OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR CALCIUM CARBONATE

INTRODUCTION

This guideline summarizes pertinent information about calcium carbonate 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 Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether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**

  $CaCO_3$

- **Synonyms**

  Aragonite, agricultural limestone, agstone, Bell mine pulverized limestone, calcite, chalk, domolite, franklin, limestone, lithographic stone, marble, Portland Stone, Sohnhofen stone

- **Identifiers**

  1. CAS No.: 1317-65-3
  2. RTECS No.: EV9580000
  3. DOT UN: None
  4. DOT label: None

- **Appearance and odor**

  Calcium carbonate is a noncombustible, odorless, white powder or colorless crystalline solid. Calcium carbonate occurs naturally in the minerals aragonite, calcite, limestone, marble, and vaterite. The two natural forms of calcium carbonate that are important commercially are aragonite and calcite.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

  1. Molecular weight: 100.09
  2. Boiling point: Not applicable
  3. Specific gravity at 20°C (68°F) (water = 1): 2.83 (aragonite); 2.71 (calcite)
  4. Vapor density: Not applicable
  5. Melting point: 825°C (1,517°F) (aragonite); 1,339°C (2,442°F) (calcite)
  6. Vapor pressure: Not applicable
  7. Solubility: Insoluble in water and alcohol; soluble in dilute acids.
  8. Evaporation rate: Not applicable

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

Reactivity

1. Conditions contributing to instability: None

2. Incompatibilities: Contact of calcium carbonate with acids, alum, ammonium salts, or mercury and hydrogen causes a reaction, and contact with fluorine causes ignition.

3. Hazardous decomposition products: Toxic particulates (such as calcium oxide) may be released in a fire involving calcium carbonate.

4. Special precautions: None

Flammability

The National Fire Protection Association has not assigned a flammability rating to calcium carbonate; 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 calcium carbonate 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 calcium carbonate.

EXPOSURE LIMITS

OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for calcium carbonate is 15 mg/m^3 of air (total dust) and 5 mg/m3 (respirable fraction) as 8-hr 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/m^3 (total dust) and 5 mg/m^3 (respirable fraction) as a TWA for up to a 10-hr workday and a 40-hr workweek [NIOSH 1992].

- **ACGIH TLV**

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned calcium carbonate a threshold limit value (TLV) of 10 mg/m^3 (total dust) as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1993].

- **Rationale for limits**

The OSHA and ACGIH limits are based on the risk of physical irritation associated with exposure to calcium carbonate.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Exposure to calcium carbonate can occur through inhalation and eye or skin contact.

- **Summary of toxicology**

1. *Effects on Animals:* Calcium carbonate causes moderate-to-severe irritation in contact with the tissues of animals. Instilled into rabbits' eyes, calcium carbonate caused severe irritation [NIOSH 1991]. In contact with the skin of rabbits for 24 hr, this substance caused moderate irritation [NIOSH 1991]. The oral LD_{50} in rats is 6,450 mg/kg [NIOSH 1991].

2. *Effects on Humans:* Calcium carbonate dust is a physical irritant of the eyes, nose, mucous membranes, and skin of humans. Contact of calcium carbonate dust with the eyes causes redness, pain, and inflammation of the eyelids while contact with the skin causes local irritation of moderate degree [NLM 1991]. Exposure to large amounts of the dust of this substance causes coughing, sneezing, and nasal irritation [NLM 1991]. Although chronic exposure to pure calcium carbonate does not cause pneumoconiosis, similar exposure to impure limestone (calcium carbonate) containing 3% to 20% quartz may pose a silicosis risk [ACGIH 1991].

- **Signs and symptoms of exposure**

1. *Acute exposure:* Overexposure to calcium carbonate

dust can cause irritation of the eyelids; redness, tearing, and pain in the eyes; runny nose; sneezing; and coughing. Contact with the skin causes dryness and irritation.

2. *Chronic exposure:* Although no signs or symptoms of chronic exposure to calcium carbonate have been reported, quartz contamination of limestone in excess of 2% may pose a silicosis risk.

- **Emergency procedures**

> **WARNING!**
>
> **Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of toxicity or 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 victim blow his or her nose, or use a soft tissue to remove particulates or residues from the nostrils.

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

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

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

   —Have the victim drink a glass (8 oz) of fluid such as water.

   —Induce vomiting by giving syrup of ipecac as directed on the package. If ipecac is unavailable, have the victim touch the back of the throat with a finger until productive vomiting ceases.

   —Do ***not*** induce vomiting if calcium carbonate has been mixed with a petroleum distillate such as kerosene or diesel fuel.

   —Do ***not*** force an unconscious or convulsing person to drink fluid or to vomit.

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

EXPOSURE SOURCES AND CONTROL METHODS

The following uses may involve calcium carbonate and may result in worker exposures to this substance:

—Use as a neutralizing agent, filler, and extender in rubber, plastic, and paint products, and as an opacification agent in paper products

—Use in the manufacture of putty, tooth powders, antacids, whitewash, quicklime, Portland cement, dentifrices, ceramics, polishes, insecticides, inks, shoe dressings, foods, cosmetics, pharmaceuticals, antibiotics, adhesives, matches, pencils, crayons, linoleum, welding rods, and insulating compounds

—Use in removing sulfur dioxide from stack gases and as a metallurgical flux

—Use in analytical chemistry to detect and measure halogens in organic combinations and in the laboratory generation of carbon dioxide

—Use as a pigment and as a source of lime

—Use in human and veterinary medicine as an antacid.

—As a dietary supplement, as a nutrient, and as an antidiarrheal agent

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

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. Industrial ventilation—a manual of recommended practice. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

2. Burton DJ [1986]. Industrial ventilation—a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.

4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.

5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

MEDICAL MONITORING

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

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

- **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 calcium carbonate exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of calcium carbonate on the eyes and skin. 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 calcium carbonate.

- **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 job placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

The OSHA method for determining worker exposures to airborne concentrations of calcium carbonate (total dust) is made using a tared, low-ash polyvinyl chloride filter (LAPCF) with a 5-micron pore size; the filter is contained in a 37-mm cassette. Samples are collected at a maximum flow rate of 2 liters/min until a maximum air volume of 960 liters is collected. Analysis is conducted by gravimetric measurement (weighing) of the filter. This method has a sampling and analytical error of 0.10 and is included in the OSHA Computerized Information System as Dust, Total [OSHA 1989] and in the *OSHA Chemical Information Manual* [OSHA 1987]. NIOSH has a similar method (Method 0500) in the *NIOSH Manual of Analytical Methods* [NIOSH 1984a] which also involves gravimetric analysis. In the NIOSH method, samples are collected at a flow rate of 1.5 to 2 liters/min. The minimum sample volume for an airborne concentration of 15 mg/m^3 is 15 liters, and the maximum is 133 liters. The overall precision for the NIOSH method is 0.056.

The OSHA method for determining worker exposures to airborne concentrations of calcium carbonate (respirable fraction) is made using a tared, low-ash polyvinyl chloride filter (LAPCF) with a 5-micron pore size; the filter is contained in a 37-mm cassette. Air is drawn through the filter cassette, which is held in a 10-mm nylon cyclone, at a flow rate of 1.7 liter/min until a maximum air volume of 800 liters is collected. Analysis is conducted by gravimetric measurement (weighing) of the filter. This method has a sampling and analytical error of 0.10 and is included in the OSHA Computerized Information System as Dust (Respirable Nuisance) [OSHA 1989] and in the *OSHA Chemical Information Manual* [OSHA 1987]. NIOSH has a similar method (Method 0600) in the *NIOSH Manual of Analytical Methods* [NIOSH 1984b], which also involves gravimetric analysis. In the NIOSH method, samples are collected at a flow rate of 1.7 liter/min. The minimum sample volume for an airborne concentration of 5 mg/m^3 is 75 liters, and the maximum is 1,000 liters. The overall precision for the NIOSH method ranges from 0.043 to 0.145 in laboratory tests and from 0.144 to 0.227 in field tests.

PERSONAL HYGIENE

If calcium carbonate collects on the skin in large quantities, workers should immediately wash the affected areas with soap and water.

Clothing contaminated with calcium carbonate should be removed immediately, and provisions should be made for safely removing this chemical from these articles.

A worker who handles calcium carbonate 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 calcium carbonate is handled, processed, or stored.

STORAGE

Calcium carbonate should be stored in a cool, dry, well-ventilated area in tightly sealed containers. Containers of calcium carbonate should be protected from physical damage and should be stored separately from acids, alum, ammonium salts, fluorine, mercury, hydrogen, heat, sparks, and open flame.

SPILLS AND LEAKS

In the event of a major spill involving calcium carbonate, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup is complete. The following steps should be undertaken following a major spill:

1. For small spills, vacuum or wet down the spilled material and place into waste containers for disposal.

2. For large spills, wet down the material and dike for later disposal.

3. To the extent feasible, avoid generating dust during cleanup.

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

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

Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of calcium carbonate; 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 calcium carbonate 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 calcium carbonate is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [42 USC 6901 et seq.], EPA requires employers to treat 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 calcium carbonate exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

- **Respiratory protection program**

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

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent any skin contact with calcium carbonate. 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 calcium carbonate 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 calcium carbonate.

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

Safety glasses, goggles, or face shields should be worn during operations in which calcium carbonate 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 calcium carbonate. Contact lenses should not be worn if the potential exists for calcium carbonate exposure.

REFERENCES CITED

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