A Guide to the Safe Handling of Diatomaceous Earth Products
- North American Version
This guide was developed to provide distributors and users of diatomaceous earth products information on the safe handling of these important products in the North American workplace. It is the collaborative effort of the members of the International Diatomite Producers Association (IDPA) as part of their continued commitment to the protection of all workers from exposure to respirable crystalline silica in the workplace.

This guide provides a general overview of diatomaceous earth and identifies the uses, possible health effects and good practices for the safe handling of products comprised of diatomaceous earth. It is not, however, intended to be a comprehensive guide. For further information, consult the reference materials at the end of this guide. Those who use or handle industrial products should always consult with occupational health and safety professionals regarding exposure to and control of specific substances and materials in their individual workplaces.

Diatomaceous earth - also known as DE, diatomite, diatomaceous silica, kieselguhr and infusorial earth - is a non-metallic mineral composed of the skeletal remains of microscopic single-celled aquatic algae called diatoms. Living diatoms have the unique ability to absorb water soluble forms of silica from their natural environment to form a highly porous yet rigid silica skeleton. Over the eons, their skeletal remains settled to form deposits on prehistoric ocean and lake floors, some of which were later exposed as ocean beds rose and lakes evaporated. In rare cases these diatomite deposits formed in sufficient thickness and purity to be mined for many beneficial uses. Thousands of different diatom species exist, each species leaves behind a unique and intricate skeleton, and every deposit can contain a different mix of species. A few examples of different types of diatoms are shown to the left.

Diatomaceous earth as it naturally occurs is predominantly composed of amorphous silica - that is, non-crystalline silicon dioxide. It may also contain small amounts of naturally occurring crystalline silica, typically in the form of quartz.

Diatomite ore is mined and then processed to produce a final product which falls into one of three categories: a natural grade, a calcined grade, or a flux-calcined grade. Diatomaceous earth products are used in diverse applications ranging from absorbents to filtration aids to fillers and functional additives to carriers for active ingredients in products. Diatomite products may be shipped in a variety of containers, including paper or plastic bags, semi-bulk bags and cardboard containers, as well as in bulk by rail hopper cars and tank trucks.
Natural Grades

Natural grade products are dried at relatively low temperatures, and then classified to produce a variety of particle-sized products - from powders a few microns in size to centimeter-sized granules. These natural grade products consist primarily of amorphous silica, but may contain small percentages (typically less than 3%) of naturally occurring crystalline silica. Natural grades are used for a very broad range of applications such as fillers, functional additives, natural insecticide, animal feed additives, catalyst substrates, absorbents, soil amendments, and fine filter aids. The color of these grades can vary from white to buff to red.

Calcined Grades

Calcined grade products are produced by calcining, or sintering, at higher temperatures, typically around 1800°F (1000°C), and then classified to produce a variety of particle-sized products. During calcination, some of the amorphous silica may undergo a physical mineralogical transformation to form crystalline silica, predominantly as cristobalite. As a result, calcined DE may contain from 0 to 40% crystalline silica. Calcined grades are most commonly used for fine (high clarity) filtration applications and are typically buff to orange or pink in color.

Flux-Calcined Grades

Flux-calcined products are also produced by calcining at high temperatures, but in the presence of a fluxing agent such as soda ash (sodium carbonate), and then classified to produce a variety of particle-sized products. Some DE deposits contain natural fluxing agents. During flux calcination, the fluxing agent helps to fuse the diatoms together, which considerably increases the particle size of the product. As with calcined grades, a portion of the amorphous silica undergoes a transformation to crystalline silica in the process. Flux-calcined grades may contain up to 70% crystalline silica. These grades are used for a wide variety of filtration, filler, and functional additive applications. They can range in color from light orange to light pink to bright white.

CRYSSTALINE SILICA

As mentioned earlier, natural grades of diatomaceous earth are composed primarily of amorphous silica. Processed DE, on the other hand, may have a more significant crystalline silica component which varies depending on ore source and processing method.

Amorphous silica is a mild irritant of the upper respiratory tract and eyes and can irritate the skin because of its drying properties. Chronic health effects have rarely been reported for amorphous silica.

Prolonged inhalation of crystalline silica, on the other hand, has been associated with damage of the respiratory system, silicosis and cancer.

Crystalline silica (most commonly seen as sand and quartz) is one of the most abundant substances in the world and comprises over 12% of the earth’s crust. It exists in most types of rock, sand, and soil, and most people come into contact with it every day. The most common forms of crystalline silica are quartz, cristobalite, and tridymite.

Chronic inhalation of dust containing crystalline silica was a major contributor to occupational disease in mining, farming, and other industries in past centuries, but implementation of improved industrial hygiene practices has greatly reduced worker exposure and the incidence of silica-related disease over the last 40 years.

The International Agency for Research on Cancer (IARC) was formed in the late 1960s to evaluate potential carcinogenic risks of chemicals to humans based on a critical evaluation of the existing epidemiological and toxicological literature. In 1997, IARC concluded that “there is sufficient evidence in humans for the carcinogenicity of inhaled quartz or cristobalite from occupational sources” and that there is “inadequate evidence in humans for the carcinogenicity of amorphous silica”.

The extent to which crystalline silica may present a carcinogenic risk and how to control that risk remains a topic of debate in the scientific and regulatory community worldwide. A recommendation from the European Union Scientific Committee for Occupational Exposure Limits (SCOEL) in June 2003 made the following significant conclusions:

“The main effect in humans of the inhalation of respirable silica dust is silicosis. There is sufficient information to conclude that the relative lung cancer risk is increased in persons with silicosis (and, apparently, not in employees without silicosis exposed to silica dust in quarries and in the ceramic industry). Therefore, preventing the onset of silicosis will also reduce the cancer risk.”

The American Conference of Governmental Industrial Hygienists (ACGIH) evaluates a broad spectrum of materials and chemicals to determine levels at which they believe individuals can work safely with products containing these materials. The Threshold Limit Value, or TLV, represents a guideline, not a legal standard or regulation, with respect to the chemical concentration level at which ACGIH believes an individual can be exposed without an unreasonable risk of adverse health effects over a lifetime of exposure. ACGIH has set a TLV for cristobalite at 0.025 milligrams/m³.

The United States Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), on the other hand, regulate the chemical exposure limits of individuals in the workplace. The Permissible Exposure Limit (PEL) is defined as the concentration of a contaminant to which a worker can be safely exposed during an 8-hour shift for a 40-hour work week. PELs for DE and forms of crystalline silica are included under Table Z-1-A, Limits for Air Contaminants (Chapter 29 of the Code of Federal Regulations, 29 CFR 1900.100). The OSHA PEL for natural DE (containing less than 1% crystalline silica) is 10 milligrams/m³ and the MSHA PEL is 5 milligrams/m³. OSHA and MSHA both currently list the same PEL for pure cristobalite - effectively 0.050 milligrams/m³.

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WORKING SAFELY WITH DIATOMACEOUS EARTH

Proper handling techniques and engineered ventilation controls should ensure that dust concentrations in the workplace are maintained below the exposure limits OSHA and MSHA have determined protective of worker health. IDPA members recommend that personal protective equipment also be used to provide an additional margin of protection.

Specifications for engineered ventilation are beyond the scope of this Guide. The systematic application of a good industrial health and hygiene plan, including routine ambient dust monitoring, coupled with engineering controls and good work practices can help to ensure that workplace exposures remain below applicable standards. With that, there are certain universal good practices generally applicable to the safe handling and use of diatomaceous earth products.

Good practices include avoiding the creation of spills and airborne dust and promptly cleaning any spillage. Engineering controls should be designed, maintained and operated to capture dust that may become airborne during handling. Workers should be trained in the safe handling of all products used in their workplace and in the use and maintenance of appropriate personal protective equipment.

IDPA members recommend the following good work practices in all handling of diatomaceous earth products.

- Inspect all shipments of products on arrival. Powder spills should be removed by vacuum cleaning or wet sweeping. Always avoid dry sweeping.
- Fork lift truck operators should exercise care to prevent bag damage.
- Broken bags should be taped or covered with recuperage (slipover) bags.
- At the charging station, provide hoods with mechanical exhaust ventilation for dust control and vacuum cleaning equipment for spill pickup. Specific ventilation design criteria are available in standard engineering textbooks and through qualified HVAC contractors.
- Respirators approved by the National Institute for Occupational Safety and Health (NIOSH) should be worn during cleaning or any other operations where there is a potential for dust exposure. See the following section entitled Personal Protective Equipment for additional information.
- Waste material should be transported and disposed of in a manner consistent with local regulations to avoid creating airborne dust.

The preferred method for shipping large quantities of DE is via pressure differential (PD) hopper rail cars or tank trucks, which are unloaded by pneumatic conveying systems directly to storage silo or bin. Transfer by this method minimizes release of dust into the atmosphere because it utilizes a “closed system” where outlets of the conveying system are protected by dust collection devices.

PERSONAL PROTECTIVE EQUIPMENT

Whenever handling potentially dusty materials, IDPA members recommend and practice the use of engineering controls to meet applicable exposure limits. When these controls are not sufficient or feasible, however, a respirator providing protection consistent with the highest dust levels that might possibly be encountered should be used. When exposure levels are consistently below established exposure limits, respiratory protection is not legally required, but it may still be prudent to make respirators available for use at the worker’s option.

IDPA members utilize personal protective equipment to provide an extra measure of protection in their workplaces. Properly selected, fitted, and maintained respiratory protective equipment is an integral component in the reduction of potential exposures, as are other personal protective equipment such as safety glasses and gloves. Of course, consistent use of this equipment is also necessary.

In the U.S., respirator specifications are based on OSHA and MSHA regulations (29 CFR 1910.134; 30 CFR 56.5001-56.5005) and the NIOSH federal respiratory regulations and certification program (42 CFR Part 84) for respiratory protection. OSHA and MSHA have specific requirements for individuals using respiratory protection, which include selection, training, storage, fit testing (for example, facial hair may interfere with proper fit), maintenance, and medical surveillance. NIOSH published a Guide to the Selection and Use of Particulate Respirators (Publication No 96-101, published in January, 1996) which may be referred to when selecting appropriate respirators.

NIOSH certifies three categories of resistance to filter efficiency degradation. These categories are labeled N-, R-, and P-series with three levels of filter efficiency, 95%, 99%, and 99.7% respectively. The appendices to the NIOSH Guide provide simplified flow charts and guidelines to assist in the selection of an appropriate respirator. Respirator technology and applicable regulations change from time to time. In order to assist the reader, we note that, as of the date of this Guide, there are a number of popular respirators utilized, including, the 3M 6000 series, the North Safety 5500 series and the North Safety 7700 series; each with a P100 particulate filter cartridge. The foregoing list is meant for convenience purposes only and is not intended to be all inclusive or to be viewed as a recommendation by IDPA or its members.
Do You Have Questions?

It is not possible to cover every potential question about diatomaceous earth or crystalline silica in one short pamphlet, but hopefully you have found the information here helpful. Please contact your employer or your DE supplier if you have any additional questions about the safe use of DE. The following links also provide more information that may be useful:

For Information on Crystalline Silica in General:
- Silica: NIOSH Publication (http://www.cdc.gov/niosh/topics/silica/)

For Information on Safe Handling Practices for Crystalline Silica Containing Products:
- Information on the Social Dialogue Agreement on Respirable Silica (http://www.emf-fem.org/Areas-of-work/Social-Dialogue/nepSi-Agreement-on-respirable-silica)
- Good Practice Guide on Workers Health Protection through the Good Handling and Use of Crystalline Silica and Products Containing It (2 volumes) (http://www.emf-fem.org/areas_of_work/social_dialogue/nepsi_agreement_on_respirable_silica/good_practice_guide)

The International Diatomite Producers Association

The International Diatomite Producers Association (IDPA) is a trade association representing major manufacturers of diatomaceous earth products worldwide. Founded in 1987, IDPA is committed to the safe use of diatomaceous earth products and to advancing research and maintaining a dialogue with industry, regulatory agencies and the scientific community in support of the safety of our employees, our customers, and the communities we serve.

IDPA Members:
- CECA, Specialty Chemicals (A subsidiary of Arkema Group)
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