

# Occupational Health Guideline for Portland Cement

## 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: Typically mixture of: 2 CaO-SiO<sub>2</sub>, 3 CaO-Al<sub>2</sub>O<sub>3</sub>, 3 CaO-SiO<sub>2</sub>, 4 CaO-Al<sub>2</sub>O<sub>3</sub>-Fe<sub>2</sub>O<sub>3</sub>
- Synonyms: Hydraulic cement; cement
- Appearance and odor: Odorless gray powder containing less than 1% crystalline silica.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for Portland cement is 50 million particles of Portland cement per cubic foot of air (mppcf) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended that the permissible exposure limit be reduced to 30 mppcf.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Portland cement 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

Exposure to Portland cement may cause irritation of the eyes, nose, and skin. It may cause chronic irritation of the eyes, nose ulcers, and skin rashes. Allergic skin rashes may also occur. Repeated exposure over a long period to time to cement dust has produced x-ray changes of the lungs and an increased amount of wheezing, shortness of breath, and cough with sputum. Exposure for a long period of time to very high

concentrations of Portland cement may cause cough with phlegm.

### • 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 Portland cement.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to Portland cement 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 the respiratory tract and eyes should be stressed. The skin should be examined for evidence of chronic disorders.

—14" x 17" chest roentgenogram: Portland cement mixtures have been reported to cause x-ray changes. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Portland cement mixtures may cause signs of respiratory impairment. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is necessary only when indicated by the results of pulmonary function testing, or by signs and symptoms of respiratory disease.

### • Summary of toxicology

Portland cement dust irritates the eyes and causes dermatitis. There are reports of increased incidence of bronchitis and chest x-ray changes after prolonged heavy exposure to undefined mixtures of cement and other dusts. Exposure to cement can cause chronic conjunctivitis, blepharitis, and ulcers of the nose. Repeated and prolonged skin contact with cement can result in dermatitis of the hands, forearms, and feet; this is a primary irritant dermatitis and may be complicated in some instances by a secondary contact sensitivity to

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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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hexavalent chromium. In a study of 95 cement workers, 15 had a mild dermatitis of the hands, which consisted of xerosis with erythema and mild scaling; 20 workers had a more active disorder manifested by eczematous lesions with vesicles, erythema, and fissures; when all 95 workers were patch tested with 0.25% potassium dichromate, one person had a mild reaction and the others were negative. In one survey of 2278 cement workers, it was concluded that exposure to finished Portland cement caused no significant findings on chest roentgenograms even after heavy and prolonged exposures. However, in a follow-up study of 195 of these workers after further exposure of 17 to 20 years, 13 showed increases in lung markings on roentgenograms; an additional 6 workers, who had been exposed largely to raw dusts which contained varying amounts of free silica, had marked linear exaggeration with ill-defined micronodular shadows, but no symptoms referable to the chest. In contrast, a more recent study of 847 cement workers with at least 5 years of exposure to levels ranging from 14 to 3020 mppcf in cement plants revealed that symptoms such as cough, expectoration, exertional dyspnea, wheezing, and chronic bronchitis syndromes were consistently more frequent than in a group of 460 control workers; a higher prevalence of these symptoms was also found in nonsmokers exposed to cement than in a control group of nonsmokers.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: Variable
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): Much greater than 1
4. Vapor density (air = 1 at boiling point of Portland cement): Not applicable
5. Melting point: Not applicable
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

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

### • Reactivity

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

### • Flammability

1. Not combustible

### • Warning properties

Grant states that Portland cement "is a fine, gray, alkaline powder which is made by firing a mixture of limestone, alumina, and silica. It is mixed with water, sand, and stones to make concrete. While this mixture is still fluid or plastic, it is sufficiently alkaline to injure the corneal epithelium. A splash in the eye causes smarting and burning sensation, and induces corneal edema. The victim may immediately see colored rings or haloes

about lights. Superficial injuries of the conjunctiva may also occur.

"Portland cement or concrete is not as dangerous as mortar, which contains a greater amount of free calcium hydroxide (lime) and is more strongly alkaline. Splashes of mortar cause 'lime burns,' which may be very severe if irrigation is not performed promptly. After concrete or mortar have been mixed and set, they slowly become less alkaline and less apt to cause chemical injury of the eye.

"In one instance, squamous carcinoma in the conjunctiva and epithelioma of the cornea developed two years after slight injuries of the conjunctiva by cement particles, but the relationship was uncertain."

## 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 Portland cement 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 repeated or prolonged skin contact with powdered Portland cement or liquids containing Portland cement.

- Non-impervious clothing which becomes contaminated with Portland cement should be removed promptly and not reworn until the Portland cement is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where powdered Portland cement or liquids containing Portland cement may contact the eyes.

## SANITATION

- Skin that becomes contaminated with powdered Portland cement or liquids containing Portland cement should be promptly washed or showered with soap or mild detergent and water to remove any Portland cement.
- Eating and smoking should not be permitted in areas where powdered Portland cement is handled, processed, or stored.
- Employees who handle powdered Portland cement or liquids containing Portland cement should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Liberation from manufacture, mixing, and transfer of concretes	Process enclosure; local exhaust ventilation; personal protective equipment
Use in manufacture of mortars for building blocks, bricks, stone, and pre-cast items; as a moisture sealant for exterior of concrete blocks	Process enclosure; local exhaust ventilation; personal protective equipment

## Operation

Use in concrete on highway paving; domestic and commercial building construction; use in pre-cast concrete articles; use in construction of agricultural stone; use in light-weight concrete, terrazzo, stucco, asbestos cement products, gas and foamed concretes, interior surfaces, and exterior surfaces

## 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 powdered Portland cement or liquids containing Portland cement 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 powdered Portland cement or liquids containing Portland cement get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If powdered Portland cement or liquids containing Portland cement penetrate through the clothing, remove the clothing immediately 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 Portland cement, 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 Portland cement has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

## SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If Portland cement is spilled, the following steps should be taken:

1. Ventilate area of spill.
  2. Collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill.
- Waste disposal method:  
Portland cement may be disposed of in a secured sanitary landfill.

## REFERENCES

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## RESPIRATORY PROTECTION FOR PORTLAND CEMENT

<b>Condition</b>	<b>Minimum Respiratory Protection* Required Above 50 mppcf</b>
<b>Particulate Concentration</b>	
250 mppcf or less	Any dust respirator.
500 mppcf or less	Any dust respirator, except single-use or quarter-mask respirator. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
2500 mppcf 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.
25,000 mppcf or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 25,000 mppcf 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.

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