Occupational Health Guideline for Methylcyclohexane

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $CH_3C_6H_{11}$
- Synonyms: Cyclohexylmethane; hexahydrotoluene
- Appearance and odor: Colorless liquid with a faint, benzene-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for methylcyclohexane is 500 parts of methylcyclohexane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 2000 milligrams of methylcyclohexane per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for methylcyclohexane a Threshold Limit Value of 400 ppm.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Methylcyclohexane can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Overexposure to methylcyclohexane may cause light-headedness and drowsiness. It may also cause a slight irritation of the eyes, nose, and throat. At high concentrations, it may cause unconsciousness and death.

2. Long-term Exposure: Prolonged exposure to the liquid may cause irritation of the skin.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to methylcyclohexane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to methylcyclohexane at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from methylcyclohexane exposure.

—Skin disease: Methylcyclohexane is a skin defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although methylcyclohexane is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although methylcyclohexane is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of methylcyclohexane might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Methylcyclohexane vapor is a mild narcotic. Concentrations of 10,000 to 12,500 ppm were fatal to mice. Rabbits exposed to 3330 ppm for 300 hours showed minor evidence of liver and kidney injury, while 1200 ppm was innocuous for rabbits, and prolonged exposure at 370 ppm was harmless to monkeys. No toxic effects from industrial exposure have been reported. Prolonged

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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or repeated skin contact may produce drying and irritation due to defatting action.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 98
  2. Boiling point (760 mm Hg): 101 C (214 F)
  3. Specific gravity (water = 1): 0.77
  4. Vapor density (air = 1 at boiling point of methylcyclohexane): 3.4
  5. Melting point: −126 C (−196 F)
  6. Vapor pressure at 20 C (68 F): 37 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
  8. Evaporation rate (butyl acetate = 1): Data not available
- **Reactivity**
  1. Conditions contributing to instability: Heat
  2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
  3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving methylcyclohexane.
  4. Special precautions: Methylcyclohexane will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: −3.9 C (25 F) (closed cup)
  2. Autoignition temperature: 250 C (482 F)
  3. Flammable limits in air, % by volume: Lower: 1.2; Upper: 6.7
  4. Extinguishant: Dry chemical, foam, carbon dioxide
- **Warning properties**
  1. Odor Threshold: Sax states that at the level of 500 ppm, methylcyclohexane "exhibits only a very faint odor."
  2. Irritation Levels: Sax states that "this material does not cause irritation to the eyes and nose."
  3. Evaluation of Warning Properties: At concentrations within two or three times the permissible exposure limit, methylcyclohexane can be detected through its odor. Therefore, for the purposes of this guideline, it is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of methylcyclohexane vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure methylcyclohexane may be used. An analytical method for methylcyclohexane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid methylcyclohexane.
- Clothing wet with liquid methylcyclohexane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of methylcyclohexane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the methylcyclohexane, the person performing the operation should be informed of methylcyclohexane's hazardous properties.
- Any clothing which becomes wet with liquid methylcyclohexane should be removed immediately and not reworn until the methylcyclohexane is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid methylcyclohexane may contact the eyes.

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SANITATION

• Skin that becomes wet with liquid methylcyclohexane should be promptly washed or showered with soap or mild detergent and water to remove any methylcyclohexane.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to methylcyclohexane may occur and control methods which may be effective in each case:

Operation	Controls
Use as a diluent solvent for cellulose during spray application of lacquers	Process enclosure; local exhaust ventilation; personal protective equipment
Liberation during wire- and textile-coating operations with resins and rubber	General dilution ventilation
Liberation during brush and hand application of synthetic varnishes, lacquers, and paints	General dilution ventilation; personal protective equipment
Use during manufacture of rotogravure inks	Process enclosure; local exhaust ventilation; personal protective equipment
Use as a solvent for oils, fats, waxes, and rubber; use as a diluent in resin molding; use as a degreasing agent	General dilution ventilation; personal protective equipment
Use in industrial organic synthesis in hydro-reforming process	Process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If methylcyclohexane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If methylcyclohexane gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If methylcyclohexane soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of methylcyclohexane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

If methylcyclohexane has been swallowed, do not induce vomiting. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If methylcyclohexane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Methylcyclohexane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal method:

Methylcyclohexane may be disposed of by atomizing in a suitable combustion chamber.

REFERENCES

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RESPIRATORY PROTECTION FOR METHYLCYCLOHEXANE

Condition	Minimum Respiratory Protection* Required Above 500 ppm
Vapor Concentration	
1000 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s).
5000 ppm or less	A gas mask with a chin-style organic vapor canister. Any supplied-air respirator. Any self-contained breathing apparatus.
10,000 ppm or less	A gas mask with a front- or back-mounted organic vapor canister. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 10,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

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