

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR PORTLAND CEMENT

INTRODUCTION

This guideline summarizes pertinent information about Portland cement (containing less than 1 percent quartz) 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 Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether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

Varies with composition of specific cement

• Synonyms

Hydraulic cement, Portland cement silicate, cement

• Identifiers

1. CAS No.: 65997-15-1
2. RTECS No.: VV8770000
3. DOT UN: None
4. DOT label: None

• Appearance and odor

Portland cement is a finely divided gray powder containing less than 1 percent silica and composed of lime,

alumina, silica, and iron oxide; small amounts of magnesium, sodium, potassium, and sulfur are also present. This substance is odorless.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: Varies with specific cement
2. Boiling point: Not applicable
3. Specific gravity: Not reported
4. Vapor density: Not applicable
5. Melting point: Not applicable
6. Vapor pressure at 20°C (68°F): Not applicable
7. Solubility: Insoluble in water
8. Evaporation rate: Not applicable

• Reactivity

1. Conditions contributing to instability: None reported
2. Incompatibilities: None reported
3. Hazardous decomposition products: None reported
4. Special precautions: None reported.

• Flammability

The National Fire Protection Association has not

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

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

assigned a fire hazard rating for Portland cement; 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 an extinguishant that is suitable for the materials involved in the surrounding fire.

Fires involving Portland cement should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving Portland cement.

EXPOSURE LIMITS

OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for Portland cement is 15 mg/m³ (total dust) and 5 mg/m³ (respirable fraction) as 8-hour time-weighted average (TWA) concentrations [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 10 mg/m³ (total dust) and 5 mg/m³ (respirable fraction) as TWAs 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 Portland cement a threshold limit value (TLV) of 10 mg/m³ (total dust) 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 physical irritation associated with exposure to Portland cement [NIOSH 1992; ACGIH 1991].

HEALTH HAZARD INFORMATION

Routes of exposure

Exposure to Portland cement can occur through inhalation, ingestion, and eye or skin contact.

Summary of toxicology

1. *Effects on Animals:* Instilled intratracheally, cement dust caused an absorptive reaction in guinea pig lungs. Peritoneal nodules formed initially and then decreased progressively in size and eventually resolved spontaneously [ACGIH 1991].
2. *Effects on Humans:* Portland cement dust causes eye irritation, and prolonged or repeated contact of the dust or cement with the skin causes dermatitis [Hathaway et al. 1991]. Fifteen of 95 cement workers studied had a mild dermatitis of the hands [Hathaway et al. 1991]. A study of 2,736 Portland cement workers revealed that 5.4 percent of these workers had dyspnea, compared with a 2.7 percent prevalence among controls. There were no differences in mean pulmonary function test results between the two groups [Hathaway et al. 1991]. The mean cement dust exposure for these workers was 0.57 mg/m³ (respirable dust), with peaks to 46 mg/m³ [Hathaway et al. 1991].

Signs and symptoms of exposure

1. *Acute exposure:* The signs and symptoms of acute exposure to Portland cement include physical irritation of the eyes, with redness and tearing; coughing; and redness, roughness, and scaling of the skin.
2. *Chronic exposure:* The signs and symptoms of repeated or prolonged exposure of the skin to Portland cement include coughing, expectoration, exertional dyspnea, and skin redness, blistering, burns, and, in some individuals, raised itching areas characteristic of hives.

Emergency procedures

WARNING!

Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of irritation!

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Irritation may result. **Immediately and thoroughly** flush the eyes with large amounts of water, occasionally lifting the upper and lower eyelids.
2. *Skin exposure:* Irritation may result. **Immediately and thoroughly** wash contaminated skin with soap and water.
3. *Inhalation exposure:* Move the victim to fresh air **immediately**. Have the 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:* Seek medical attention and take the following steps if a large amount of Portland cement is ingested:

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.

—Have the victim drink a fluid such as water.

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, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

EXPOSURE SOURCES AND CONTROL METHODS

The following operation may involve Portland cement and lead to worker exposures to this substance:

—Use as a binding agent in concrete and mortar

The following methods are effective in controlling worker exposures to Portland cement, depending on the feasibility of implementation:

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information on 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 detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically 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 Portland cement, 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 tract. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to Portland cement at or below the prescribed exposure limit. The 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 tract.

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 Portland cement exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of Portland cement on the eyes, skin, or respiratory tract. 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 monitoring test acceptable for routine use has yet been developed for Portland cement.

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 to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

Determination of a worker's exposure to airborne Portland cement is made using a tared low ash polyvinyl chloride (LAPVC) filter, 5 microns, preceded by a 10-mm nylon cyclone. A maximum air volume of 960 liters is collected at a maximum flow rate of 2 liters/min. A gravimetric analysis is then performed to measure compliance with the respirable Portland cement standard. Following this determination, an x-ray diffraction analysis of respirable quartz is done to determine compliance with the quartz standard. These methods are described in the *OSHA Industrial Hygiene Technical Manual* [OSHA 1985a], *NIOSH Occupational Exposure Sampling Strategy Manual* [NIOSH 1977] and Method No. ID-142 of the *OSHA Analytical Methods Manual* [OSHA 1985b].

PERSONAL HYGIENE

If Portland cement dust contacts the skin, workers should flush the affected areas immediately with plenty of water, and then wash with soap and water.

Clothing contaminated with Portland cement dust should be removed, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of Portland cement, particularly its potential to cause dermatitis on prolonged contact.

A worker who handles Portland cement 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 Portland cement is handled, processed, or stored.

STORAGE

Portland cement 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]. Containers of Portland cement should be protected from physical damage.

SPILLS

In the event of a spill involving Portland cement, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill:

1. Do not touch the spilled material.
2. Notify safety personnel.
3. Avoid creating dust during cleanup by using a vacuum or a wet method for cleanup.
4. For dry spills, use a 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.

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

Portland cement 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 355.30] to notify the National Response Center of an accidental release of Portland cement; 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 Portland cement 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. Although Portland cement is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

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 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 Portland cement 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* [1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing (gloves, boots, and gauntlets) should be worn to prevent prolonged skin contact with Portland cement. 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 Portland cement permeation. 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 Portland cement.

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

ATS [1987]. Standardization of spirometry—1987 update. American Thoracic Society. *Am Rev Respir Dis* 136:1285-1296.

CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

Hathaway GJ, Proctor NH, Hughes JP, and Fischman, ML [1991]. Proctor and Hughes' chemical hazards of the workplace. 3rd ed. New York, NY: Van Nostrand Reinhold.

NIOSH [1977]. Occupational Exposure Sampling Strategy Manual. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 77-173.

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.

OSHA [1985a]. Industrial hygiene technical manual. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA [1985b]. OSHA analytical methods manual. Salt Lake City, UT: U.S. Department of Labor, OSHA Analytical Laboratory.

