

Occupational Health Guideline for Allyl Chloride

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: $\text{CH}_2=\text{CHCH}_2\text{Cl}$
- Synonyms: 3-Chloroprene; 1-chloro-2-propene
- Appearance and odor: Colorless, yellow, or purple liquid with an unpleasant, pungent odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for allyl chloride is 1 part of allyl chloride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 3 milligrams of allyl chloride per cubic meter of air (mg/m^3). NIOSH has recommended that a ceiling level of 3 ppm ($9 \text{ mg}/\text{m}^3$) be adopted to supplement the existing permissible exposure limit. The NIOSH Criteria Document for Allyl Chloride should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Allyl chloride can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin.

• Effects of overexposure

1. Short-term Exposure: Allyl chloride vapors may cause nose, throat, lung, and eye irritation (with eye pain) and injury to the liver and kidney. Lung injuries may appear several hours after exposure. Liquid allyl chloride may cause a chemical burn and deep-seated eye pain on contact with the eyes. It may also irritate the skin and be absorbed through the skin.

2. Long-term Exposure: Repeated or prolonged exposure to allyl chloride by inhalation or skin contact may cause injury to the kidneys or liver. Prolonged skin contact may burn the skin and may also produce a delayed deep muscle ache described as "deepbone" ache.

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 allyl chloride.

• Recommended medical surveillance

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

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of respiratory system, eyes, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—FVC and FEV (1 sec): Allyl chloride is a severe pulmonary irritant in animals.

—14" x 17" chest roentgenogram: Allyl chloride may cause lung damage. Surveillance of the lungs is indicated.

—Liver function tests: Allyl chloride may cause liver damage. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage may occur, a urinalysis should be obtained to include, at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

—A complete blood count: A complete blood count should be performed, including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual

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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basis, except that an x-ray is necessary only when indicated by the results of pulmonary function testing.

• Summary of toxicology

Allyl chloride vapor is a respiratory irritant, and in animals has caused damage to the liver and kidneys. Rats did not survive when exposed for more than 15 minutes to 29,300 ppm, or longer than 3 hours to 290 ppm; they suffered alveolar hemorrhage in the lungs and severe kidney injury. Several species of animals exposed to 8 ppm for 7 hours daily for 1 month showed no apparent ill effects, but histopathologic examination revealed focal necrosis in the liver and necrosis of the convoluted tubules of the kidney; at 3 ppm for 6 months, rats showed slight centri-lobular degeneration in the liver. The most frequent effects in man following overexposure have been conjunctival irritation and eye pain with photophobia; eye irritation occurs between 50 and 100 ppm. Irritation of the nose occurs at levels below 25 ppm. This substance is a skin irritant and may be absorbed through the skin, causing deep-seated pain. If splashed in the eye, severe irritation would be expected. Systemic intoxication of humans has not been reported.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 76.5
2. Boiling point (760 mm Hg): 44.6 C (112 F)
3. Specific gravity (water = 1): 0.94
4. Vapor density (air = 1 at boiling point of allyl chloride): 2.6
5. Melting point: -134.5 C (-209 F)
6. Vapor pressure at 20 C (68 F): 295 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.36
8. Evaporation rate (butyl acetate = 1): 7 (approximately)

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers, acids, aluminum, zinc, amines, peroxides, and chlorides of iron and aluminum may cause violent polymerizations, fires, and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving allyl chloride.
4. Special precautions: Allyl chloride will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: -31.7 C (-25 F) (closed cup)
2. Autoignition temperature: 391 C (737 F)
3. Flammable limits in air, % by volume: Lower: 3.3; Upper: 11.1
4. Extinguishant: Dry chemical, alcohol foam, carbon dioxide

• Warning properties

Both the odor threshold and the irritation thresholds of allyl chloride are well above the permissible exposure level, as stated in Patty. Allyl chloride, therefore, is treated as a material with poor warning properties. Allyl chloride is an eye irritant, according to Patty, at concentrations of 50 to 100 ppm. Grant reports that only slight eye irritation has been observed in guinea pigs and albino rats exposed to 10 mg/l (3190 ppm) allyl chloride.

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).

• Peak Above Ceiling Evaluation

Measurements to determine peak employee exposure should be taken during periods of maximum expected airborne concentration of allyl chloride. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with benzene and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure allyl chloride may be used. An analytical method for allyl chloride 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 allyl chloride.

- Where exposure of an employee's body to liquid allyl chloride may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Any clothing which becomes wet with allyl chloride or non-impervious clothing which becomes contaminated with liquid allyl chloride should be removed immediately and not reworn until the allyl chloride is removed from the clothing.

- Clothing wet with liquid allyl chloride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of allyl chloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the allyl chloride, the person performing the operation should be informed of allyl chloride's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where liquid allyl chloride may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid allyl chloride should be immediately washed or showered to remove any allyl chloride.

- Eating and smoking should not be permitted in areas where liquid allyl chloride is handled, processed, or stored.

- Employees who handle liquid allyl chloride should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

COMMON OPERATIONS AND CONTROLS

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

Operation

Use during manufacture of glycerin, epichlorohydrin, allyl alcohol, allylamines, allyl silanes, allyl ethers of starch, 1,2,3-trichloropropane, and pharmaceuticals

Controls

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

• Skin Exposure

If allyl chloride gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If allyl chloride soaks through the clothing, remove the clothing promptly 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 allyl chloride, 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

When allyl chloride has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• 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 allyl chloride 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 reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Allyl chloride should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal method:

Allyl chloride may be disposed of by atomizing in a suitable combustion chamber equipped with an effluent gas cleaning device.

REFERENCES

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RESPIRATORY PROTECTION FOR ALLYL CHLORIDE

Condition	Minimum Respiratory Protection* Required Above 1 ppm
Vapor Concentration	
50 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
300 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 300 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.

