

# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR CESIUM HYDROXIDE

## INTRODUCTION

This guideline summarizes pertinent information about cesium hydroxide for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

## SUBSTANCE IDENTIFICATION

### • Formula

CsOH

### • Synonyms

Cesium hydrate; cesium hydroxide dimer; cesium hydroxide, solid; cesium hydroxide, solution

### • Identifiers

1. CAS No.: 21351-79-1
2. RTECS No.: FK9800000
3. DOT UN: 2682 60 (solid); 2681 60 (solution)
4. DOT label: Corrosive

### • Appearance and odor

Cesium hydroxide is a noncombustible, colorless or yellowish, deliquescent, crystalline solid.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 149.92
2. Boiling point: Data not available
3. Specific gravity (water = 1): 3.68
4. Vapor density: Data not available
5. Melting point: 272.3°C (522.1°F)
6. Vapor pressure at 20°C (68°F): Data not available
7. Solubility: Very soluble in water (generates heat); soluble in alcohol
8. Evaporation rate: Data not available

### • Reactivity

1. Conditions contributing to instability: Cesium hydroxide is a strong base; in contact with water or moisture, it causes the generation of considerable heat.
2. Incompatibilities: Contact of cesium hydroxide with

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acids, many organic compounds, many metals (such as aluminum, lead, tin, or zinc), glass, oxygen, or carbon dioxide causes a violent reaction.

3. Hazardous decomposition products: None reported
4. Special precautions: Cesium hydroxide must be stored in silver or platinum and out of contact with air because of its reactivity with glass and carbon dioxide.

### Flammability

The National Fire Protection Association has not assigned a flammability rating for cesium hydroxide; this substance is not combustible.

1. Flash point: Not applicable
2. Autoignition temperature: Not applicable
3. Flammable limits in air: Not applicable
4. Extinguishant: Use dry chemical, carbon dioxide, water spray, or standard foam to extinguish fires involving cesium hydroxide.

Fires involving cesium hydroxide should be fought upwind and from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Containers of cesium hydroxide may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Dikes should be used to contain fire-control water for later disposal. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving cesium hydroxide. Structural firefighters' protective clothing may provide limited protection against fires involving cesium hydroxide.

## EXPOSURE LIMITS

### OSHA PEL

The Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure limit (PEL) for cesium hydroxide [29 CFR 1910.1000, Table Z-1].

### • NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 2 mg/m<sup>3</sup> as a TWA for up to a 10-hr workday and a 40-hr workweek [NIOSH 1992].

### • ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned cesium hydroxide a threshold limit value (TLV) of 2 mg/m<sup>3</sup> as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1993].

### • Rationale for limits

The NIOSH and ACGIH limits are based on the risk of eye irritation associated with exposure to cesium hydroxide.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Exposure to cesium hydroxide can occur through inhalation and eye or skin contact.

### • Summary of toxicology

1. *Effects on Animals:* In animals, cesium hydroxide is irritating and corrosive to the eyes, mucous membranes, skin, and upper respiratory tract; the severity of these effects depends on the concentration of cesium hydroxide. Application of 5 mg cesium hydroxide to the eye of rabbits for 5 min, followed by rinsing with water, caused severe eye irritation; application of 5 mg to the skin of rabbits for 24 hr caused mild skin irritation [NIOSH 1993; Sax and Lewis 1989]. The oral LD<sub>50</sub> for cesium hydroxide in the rat is 570 mg/kg, and the intraperitoneal LD<sub>50</sub> in the same species is 100 mg/kg [NIOSH 1993]. The oral LD<sub>50</sub> in mice is 800 mg/kg [NIOSH 1993; Sax and Lewis 1989; ACGIH 1991].

2. *Effects on Humans:* In humans, cesium hydroxide is irritating and corrosive to the eyes, nose, throat, and skin. Solutions containing 5% cesium hydroxide are regarded as safe for human skin contact; however, in contact with the eyes, a solution of this concentration causes extreme irritation and corneal corrosion [Sittig

1985]. Stronger solutions of cesium hydroxide cause eye and skin burns and may cause permanent damage. There is no other toxicological information on the effects of exposure to cesium hydroxide in humans.

• **Signs and symptoms of exposure**

1. *Acute exposure:* The signs and symptoms of acute inhalation exposure to cesium hydroxide include a burning sensation in nose, throat, and upper respiratory tract; runny nose; pain, redness and tearing of the eyes; difficult breathing; and redness, pain, and burns of the skin.
2. *Chronic exposure:* No signs or symptoms of continued low-level exposure to cesium hydroxide have been reported.

• **Emergency procedures**

**WARNING!**  
**Transport victims immediately to emergency medical facility!**

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. *Immediately* initiate the following emergency procedures, continuing them as appropriate en route to the emergency medical facility:

1. *Eye exposure:* Tissue destruction and blindness may result! *Immediately* but *gently* flush the eyes with large amounts of water for at least 15 min, occasionally lifting the upper and lower eyelids.
2. *Skin exposure:* Severe burns and skin corrosion may result! *Immediately* remove all contaminated clothing! *Immediately, continuously, and gently* wash skin for at least 15 min. Use soap and water if skin is intact; use only water if skin is not intact.
3. *Inhalation exposure:* Move the victim to fresh air *immediately*. Have victim blow his or her nose, or use a soft tissue to remove particulates or residues from the nostrils.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure:* Take the following steps if cesium hydroxide or any material containing it is ingested:

—Do *not* induce vomiting.

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water. Immediately after rinsing, have the victim drink one cup (8 oz) of fluid and *no more*.

—Do *not* permit the victim to drink milk or carbonated beverages!

—Do *not* permit the victim to drink any fluid if more than 60 min have passed since initial ingestion.

**NOTE:** These instructions must be followed exactly. Drinking a carbonated beverage or more than one cup of fluid could create enough pressure to perforate already damaged stomach tissue. The tissue-coating action of milk can sometimes impede medical assessment of tissue damage. Ingestion of any fluid more than 60 min after initial exposure could further weaken damaged tissue and result in perforation.

5. *Rescue:* Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

## EXPOSURE SOURCES AND CONTROL METHODS

The following uses may involve cesium hydroxide and may result in worker exposures to this substance:

—Use as an electrolyte in alkaline storage batteries at sub-zero temperatures

—Use as a polymerization catalyst for siloxanes

—Use as an agent in the removal of sulfur from heavy oils

—Use as a raw material in the production of cesium salts, which are then used to produce cesium metal for electronic devices

The following methods are effective in controlling worker

exposures to cesium hydroxide, depending on the feasibility of implementation:

- Process enclosure
- Local exhaust ventilation
- General dilution ventilation
- Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. *Engineering design for control of workplace hazards*. New York, NY: McGraw-Hill.
5. Plog BA [1988]. *Fundamentals of industrial hygiene*. Chicago, IL: National Safety Council.

## MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) period-

ically during the term of employment, and (3) at the time of job transfer or termination.

### • Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to cesium hydroxide, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, and respiratory system.

A preplacement medical evaluation is recommended to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to cesium hydroxide at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the eyes, skin, or respiratory system.

### • Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to cesium hydroxide exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of cesium hydroxide on the eyes, skin, or respiratory system. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitor-

ing test acceptable for routine use has yet been developed for cesium hydroxide.

- **Medical examinations recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

## **WORKPLACE MONITORING AND MEASUREMENT**

A worker's exposure to airborne cesium hydroxide is determined by using a mixed cellulose ester filter (MCEF) (0.8 micron). Samples are collected at a maximum flow rate of 2.0 liters/min until a maximum air volume of 960 liters is collected. Elemental cesium analysis is conducted by atomic absorption spectroscopy, and the results are reported as cesium hydroxide. This method is described in the OSHA Laboratory In-House Methods File [OSHA 1989].

## **PERSONAL HYGIENE**

If cesium hydroxide contacts the skin, workers should immediately wash the affected areas with soap and water.

Clothing contaminated with cesium hydroxide should be removed immediately, and provisions should be made for safely removing this chemical from these articles. Persons laundering the clothes should be informed of the hazardous properties of cesium hydroxide, particularly its potential to cause eye and skin burns.

A worker who handles cesium hydroxide should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, or applying cosmetics.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where cesium hydroxide or a solution containing cesium hydroxide is handled, processed, or stored.

## **STORAGE**

Cesium hydroxide should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Cesium hydroxide should not be stored in glass containers. Containers of cesium hydroxide should be protected from physical damage and should be stored separately from acids, organic compounds, metals, oxygen, carbon dioxide, moisture, heat, sparks, and open flame. Because containers that formerly contained cesium hydroxide may still hold product residues, they should be handled appropriately.

## **SPILLS AND LEAKS**

In the event of a spill or leak involving cesium hydroxide or a solution containing cesium hydroxide, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup is complete. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
2. Notify safety personnel.
3. Do not use water in clean-up.
4. For small dry spills, use a scoop or clean shovel and gently place the material into a clean, dry container, creating as little dust as possible; cover and remove the container from the spill area.
5. For liquid spills, dilute the concentration of cesium hydroxide with water, neutralize the spilled material with dilute acid, absorb with sand or other noncombustible absorbent material, and place into closed containers for later disposal.

## **SPECIAL REQUIREMENTS**

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

## Emergency planning requirements

Cesium hydroxide is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

## Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of cesium hydroxide; there is no reportable quantity for this substance.

## Community right-to-know requirements

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of cesium hydroxide emitted or released from their facility annually.

## Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Cesium hydroxide is listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], and has been assigned EPA Hazardous Waste No. D002. This substance has been banned from land disposal and may be treated by deactivation.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for the waste removal and disposal.

## RESPIRATORY PROTECTION

### • Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of cesium hydroxide exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

### • Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information about the selection and use of respirators and about the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

## PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent any skin contact with cesium hydroxide. Rubber gloves, rubber aprons, or protective suits and rubber boots should be worn when needed to prevent contact with cesium hydroxide. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under

actual conditions of use. No reports have been published on the resistance of various protective clothing materials to cesium hydroxide permeation; however, neoprene and polyvinyl-chloride have been tested against chemically similar materials (sodium hydroxide and potassium hydroxide) and may provide greater than 8-hr of resistance to permeation. Since specific test data are not available for cesium hydroxide, the information provided here should be considered as a guideline only. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to cesium hydroxide.

If cesium hydroxide is dissolved in water or an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or face shields should be worn during operations in which cesium hydroxide might contact the eyes (e.g., through splashes of solutions containing cesium hydroxide). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with cesium hydroxide. Contact lenses should not be worn if the potential exists for cesium hydroxide exposure.

## REFERENCES CITED

- ACGIH [1991]. Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- ACGIH [1993]. 1993-1994 Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
- NIOSH [1987a]. NIOSH guide to industrial respiratory protection. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-116.
- NIOSH [1987b]. NIOSH respirator decision logic. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-108.
- NIOSH [1992]. NIOSH recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.
- NIOSH [1993]. Registry of toxic effects of chemical substances database: cesium hydroxide. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Standards Development and Technology Transfer, Technical Information Branch.
- OSHA [1989]. OSHA laboratory in-house methods file. Salt Lake City, UT: U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Analytical Laboratory.
- Sax NI, Lewis RJ [1989]. Dangerous properties of industrial materials. 7th ed. New York, NY: Van Nostrand Reinhold Company.
- Sittig M [1985]. Handbook of toxic and hazardous chemicals. 2nd ed. Park Ridge, NJ: Noyes Publications.

