

Occupational Health Guideline for Calcium Oxide

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: CaO
- Synonyms: Quicklime; pebble lime
- Appearance and odor: White or gray odorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for calcium oxide is 5 milligrams of calcium oxide per cubic meter of air (mg/m³) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended for calcium oxide a Threshold Limit Value of 2 mg/m³.

HEALTH HAZARD INFORMATION

• Routes of exposure

Calcium oxide 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:* Calcium oxide causes irritation of the eyes, nose, throat, and skin. Severe burns may result from contact with this chemical. It may also cause bronchitis and pneumonia.

2. *Long-term Exposure:* Repeated or prolonged exposure to calcium oxide may cause irritation of the skin and ulceration and perforation of the nasal septum.

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 calcium oxide.

• Recommended medical surveillance

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

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

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

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

• Summary of toxicology

Calcium oxide dust irritates the eyes and upper respiratory tract. The irritant effects are probably due primarily to its alkalinity, but dehydrating and thermal effects also may be contributing factors. Inflammation of the respiratory passages, ulceration, and perforation of the nasal septum, and pneumonia have been attributed to inhalation of calcium oxide dust; severe irritation of the upper respiratory tract ordinarily causes persons to avoid serious inhalation exposure. Particles of calcium oxide have caused severe burns of the eyes; prolonged or repeated contact with skin could cause dermatitis.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 56.1
2. Boiling point (760 mm Hg): 2850 C (5162 F)
3. Specific gravity (water = 1): 3.30

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

4. Vapor density (air = 1 at boiling point of calcium oxide): Not applicable
5. Melting point: 2570 C (4658 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 slaked lime

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

• **Reactivity**

1. Conditions contributing to instability: Moisture
2. Incompatibilities: Contact with water causes violent spattering and heat liberated may cause ignition of combustible substances.
3. Hazardous decomposition products: Slaked lime
4. Special precautions: Calcium oxide will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Not combustible

• **Warning properties**

Grant states that "burns of the eye caused by particles of calcium oxide are severe and of the same nature as those caused by calcium hydroxide."

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**

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by treatment with nitric and perchloric acids, solution in hydrochloric acid, and analysis with an atomic absorption spectrophotometer. An analytical method for calcium oxide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

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 skin contact with calcium oxide, where skin contact may occur.

• If employees' clothing may have become contaminated with calcium oxide, employees should change into uncontaminated clothing before leaving the work premises.

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

• Where exposure of an employee's body to calcium oxide may occur, 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 calcium oxide should be removed promptly and not reworn until the calcium oxide is removed from the clothing.

• Employees should be provided with and required to use dust-resistant safety goggles where there is any possibility of calcium oxide contacting the eyes.

• Where there is any possibility that employees' eyes may be exposed to calcium oxide, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

• Workers subject to skin contact with calcium oxide should wash with soap or mild detergent and water any areas of the body which may have contacted calcium oxide at the end of each work day.

• Skin that becomes contaminated with calcium oxide should be promptly washed or showered with soap or mild detergent and water to remove any calcium oxide.

• Eating and smoking should not be permitted in areas where calcium oxide is handled, processed, or stored.

- Employees who handle calcium oxide 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 calcium oxide may occur and control methods which may be effective in each case:

Operation	Controls
Use in preparation of lime; use in manufacture of Portland cement, mortar, stucco, and plaster	Process enclosure; local exhaust ventilation; personal protective equipment
Liberation during weighing and mixing of construction bonding agents	Personal protective equipment
Use during manufacture of construction, insulation, and refractory materials	Process enclosure; local exhaust ventilation; personal protective equipment
Use for preparation and mixing with soil, lime, and water in soil and sub-base stabilization	Personal protective equipment
Use in manufacture of iron and steel in wire-drawing; during metal refining and smelting as a flux	Process enclosure; local exhaust ventilation; personal protective equipment
Use as a softening, purifying, coagulating, and suspending compound in water treatment and purification; use in sewage and waste treatment in steel fabrication, waste plants, chemical, pharmaceutical, and explosives industry; sulfur removal in petroleum refining	Personal protective equipment
Use in synthesis of chemicals, dye intermediates, paint pigments, and pharmaceuticals; during Kraft pulp processing of paper; during food processing including	Process enclosure; local exhaust ventilation; personal protective equipment

Operation	Controls
cane and beet sugar refining	Process enclosure; local exhaust ventilation; personal protective equipment
Use in manufacture of silicate and non-silicate glass; during liming of hides in leather manufacture; in manufacture of pesticides and fungicides, and in cleaning operations as bleach, disinfectant, deodorizer, sewer, cesspool, and septic tank cleaners	
Handling and application of agricultural lime and mixing of agricultural fungicides	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 calcium oxide 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 calcium oxide gets on the skin, immediately flush the contaminated skin with large amounts of water. If calcium oxide penetrates through the clothing, remove the clothing immediately and flush the skin with large amounts of water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of calcium oxide, 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 calcium oxide has been swallowed and the person is conscious, give him large quantities of water immediately to dilute the calcium oxide. 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. Under-

stand 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 calcium oxide is spilled, the following steps should be taken:

1. Ventilate area of spill.

2. 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.

- Waste disposal method:

Calcium oxide may be disposed of in sealed containers in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Calcium Oxide (Lime)," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- 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.
- International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1971.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Schwartz, L., Tulipan, L., and Birmingham, D.: *Occupational Diseases of the Skin* (3rd. ed. rev.), Lea and Febiger, Philadelphia, 1957.
- Stecher, P. G. (ed.): *The Merck Index* (8th ed.), Merck Co., Inc., Rahway, New Jersey, 1968.
- von Oettingen, W. F.: *Poisoning: A Guide to Clinical Diagnosis and Treatment* (2nd ed.), Saunders, Philadelphia, 1958.

RESPIRATORY PROTECTION FOR CALCIUM OXIDE

Condition	Minimum Respiratory Protection* Required Above 5 mg/m ³
Particulate Concentration	
25 mg/m ³ or less	Any dust and mist respirator.**
50 mg/m ³ or less	Any dust and mist respirator, except single-use or quarter-mask respirator.** Any fume respirator or high efficiency particulate respirator.** Any supplied-air respirator.** Any self-contained breathing apparatus.**
250 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.
Greater than 250 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.

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.

