

Occupational Health Guideline for Lithium Hydride

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: LiH
- Synonyms: None
- Appearance and odor: Off-white, translucent solid which is odorless.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for lithium hydride is 0.025 milligram of lithium hydride per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Lithium hydride can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Lithium hydride causes sneezing, coughing, and severe irritation of the nose and throat. Lithium hydride can cause severe eye and skin burns. If swallowed, the mouth, trachea, and esophagus may be burned. Inadvertent ingestion of lithium hydride may cause nausea, muscle twitches, mental confusion, blurring of vision, coma, and death.

2. Long-term Exposure: None reported. Nervous system damage has been reported from high short-term exposure.

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 lithium hydride.

• Recommended medical surveillance

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

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

—Skin disease: Lithium hydride is a primary skin irritant. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Eye disease: Lithium hydride is a severe eye irritant and may cause tissue damage. Persons with pre-existing eye conditions may be at increased risk from exposure.

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

• Summary of toxicology

Lithium hydride dust is a severe irritant of the eyes, respiratory tract, and skin due to the formation of lithium hydroxide and its caustic action on moist surfaces. The inherent toxicity of the lithium ion is high; a few milliequivalents in the plasma give rise to signs and symptoms of serious nervous system effects: anorexia, nausea, tremor, muscle twitches, apathy, mental confusion, blurring of vision, coma and death. Exposure of animals to concentrations of 5 to 55 mg/m^3 of lithium hydride caused sneezing and coughing; levels of 10 mg/m^3 corroded the body fur and skin of the legs, and there was occasionally severe inflammation of the eyes and nasal septum. Lesions of the nose and paws were similar to thermal burns and were attributed to the alkalinity of

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.

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

the hydrolysis product of lithium hydride. The explosion of a cylinder of lithium hydride led to eye contact and swallowing of a small amount of the dust by a technician. The resulting burns caused scarring of both corneas, with strictures of the larynx, trachea, bronchi and esophagus; delayed death occurred. Exposure of humans to 0.5 mg/m³ caused eye and skin irritation; 0.025 mg/m³ caused sneezing, to which some degree of tolerance was acquired. Although unlikely to occur from industrial exposures, ingestion will cause severe burns of the mouth and esophagus. Restricted sodium intakes are reported to increase the toxicity of lithium.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 7.95
2. Boiling point (760 mm Hg): Decomposes at very high temperatures
3. Specific gravity (water = 1): 0.78
4. Vapor density (air = 1 at boiling point of lithium hydride): Not applicable
5. Melting point: 686 C (1267 F)
6. Vapor pressure at 20 C (68 F): 0 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Reacts to form hydrogen gas and lithium caustic

8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: Moisture and carbon dioxide, even in concentrations normally in air; heat

2. Incompatibilities: Contact with oxidizers, halogenated hydrocarbons, and acids will cause fires and explosions. Contact with water will cause formation of flammable and explosive hydrogen gas. The heat of the reaction may be sufficient to cause ignition.

3. Hazardous decomposition products: Toxic gases and vapors (such as lithium hydride oxide) may be released in a fire involving lithium hydride.

4. Special precautions: Solid lithium hydride will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: Not applicable
2. Autoignition temperature: 200 C (392 F) (may ignite spontaneously in moist air even at ambient temperatures)

3. Flammable limits in air, % by volume: Not applicable

4. Extinguishant: Smother with nitrogen or other inert gas, or by covering containers, or cover with dry graphite or dry dolomite.

• Warning properties

According to Grant, "in rats, rabbits, and guinea pigs, it (lithium hydride dust) has been observed to cause irritation and inflammation in the eyes at concentrations which were very irritating to the respiratory tract." Grant states that even very low concentrations can produce respiratory irritation. According to the AIHA

Hygienic Guide, "well-fitted respirators of the half mask type, when used with dust filters, protect adequately to 0.1 mg/m³," because "persons with some degree of adaptation complain of eye and nose irritation at concentrations above 0.1 mg/m³ . . ."

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

At the time of publication of this guideline, no measurement method for lithium hydride had been published by NIOSH.

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 any possibility of skin contact with lithium hydride or liquids containing lithium hydride.

• 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 lithium hydride at or above an airborne concentration of 0.1 mg/m³.

- If employees' clothing has had any possibility of being contaminated with lithium hydride or liquids containing lithium hydride, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing which has had any possibility of being contaminated with lithium hydride or liquids containing lithium hydride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of lithium hydride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the lithium hydride, the person performing the operation should be informed of lithium hydride's hazardous properties.

- Where there is any possibility of exposure of an employee's body to lithium hydride, liquids containing lithium or airborne concentrations of lithium hydride exceeding 0.5 mg/m³, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with lithium hydride should be removed immediately and not reworn until the lithium hydride is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of lithium hydride or liquids containing lithium hydride contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to lithium hydride or liquids containing lithium hydride, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with lithium hydride should be immediately brushed to remove any solid lithium hydride from the skin and washed or showered with copious quantities of water to remove any lithium hydride.

- Workers subject to skin contact with lithium hydride or liquids containing lithium hydride should wash any areas of the body which may have contacted lithium hydride at the end of each work day.

- Eating and smoking should not be permitted in areas where lithium hydride or liquids containing lithium hydride are handled, processed, or stored.

- Employees who handle lithium hydride or liquids containing lithium hydride should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation

Use in powder metallurgy; use in manufacture of buoyancy devices, fuel cells, and portable field generators; use in manufacture of reducing agent and propellant

Use as a shielding material for thermal neutrons in nuclear industry; use as a desiccant; use as a condensing agent in organic synthesis; use in a condensation polymerization; use in manufacture of electronic tubes and in ceramics

Use as an intermediate in manufacture of lithium aluminum hydride and lithium amide

Controls

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; 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 lithium hydride or liquids containing lithium hydride get 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 lithium hydride or liquids containing lithium hydride get on the skin, immediately flush the contaminated skin with large amounts of water. If lithium hydride or liquids containing lithium hydride penetrate through the clothing, remove the clothing immediately and flush the skin with large amounts of water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of lithium hydride, 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 lithium hydride or liquids containing lithium hydride have been swallowed and the person is conscious, give him large quantities of water immediately to dilute the

lithium hydride. Do not attempt to make the exposed person vomit. 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 AND DISPOSAL PROCEDURES

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

- If lithium hydride is spilled, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill.
3. Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in a secured sanitary landfill. Avoid contact with water.

- **Waste disposal method:**

Lithium hydride may be disposed of in dry sealed containers in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Lithium Hydride," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Lithium Hydride," *Hygienic Guide Series*, Detroit, Michigan, 1964.
- Browning, E.: *Toxicity of Industrial Metals* (2nd ed.), Butterworths, London, 1969.
- Cracovaner, A. J.: "Stenosis After Explosion of Lithium Hydride," *Archives of Otolaryngology*, 80:87-92, 1964.
- Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Spiegl, C. J., et al.: "Acute Inhalation Toxicity of Lithium Hydride," *A.M.A. Archives of Industrial Health*, 14:468-470, 1956.

RESPIRATORY PROTECTION FOR LITHIUM HYDRIDE

Condition	Minimum Respiratory Protection* Required Above 0.025 mg/m ³
Particulate Concentration	
0.1 mg/m ³ or less	Any high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
1.25 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
25 mg/m ³ or less	A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter.
50 mg/m ³ 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 50 mg/m ^{3**} 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	A high efficiency particulate filter respirator with a full facepiece. Any escape self-contained breathing apparatus.

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

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of lithium hydride; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 50 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

