

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** CALCIUM OXIDE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for CALCIUM OXIDE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance CALCIUM OXIDE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of calcium oxide not in excess of 5 milligram per cubic meter (mg/M3), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for calcium oxide.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which calcium oxide is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of calcium oxide at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of calcium oxide.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to calcium oxide;

(ii) Any measurements of calcium oxide taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to calcium oxide; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to calcium oxide at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to calcium oxide at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to calcium oxide at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to calcium oxide above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to calcium oxide above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to calcium oxide below the action level, the employer may terminate measurement for the employee.

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(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (iv) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
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Above permissible exposure	$\pm 25\%$
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At or below permissible exposure and above the action level	$\pm 35\%$
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At or below the action level	$\pm 50\%$
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(d) Compliance. (1) No employee shall be exposed to calcium oxide above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of calcium oxide shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of calcium oxide.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

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(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of calcium oxide to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR CALCIUM OXIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION

Particulate Concentration	
25 mg/M3 or less	Any dust and mist respirator.
50 mg/M3 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/M3 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/M3 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.

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Escape A high efficiency particulate filter respirator with
a full facepiece.

Any escape self-contained breathing apparatus.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for calcium oxide.

(2) Calcium oxide shall be stored so as not to come in contact with water.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees 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. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that employees whose clothing may have become contaminated with calcium oxide change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing contaminated with calcium oxide is placed in closed containers for storage until it can be discarded or until the employer provides 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 employer shall inform the person performing the operation of the hazardous properties of calcium oxide.

(4) Where exposure of an employee's body to calcium oxide may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(5) Employers shall ensure that non-impervious clothing which becomes contaminated with calcium oxide be removed promptly and not reworn until the calcium oxide is removed from the clothing.

(6) Employers shall provide and ensure that employees use dust-resistant safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133(a)(2)-(a)(6) where there is any possibility of calcium oxide contacting the eyes.

(7) Where there is any possibility that an employee's eyes may be exposed to calcium oxide, employers shall provide an eye-wash fountain within the immediate work area for emergency use.

(g) Spills and disposal. In the event that calcium oxide is spilled the employer shall immediately provide available ventilation and then clean up the spill.

(h) Sanitation. (1) Employers shall ensure that all employees subject to skin contact with calcium oxide 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.

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(2) Employers shall ensure that employees whose skin becomes contaminated with calcium oxide promptly wash or shower with soap or mild detergent and copious quantities of water to remove any calcium oxide from the skin.

(3) Employers shall ensure that employees do not eat or smoke in areas where calcium oxide is handled, processed or stored.

(4) Employers shall ensure that employees who handle calcium oxide wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which calcium oxide is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to calcium oxide above the action level or employees who may have skin or eye contact with calcium oxide, or employees who work where a spill of calcium oxide may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for calcium oxide (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to calcium oxide.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to calcium oxide which are listed in Appendix A of the section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to calcium oxide.

(j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed to airborne concentrations of calcium oxide at or above the action level information as to whether such employee has a history of any of the following medical conditions:

(i) Chronic lung disease

(ii) Skin disease

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to calcium oxide which are listed in Appendix A which the employee suspects are caused by exposure to calcium oxide.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for calcium oxide;

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(ii) A description of the affected employee's duties as they relate to his exposure to calcium oxide;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to calcium oxide or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to calcium oxide including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to calcium oxide.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to airborne concentrations of calcium oxide in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to calcium oxide.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to calcium oxide.

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(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to calcium oxide which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to calcium oxide;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration and for one year after termination of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

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(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to calcium oxide which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to calcium oxide requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of calcium oxide that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR CALCIUM OXIDE

I. SUBSTANCE IDENTIFICATION

A. Substance: Calcium oxide

B. Permissible Exposure: 5 milligrams of calcium oxide per cubic meter of air (mg/M3) averaged over an eight-hour work shift.

C. Appearance and Odor: White or gray, odorless solid

II. HEALTH HAZARD DATA

A. Ways in which the chemical affects your body: Calcium oxide can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it.

B. Effects of Overexposure:

1. Short-term Exposure: Calcium oxide causes irritation of the eyes, nose, throat, and skin. Severe burns may

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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: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to calcium oxide.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If calcium oxide gets into your eyes, wash your 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.
- B. Skin Exposure: If calcium oxide gets on your skin, immediately flush the contaminated skin with large amounts of water. If calcium oxide penetrates through your clothing, remove the clothing immediately and flush the skin with large amounts of water. If irritation persists after washing, get medical attention.
- C. Breathing: If you or any other 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.
- D. Swallowing: When calcium oxide has been swallowed, if 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.
- E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to calcium oxide. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.

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- B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent skin contact with calcium oxide where skin contact may occur. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear dust-resistant safety goggles where there is any possibility of calcium oxide contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Large amounts of water are necessary for skin and eye flushing because calcium oxide will react with water to form caustic calcium hydroxide with liberation of heat.
- B. Calcium oxide must be stored in tightly closed containers in a well ventilated area away from water.
- C. If your work clothing may have become contaminated with calcium oxide, you must change into uncontaminated clothing before leaving the work premises.
- D. You must promptly remove any non-impervious clothing that becomes contaminated with calcium oxide and this clothing must not be reworn until the calcium oxide is removed from the clothing.
- E. If your skin becomes contaminated with calcium oxide you must wash or shower with soap or mild detergent and large amounts of water to remove the calcium oxide from your skin.
- F. If you are subject to skin contact with calcium oxide at the end of each work day you must wash with soap or mild detergent and water any areas of your body that may have contacted calcium oxide.
- G. You must not eat or smoke in areas where calcium oxide is handled, processed or stored.
- H. If you handle calcium oxide, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- I. Eye flushing facilities and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.
- J. Ask your supervisor where calcium oxide is used in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

- A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for calcium oxide. In addition, your employer must instruct you in the safe use of calcium oxide, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to calcium oxide. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.

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- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR CALCIUM OXIDE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Quicklime; pebble lime
2. Formula: CaO
3. Molecular weight: 56.1

B. Physical Data

1. Boiling point (760 mm Hg): 2850 C (5162 F)
2. Specific gravity (water = 1): 3.30
3. Vapor density (air = 1 at boiling point of calcium oxide): Not applicable
4. Melting point: 2570 C (4658 F)
5. Vapor pressure at 20 C (68 F): 0 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Reacts to form slaked lime
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: White or gray, odorless solid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Not combustible

B. 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.

III. SPILL AND DISPOSAL PROCEDURES

A. 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.

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- B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
- C. Waste disposal methods: Calcium oxide may be disposed of in sealed containers in a secured sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average eight-hour exposure may be determined from a single eight-hour sample or 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). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of the particulates using a high efficiency membrane filter with subsequent chemical analyses. The method of measurement must determine the concentration of calcium oxide to plus or minus 35%.
- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of calcium oxide to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set N" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store calcium oxide in tightly closed containers in a well ventilated area.
- B. Employers should advise employees of all areas and operations where exposure to calcium oxide could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to calcium oxide is likely to occur are: During its preparation by the calcination of limestone, including grinding and packaging; its use as a fertilizer; its hydration to make hydrated lime, mortar, plaster, masonry, cellular concrete; its use in the manufacture of calcium compounds, iron, steel, other metals, pesticides, bleaches, paints, pigments, pharmaceuticals, dye intermediates, glass, desiccants, and its use

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in food processing, water treatment, sewage treatment, manufacture of paper, to absorb carbon dioxide and as a soil stabilizer.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Calcium oxide dust is an irritant to 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.

III. SIGNS AND SYMPTOMS

Irritation of the eyes and upper respiratory tract; ulceration and perforation of nasal septum; pneumonia; prolonged or repeated contact with the skin causes dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, immediately administer large amounts of water orally to dilute but do not induce vomiting. Give artificial resuscitation if indicated.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Calcium oxide causes irritation of the eyes and upper respiratory tract. It is important that the physician become familiar with plant operating conditions in which exposure to calcium oxide occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

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Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from calcium oxide exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. 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.
2. Skin disease -- Calcium oxide is a primary skin irritant. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Calcium Oxide (Lime)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 36.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 863-864.
3. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles C. Thomas, Springfield, Illinois, 1974, p. 225.

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REFERENCES AND SOURCES
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1910.93

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye"
Skin: "Encyclopedia of Occupational Health and Safety," International
Labour Office; Von Oettingen, "Poisoning;" Schwartz et al.,
"Occupational Diseases of the Skin;" Hunter, "The Diseases
of Occupations"
Ingestion: Gleason, "Clinical Toxicology of Commercial Products;"
Stecher, "The Merck Index"

COMMENTS

Eye - Classification: 5

Output statement numbers: 11, 13

Exceptions: None

Calcium oxide reacts with water, with the generation of heat, to produce calcium hydroxide. Grant reports that "burns of the eye caused by particles of calcium oxide are severe and of the same nature as those caused by calcium hydroxide." For calcium hydroxide, he reports that it "in various forms is one of the commonest causes of severe chemical burns of the eye, most commonly known as lime burns." He continues, "the result in almost all cases is that there is a semisolid particulate paste in contact with the cornea and conjunctiva tending to adhere and to dissolve slowly, forming strongly alkaline calcium hydroxide solution. Mild lime burns in patients typically cause a frosted or ground-glass type of opacity located very superficially approximately at the level of Bowman's membrane . . . This type of opacity is observable immediately after lime burn in human eyes . . . Corneas severely burned . . . typically are anesthetic for many days after the injury; this has been presumed due to damage of corneal nerves. In the most severe calcium hydroxide burns, the corneal stroma becomes and remains totally opaque grayish-white." He adds that glaucoma may be a complication and that in some cases multiple operations were necessary to relieve elevated intraocular pressure. "In general, these eyes were so badly damaged that the visual outcome was very poor."

It is clearly evident that a classification of 5 is warranted.

Skin - Classification: 6

Output statement numbers: 2, 5b, 7a, 8b, 17g, 15, 17i, 20a

Exceptions: See below

The ILO notes that "the harmful effects of calcium oxide result from its alkalinity and the fact that it combines exothermically to water." It states, "exposure to lime may result in a number of different forms of dermatitis, accompanied by desquamation and vesicular rash" and adds that "dermatitis normally regresses following cessation of exposure; however, cases have been reported of relatively severe recurring dermatitis leading to permanent disability." It also reports the occurrence of

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serious lime burns "to workers who have fallen into lime pits . . . in some cases the extensive nature of the lesions leading to a fatal outcome." According to Von Oettingen, skin contact is followed by "dermatitis with a rash of more or less follicular distribution, followed by reddening, weeping, and patches of desquamation and later by papular or vesicular eruptions or pustular folliculitis." He comments that "the skin becomes dull, cracked and dry, showing scales and fissures. Schwartz et al. state that "when calcium oxide comes in contact with skin and the nails, it absorbs moisture from them and causes dermatitis or burns depending on the quantity of lime, length of time present on the skin and the amount of moisture on the skin, it causes chronic thickening, scaling, fissuring of the skin and brittleness of the nails."

ILO recommends protective clothing to prevent contact and adds "workers should not be allowed to shower until all traces of lime adhering to the body have been removed with oil or vaseline. Workers should be encouraged to change their underwear and workclothes at the end of the shift. The consumption of food or beverages in workshops should be prohibited."

Calcium oxide is a solid with a melting point of 2570 degrees C. As noted previously, it reacts with water to form hydrated lime, calcium hydroxide.

A classification of 6 is concluded to be most appropriate if statement 2 is used to prevent contact where it "may occur." Since contact with dry skin will not necessarily immediately cause significant effects, statements 17g and 17i are specified. However, since some contacts may be immediately harmful, quick drenching facilities are required by use of statement 8b. It is assumed that if the worker feels he is being burned he will not hesitate to remove his clothing and the contaminant from the skin. ILO's comments indicate that washing contaminated skin may not be wise until all significant amounts of the substance have been removed from the skin by other means. This is reasonable given the reactive nature of the substance. Due to the reactive nature of calcium oxide, statement 17i is modified to ensure that washing is done using "copious quantities of water". It is to be noted that the standard is written specifically for calcium oxide and not for aqueous solutions of calcium hydroxide.

Ingestion - Classification: 6

Output statement numbers: 19, 20a

Exceptions: None

A search of the literature failed to reveal much information on the toxicological properties of calcium oxide upon oral intake. The Merck Index classifies it as a "strong caustic" and Gleason refers to it under LYE. As a strong alkali, calcium oxide is markedly corrosive and penetrating. Gleason notes that usually the first mouthful of a lye solution makes further swallowing impossible because of intense pain and

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spasms. He adds that death after lye ingestion may result from any one of several complications - circulatory shock, asphyxia due to glottic or laryngeal edema, perforation of the esophagus, intercurrent infection or inanition due to late stricture formation. He includes that pulmonary complications are possible and "may result from aspiration secondary to regurgitation or overflow."

A classification of 6 is concluded to be appropriate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Mississippi Lime Co., Material Safety Data Sheet (Miss)

Foote Mineral Co., Material Safety Data Sheet (Foote)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 12, p. 414 (K-O)

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)

Sources of data items used:

- I. A. 1. Synonyms: NFPA-49, Foote
- 2. Formula: Miss
- 3. Molecular weight: Miss
- B. 1. Boiling point: Miss, K-O
- 2. Specific gravity: Miss, K-O
- 3. Vapor density: Not available
- 4. Melting point: K-O
- 5. Vapor pressure: ADL
- 6. Solubility in water: Miss, K-O
- 7. Evaporation rate: Not applicable
- 8. Appearance and odor: Miss, Foote
- II. A. 1. Fire data: Not applicable
- B. 1. Conditions contributing to instability: Miss
- 2. Incompatibilities: NFPA-491M, Miss
- 3. Hazardous decomposition products:
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: Foote, ADL
- C. Waste disposal method: ADL
- V. Miscellaneous precautions: Foote

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

"Calcium Oxide," Manufacturer's Safety Data Sheet, Foote Mineral Company (Foote)

"Calcium Oxide," U. S. Department of Labor, Material Safety Data Sheet (USOL)

Fehnel, J. W., "Health Hazards in Steel Mills," Industrial Medicine 3:358 - 360, 1942 (Fehnel)

Gardner, L. U., Durkan, T. M., Brumfiel, D. M. and Sampson, "Survey in Seventeen Cement Plants of Atmospheric Dusts and Their Effects upon the Lungs of Twenty-Two Hundred Employees," Journal of Industrial Hygiene and Toxicology 21:279 - 318, 1939 (Gardner)

International Labour Organization, "Encyclopedia of Occupational Health and Safety, Geneva, 1972 (ILO)

McConnell, W. J., Fehnel, J. W. and Ferry, J. J., "Potential Health Hazards of the Leather Industry," The Journal of Industrial Hygiene and Toxicology 24:93 - 108, 1942 (McConnell)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience

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Publishers, Division of John Wiley, 2nd edition, 1972 (K-O)
"Merck Index of Chemicals and Drugs," Merck and Co., Inc., Rahway, N.J.,
8th edition, 1968 (Merck)
Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience
Publishers, 1962 (Patty)
Schepers, G. W. and Durkan, T. M., "Pathological Study of the Effects of
Inhaled Gypsum Dust on Human Lungs," Archives of Industrial Health
12:209 - 217, 1955 (Schepers)
Schwartz, L., "Skin Hazards in American Industry, IX, Skin Hazards in Glass
Manufacture," Public Health Bulletin 249:62 - 69, 1939 (Schwartz)
Stanford Research Institute, "Chemical Origins and Markets," SRI, Menlo
Park, California, 1967 (Chem Origins)
U. S. Environmental Protection Agency, "Water Pollution Potential of
Manufactured Products," Catalogue Sections II and III (EPA-R2-73-
179 c and d), April 1973 (EPA)

References for Specific Use/Exposures

1. ILO
2. Gardner, Patty, ILO
3. K-O, Patty, ILO, Schepers
4. K-O, Chem Origins
5. K-O, SRI
6. Fehnel
7. K-O
8. K-O
9. K-O, SRI
10. Chem Origins
11. SRI, Chem Origins
12. ILO
13. K-O
14. Schwartz
15. McConnell, Merck
16. K-O
17. EPA, K-O

References for Specific Control Methods

1. ILO, USDL
2. ILO, USDL

USDL and Foote were the references used in numbers 3 - 17 of the Specific
Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Calcium oxide

D. O. L. STANDARD: 5 mg/M3

Eye Irritation Level: 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."

IDLH: 250 mg/M3

Basis for IDLH Value: There is no acute inhalation toxicity information
available upon which to base an IDLH concentration for calcium oxide.
Since Patty reports that inhalation of the dust can cause chemical
pneumonia and severe respiratory tract irritation, "only highly
reliable breathing apparatus providing maximum worker protection is
permitted" at a concentration greater than 50 times the permissible
exposure limit (250 mg/M3). The available toxicological information

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indicates that severe respiratory irritation could inhibit escape. Other Toxicological Information: According to the Documentation of TLV's, "the irritant effects of lime are probably due primarily to its alkalinity, but dehydrating and thermal effects may be contributing factors. Inflammation of the respiratory passages, ulceration and perforation of the nasal septum, and even pneumonia have been attributed to inhalation of lime dust. The major complaints of workers exposed to lime consist of irritation of the skin and eyes, however, and would not be expected to relate closely to air-borne concentration.

"Calcium hydroxide is a strong base and reacts rapidly with carbon dioxide to form the insoluble and relatively innocuous calcium carbonate. For this reason, and because of the rather favorable industrial experience, a threshold limit somewhat higher than that of the hydroxides of the alkali series is indicated. The suggested level of 5 mg/M3 would correspond, in total alkalinity to 7 mg/M3 of sodium hydroxide, or 3-1/2 times the TLV of the latter substance. It should be sufficiently low to protect against undue irritation."

Patty states that calcium oxide, "a moderately caustic irritant, is reported to have caused chemical pneumonia as a result of dust inhalation, but the severe irritation of the upper respiratory tract ordinarily causes persons to avoid serious inhalation exposure."

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of dust and skin contact with dust during preparation and handling of lime	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
2.	Inhalation of dust and skin contact with dust during manufacture and handling of construction bonding agents (primarily Portland cement; also mortar, stucco, plaster)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
3.	Inhalation of dust and skin contact with dust during weighing and mixing of construction bonding agents (including Portland cement; masonry mortar, interior and exterior plaster and stucco)	A,B	Personal protective equipment (goggles, gloves, respiratory protective devices)
4.	Inhalation of dust and skin contact with dust during manufacture of construction, insulation, and refractory materials (including sand-lime brick and block; light - molded insulation materials of diatomaceous earth or silica and asbestos fines; refractory brick)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
5.	Inhalation of dust and skin contact with dust during preparation and mixing of soil, lime, and water in soil and sub-base stabilization (including highways, runways, railroad beds, and building foundations)	A,B	Personal protective equipment (goggles, gloves, respiratory protective devices)
6.	Inhalation of dust and skin contact with	A,B	Process enclosure; local exhaust ventilation; per-

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dust during manufacture
of iron and steel
(including wire drawing)

sonal protective equipment
(goggles, gloves, respira-
tory protective devices)

- | | | | |
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| 7. | Inhalation of dust and skin contact with dust during metal refining and smelting (including refining of bauxite and beneficiation of nonferrous ores; use as flux in smelting and refining of copper, lead, zinc, manganese, antimony, chrome and nickel) | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |
| 8. | Inhalation of dust and skin contact with dust during use in water purification and treatment (including softening, purification, coagulation of suspended solids, and neutralization of acid water) | A,B | Personal protective equipment (goggles, gloves, respiratory protective devices) |
| 9. | Inhalation of dust and skin contact with dust during use in sewage and waste treatment (including sewage plants and waste treatment operations in steel fabrication, metal plating, chemical, pharmaceutical, and explosives industries; sulfur removal in petroleum refining) | A,B | Personal protective equipment (goggles, gloves, respiratory protective devices) |
| 10. | Inhalation of dust and skin contact with dust during synthesis of other chemicals (including calcium compounds, sodium carbonate, sodium hydroxide, ethylene and propylene oxides and glycol, dye intermediates, citric acid, azo dyes, paint pigments, and | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |

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pharmaceuticals)

- | | | | |
|-----|---|-----|---|
| 11. | Inhalation of dust and skin contact with dust during Kraft pulp processing in paper manufacture | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |
| 12. | Inhalation of dust and skin contact with dust during handling and application of agricultural lime and mixing of agricultural fungicides | A,B | Personal protective equipment (goggles, goggles, respiratory protective devices) |
| 13. | Inhalation of dust and skin contact with dust during food processing (including refining of beet and cane sugar and manufacture of baking powder and gelatin, deodorizing vegetable oils) | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |
| 14. | Inhalation of dust and skin contact with dust during glass manufacture (silicate and nonsilicate glass) | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |
| 15. | Inhalation of dust and skin contact with dust during preparation of solutions for liming of hides in leather manufacture | A,B | Personal protective equipment (goggles, goggles, respiratory protective devices) |
| 16. | Inhalation of dust and skin contact with dust during manufacture of pesticides (including the insecticide calcium arsenate and fungicides) | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |
| 17. | Inhalation of dust and skin contact with dust during manufacture of cleaning preparations (chlorinated lime bleaching powder; disinfectants and deodorizers; sewer, cesspool, and | A,B | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices) |

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septic tank cleaners)

- A -- Inhalation
- B -- Skin and eye contact resulting in
localized irritation
- C -- Ingestion
- D -- Skin contact resulting in
absorption and subsequent
systemic poisoning