.*)

### DISABILITY:

No occupational impairments have been reported  
Neurologic damage can be both severe and permanent

### Preventive Measures:

Educate employees  
Appropriate protective measures including respiratory protection,  
long sleeve coveralls, gloves, and boots  
No eating or smoking in work area  
Good personal hygiene  
Physical examination of exposed personnel at regular intervals with  
special attention to the nervous system  
Preclude from exposure those with diseases of the central nervous  
system

Senanayake, N. 1981. Toxic polyneuropathy due to gingili oil  
contaminated with tri-cresyl phosphate affecting adolescent girls in  
Sri Lanka. *Lancet* I:88.

## TRIETHYLAMINE

### Synonyms:

N,N-diethyl ethanamine

### Description:

Colorless liquid, ammoniacal odor

### Occupational Exposure:

Chemical synthesis • Core binding resin • Corrosion inhibitor •  
Propellant • Rubber accelerator

### Threshold Limit Value:

10 ppm • 40 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

## TRIETHYLAMINE (*cont'd.*)

### MODE OF ACTION:

Irritant and corrosive

### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis with hazy vision and halos

Dermal burns

Respiratory tract irritation with cough and dyspnea if inhaled

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat skin burns in normal manner

Cardiorespiratory support as indicated

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Akesson, B. et.al. 1985. Visual disturbances after experimental human exposure to triethylamine. *Brit. J. Ind. Med.* 42:848.

## TRIMELLITIC ANHYDRIDE

### Synonyms:

Anhydro trimellitic acid • 4-Carboxy phthalic anhydride • TMA

### Description:

Crystals

### Occupational Exposure:

Agricultural chemicals • Dyes and pigments • Epoxy curing agent •  
Paints and coatings • Pharmaceuticals • Plasticizers • Resins

## TRIMELLITIC ANHYDRIDE (*cont' d.*)

### Threshold Limit Value:

0.005 ppm • 0.04 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation, dusts or fumes

#### MODE OF ACTION:

Irritant

Sensitizer—appears to combine with serum albumin or red blood cells to form a trimellitic-protein complex

#### SIGNS AND SYMPTOMS: Four clinical syndromes have been proposed

Irritant response—dose related without sensitization, consisting of rhinorrhea sometimes with epistaxis and cough

Immediate onset rhinitis and asthma

Follows a work exposure period of weeks–years

Characterized by rhinorrhea, cough, and asthma

Once sensitized, patient's symptoms appear almost immediately upon reexposure

Mediated by IgE antibody

Late respiratory syndrome—"TMA flu"

Follows a work exposure period of weeks–years

Cough, dyspnea, wheezing, and sputum production occur 4–12 hours post exposure

Associated with malaise, chills, fever, and myalgia

Pulmonary disease—anemia syndrome

Frequently related to exposure of hot TMA fumes

Latent period seldom exceeds weeks of exposure

Cough, dyspnea, hemoptysis, and chest discomfort

Associated with pulmonary infiltrates, compromised respiratory function and anemia (via hemolysis?)

#### DIAGNOSTIC TESTS:

Skin test may be positive

RAST may be positive

X-rays show scattered areas of pulmonary edema throughout lung fields

## TRIMELLITIC ANHYDRIDE (*cont'd.*)

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Sensitization is probably permanent

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Protective clothing

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the respiratory tract and including a chest x-ray and pulmonary function test

Preclude from exposure those with pulmonary disease

McGrath, K.G. et.al. 1984. Four-year evaluation of workers exposed to trimellitic anhydride. *JOM* 26:671.

Paterson, R. et.al. 1979. Antihapten antibodies in workers exposed to trimellitic anhydride fumes: A potential immunopathogenic mechanism for the trimellitic anhydride pulmonary disease-anemia syndrome. *Am. Rev. Resp. Dis.* 120:1259.

Zeiss, C.R. et.al. 1980. Quantitation and new antigenic determinant specificity of antibodies induced by inhalation of trimellitic anhydride in man. *Int. Arch. Allergy Appl. Immunol.* 61:380.

## TRIMETHYLAMINE

### Synonyms:

N,N-dimethyl methanamine

### Description:

Colorless gas, ammoniacal odor

### Occupational Exposure:

Chemical synthesis • Corrosion inhibitor • Disinfectant manufacture  
• Ion exchange resins

### Threshold Limit Value:

10 ppm • 24 mg/m<sup>3</sup>

## TRIMETHYLAMINE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritation

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis

Petechiae of skin and skin burns

Respiratory tract irritation might be anticipated

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat dermal burns in normal manner

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

1980. Workplace environmental exposure level guide: Trimethylamine.  
*Am. Ind. Hyg. Assoc. J.* 41:A35.

## TRIMETHYL BENZENES

### Synonyms:

Hemimellitene (1,2,3-trimethyl benzene) • Mesitylene (1,3,5-trimethyl benzene) • Pseudocumene (1,2,4-trimethyl benzene)

### Description:

Colorless liquids

## TRIMETHYL BENZENES (*cont'd.*)

### Occupational Exposure:

Dyes • Perfumes • Resins • Solvents

### Threshold Limit Value:

25 ppm • 125 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Thrombocytopenia has been reported

#### SIGNS AND SYMPTOMS:

Irritation of eyes and skin  
Nose and throat irritation • Bronchitis  
Headache • Fatigue • Drowsiness

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

## 2,4,6-TRINITRO TOLUENE

### Synonyms:

Methyl trinitrobenzene • TNT • *sym*-Trinitro toluene • *a*-Trinitro toluol

## 2,4,6-TRINITRO TOLUENE (*cont' d.*)

### Description:

Yellow crystals

### Occupational Exposure:

Dyestuffs • Explosives • Photographic chemicals

### Threshold Limit Value:

0.5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant and sensitizer

Liver and kidney damage

Aplastic anemia

Methemoglobinemia is possible

#### SIGNS AND SYMPTOMS:

Conjunctivitis • Cataracts have been associated with chronic exposures

Respiratory tract irritation with sneezing, cough, and sore throat

Yellow-orange discoloration of hands, nails, face, and hair

Erythematopapular dermatitis and eczema commonly involve the exposed skin surfaces

Hepatomegaly and jaundice

Peripheral neuritis and muscular pains have been reported

Purpura may accompany the anemia

#### DIAGNOSTIC TESTS:

TNT or 2,6-dinitro-4-aminotoluene in urine

Methemoglobinemia

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Treat methemoglobinemia if it occurs

Symptomatic and supportive



## 2,4,6-TRINITRO TOLUENE (*cont'd.*)

### DISABILITY:

Permanent impairment is possible

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves and protective coveralls

Good personal hygiene

Physical examination of exposed personnel at regular intervals with special attention to the eyes and skin and including a blood count and liver function studies

Preclude from exposure those with blood and liver diseases

Goodwin, J.W. 1972. Twenty years handling TNT in a shell loading plant. *Am. Ind. Hyg. Assoc. J.* 33:41.

Hathaway, J.A. 1977. Trinitro toluene: A review of reported dose-related effects providing documentation for a workplace standard. *JOM* 19:341.

## TUNG OIL

### Synonyms:

Chinawood oil

### Description:

Yellow liquid

### Occupational Exposure:

Paints and varnishes • Waterproofing

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

None

#### MODE OF ACTION:

Irritant • Sensitizer

## TUNG OIL (*cont' d.*)

### SIGNS AND SYMPTOMS:

Irritation of eyes  
Vesicular dermatitis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Chemical goggles • Rubber gloves

## TUNGSTEN CARBIDE

### Synonyms:

Hard metal

### Description:

Cemented tungsten carbide is a tungsten-carbon alloy containing 5–15% cobalt and small amounts of nickel, chromium, titanium, or other metals

### Occupational Exposure:

Abrasives • Dies and cutting tools • Wear-resistant parts

### Threshold Limit Value:

Tungsten insoluble compounds — 5 mg/m<sup>3</sup>  
Tungsten soluble compounds — 1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

# TUNGSTEN CARBIDE (*cont' d.*)

## MODE OF ACTION:

Cobalt sensitization; compare Cobalt

## SIGNS AND SYMPTOMS:

Conjunctivitis and rhinitis

Pruritic dermatitis with urticaria and erythematous papules

Hard metal disease may follow several patterns:

Obstructive airways syndrome—after 6–18 months exposure—Cough, dyspnea, and wheezing relieved completely by cessation of exposure • Chest x-rays are normal

Interstitial pneumonitis similar to allergic alveolitis—Several hours after exposure the sensitized worker develops dyspnea, chest tightness, cough, and rales which subside in 12–24 hours • Chest x-rays may show minor changes such as slight linear opacities in the lower and mid zones • These patients exhibit a more intense patch test reaction to cobalt, but symptoms do subside if exposure ceases

Interstitial fibrosis—after 10 years or more exposure—Cough, dyspnea, tachypnea, and finger clubbing • Chest x-rays reveal nodular and reticular densities which progress to pulmonary fibrosis • Pulmonary function tests show restrictive disease

## DIAGNOSTIC TESTS:

History of exposure and clinical features as described

Cobalt patch tests may be positive

## TREATMENT:

Remove from exposure

Symptomatic and supportive

## DISABILITY:

Sensitization is permanent

Pulmonary impairment can occur

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel on a regular basis with special attention to the respiratory system and including a chest x-ray and pulmonary function tests

## TUNGSTEN CARBIDE (*cont'.d*)

### Preventive Measures (*cont'.d.*):

Preclude from exposure those with allergies and pulmonary disease  
Since dermatologic manifestations appear to precede the pulmonary changes, it has been suggested that employees with skin sensitization and positive patch tests should be removed from further exposure

Demedts, M. et.al. 1984. Cobalt lung in diamond polishers. *Am. Rev. Resp. Dis.* 130:130.

Morgan, L.G. 1983. A study into the health and mortality of men exposed to cobalt and oxides. *J. Soc. Occup. Med.* 33:181.

Sjögren, I. et.al. 1980. Hard metal lung disease: Importance of cobalt in coolants. *Thorax* 35:653.

## TURPENTINE

### Synonyms:

Gum thus • Oil of turpentine • Spirits of turpentine • Wood turpentine

### Description:

Colorless liquid, penetrating odor

### Occupational Exposure:

Insecticide • Perfumes • Pharmaceuticals • Polishes • Solvent • Textile industry • Thinner

### Threshold Limit Value:

100 ppm • 560 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

#### MODE OF ACTION:

Irritant • Central nervous system depressant  
Kidney damage  
Sensitizer

## TURPENTINE (*cont' d.*)

### SIGNS AND SYMPTOMS:

Conjunctivitis • Corneal burns  
Contact dermatitis • Allergic eczema  
Headache • Dizziness • Anxiety • Mental confusion  
Cough • Chest pain • Bronchitis  
Anorexia • Nausea • Vomiting • Abdominal colic • Diarrhea  
Oliguria • Hematuria • Albuminuria • Casts in urine

### DIAGNOSTIC TESTS:

Turpentine in vomitus and urine

### TREATMENT:

Irrigate eyes with water  
Wash contaminated areas of body with soap and water  
Treat skin burns in normal manner  
Gastric lavage, if ingested, followed by saline catharsis and then demulcents  
Severe exposures may require hospitalization for close monitoring

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Hellerström, S. and Raika, G. 1970. On the present situation of the research into turpentine allergy. *Allergie and Asthma Band.* 16 Heft 1/2:28.

# URANIUM AND COMPOUNDS

## Synonyms:

Multiple compounds of chlorides, fluorides, and nitrates

## Description:

Powders and crystals

## Occupational Exposure:

Alloys • Catalysts • Fuel for nuclear reactors • Glass and ceramics •  
Radium salts

## Threshold Limit Value:

0.2 mg/m<sup>3</sup>

Carcinogen

**Toxicity:** All compounds are both toxic and radioactive hazards

## ROUTE OF ENTRY:

Ingestion • Inhalation • Percutaneous

## MODE OF ACTION:

Soluble compounds are irritants producing pulmonary, hepatic, and renal damage

Radiation effects from chronic exposure result in lymphoma, osteosarcoma, and cancer of the lung

## SIGNS AND SYMPTOMS:

*Acute*—primarily the soluble compounds

Conjunctivitis and dermatitis including skin burns

Respiratory tract irritation with cough, dyspnea, rales, pneumonitis, and pulmonary edema

Oliguria, hematuria, and albuminuria

Jaundice

*Chronic*—primarily the effects of radiation from insoluble compounds

Pneumoconiosis and pulmonary fibrosis

Lymphoma, osteosarcoma, and lung cancer

## DIAGNOSTIC TESTS:

Uranium in urine (normal < 0.3 µg/g creatinine)

Whole body counting

## URANIUM AND COMPOUNDS (*cont' d.*)

### TREATMENT:

Irrigate eyes with water

Decontaminate body surfaces in keeping with radiation standards

Gastric lavage, if ingested, followed by saline catharsis

Calcium disodium edetate is recommended

Symptomatic and supportive

### DISABILITY:

Permanent impairment can occur

### Preventive Measures:

Familiarity with recommended procedures for handling radioactive materials is important

Adequate ventilation • Approved respiratory protection and protective clothing

Good personal hygiene

Physical examination of exposed personnel at regular intervals including studies of liver and kidney function as well as chest x-ray

Radiation monitoring as indicated

Preclude from exposure those with diseases of lungs, liver, and kidneys

Archer, V.E. 1981. Health concerns in uranium mining and milling. *JOM* 23:502.

Gottlieb, L.S. and Husen, L.A. 1982. Lung cancer among Navajo uranium miners. *Chest* 81:449.

# VANADIUM AND COMPOUNDS

## Synonyms:

Ammonium metavanadate • Sodium vanadite • Vanadium pentoxide • Others

## Description:

Vanadium is a silvery white solid  
Compounds are yellow powders and red crystals

## Occupational Exposure:

Alloys • Catalyst • Chemical reagents • Cleaning oil- and gas-fired boilers • Electronics • Glass and ceramics • Inks • Mordants • Paints • Pesticides • Photography

## Threshold Limit Value:

0.05 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Ammonium metavanadate and vanadium pentoxide appear to be irritants

Adverse effects are not reported with vanadium itself or other compounds

Sensitizer

### SIGNS AND SYMPTOMS:

Conjunctivitis with lacrimation and burning

Rhinitis with sneezing and epistaxis and sore throat

Cough, retrosternal discomfort, rales, dyspnea, and wheezing respiration accompany tracheitis, bronchitis, bronchopneumonia, and even pulmonary edema

A greenish discoloration of the tongue may be seen and complaints of metallic taste and gastrointestinal irritation have been reported

Headache, fatigue, and weakness have also been noted

Dermatitis and seborrhea-like eczema can occur

### DIAGNOSTIC TESTS:

Vanadium in urine (normal < 1 µg/g creatinine)

Patch test may be positive if eczema has occurred

Transitory decline in FEV<sub>1</sub> and FVC is common



## VANADIUM AND COMPOUNDS (*cont'd.*)

### TREATMENT:

- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Cardiorespiratory support as indicated
- Symptomatic and supportive

### DISABILITY:

- Respiratory symptoms may persist for years but no permanent effects are reported

### Preventive Measures:

- Adequate ventilation • Chemical goggles • Approved respiratory protection
- Physical examination of exposed personnel at regular intervals including tests of pulmonary function

Kiviluoto, M. 1980. Observations on the lungs of vanadium workers. *Brit. J. Ind. Med.* 37:363.

Lees, R.E.M. 1980. Changes in lung function after exposure to vanadium compounds in fuel oil ash. *Brit. J. Ind. Med.* 37:253.

Musk, A.W. and Tees, J.G. 1982. Asthma caused by occupational exposure to vanadium compounds. *Med. J. Australia* 1:183.

## VINYL ACETATE

### Synonyms:

- Acetic acid ethenyl ester • Acetic acid vinyl ester

### Description:

- Colorless liquid, sweetish odor

### Occupational Exposure:

- Adhesives • Chemical synthesis • Paper coating • Polyvinyl resins • Safety glass layer • Textile finishing

### Threshold Limit Value:

- 10 ppm • 30 mg/m<sup>3</sup>

## VINYL ACETATE (*cont' d.*)

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Irritation of eyes, skin, and respiratory tract

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Deese, D.E. et.al. 1969. Vinyl acetate: A study of chronic human exposure. *Am. Ind. Hyg. Assoc. J.* 30:449.

## VINYL CHLORIDE

### Synonyms:

Chloroethene • Chloroethylene • Ethylene monochloride • VC

### Description:

Colorless gas, ethereal odor

### Occupational Exposure:

Chemical synthesis • Manufacture of PVC and other resins • Plastics adhesive • Refrigerant • Solvent

# VINYL CHLORIDE (*cont'd.*)

## Threshold Limit Value:

5 ppm • 10 mg/m<sup>3</sup>

Specific OSHA regulations apply

Carcinogen

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant • Central nervous system depressant • Carcinogen

### SIGNS AND SYMPTOMS:

*Local:* Irritation of eyes and skin • Frostbite may follow direct contact with the liquid

*Neurologic:* Headache, dizziness, dulling of senses, fatigue, somnolence, and nausea • Central nervous system malignancies are under investigation

*Peripheral vascular effects:*

Paresthesias of the fingers and toes are frequently the presenting symptoms

Raynaud's phenomenon is now known to be associated with capillary circulatory changes

Scleroderma-like changes with thickened skin and raised nodules tend to affect the dorsal hands and distal forearms; extremities are cold, moist, and swollen

Acroosteolysis is an ischemic bone necrosis stemming from stenosing arteriolitis and involving primarily the terminal phalanges of the fingers but bone destruction has also occurred in the toes, radial, and ulnar styloid processes, sacroiliac joints, and patellae

*Liver:* Hepatic fibrosis associated with splenomegaly and portal hypertension has been reported • Hepatic angiosarcoma has occurred after latent periods of 4–32 years: reported symptoms include weakness, pleuritic pain, abdominal pain, gastrointestinal bleeding, and weight loss

*Pulmonary:* Respiratory irritation is not uncommon • Lung cancers are under investigation

Hematopoietic effects, lymphatic tremors, cytogenetic and reproductive effects are all under study

## VINYL CHLORIDE (*cont'd.*)

### DIAGNOSTIC TESTS:

Nailfold capillaroscopic abnormalities and angiography of the hands are helpful in peripheral vascular afflictions  
Thiodiglycolic acid in urine (normal < 2 mg/g creatinine)

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

Raynaud's phenomenon may persist and cause impairment  
Acroosteolysis may leave residuals  
Angiosarcoma is fatal

### Preventive Measures:

Closed systems with close monitoring of the work environment  
No eating or smoking in work areas  
Chemical goggles, protective coveralls with hood and gloves and protective footwear  
Approved respiratory protection  
Good personal hygiene  
Physical examination of exposed personnel on a regular basis with special attention to the target organs and special studies of peripheral circulation, studies of liver function and appropriate x-rays  
Preclude from exposure those with diseases which could be aggravated by exposure  
Special review should be made of those who are in the reproductive age groups

- Langauer-Lewoicka, H. et.al. 1983. Vinyl chloride disease—Neurological disturbances. *Int. Arch. Occup. Environ. Hlth.* 52:151.  
Milby, T.H. (ed.). 1978. Vinyl chloride: An information resource. DHEW Pub. No. (NIH) 78-1599. Washington, D.C.: U.S. Gov't. Printing Office.  
Spiras, R. and Kaminski, R. 1977. Angiosarcoma of the liver in vinyl chloride/polyvinyl chloride workers: 1977 update of the NIOSH register. *JOM* 20:427.  
Veltman, G. et.al. 1975. Clinical manifestations and course of vinyl chloride disease. *Ann. N.Y. Acad. Sci.* 246:6.

# VINYLDENE CHLORIDE

## Synonyms:

1,1-Dichloroethylene • VDC

## Description:

Clear liquid, sweetish odor

## Occupational Exposure:

Chemical synthesis • Resins

## Threshold Limit Value:

5 ppm • 20 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

Central nervous system depression is possible

Liver damage?

### SIGNS AND SYMPTOMS:

Irritation of eyes and skin

Narcosis

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection (canisters containing alkaline materials should not be used because dichloro acetylene can be formed) • Rubber gloves

Norris, J.M. Jan., 1977. The MCA-toxicology program for vinylidene chloride. European Tappi Meeting, Hamburg, Germany.

# VINYL TOLUENE

**Synonyms:**

Two isomers: *meta*-, *para*- • Methyl styrene

**Description:**

Colorless liquid

**Occupational Exposure:**

Chemical synthesis • Pharmaceuticals • Plastics

**Threshold Limit Value:**

50 ppm • 240 mg/m<sup>3</sup>

**Toxicity:****ROUTE OF ENTRY:**

Inhalation

**MODE OF ACTION:**

Irritant

**SIGNS AND SYMPTOMS:**

Conjunctivitis

Irritation of nose and throat

Dermatitis

**DIAGNOSTIC TESTS:**

Atrolactic acid in urine

**TREATMENT:**

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

**DISABILITY:**

No permanent effects reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

# XYLENE

## Synonyms:

Dimethyl benzene • Three isomers: *o*-, *m*-, *p*-xylene

## Description:

Clear liquid, aromatic odor

Commercial preparations may contain benzene

## Occupational Exposure:

Adhesives • Cements • Chemical synthesis • Cleaning fluids • Degreasing • Dyes • Fuel additive • Inks • Insect repellants • Paints and lacquers • Perfumes • Pharmaceuticals • Resins • Solvent

## Threshold Limit Value:

100 ppm • 435 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation • Percutaneous

### MODE OF ACTION:

Irritant

Central nervous system depression

Renal and hepatic damage

### SIGNS AND SYMPTOMS:

Conjunctivitis • Keratitis

Irritation of nose and throat

Defatting dermatitis

Headache • Vertigo • Mental confusion • Drowsiness • Ataxia • Narcosis

Anorexia • Nausea • Vomiting • Gastric discomfort

Renal and hepatic damage have been reported

### DIAGNOSTIC TESTS:

Xylene in expired air and blood

Methyl hippuric acid in urine

### TREATMENT:

Irrigate eyes with water

Wash contaminated areas of body with soap and water

Symptomatic and supportive

## XYLENE (*cont' d.*)

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Physical examination of exposed personnel on a regular basis with special attention to the eyes and central nervous system and including a blood count and studies of liver and kidney function

Preclude from exposure those with diseases of the central nervous system, liver, kidneys, and blood

Klaucke, D.N. et.al. 1982. An outbreak of xylene intoxication in a hospital. *Am. J. Ind. Med.* 3:173.

VonBurg, R. 1982. Toxicology updates: Xylene. *J. Appl. Toxicol.* 2:269.



# YTTRIUM AND COMPOUNDS

## Synonyms:

Yttrium chloride, -nitrate, -oxide, -phosphate

## Description:

Element is dark gray metal

Compounds are red to yellow powders

## Occupational Exposure:

Alloys • Gas mantles • Lasers • Semiconductors

## Threshold Limit Value:

1 mg/m<sup>3</sup>

## Toxicity:

### ROUTE OF ENTRY:

Inhalation

### MODE OF ACTION:

Irritant

### SIGNS AND SYMPTOMS:

Local and respiratory tract irritation are possible

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

## Preventive Measures:

Adequate ventilation • Approved respiratory protection

Physical examination of exposed personnel at regular intervals including a chest x-ray

## ZEOLITES

### Synonyms:

Chabaszite • Erionite • Mordenite • Others

### Description:

Fibrous hydrated aluminum, sodium, and/or calcium silicates occurring as natural minerals

Current exposures have been documented in the Karain-Tuzkoy area of Turkey

### Occupational Exposure:

Mining, milling, and processing • Adsorbents • Catalysts • Filters

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Carcinogen?

#### SIGNS AND SYMPTOMS:

No specific occupational diseases have been reported

Among the inhabitants of Turkish villages with demonstrated exposures to erionite there have been cases of:

Pleural fibrosis and calcification

Interstitial pulmonary fibrosis

Pleural and peritoneal mesothelioma

#### DIAGNOSTIC TESTS:

Biopsy

#### TREATMENT:

Symptomatic and supportive

#### DISABILITY:

Permanent impairment and death occur

### Preventive Measures:

Adequate ventilation and dust control

Isolation of work areas

## ZEOLITES (*cont' d.*)

### Preventive Measures (*cont' d.*):

Good working practices

Full protective equipment where adequate dust control is not achieved

Physical examination of exposed personnel annually including tests of pulmonary function and chest x-ray

Preclude from exposure those with pulmonary disease

Artvinli, M. and Barris, Y.I. 1982. Environmental fiber induced pleuro-pulmonary diseases in an Anatolian village: An epidemiologic study. *Arch. Environ. Health*. 37:177.

## ZINC CHLORIDE

### Synonyms:

Butter of zinc

### Description:

White powder

### Occupational Exposure:

Adhesives • Dehydrating agent • Disinfectant • Etchant • Electroplating • Fireproofing wood • Galvanizing • Mercerizing cotton • Mordant • Oil refining • Soldering flux • Smoke generator • Solvent • Steel manufacture • Taxidermy fluids • Vulcanizing rubber

### Threshold Limit Value:

Zinc chloride fume — 1 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

## ZINC CHLORIDE (*cont'd.*)

**SIGNS AND SYMPTOMS:** Most of these have been from smoke bomb fumes

Conjunctivitis • Corneal burns

Dermatitis, ulcers, and burns of skin

Rhinitis, pharyngitis, bronchopneumonia, and pulmonary edema with cough, dyspnea, chest tightness, retrosternal and epigastric pain, and cyanosis

**DIAGNOSTIC TESTS:**

None established

**TREATMENT:**

Irrigate eyes with water or 1.7% EDTA solution

Wash contaminated areas of body with soap and water

Treat skin burns in normal manner

Cardiorespiratory support as indicated

Symptomatic and supportive

**DISABILITY:**

Pulmonary impairment has been reported

**Preventive Measures:**

Adequate ventilation • Chemical goggles • Approved respiratory protection • Rubber gloves

Physical examination of exposed personnel at regular intervals including chest x-ray and pulmonary function studies

Johnstone, M.A. et.al. 1973. Experimental zinc chloride ocular injury and treatment with disodium edetate. *Am. J. Ophth.* 76:137.

Milliken, J.A. et.al. 1963. Acute interstitial pulmonary fibrosis caused by a smoke bomb. *Can. Med. Assoc. J.* 88:36.

Schmahl, K. 1974. Clinical signs in poisoning with fumes of zinc chloride. *Pneumonologie* 150:161.

## ZINC OXIDE

**Synonyms:**

Chinese white • Flowers of zinc • Zinc white

**Description:**

White powder

## ZINC OXIDE (*cont'd.*)

### Occupational Exposure:

Ceramics and glass • Cosmetics • Electrostatic copy paper • Feed additive • Ink pigment • Laboratory reagent • Matches • Paints • Pharmaceuticals • Photography • Pigment • Rubber manufacture • Welding

### Threshold Limit Value:

5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant

#### SIGNS AND SYMPTOMS:

Dermatitis of exposed body surfaces with itching and red papulopustular lesions

Metal fume fever from inhalation of fumes

After an incubation period of 4–6 hours,

Metallic taste, chest tightness, cough, and dyspnea

Headache, chills, fever, sweating, and myalgia follow

Nausea, vomiting, and weakness are not uncommon

Symptoms usually subside in 24–36 hours

#### DIAGNOSTIC TESTS:

Leucocytosis during first 12 hours

LDH elevation

#### TREATMENT:

Wash contaminated areas of body with soap and water

Symptomatic and supportive

#### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection

Armstrong, C.W. et.al. 1983. An outbreak of metal fume fever. *JOM* 25:886.

## ZINC PHOSPHIDE

### Synonyms:

None

### Description:

Dark gray crystals

### Occupational Exposure:

Rodenticide

### Threshold Limit Value:

None established

### Toxicity:

#### ROUTE OF ENTRY:

Ingestion • Inhalation

#### MODE OF ACTION:

Phosphine is formed in the presence of moisture  
Heart, liver, and kidney damage are possible

#### SIGNS AND SYMPTOMS:

Inhalation is reported to cause dyspnea and diarrhea

##### *Ingestion:*

Nausea, vomiting, abdominal pain, and sometimes jaundice

Chest tightness, dyspnea, and pulmonary edema

Shock, oliguria, and coma

Thrombocytopenia may occur

#### DIAGNOSTIC TESTS:

None established

#### TREATMENT:

Symptomatic and supportive

If ingested, induce vomiting, follow with gastric lavage and then saline catharsis

Monitor fluids and electrolytes carefully

#### DISABILITY:

No occupational disability reported

## ZINC PHOSPHIDE (*cont'd.*)

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Good personal hygiene

Stephenson, J.B.P. 1967. Zinc phosphide poisoning. *Arch. Environ. Hlth.* 15:83.

## ZIRCONIUM AND COMPOUNDS

### Synonyms:

Baddeleyite • Eudialyte • Malcon • Zircon • Zirconium carbide • Zirconium oxide (zirconia) • Zirconium silicate

### Description:

Zirconium is a grayish metal or blue-black powder  
Compounds are generally white powders

### Occupational Exposure:

Alloys • Atomic reactors • Deoxidizer • Explosives • Flash bulbs • Glazes • Lamp filaments • Pyrotechnics • Welding fluxes • Vacuum tubes

### Threshold Limit Value:

5 mg/m<sup>3</sup>

### Toxicity:

#### ROUTE OF ENTRY:

Inhalation

#### MODE OF ACTION:

Irritant • Sensitizer

#### SIGNS AND SYMPTOMS:

Repeated application of zirconium salts to the skin have produced granulomas

Benign pneumoconiosis has also been reported

## ZIRCONIUM AND COMPOUNDS (*cont' d.*)

### DIAGNOSTIC TESTS:

None established

### TREATMENT:

Symptomatic and supportive

### DISABILITY:

No permanent effects reported

### Preventive Measures:

Adequate ventilation • Approved respiratory protection • Gloves and protective clothing as indicated

Hadjimichael, O.C. and Brubaker, R.E. 1981. Evaluation of an occupational respiratory exposure to a zirconium containing dust. *JOM* 23:543.



## Appendix A

### TREATMENT OF CYANIDE INTOXICATION

Those responsible for the care of cyanide intoxications should review the several available treatment methods and establish a precise treatment protocol.

#### General Measures:

- Remove the patient from further exposure
- Begin resuscitative efforts and administer oxygen
- Irrigate eyes with water
- Wash contaminated areas of body with soap and water
- Gastric lavage, if ingested, using 1:5000 solution of potassium permanganate or 1% sodium thiosulfate
- Hospitalize to ensure:
  - Controlled ventilation
  - Precise fluid and electrolyte balance
  - Correction of severe acidosis
  - Diuresis

#### Cyanide Antidote Kit:

- Amyl nitrite pearls by inhalation every 5 minutes until sodium nitrite can be administered
- 10 ml of 3% sodium nitrite intravenously over a period of 2 minutes
- Follow by 50 ml 25% sodium thiosulfate intravenously
- Repeat in 1-2 hours if required

#### Kelocyanor (cobalt ethylene diamine tetraacetate)

- 10 ml doses intravenously at 10-minute intervals for up to 3 doses
- Follow by 50 ml hypertonic glucose intravenously
- [This chelating agent is not currently available in U.S.]

Hydroxocobalamine (vitamin B<sub>12a</sub>) intravenously combines with cyanide to form cyanocobalamin (vitamin B<sub>12</sub>) and appears to be nontoxic

Cysteine hydrochloride may also prove to be of value

## APPENDIX A

- Aw, T.C. and Bishop, C.M. 1981. Letter to the editor. *J. Soc. Occup. Med.* 31:173.
- Garnier, R. et.al. 1981. Letter to the editor. *Brit. Med. J.* 283:1610.
- Graham, D.L. et.al. 1977. Acute cyanide poisoning complicated by lactic acidosis and pulmonary edema. *Arch. Intern. Med.* 137:1051.
- McLaughlin, M. et.al. 1976. Evaluation of antidotes for acrylonitrile poisoning. *Toxicol. Appl. Pharmacol.* 37(1):133.

## Appendix B

### PREPARATION OF A FAT BIOPSY

A biopsy is always necessary when fat must be analyzed for soluble insecticides. To ensure a correct result, the following instructions for obtaining and shipping a fat biopsy should be carefully followed:

1. Fat from any portion of the body is suitable. When performing an operation primarily for the purpose of obtaining a biopsy, it is convenient to obtain the fat from the subcutaneous tissue of the anterior part of the abdomen. It is more comfortable for the patient if the belt line is avoided as the site of incision. This minor surgical procedure may be done on an outpatient basis.
2. The amount of fat should be about 2.5 grams. This is a piece about the size of the tip of a man's thumb. The fat should be separated from any attached skin or other nonfatty tissue, blotted with paper toweling, and then weighed carefully on pharmacist's balance (or one more accurate).
3. Immediately after weighing, the biopsy should be placed in a small wide-mouth bottle and frozen. No preservative should be used because of interference with certain tests, except that 10% formalin may be used if chlorinated hydrocarbons are the only compounds for which analysis is desired. The container should be tightly closed and taped and labeled with the following information:

Name of patient

Weight of sample in grams (accurate to at least two decimal places)

Date sample taken

Name of referring physician

Frozen samples should be shipped in dry ice by air. Samples preserved with formalin may be shipped by surface mail. Specimens should be sent to the nearer of the following addresses:

Toxicology Section  
Communicable Disease Center  
Atlanta, Georgia 30322

U.S. Public Health Service  
P.O. Box 73  
Wenatchee, Wash. 98801

## Bibliography

- AMA. 1985. *Effects of Toxic Chemicals on the Reproductive System*. Council on Scientific Affairs. JAMA 253:3431.
- Amoore, J.E. and Hautala, E. 1983. Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. *J. Appl. Toxicol.* 3(6):272.
- Arena, J.M. 1979. *Poisoning: Toxicology, symptoms, treatment*. 45th ed. Thomas Publishers.
- Barlow, S.M. and Sullivan, F.M. 1982. *Reproductive hazards of industrial chemicals*. New York: Academic Press.
- Clayton, G. and Clayton, F. 1978, 1979, 1981. *Patty's industrial hygiene and toxicology*. 3rd ed. 3 vols. New York: Wiley Interscience.
- Deichmann, W.B. 1979. *Toxicology and occupational medicine*. New York: Elsevier.
- Dreisbach, R.H. 1980. *Handbook of poisoning*. 10th ed. Los Altos: Lange Medical Publications.
- Englund, A., Ringen, K., Mehlman, M.A. 1982. *Occupational health hazards of solvents*. Princeton: Princeton Scientific Publishers.
- Finkel, A.J. 1983. *Hamilton and Hardy's industrial toxicology*. 4th ed. Boston: John Wright, PSG Inc.
- Friberg, L., Nordberg, G.F. and Vouk, V.B. eds. 1979. *Handbook on the toxicology of metals*. N. Holland: Elsevier.
- Gosselin, R.E., Hodge, H.C., Smith, R.P., and Gleason, M.N. 1976. *Clinical toxicology of commercial products*. 4th ed. Baltimore: Williams & Wilkins.
- Harrington, J.M. and Gill, F.S. 1983. *Occupational Health*. Edinburgh: Blackwell Scientific Publications.
- Hunt, V.R. 1979. *Work and the health of women*. Boca Raton: CRC Press.
- International Labour Office. *Encyclopedia of Occupational Health and Safety*. 3rd ed. CH 1211. Geneva:ILO.
- Lauwerys, R.R. 1983. *Industrial chemical exposure: Guidelines for biological monitoring*. Davis: Biomedical Publications.
- Lee, D.H.K. 1972. *Metallic contaminants and human health*. New York: Academic Press.

- Lee, D.H.K. and Kotin, P. 1972. *Multiple factors in the causation of environmentally induced disease*. New York: Academic Press.
- Morgan, W.K.C. and Seaton, A. 1984. *Occupational lung diseases*. 2nd ed. Philadelphia: W.B. Saunders.
- NIOSH. *Current Intelligence Bulletins*. Washington, DC: U.S. Gov't. Printing Office.
- NIOSH. 1980. *Registry of Toxic Effects of Chemical Substances*. Washington, DC: U.S. Gov't. Printing Office.
- Proctor, N.H. and Hughes, J.P. 1978. *Chemical hazards of the workplace*. Philadelphia: J.B. Lippincott.
- Rom, W.N. ed. 1983. *Environmental and occupational medicine*. Boston: Little, Brown, and Co.
- Scott, T.S. 1962. *Carcinogenic and chronic toxic hazards of aromatic amines*. New York: Elsevier.
- Shapiro, H.A. 1970. *Pneumoconiosis*. Proceedings of the International Conference Johannesburg, 1969. New York: Oxford University Press.
- U.S. Dep't. of Health, Education and Welfare (NIOSH). 1977. *Occupational Diseases—A Guide to their Recognition*. Publication 77-181. Washington, DC: U.S. Gov't. Printing Office.
- Zielhuis, R.L., Slijkel, A. Verberk, M.M. and van de Poel-Bot, M. 1984. *Health risks to female workers in occupational exposure to chemical agents*. New York: Springer-Verlag.

# Index

## A

- abrin, 1
- abrus precatorius, 1
- acacia gum, 278
- acetaldehyde, 2
- acetate of lead, 318
- acetic acid, 3
  - acid dimethylamide, 193
  - acid ethenyl ester, 564
  - acid isopropyl ester, 306
  - acid methyl ester, 341
  - acid *n*-propyl ester, 456
  - acid vinyl ester, 564
  - aldehyde, 2, 227
  - anhydride, 5
  - ether, 226
  - oxide, 5
- acetone, 6, 8
- acetonitrile, 159
- acetophenone, 7
- acetyl benzene, 7
  - oxide, 5
- acetylene, 8, 97
  - black, 105
  - dichloride, 180
  - tetrabromide, 517
  - tetrachloride, 518
- acetylenogen, 97
- acridine, 9
- acrodynia, 333
- acrolein, 10
- acroosteolysis, 566
- acrylaldehyde, 10
- acrylamide, 12
- acrylic acid, 14
  - aldehyde, 10
  - amide, 12
  - compounds, 13, 15
  - resins, 13
- acrylon, 15
- acrylonitrile, 15
- actinolite, 45
- activated charcoal, 105
- Aerозine 50, 288
- African gum, 277
- AGE, 274
- agent orange, 425
- agglutinin, 1
- air conditioner lung, 405
- alabaster, 103
- albite, 258
- Aldrin, 279
- alkyl aluminum compounds, 20
  - mercaptans, 330
  - mercury compounds, 334
- allergic alveolitis, 311
- allethrin, 467
- allyl alcohol, 16
  - aldehyde, 10
  - bromide, 17
  - chloride, 18
- allylene, 341
- allyl glycidyl ether, 274
  - trichloride, 547
- alumina, 20
- aluminosis, 20
- aluminum, 20
  - ammonium sulfate, 25
  - chloride, 20
  - oxide, 20
  - silicate, 20
- alundum, 20
- amber mica, 372
- aminobenzene, 32
- 1-aminobutane, 85
- aminocyclohexane, 165
- 4-aminodiphenyl, 215
- aminoethane, 228
- 2-aminoethanol, 224
- aminomethane, 345
- 1-amino-2-nitrobenzene, 391

# HANDBOOK OF INDUSTRIAL TOXICOLOGY

- amino-4-nitro-*o*-cresol, 206
- amino-
  - phen, 32
  - phenols, 21
  - phenyl methan, 359
- 2-aminopropane, 308
- 2-aminopyridine, 23
- ammonia, 24
- ammonium alum, 25
  - carbazotate, 27
  - chloroplatinate, 441
  - cyanate, 159
  - hexachloroplatinate, 441
  - metavanadate, 563
  - molybdate, 375
  - monosulfide, 28
  - peroxydisulfate, 26
  - persulfate, 26
  - picrate, 27
  - picronitrate, 27
  - sulfide, 28
  - tetrachloroplatinate, 441
- amobam, 217
- amorphous silica, 480
- amosite, 45
- amyl acetate, 29
  - alcohols, 31
- amylene, 32
- amyl ethyl ketone, 229
  - hydride, 418
- AN, 15
- anatase, 535
- anesthetic ether, 250
- anhydro trimellitic acid, 550
- anhydrous ammonia, 24
  - borates, 75
  - hydrobromic acid, 293
- aniline, 32
  - oil, 32
  - violet, 271
- anilism, 33
- animal charcoal, 105
- anorthite, 258
- anorthoclase, 258
- anprolene, 249
- anthophyllite, 45
- anthracene, 34
- antimoniosis, 36
- antimonous chloride, 37
  - sulfide, 39
- antimony, 36
  - hydride, 501
  - regulus, 36
  - trichloride, 37
  - trisulfide, 39
- ANTU, 384
- aqua fortis, 389
- aqueous ammonia, 24
  - fluorine, 292
- argentum, 486
- argilla, 313
- argyria, 487
- arsenate of soda, 319
- arsenic, 40
  - acid, 40
  - compounds, 40
  - hydride, 43
  - pentoxide, 40
  - trichloride, 40
  - trioxide, 40
- arseniuretted hydrogen, 43
- arsine, 43
- aryl mercury compounds, 334
- asbestos, 45
- asbestosis, 47
- asphalt, 48
- asphaltum, 48
- 10-azaaanthracene, 9
- azacyclopropane, 247
- azides, 49
- azimethylene, 171
- azine, 468
- aziridine, 247
- azoimide, 49
- azotic acid, 388

## B

- Baddeleyite, 578
- bagassosis, 405
- Bakelite, 52
- baker's asthma, 27, 405
- banana oil, 29
- baritosis, 54
- barium compounds, 53
- bauxite, 20



# INDEX

- Baygon, 351
- BCME, 70
- bentonite, 55
- benzanthrone, 56
- benzene, 57
  - amine, 32
- 1,3-benzenediol, 473
- 1,4-benzenediol, 297
- benzene hexachloride, 279
- 1,2,3-benzentriol, 470
- benzidine, 59
- benzol, 57
- 1,4-benzoquinone, 472
- benzoyl peroxide, 61
  - superoxide, 61
- benzyl chloride, 61
  - hydroquinone, 376
- p*-benzyloxy phenol, 376
- beryl ore, 63
- beryllium chloride, 63
  - fluoride, 63
  - nitrate, 63
  - nitrite, 63
  - oxide, 63
  - sulfate hydrate, 63
- BGE, 87, 274
- bibenzene, 213
- bicycloheptadiene dibromide, 66
- biethylene, 80
- bimethyl, 223
- biotite, 372
- biphenyl, 213
- 4,4'-biphenyl diamine, 59
- bipyridyls, 67
- bird breeder's lung, 405
- bis-
  - (2-chloroethyl) ether, 181
  - (chloromethyl) ether, 70, 264
  - chlorophenyls, 279
  - (dimethyl thiocarbamyl) disulfide, 524
- bismuth, 71
  - nitrate, 71
  - oxide, 71
  - sulfide, 71
  - telluride, 72
  - trichloride, 71
- bisphenol A, 221
- bitumen, 48
- bivinyll, 80
- black lead, 276
- blasting oil, 398
- bleach, 495
- bleaching powder, 100
- blue asbestos, 45
- blue men, 487
- boracic acid, 75
- boranes, 73
- borax, 75
- boric acid, 75
  - anhydride, 75
  - oxide, 75
- bornanone, 104
- boroethane, 73
- boron, 75
  - fluoride, 75
  - hydrides, 73
  - oxide, 75
  - trifluoride, 75
  - trioxide, 75
- brass fever, 338
  - founder's ague, 338
- brick oil, 152
- brimstone, 505
- bromic ether, 231
- brominated bicycloheptadiene, 66
- bromine, 76
  - azide, 49
- bromo-
  - allylene, 17
  - biphenyls, 442
  - chloromethane, 78
  - ethane, 231
  - form, 79
  - methane, 347
- 3-bromopropene, 17
- 3-bromopropylene, 17
- bromotrifluoroemthane, 128
- burnt lime, 101
- butadiene, 80
- butanaloxime, 93
- butane, 81
  - thiol, 330
- 1-butanol, 84
- 2-butanone, 363
- 2-butenal, 155



# HANDBOOK OF INDUSTRIAL TOXICOLOGY

*cis*-butenedioic acid, 326  
 anhydride, 327  
 1-*n*-butoxy-2,3-epoxypropane, 87  
 2-butoxy ethanol, 241  
 butter of zinc, 574  
   yellow, 195  
 butyl acetate, 82  
*n*-butyl alcohol, 84  
 butyl amine, 85  
   catechol, 86  
   cellosolve, 241  
*sec*-butylchloroformate, 131  
 4-*tert*-butyl-1,2-dihydroxybenzene, 86  
 butyl formate, 87  
*n*-butyl-glycidyl ether, 87, 274  
 butyl hydride, 81  
*n*-butyl-beta-hydroxyethyl ether, 241  
 butyl mercaptan, 330  
   2-methacrylate, 89  
   methanoate, 87  
   2-methyl-2-propenoate, 89  
*tert*-butyl perbenzoate, 90  
*tert*-butyl peroxybenzoate, 90  
*p*-*tert*-butyl phenol, 91  
 butyl toluene, 92  
*n*-butyraldoxime, 93  
 butyric alcohol, 84  
 byssinosis, 150, 405

## C

cadmium, 95  
   chloride, 95  
   oxide, 95  
   sulfide, 95  
 calcined magnesium, 325  
 calcium arsenate, 40  
   arsenite, 40  
   carbide, 97  
   carbimide, 99  
   chloride, 98  
   chloride dihydrate, 98  
   cyanamide, 99  
   cyanamide hydroxide, 97, 102

hypochlorite, 100  
 molybdate, 375  
 oxide, 101  
 oxychloride, 100  
 sulfate, 103  
 calx, 101  
 2-camphanone, 104  
 camphor, 104  
 cannabosis, 405  
 Carbaryl, 351  
 carbasotic acid, 439  
 carbide, 97  
 carbinol, 343  
 Carbofuran, 353  
 carbolic acid, 422  
 carbomethane, 315  
 carbon bisulfide, 108  
   black, 105  
   dioxide, 106  
   disulfide, 108  
   hexachloride, 282  
 carbonic acid gas, 106  
   anhydride, 106  
   dichloride, 428  
   oxide, 110  
 carbon monoxide, 110, 358  
   tetrachloride, 112  
   trichloride, 282  
 carbonyl chloride, 428  
 carbophenothion, 408  
 4-carboxy phthalic anhydride, 550  
 carnallite, 449  
 castor pomace, 114  
 cat litter, 21  
 caustic, 493  
   antimony, 37  
   potash, 451  
   soda, 493  
 cellosolve, 242  
   acetate, 244  
 cereal grass straw, 474  
 cerium, 116, 219  
 chabasite, 573  
 chalcosis, 149  
 cheesewasher's lung, 405  
 cheeseworker's illness, 405  
 charcoal, activated, 105  
   animal, 105

# INDEX

- china clay, 313
- chinawood oil, 556
- Chinese
  - cinnamon oil, 140
  - white, 575
- chinsonone, 472
- chloracne, 213, 416, 443-445
- chlordane, 279
- chloride of lime, 100
- chlorinated
  - naphthalenes, 117, 444
  - terpenes, 279
- chlorine, 118
  - dioxide, 120
  - fluoride, 121
  - fluoride oxide, 420
  - nitride, 395
  - oxyfluoride, 420
  - peroxide, 120
  - trifluoride, 121
- chloro-
  - acetaldehyde, 122, 236
  - acetic acid, 123, 236
  - acetophenone, 124
  - allylene, 18
  - benzenes, 125
  - benzilidene malonitrile, 127
  - bromomethane, 78
- 2-chlorobuta-1,3-diene, 136
- chloro (chloromethoxy) methane, 70
- 3-chloro-1,2-dibromopropane, 172
- chlorodiphenyls, 444
- 1-chloro-2,3-epoxy propane, 220
- chloro-
  - ethane, 233
  - ethanoic acid, 123
- 2-chloroethanol, 235
- chloroethene, 565
- 2-chloroethyl alcohol 235
- chloro-
  - ethylene, 565
  - ethylene polymer, 446
  - fluorocarbons, 128
  - fluoromethane, 128
  - form, 130
  - formates, 131
  - formyl chloride, 428
  - genic acid, 114
  - hydric acid, 290
  - methane, 353
- (chloromethyl) benzene, 61
- chloromethyl
  - bromide, 78
  - oxirane, 220
- chloro-
  - nitrobenzenes, 132
  - nitropropane, 134
  - phenols, 212
- 2-chloro-1-phenyl ethanone, 124
- chloro-
  - picrin, 135
  - platينات, 441
  - prene, 136
- 3-chloro-1-propene, 18
- 3-chloropropylene, 18
- chloropropylene oxide, 220
- 3-chloro-1,2-propylene oxide, 220
- chlorosulfuric acid, 510
- Chlorothion, 408
- alpha-chlorotoluene, 61
- chlorotrifluoromethane, 128
- chrome holes, 138
- chromic acid, 138
  - anhydride, 138
  - oxide, 138
  - sulfate, 138
- chromite dust, 139
- chromium, 138
  - metal, 138
- chrysinnerol, 467
- chrysanthemum cinerariae
  - coccineum, 467
  - folium, 467
- chrysotile, 45
- cinerin I, 467
- II, 467
- cinnamene, 503
- cinnamic aldehyde, 140
- cinnamon, 140
- clay, colloidal, 56
- coal, 141
  - naphtha, 57
  - tar creosote, 152

# HANDBOOK OF INDUSTRIAL TOXICOLOGY

coal tar pitch, 143  
 worker's pneumoconiosis, 142  
 cobalt, 145, 558  
 blue, 145  
 carbonyl, 145  
 chloride, 145  
 hydrocarbonyl, 145  
 lung, 559  
 cobaltous nitrate, 145  
 oxide, 145  
 phosphate octahydrate, 145  
 coffee worker's lung, 405  
 coke, 147  
 colamine, 224  
 colloidal clay, 55  
 Compound 1080, 492  
 coolants, 157  
 copper, 148  
 acetate, 148  
 azide, 49  
 colic, 338  
 sulfate, 148  
 corundum, 20  
 cotton dust, 150  
 creosols, 153  
 creosote, 152  
 oil, 152  
 creosotum, 152  
 cresylic acid, 153  
 cresylol, 153  
 cristobalite, 482  
 crocidolite, 45  
 crotonaldehyde, 155  
 crotonic aldehyde, 155  
 crystal carbonate, 490  
 violet, 271  
 CS, 127  
 cumene, 156  
 cumol, 156  
 cupric arsenite, 40  
 oxide, 148  
 oxyacetate, 148  
 cutting oils, 157  
 CWP, 142  
 cyanamide, 99  
 cyanates, 159  
 cyanides, 159, 580  
 cyanoethylene, 15

cyanogen, 159  
 bromide, 159  
 chloride, 159  
 cyclethrin, 467  
 cyclo-  
 -dienes, 279  
 -hexanamine, 165  
 -hexane, 161  
 -hexanol, 162  
 -hexanone, 163  
 -hexatriene, 57  
 -hexene, 164  
 -hexylamine, 165  
 -nite, 166  
 -paraffins, 279  
 -pentadiene, 168  
 -propane, 168  
 -trimethylene trinitramine, 166

## D

1,2-D, 459  
 2,4-D, 425  
 2,4-DB, 425  
 DBCP, 172  
 DDH, 177  
 DDM, 359  
 DDT, 279  
 DEAE, 185  
 deca-  
 -borane, 73  
 -boron tetradecahydride, 73  
 DEF, 408  
 demeton, 408  
 derris root, 475  
 DES, 189  
 DETA, 188  
 detergents, 405  
 DGE, 274  
 diacetone alcohol, 170  
 dialkyl tin salts, 533  
 diallyl phthalate, 437  
*p*-diamino benzene, 426  
 4,4'-diaminobiphenyl, 59  
 2,2'-diamino diethylamine, 188  
 4,4'-diaminodiphenyl, 59  
 diaminodiphenyl methane, 221,  
 359

# INDEX

- 1,2-diamino ethane, 237
- 1,6-diamino hexane, 283
- diamino toluene, 538
- dianilino methane, 359
- diatomaceous earth, 221, 480
- diatomite, 480
- Diazinon, 408
- diazomethane, 171
- dibenzo-
  - furans, 444, 516
  - pyridine, 9
- dibenzoyl peroxide, 61
- diborane, 73
- diboron hexahydride, 75
- dibromo-
  - chloropropane, 172
  - difluoromethane, 128
- 1,2-dibromoethane, 238
- dibutyl
  - phthalate, 437
  - tin chloride, 533
- dichloro-
  - acetylene, 173, 544, 568
  - benzene, 125, 175
- 3,3'-dichlorobenzidine, 176
- 3,3'- dichloro -4,4'- biphenyldi-  
amine, 176
- 3,5 - dichloro -N- (3,4-dichloro-  
phenyl) -2- hydroxy benzamide,  
521
- dichlorodifluoromethane, 128
- sym*-dichlorodimethyl ether, 70
- dichloro dimethyl hydantoin, 177
- 1,3-dichloro-5,5-dimethyl-2,4-im-  
idazolidenedione, 177
- 1,1-dichloroethane, 253
- 1,2-dichloroethane, 178
- 1,1-dichloroethylene, 568
- 1,2-dichloroethylene, 180
- dichloro-
  - ethyl ether, 181
  - ethyl oxide, 181
  - fluoromethane, 128
  - hydrin, 182
- sym*-dichloro isopropyl alcohol,  
182
- dichloro-
  - methane, 358
  - methyl ether, 70
  - naphthalene, 117
- 1,1-dichloro-1-nitroethane, 183
- 2,4-dichlorophenoxy acetic acid,  
425
- 4-2,4-dichlorophenoxy butyric ac-  
id, 425
- 1,2-dichloropropane, 459
- 1,3-dichloro-2-propanol, 182
- dichlorotetrafluoromethane, 128
- Dichlorvos, 408
- dichromate salts, 138
- dicyandiamine, 221
- diethyl-
  - amine, 184
  - amino ethanol, 185
  - aniline, 186
  - carbonate, 187
- 1,4-diethylene dioxide, 210
- diethylene ether, 210
  - imidoxide, 377
  - oxide, 521
  - oximide, 377
  - triamine, 188, 221
- N,N-diethyl ethanamine, 549
- diethyl ethanedioate, 256
- N,N-diethyl ethanolamine, 185
- diethyl ether, 250
- di-2-ethylhexyl adipate, 446
- diethyl oxalate, 256
  - phthalate, 437
  - stilbestrol, 189
- diglycidyl ether, 274
- m*-dihydroxy benzene, 473
- p*-dihydroxy benzene, 297
- diisobutyl ketone, 191
- diisopropyl-
  - amine, 192
  - ether, 309
  - peroxy dicarbonate, 310
- dimethoxy methane, 342
- dimethyl, 223
  - acetamide, 193
  - amine, 194
  - amino azobenzene, 195
  - amino propionitrile, 195
- N,N-dimethyl aniline, 197
- dimethyl benzene, 570

# HANDBOOK OF INDUSTRIAL TOXICOLOGY

- N,N-dimethyl benzeneamine, 197
- dimethyl carbinol, 306
  - chlorothionophosphate, 201
- dimethylene imine, 247
- dimethyl ether, 362
- 4-(1,1-dimethyl ethyl) phenol, 91
- N,N-dimethyl formamide, 198
- 2,6-dimethyl-4-heptanone, 191
- N,N-dimethyl hydrazine, 288
- dimethyl ketone, 6
- N,N-dimethyl methanamine, 552
- dimethyl methane, 454
  - nitrosamine, 200
  - phenylamine, 197
  - phosphorochloriodothionate, 201
  - phthalate, 437
  - selenide, 478
  - sulfate, 202
  - telluride, 514
  - thionochlorophosphate, 201
- dinitro-
  - benzenes, 204
  - benzol, 204
  - cresol, 206
- 3,5-dinitro-2-hydroxy toluene, 206
- 4,6-dinitro-*o*-cresol, 206
- 2,4-dinitrophenol, 207
- dinitro-
  - toluene, 208
  - toluol, 208
- dioxane, 210
- dioxin, 211
- dioxonium perchlorate, 419
- DIPA, 192
- diphenyl, 213
  - amine, 215
  - benzenes, 515
- 4,4'-diphenylene diamine, 59
- diphenyl methane, 213
- 4,4'-diphenyl methane diisocyanate, 311
- dipropylene glycol methyl ether, 216
- dipropyl methane, 281
- Dipterex, 408
- diquat, 67
- disulfur dichloride, 506
- dithio-
  - carbamate, 217
  - carbonic anhydride, 108
- divinyl, 80
- DMA, 194
- DMAC, 193
- DMAPN, 195
- DMF, 198
- DMFA, 198
- DMN, 200
- DMPCT, 201
- DMS, 202
- DNC, 206
- DNOC, 206
- DNP, 207
- DNT, 208
- dog house disease, 405
- DPA, 215
- dry ice, 107
- dry rot lung, 405

## E

- EAK, 229
- earth flax, 45
- EDB, 238
- EGDN, 398
- Ekatin, 408
- elayl, 234
- emulsifying oils, 157
- Endrin, 279
- engraver's acid, 389
- epichlorohydrin, 220
- EPN, 408
- epon resins, 221
- epoxide resins, 221
- epoxies, 221
- 1,2-epoxy-
  - 3-chloropropane, 220
  - ethane, 249
  - propane, 464
- 2,3-epoxy-1-propanol, 273
- epoxy resin hardeners, 222
  - resins, 221
- erethism, 333
- erionite, 573

# INDEX

- erythrene, 80
- ethanal, 2
- ethanamine, 228
- ethane, 223
- 1,2-ethane diamine, 237
- ethanedioic acid, 412
- 1,2-ethanediol, 239
- ethanethiol, 330
- ethanoic acid, 3
  - anhydride, 5
- ethanol, 227
  - amine, 224
- ethene, 234
- ethenone, 315
- n*-ethyle-ethanamine, 184
- ethide, 183
- ethine, 8
- ethinyl trichloride, 544
- 6-ethoxy- 1,2 -dihydro- 2,2,4 -tri-
  - methyl quinoline, 225
- ethoxy ethane, 250
- 2-ethoxy ethanol, 242
- 2-ethoxyethyl acetate, 244
- ethoxyquin, 225
- ethyl acetate, 226
  - acetone, 370
  - acrylate, 14
  - alcohol, 227
  - aldehyde, 2
  - amine, 228
  - amyl ketone, 229
  - benzene, 230
  - bromide, 231
  - butyl ketone, 232
  - carbonate, 187
  - chloride, 233
  - chloroformate, 131
  - cyanide, 159
- ethylene, 234
  - bromide, 238
  - chloride, 178
  - chlorohydrin, 235
  - diamine, 221, 237
  - dibromide, 238
  - dichloride, 178
  - glycol, 239
  - glycol dinitrate, 398
  - glycol monobutyl ether, 241
  - glycol monoethyl ether, 242
  - glycol monoethyl ether ace-  
tate, 244
  - glycol monomethyl ether, 245
  - glycol monomethyl ether ace-  
tate, 246
  - imine, 247
  - monochloride, 565
  - oxide, 250
  - tetrachloride, 519
- ethyl ether, 250
  - formate, 252
  - hydride, 223
- ethylic acid, 3
- ethylidene chloride, 253
- ethyl isothiocyanate, 254
  - mercaptan, 330
  - mercury chloride, 334
  - methanoate, 252
- N*-ethyl morpholine, 255
- ethyl mustard oil, 254
- ethylolamine, 224
- ethyl oxalate, 256
  - oxide, 250
- ethyloxyline resins, 221
- ethyl silicate, 257
  - thiocarbimide, 254
- ethyne, 8
- ethythrins, 467
- Eudialyte, 578
- (extrinsic) allergic alveolitis, 53,  
407

## F

- farmer's lung, 405
- feathers, 405
- feldspars, 258
- fenvalerate, 468
- Ferbam, 217
- ferric chloride, 259
  - oxide, 301
  - trichloride, 259
- ferrous oxide, 301
- fiberglass, 374
  - warts, 374
- fibrous talc, 512
- flax, 405



# HANDBOOK OF INDUSTRIAL TOXICOLOGY

Flowers of zinc, 575  
 flue gas, 110  
 fluorides, 260  
 fluoro-  
   -acetic acid, sodium salt, 492  
   -carbon polymers, 262  
   -polymers, 262  
 fluxing lime, 101  
 formal, 342  
 formaldehyde, 263  
 formalin, 263  
 formic acid, 265  
   acid ethyl ester, 252  
   acid methyl ester, 365  
   aldehyde, 263  
   ether, 252  
 fossil flour, 480  
 Fraude's reagent, 408  
 French chalk, 512  
 Freons, 128  
 fuel oil no. 1, 314  
 fumed silica, 480  
 Furadan, 351  
 2-furaldehyde, 266  
 2-furan carbinol, 267  
 2-furan carboxy aldehyde, 266  
 2,5-furandione, 327  
 2-furan methanol, 267  
 furan polymers, 268  
 Furethrin, 467  
 furfural, 266  
 furfuraldehyde, 266  
 furfuryl alcohol, 267  
 furrier's lung, 405  
 fused silica, 480  
 fusel oil, 31

## G

gallium, 269  
   fluoride, 269  
   nitrate, 269  
 gas black, 105  
 gasoline, 270  
 GDCH, 182  
 gentian violet, 271  
 glass fiber, 374  
   -grinder's lung, 466

  wool, 374  
 glycerol, 10  
   *sym*-glycerol dichlorohydrin, 182  
   glycerol trichlorohydrin, 547  
     trinitrate, 398  
 glycidol, 273  
 glycidyl ethers, 221, 274  
 glycol, 239  
   chloroformate, 131  
   chlorohydrin, 235  
   dinitrate, 398  
   ethers, 221  
 glycolic acid, 275  
 glycolonitrile, 159  
 grain alcohol, 227  
   oil, 31  
 graphite, 276  
 graphitosis, 276  
 green oil, 34  
 gum arabic, 277  
   camphor, 104  
   thus, 559  
 gypsum, 103

## H

halogenated pesticides, 279  
 hard metal, 557  
   metal disease, 145  
 HCl, 290  
 HDI, 311  
 hematite, 404  
 hemimellitene, 553  
 hemp, 405  
 heptachlor, 279  
 heptane, 281  
 3-heptanone, 232  
 HETP, 408  
 hexachloro-  
   -ethane, 282  
   -naphthalene, 117  
   -platinates, 441  
 hexafluoroethane, 128  
 hexahydro-  
   -aniline, 165  
   -benzene, 161  
 hexahydro-  
   -benzoic acid, 380

# INDEX

- hexahydro-
  - cresol, 356
  - methyl phenol, 356
  - phenol, 162
  - toluene, 355
  - 1,3,5-trinitro triazine, 166
- hexalin, 162
- hexamethylene, 161
  - diamine, 283
  - diisocyanate, 311
- hexanaphthalene, 161
- hexane, 284
  - 1,6-hexane diamine, 283
  - 2,5-hexanedione, 285, 349
  - 2-hexanone, 349
- hexavalent chromium compounds, 138
- 1-hexene, 287
- hexone, 368
- sec*-hexyl acetate, 286
- hexylene, 287
- HF, 291
- hyalophane, 258
- hydracrylic acid beta-lactone, 455
- hydrated ferric oxides, 404
  - silica, 481
- hydraulic cement, 447
- hydrazine diamine, 288
- hydrazines, 288
- hydrazino benzene, 288
- hydrazoic azide, 49
- hydrochloric acid, 290
  - ether, 233
- hydrofluoric acid, 291
- hydrogen antimonide, 501
  - arsenide, 43
  - azide, 49
  - borides, 73
  - bromide, 293
  - carboxylic acid, 265
  - cyanide, 159
  - dioxide, 295
  - peroxide, 295
  - phosphide, 430
  - selenide, 477
  - sulfate, 509
  - sulfide, 296
  - telluride, 513
- hydronium perchlorate, 419
- hydroperoxide, 295
- hydroquinol, 297
- hydroquinone, 297
  - monobenzyl ether, 376
- hydrosulfuric acid, 296
- hydrous magnesium silicate, 512
- hydroxy-
  - acetic acid, 275
  - anilines, 21
  - benzene, 422
- 2-hydroxyethylamine, 224
- hydroxylamine, 299
- 4-hydroxy-4-methyl-2-pentanone, 170
- hydroxynaphthalenes, 381
- 2-hydroxypropanoic acid, 317
- alpha-hydroxypropionic acid, 317
- 2-hydroxy propylamine, 304
- 3-hydroxy propylene oxide, 273
- 2-hydroxy triethylamine, 185
- hypnone, 7

## I

- IGE, 274
- Indian licorice, 1
- infusorial earth, 480
- iodine, 300
- iodism, 30
- iodomethane, 366
- IPP, 310
- iron oxides, 301
  - trichloride, 259
- isinglass, 372
- isoacetophorone, 303
- isoamyl acetate, 29
  - alcohol, 31
- beta-isoamylene, 32
- 1,3-isobenzofurandione, 438
- isobutyl acetate, 302
- isocyanates, 311
- Isolan, 351
- isophorone, 303
- isopropanol, 306
- isopropanolamine, 304



# HANDBOOK OF INDUSTRIAL TOXICOLOGY

isopropenyl benzene, 371  
 2-isopropoxy propane, 309  
 isopropyl acetate, 305  
     acetone, 368  
     alcohol, 306  
     -amine, 308  
     benzene, 156  
     chloroformate, 131  
     ether, 309  
     glycidyl ether, 274  
 isopropylidene acetone, 337  
 isopropyl percarbonate, 310  
 isoton, 52  
 isovalerone, 191  
 itaconic acid, 361

## J

Jasmolin I, 467  
     II, 467  
 Jequirity bean, 1  
 jet fuel, 316  
 jute, 406

## K

kaolin, 313  
 kaolinite, 313  
 kaolinosiis, 313  
 kapok, 405  
 Kelthane, 279  
 Kepone, 279  
 kerosen, 479  
 kerosene, 314  
 kerosine, 314  
 Ketene, 315  
 ketoexamethylene, 163  
 KOH, 451

## L

Labradorite, 258  
 lactic acid, 317  
 lamp black, 105, 377  
 Lanthanum, 219  
 laurel camphor, 104  
 lead arsenate, 40, 318  
     arsenite, 40

azide, 49  
 chromate, 138  
 inorganic, 319  
 organic, 322  
 orthoarsenate, 318  
 Lepidolite, 372  
 lime, 101  
     nitrogen, 99  
 Limonite, 404  
 Lindane, 279  
 lithia mica, 372  
 lithium, 323  
     chloride, 323  
     hydride, 323  
     hydroxide, 324  
     oxide, 323  
 lye, 493

## M

MACE, 124  
 magnesia, 325  
 magnesium, 325  
     compounds, 325  
     oxide, 325  
     silicate, 511  
 magnetite, 302  
 Malathion, 408  
 Malcon, 578  
 maleic  
     acid, 326  
     anhydride, 327  
 maleinic acid, 326  
 maltworker's lung, 405  
 Maneb, 217  
 manganese, 328  
     compounds, 328  
     dioxide, 328  
 manganic psychosis, 329  
 maple bark stripper's disease, 405  
 marlstone, 479  
 marsh gas, 339  
 MBK, 349  
 MCA, 123  
 MCI, 311  
 MCPA, 425  
 MDI, 311  
 meat wrapper's asthma, 446

# INDEX

- MEK, 221, 363
- mercaptans, 330
- mercapto acetic acid, 530
- mercurialentis, 333
- mercuric compounds, 331
  - alkyl, 334, 335
  - aryl, 332, 334, 335
- mercurous compounds, 331
- mercury compounds, 331
  - inorganic, 331
  - organic, 334
- mesitylene, 553
- mesityl oxide, 337
- mesobenzanthrone, 56
- metal fume fever, 338
- metaphenylene diamine, 221
- methacrylic acid, butyl ester, 89
- methanal, 263
- methane, 339
- methanethiol, 330
- methanoic acid, 265
- methanol, 343
- methemoglobinemia, 35
- methenyl tribromide, 79
- methethyl methane, 81
- methoxychlor, 279
- 2-methoxy ethanol, 245
  - ethyl acetate, 246
- methyl acetate, 340
  - acetylene, 341
- beta-methyl acrolein, 155
- methyl acrylate, 14
- methylal, 342
- methyl alcohol, 343
  - aldehyde, 263
  - amine, 345
  - amyl acetate, 286
  - amyl alcohol, 346
- 2-methyl aziridine, 463
- methyl benzene, 537
  - bromide, 347
- 2-methyl butanal, 350
- 2-methyl-2-butene, 32
- 1-methyl-4-*tert*-butyl benzene, 92
- methyl butyl ketone, 349
- 2-methyl butyraldehyde, 350
- n*-methyl carbamates, 351
- methyl cellosolve, 245
  - cellosolve acetate, 246
  - chloride, 353
  - chloroform, 542
  - chloroformate, 131
- 2-methyl-4-chlorophenoxy acetic acid, 425
- methyl cyclohexane, 355
  - cyclohexanol, 356
  - cyclohexanone, 357
- 2-methyl cyclohexanone, 357
- methyl demeton, 408
- 2-methyl-4,6-dinitrophenol, 206
- methylene chloride, 110, 358
  - chlorobromide, 78
  - dianiline, 359
- 4,4'-methylene dianiline, 359
- p,p'*-methylene dianiline, 359
- methylene dichloride, 358
  - succinic acid, 361
- methyl ether, 362
- 1-methylethyl benzene, 156
- methyl ethylene, 458
  - ethyl ketone, 363
  - ethyl methane, 81
- N*-(1-methylethyl)-2-propan-amine, 192
- methyl formate, 365
- 5-methyl-3-heptanone, 229
- methyl hydride, 339
  - iodide, 366
  - isobutenyl ketone, 337
  - isobutyl carbinol, 346
  - isobutyl carbinol acetate, 286
  - isobutyl ketone, 221, 368
  - isocyanate, 311
  - mercaptan, 330
  - mercury, 334
- n*-methyl methanamine, 194
- methyl methane, 223
  - methanoate, 365
  - nitrite, 369
  - nitrobenzene, 402
  - octyl benzene sulfonate, 370
  - oxirane, 464
- 4-methyl-2-pentanol, 346
- 4-methyl-2-pentanol acetate, 286
- 4-methyl-2-pentanone, 368
- 4-methyl-3-penten-2-one, 337

# HANDBOOK OF INDUSTRIAL TOXICOLOGY

methyl phenol, 153  
 1-methyl-1-phenyl ethylene, 371  
 2-methyl propyl acetate, 302  
 methyl propyl ethanoate, 302  
     propyl ketone, 370  
 1- methyl -2 (3-pyridyl) pyrroli-  
     dine, 388  
 methyl rosaniline chloride, 271  
     styrene, 569  
 alpha-methyl styrene, 371  
 methyl sulfate, 202  
     trinitrobenzene, 554  
     violet, 271  
     yellow, 195  
 mica, 372  
 milk acid, 317  
 miller's bronchitis, 405  
 mill fever, 151, 405  
     worker's asthma, 405  
 mimosa gum, 277  
 mineral carbon, 276  
     fibers, synthetic, 374  
     graphite, 512  
     oil, 157  
     pitch, 48  
     white, 103  
 MIPA, 304  
 MMMF, 374  
 molybdenum compounds, 375  
     disulfide, 375  
     halides, 375  
     oxides, 375  
     trioxide, 375  
 Monday deaths, 399  
 monobenzene, 376  
 monobromo-  
     -ethane, 231  
     -methane, 347  
 monochloro-  
     -acetaldehyde, 122  
     -acetic acid, 123  
     -benzene, 125  
     -ethane, 233  
     -methane, 353  
     -naphthalene, 117  
 monoethylamine, 228  
 monoisopropanolamine, 304  
 monomethylamine, 345

mordenite, 573  
 Morfamquat, 67  
 morpholine, 377  
 mother of pearl, 405  
 moth flakes, 379  
 motor spirits, 270  
 mountain cork, 45  
 MPK, 370  
 mullite, 20  
 muriatic acid, 290  
 Muscovite, 372  
 mushroom picker's lung, 405

## N

Nabam, 217  
 Nack, 497  
 nacre, 405  
 NaK alloy, 497  
 naphthalene, 379  
 1,5-naphthalene diisocyanate, 311  
 naphthalene tetrahydride, 522  
 naphthene, 379  
 naphthenic acids, 380  
 naphthol, 381  
 naphthylamines, 382  
 alpha-naphthyl thiocarbamide, 384  
 naphthyl thiourea, 384  
 NDI, 311  
 nickel, 385  
     carbonyl, 387  
     compounds, 385  
     formate, 385  
     itch, 385  
     nitrate, 385  
 nickelous hydroxide, 385  
 nickel oxide, 385  
     sulfate, 385  
     tetracarbonyl, 387  
 nicotine, 388  
 nitramine, 527  
 nitric acid, 389  
 nitriles, 159  
 nitro-  
     -aniline, 391  
     -benzene, 392  
     -benzol, 392  
     -carbol, 400

# INDEX

nitro-  
 -chloroform, 135  
 ethane, 394  
 nitrogen chloride, 395  
 dioxide, 396  
 trichloride, 395  
 nitro-  
 -glycerin, 398  
 -glycerol, 398  
 -glycol, 398  
 -lime, 99  
 -methane, 400  
 -propanes, 401  
 N-nitroso dimethylamine, 200  
 nitrotoluene, 402  
 nitrous acid *n*-propyl ester, 465  
 nitroxanthic acid, 439

## O

O<sub>3</sub>, 413  
 OCBM, 127  
 ochre, 404  
 ochronosis, 154  
 oil acne, 158, 406  
 of ants, artificial, 266  
 of cassia, 140  
 of mirbane, 392  
 of turpentine, 559  
 of vitriol, 509  
 shale pneumoconiosis, 480  
 olefiant gas, 234  
 organic dusts, 405  
 thio alcohols, 330  
 organo-  
 -phosphates, 408  
 -siloxane, 485  
 -tin compounds, 535  
 orthoboric acid, 75  
 ortho-chlorobenzilidene, 127  
 Orthoclase, 258  
 ortho dichlorobenzene, 175  
 orthophosphoric acid, 432  
 osmic acid, 411  
 osmium tetroxide, 411  
 oxalic acid, 412  
 acid diethyl ester, 256  
 oxammonium, 299

2-oxetanone, 455  
 oxirane, 249  
 oxomethane, 263  
 1,1' - oxybis (2 - chloroethane),  
 181  
 oxymethylene, 263  
 ozone, 413

## P

paprika splitter's lung, 405  
 paragonite, 372  
 Paraquat, 67  
 Parathion, 408  
 PBBs, 442  
 PCBs, 444, 516  
 PCP, 416  
 PCTs, 516  
 pear oil, 29  
 Pegmatite, 372  
 penchlorol, 416  
 penta, 415  
 pentaborane, 73  
 pentaboron monohydride, 73  
 pentachloro  
 ethane, 415  
 -naphthalene, 117  
 phenol, 416  
 pentaerythritol tetranitrate, 417  
 pentalin, 415  
 pentane, 418  
 2,3-pentanol, 31  
 2-pentanone, 370  
 1,2-pentene, 32  
 perchloric acid, 419  
 perchloro-  
 -ethane, 282  
 -ethylene, 519  
 -methane, 112  
 -methyl mercaptan, 330  
 perchloryl fluoride, 420  
 permanganic acid, potassium salt,  
 453  
 perosmic acid, 411  
 peroxybenzoic acid, 90  
 Persian insect powder, 467  
 PETN, 417  
 petrol, 270

# HANDBOOK OF INDUSTRIAL TOXICOLOGY

- petroleum asphalt, 48
  - benzine, 270
  - naphtha, 421
- PGDN, 460
- PGE, 274
- PGME, 461
- phenacyl chloride, 124
- phenol, 422
  - marasmus, 423
- phenoxy herbicides, 425
- phenylamine, 32
- N-phenyl aniline, 215
- phenyl benzene, 213
- N-phenyl benzeneamine, 215
- n*-phenyl diethylamine, 186
- p*-phenylene diamine, 426
- phenylethane, 230
- phenyl ethylene, 503
  - glycidyl ether, 274
  - glycine acid chloride, 427
  - glycine chloride hydrochloride, 427
  - hydrazine, 288
  - hydride, 57
  - hydroxide, 422
- phenylic acid, 422
- phenyl mercuric acetate, 334
  - methane, 537
  - methyl ketone, 7
- beta-phenylpropylene, 371
- Phlogopite, 372
- phosgene, 428
- phosphine, 8, 430
- phosphoretted hydrogen, 430
- phosphoric
  - acid, 432
  - chloride, 435
  - sulfide, 435
- phosphorus
  - chloride, 435
  - compounds, 435
  - elemental, 433
  - oxychloride, 435
  - pentachloride, 435
  - pentasulfide, 435
  - red, 433
  - sesquisulfide, 435
  - trichloride, 435
  - white, 433
  - yellow, 433<sup>+</sup>
- phosphoryl chloride, 435
- phossy jaw, 434
- Phostex, 408
- phthalates, 437
- phthalic
  - acid anhydride, 221, 438
  - anhydride, 438
- picric acid, 439
  - acid, ammonium salt, 27
  - itch, 440
- piconitric acid, 439
- pigeon breeder's disease, 405
- pimelic ketone, 163
- pink disease, 333
- pitch, 143
- plaster of Paris, 103
- platinosis, 441
- platinum compounds, 441
- plumbago, 276
- plumbum, 319
- PMF, 483
- polyalcohol esters, 13
- polybrominated biphenyls, 442
- polychlorinated biphenyls, 444
  - terphenyls, 516
- polychlorotrifluoroethylene, 262
- polymer fume fever, 262
- polytetrafluoroethylene, 262
- polyvinyl
  - chloride, 446
  - fluoride, 262
- polyvinylidene fluoride, 262
- pomace, 115
- porcelain clay, 313
- Portland cement, 447
- potash, 449
- potassium azide, 49
  - chlorate, 450
  - chloride, 449
  - cyanate, 159
  - cyanide, 159
  - dichromate, 138
  - hexachloroplatinate, 441
  - hydrate, 451
  - hydroxide, 451
  - ores, 449

# INDEX

- potassium permanganate, 328, 453
    - stannate, 532
    - tellurite, 513
    - tetrachloroplatinate, 441
  - potato oil, 31
    - spirit, 31
  - precipitated silica, 480
  - printer's asthma, 278
  - propane, 454
  - 1,2-propanediol dinitrate, 460
  - 1-propanol, 457
  - 2-propanol, 306
  - 2-propanone, 6
  - 2-propenal, 10
  - propenamide, 12
  - propene, 458
  - 2-propenenitrile, 15
  - propene oxide, 464
  - propenoic acid esters, 13
  - 2-propenoic-2-methyl butyl ester, 89
  - 1-propenol-3, 16
  - 2-propenol, 16
  - propenyl alcohol, 16
  - beta-propiolactone, 455
  - propionic acid, 455
  - propyl acetate, 456
  - 2-propyl acetate, 305
  - propyl acetone, 349
  - n*-propyl alcohol, 457
  - sec*-propyl alcohol, 306
  - propylene, 458
    - dichloride, 459
    - glycol dinitrate, 460
    - glycol methyl ether, 461
    - glycol monomethyl ether, 461
    - imine, 463
    - oxide, 464
  - propyl hydride, 454
  - propylic alcohol, 457
  - n*-propyl nitrate, 465
  - propyne, 341
  - pseudocumene, 553
  - pumice, 466
  - purple salt, 453
  - PVC, 446
  - pyrethrins, 467
  - pyrethroids, 467
  - pyrethrosin, 467
  - pyrethrum powder, 467
  - pyridine, 468
  - beta-pyridyl-alpha-N-methyl pyrrolidine, 388
  - pyro-
    - acetic ether, 6
    - gallic acid, 470
    - gallol, 470
  - Pyrolan, 351
  - pyrolusite, 328
  - pyrrolylene, 80
- Q**
- quartz, 482
  - quicklime, 101
  - quicksilver, 331
  - quinone, 472
  - quinol, 297
- R**
- rare earth metals, 219
  - rat handler's lung, 405
  - RDX, 166
  - resorcin, 473
  - resorcinol, 473
  - rice, 474
    - miller's syndrome, 475
    - oil disease, 445
  - ricin, 114
  - Ronnel, 408
  - Roscoelite, 372
  - Rotenone, 475
  - Ruelene, 408
  - rutile, 535
- S**
- Saigon cinnamon, 140
  - sal soda, 490
  - satin spar, 103
  - saturnine gout, 320
  - Schradon, 408
  - selenite, 103
  - selenium, 477



# HANDBOOK OF INDUSTRIAL TOXICOLOGY

- selenium anhydride, 477
  - chloride, 477
  - dioxide, 477
  - disulfide, 477
  - fluoride, 477
  - oxide, 477
  - oxychloride, 477
  - trioxide, 477
- sequoiosis, 405
- Sericite, 372
- Sevin, 352
- shale, 479
- shalosis, 480
- Shaver's disease, 20
- siderosis, 301
- silica, amorphous, 480
  - crystalline, 482
  - flour, 221, 482
- siliceous earth, 480
- silicic acid, 485
  - acid, tetraethyl ester, 257
  - anhydride, 482
- silicon dioxide, 482
  - tetrachloride, 484
- silicoproteinosis, 483
- silicosis, 483
- silo-filler's disease, 396
- siloxanes, 485
- silver, 486
  - chloride, 486
  - nitrate, 486
  - oxide, 486
  - picrate, 486
- sisal, 405
- slate, 488
  - worker's pneumoconiosis, 489
- smelter's itch, 41
- SMFA, 492
- soapstone, 512
- soda ash, 490
  - chlorate, 491
  - ulcers, 490
- sodium arsenite, 40
  - azide, 49
  - borate, 75
  - carbonate, 490
  - chlorate, 491
  - chloroplatinate, 441
  - cyanate, 159
  - cyanide, 159
  - dichromate, 138
  - fluoroacetate, 492
  - hexachloroplatinate, 441
  - hydrate, 493
  - hydroxide, 493
  - hypochlorite, 495
  - molybdate, 375
  - monofluoroacetate, 492
  - pentachlorophenate, 496
  - pentachlorophenate phenolate, 496
  - potassium alloy, 497
  - selenite, 477
  - sesquicarbonate, 498
  - silicate, 500
  - stannate, 532
  - tetrabromate, 75
  - tetrachloroplatinate, 441
  - vanadite, 563
- spirits of turpentine, 559
- stannosis, 533
- stannous chloride, 532
  - oxide, 532
  - sulfate, 532
- stealite, 512
- stibine, 501
- stibium, 36
- stinkdamp, 297
- Stoddard solvent, 502
- stone flax, 45
- strobane, 279
- styrene, 503
  - oxide, 221
- styrol, 503
- suborosis, 405
- sulfonyl chloride, 510
- sulfur, 505
  - chloride, 506
  - dioxide, 507
- sulfuretted hydrogen, 296
- sulfur flower, 505
- sulfuric acid, 509
  - acid dimethyl ester, 202
  - chloride, 510
  - ether, 250
  - oxychloride, 510

# INDEX

sulfur monochloride, 506  
 sulfurous anhydride, 507  
   oxide, 507  
   oxychloride, 531  
 sulfur oxychloride, 531  
 sulfuryl chloride, 510  
 Sumithion, 408  
 sylvite, 449  
 synthetic amorphous silica, 480  
   mineral fibers, 374

## T

2,4,5-T, 212, 425  
 talc, 512  
 talcum, 512  
 tamarind, 405  
 tar camphor, 379  
   mollusca, 144  
 TBT, 92  
 TCA, 541  
 TCDBD, 211  
 TCDD, 211  
 2,4,5 TCP, 212  
 TDI, 311  
 tea maker's asthma, 405  
 tear gas, 128  
 telluric acid, 513  
 tellurium, 513  
   dioxide, 513  
   hexafluoride, 513  
 TEPP, 408  
 terpenes, 514  
 terphenyls, 515  
 terra alba, 103  
 tetrabromoethane, 517  
 tetrachloro-  
   -dibenzo-*p*-dioxin, 211  
   -ethane, 518  
   -ethylene, 519  
   -methane, 112  
   -naphthalene, 117  
   -platinates, 441  
   -salicylanilide, 521  
   -silane, 484  
 tetraethyl-  
   lead, 233, 322  
   orthosilicate, 257

  silicate, 257  
 1,2,3,4-tetrahydrobenzene, 164  
 tetrahydro-  
   -furan, 521  
   -naphthalene, 522  
   -1,4-oxazine, 377  
 tetralin, 522  
 tetramethyl-  
   lead, 322  
   thiuram disulfide, 524  
 tetramethylene oxide, 521  
 tetranitro-  
   methane, 525  
   methyl aniline, 527  
 tetraphosphorus trisulfide, 435  
 tetryl, 527  
 thallium, 528  
 thallos acetate, 528  
   bromide, 528  
   chloride, 528  
   oxides, 528  
   sulfide, 528  
 thermal black, 105  
 thiocyanate, 15  
 thioglycolic acid, 530  
 thionyl chloride, 531  
 thiram, 524  
 tin, inorganic compounds, 532  
   organic compounds, 533  
   oxide, 532  
   peroxide, 532  
   tetrachloride, 532  
 titanic chloride, 535  
 titanium dioxide, 535  
   tetrachloride, 535  
   white, 535  
 TMA, 550  
   flu, 551  
 TMCP, 548  
 TMTD, 524  
 TNT, 554  
 tobaccosis, 405  
 TOCP, 548  
 toluene, 221, 537  
   diamine, 538  
   diisocyanate, 311  
 toluidine, 539  
 toluol, 537



# HANDBOOK OF INDUSTRIAL TOXICOLOGY

*m*-tolylene diamine, 538  
 tolyl phosphates, 548  
 toxalbumin, 1  
 toxaphene, 279  
 toxilic anhydride, 327  
 TPCP, 548  
 tremolite, 45  
 trialkyl tin salts, 533  
 tribromomethane, 79  
 tributyl tin chloride, 533  
 Trichlorfon, 408  
 trichloro-  
   -acetic acid, 541  
   -benzenes, 125  
   -ethane, 542  
   -ethene, 544  
   -ethylene, 544  
   -fluoromethane, 128  
   -methane, 130  
   -naphthalene, 117  
   -nitromethane, 135  
   -phenol, 546  
 2,4,5-trichlorophenoxy acetic acid, 425  
 1,2,3-trichloropropane, 547  
 trichloro-*s*-triazine, 159  
 tricresyl phosphates, 548  
 tri-*o*-cresyl phosphate, 548  
 tridymite, 482  
 triethylamine, 549  
 triethylene tetramine, 221  
 triethyl tin, 533  
 1,2,3-trihydroxy benzene, 470  
 trimellitic anhydride, 221, 550  
 trimethyl-  
   -amine, 552  
   benzenes, 553  
   cyclohexanone, 303  
 trimethylene, 168  
*sym*-trimethylene            trinitramine,  
   166  
 trimethyl ethylene, 32  
   tin chloride, 533  
 trinitro glycerol, 398  
 2,4,6-trinitro-  
   -phenol, 439  
   phenyl-methyl nitramine, 527  
   toluene, 554

alpha-trinitrotoluol, 554  
 trinitro trimethylene triamine,  
   166  
 triphenyl tin acetate, 533  
 trivalent chromium compounds,  
   138  
 Trona dust, 498  
 Tubatoxin, 475  
 tung oil, 556  
 tungsten carbide, 145, 557  
 turpentine, 559

## U

UDMH, 288  
 ultraviolet curing inks, 15  
 uranium compounds, 561  
 Ursol asthma, 426

## V

vanadium, 563  
   pentoxide, 563  
 Vapam, 217  
 vaporized silica, 480  
 VC, 565  
 VDC, 568  
 vermiculite, 372  
 vinegar acid, 3  
   naphtha, 226  
 vineyard sprayer's lung, 405  
 vinyl acetate, 564  
   benzene, 503  
   carbinol, 16  
   chloride, 565  
   cyanide, 15  
   ethylene, 80  
 vinylidene chloride, 568  
 vinyl toluene, 569  
   trichloride, 542  
 volcanic powder, 466  
   rock, 466

## W

washing powder lung, 406  
 water glass, 500  
 wheat weevil disease, 406

## INDEX

white asbestos, 45  
  bole, 313  
  caustic, 493  
  spirits, 502

wood alcohol, 343  
  creosote, 152  
  spirit, 343  
  trimmer's disease, 406  
  turpentine, 559  
  worker's lung, 406

### X

xylene, 221, 570

### Y

yellow phosphorus, 433  
yttrium, 219, 572  
  chloride, 572

nitrate, 572  
oxide, 572  
phosphate, 572

### Z

Zectran, 351  
zeolites, 573  
zinc chloride, 574  
  oxide, 575  
  phosphide, 577  
  shakes, 338  
  white, 575  
Zineb, 217  
Ziram, 217  
zircon, 578  
zirconia, 578  
zirconium carbide, 578  
  oxide, 578  
  silicate, 578





















9780820603216

09/19/2019 12:40-2

22