Occupational Health Guideline for Cumene

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: $C_6H_5C_3H_7$
- Synonyms: Isopropylbenzene; 2-phenylpropane; cumol
- Appearance and odor: Colorless liquid with a sharp, penetrating, and aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cumene is 50 parts of cumene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 245 milligrams of cumene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

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

- **Effects of overexposure**

1. Short-term Exposure: Cumene may cause irritation of the skin and eyes. It may also cause dizziness, drowsiness, slight incoordination, and unconsciousness.

2. Long-term Exposure: Prolonged or repeated exposure to cumene may cause skin rash.

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 cumene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to cumene 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 cumene exposure.

—Kidney disease: Although cumene 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 possible impairment of renal function.

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

—Liver disease: Although cumene 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.

—Skin disease: Cumene is a 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.

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

- **Summary of toxicology**

The main toxic effect of cumene is irritation of the eyes, skin, and upper respiratory tract. Narcosis has been reported to occur in animals on high exposure. There are no reports of systemic effects in man as a result of industrial exposure. Chronic exposure of rats above 500 ppm causes congestion of lungs, liver, and kidneys, but no bone marrow changes.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 120
  2. Boiling point (760 mm Hg): 152 C (306 F)
  3. Specific gravity (water = 1): 0.86
  4. Vapor density (air = 1 at boiling point of cumene): 4.14
  5. Melting point: −96 C (−141 F)
  6. Vapor pressure at 20 C (68 F): 8 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
  8. Evaporation rate (butyl acetate = 1): Very low
- **Reactivity**
  1. Conditions contributing to instability: Heat
  2. Incompatibilities: Contact with 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 cumene.
  4. Special precautions: None
- **Flammability**
  1. Flash point: 44 C (111 F) (closed cup)
  2. Autoignition temperature: 425 C (797 F)
  3. Flammable limits in air, % by volume: Lower: 0.9; Upper: 6.5
  4. Extinguishant: Water spray, dry chemical, foam, carbon dioxide
- **Warning properties**
  1. Odor Threshold: The AIHA *Hygienic Guide* and the ILO both report that the odor of cumene is detectable at very low levels. May reports an odor threshold for cumene of 1.2 ppm.
  2. Eye Irritation Level: The *Documentation of TLV's* notes that cumene is an eye irritant, but the concentrations producing irritation are not given.
  3. Evaluation of Warning Properties: Since the odor threshold of cumene is below the permissible exposure limit, cumene is treated as a material with good 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 cumene 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 cumene may be used. An analytical method for cumene 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 cumene.
- Clothing wet with liquid cumene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cumene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cumene, the person performing the operation should be informed of cumene's hazardous properties.
- Non-impervious clothing which becomes wet with liquid cumene should be removed promptly and not reworn until the cumene is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid cumene may contact the eyes.

SANITATION

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

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use during organic synthesis, particularly the cumene route to phenol and 2-methyl styrene	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a constituent of solvents in 150 to 160 C boiling point; use during application of lacquers, paints, and enamels as thinner	General dilution ventilation; personal protective equipment
Use in petroleum distillates either alone or in solvent formulation and surface coating processes	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use during mixing and blending of fuels, especially aviation	General dilution ventilation; personal protective equipment
Liberation during petroleum refining processes; during production of styrene by cracking	Local exhaust ventilation; general dilution ventilation

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 cumene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If cumene gets on the skin, promptly flush the contaminated skin with water. If cumene soaks through the clothing, remove the clothing immediately and flush the skin with water. When there is skin irritation, get medical attention.

• **Breathing**

If a person breathes in large amounts of cumene, 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 cumene 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 cumene 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. Combustion may be improved by mixing with a flammable liquid. Cumene liquid should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal methods:

Cumene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber. Combustion may be improved by mixing with a flammable liquid.

REFERENCES

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RESPIRATORY PROTECTION FOR CUMENE

Condition	Minimum Respiratory Protection* Required Above 50 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s).** Any supplied-air respirator.** Any self-contained breathing apparatus.**
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2500 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
8000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 8000 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.

**If eye irritation occurs at this level, a full facepiece respirator should be worn.