Crystalline Silica and Silica Exposure – Quick Tips

Reduce crystalline silica exposure and learn about silicon dioxide hazards

The term “silica” broadly refers to the mineral compound silicon dioxide (SiO_2). Although silica can be crystalline or amorphous in form, crystalline silica is more hazardous to employees and is the focus of this document. Crystalline silica is a basic component of the Earth’s crust and can be detected in soil, sand, granite and many other minerals. While most commonly found in the form of quartz, it is also found in substances such as cristobalite, tridymite and tripoli. Breathing crystalline silica dust poses an occupational health hazard and can lead to severe health problems and even death.

Respirable crystalline silica dust particles, or particles that are less than 10 micrograms (m) in diameter, pose the greatest threat to employees working with or near crystalline silica. These dust particles occur when workers chip, cut, drill or grind objects that contain crystalline silica. About 2.3 million workers are exposed to respirable crystalline silica in U.S. workplaces. This includes 2 million construction workers who drill, cut, crush or grind crystalline silica-containing materials such as concrete and stone. It also includes 300,000 workers in general industry operations such as brick manufacturing, foundries and hydraulic fracturing, also known as fracking.

In March 2016, the Occupational Safety and Health Administration (OSHA) issued a final rule to control exposure to respirable crystalline silica. The rule is comprised of two standards: one for Construction (29 CFR 1926.1153) and the other for General Industry (29 CFR 1910.1053) and Maritime (29 CFR 1915.1053). The Maritime and General Industry standards are exactly the same but differ from the Construction standard. The key difference lies in qualifying the level of crystalline silica workers are exposed to. The General Industry/Maritime Standard requires the employer to perform air monitoring to determine the eight-hour average exposure level for each affected job task. Employers governed by the Construction standard can either use a control method spelled out for common construction work tasks or perform air monitoring as detailed in the General Industry/Maritime standard.

Compliance Deadlines

Both the General Industry/Maritime and Construction standards are effective June 23, 2016, and industries have one to five years to comply with most requirements, based on the following schedule:

- Construction: September 23, 2017
- General Industry/Maritime: June 23, 2018, two years after the effective date.

- Hydraulic Fracturing: June 23, 2018, two years after the effective date for all provisions except Engineering Controls, which have a compliance date of June 23, 2021.

Health Effects of Silicosis

Crystalline silica exposure has been linked through epidemiologic studies to chronic obstructive pulmonary disease such as bronchitis and emphysema. It has also been linked to immunologic disorders such as scleroderma, rheumatoid arthritis and lupus in addition to renal disease and stomach or gastric cancer. However, the most prominent disease linked to crystalline silica dust exposure is silicosis.

Silicosis is one of the world's oldest known occupational diseases, with reports of employees contracting the disease dating back to ancient Greece. By the 1800s, common names for silicosis included grinders' asthma, grinders' rot, masons' disease, miners' asthma, miners' phthisis, potters' rot, sewer disease, sandblasting disease and stonemasons' disease.

Silicosis is a preventable yet incurable disease that causes scar tissue to build up in the lungs, leading to a reduction in the ability to take in oxygen. Respirable crystalline silica dust particles pass through the tracheobronchial tree of the lung and collect in the deepest recesses of the lung, called the alveolar structures. This accumulation leads to a significant decrease in lung function. There are three types of silicosis:

1. Chronic or classic silicosis: Results from 15-20 years of low-to-moderate crystalline silica exposure. Chronic silicosis causes shortness of breath and clinical signs of poor oxygen/carbon dioxide exchange in the early stages. In the late stages of chronic silicosis, sufferers will experience extreme shortness of breath and fatigue, as well as chest pain and respiratory failure.
2. Accelerated silicosis: Results from 5-10 years of high exposure. Accelerated silicosis results in severe shortness of breath, weakness and weight loss.
3. Acute silicosis: This most dangerous form of silicosis also causes severe shortness of breath, weakness and weight loss. Acute silicosis arises anywhere from a few months to two years after exposure to extremely high concentrations of crystalline silica dust. Acute silicosis is often fatal.

Because of the severe side effects resulting from crystalline silica exposure, OSHA has significantly reduced the permissible exposure limit (PEL) to 50 micrograms per cubic meter of air (g/m_) averaged over an eight-hour day and introduced a new action limit of 25 g/m_ in the standard.

OSHA's Three Lines of Defense

To help control the risk of respirable crystalline silica exposure, OSHA's "three lines of defense" philosophy is suggested. The first line of defense is to eliminate and/or engineer the crystalline silica exposure hazard out. Examples of engineering/elimination controls are:

- Isolating workers from exposure with enclosures or barriers
- Installing local exhaust ventilation systems
- Using wet methods for cutting, chipping, drilling, sawing, grinding, etc.
- Using HEPA-equipped vacuums or wet sweeping for cleaning applications
- NOT using compressed air for cleaning applications
- Substituting non-crystalline silica material when possible
- Using tools with dust collection systems

When engineering/elimination controls are not feasible or practical, the second and third lines of defense can be used to help control the crystalline silica exposure hazard. The second line of defense is administrative controls, such as employee training, awareness (signage), ensuring that employees work in an area where they

will not be exposed to crystalline silica, or written programs and policies. The third and last line of defense to be considered is personal protective equipment (PPE). Some examples of PPE are air-purifying respirators and filters, supplied-air respirators and accessories, and protective clothing.

OSHA states that it is important to consult a competent industrial hygienist or other technically qualified person when determining the engineering controls to be used or when collecting air samples to quantify worker exposure. Methods for collecting air samples are outlined in the new crystalline silica rule, 29 CFR 1910.1053 Appendix A.

OSHA has provided an overview of all the requirements of the new crystalline silica rule for General Industry and Maritime in OSHA Fact Sheet 3682 (PDF) and for Construction OSHA Fact Sheet 3681 (PDF).

Commonly Asked Questions

Q: Why is OSHA issuing a new crystalline silica rule?

A: OSHA's previous PELs for crystalline silica were outdated, inconsistent and did not adequately protect workers' health. The previous PELs were based on studies from the 1960s and earlier that did not reflect more recent scientific evidence showing that low-level exposures to crystalline silica cause serious health effects, including lung cancer. In the 45 years since the previous PELs were established, several agencies including OSHA identified respirable crystalline silica as a human carcinogen. Previous construction and shipyard PELs were based on an old method of measuring worker exposures to crystalline silica that is not used today. Those previous limits are inconsistent, allowing permissible levels for construction and shipyards to be more than twice as high as levels in general industry. The revised rule will reduce the risk of disease among workers who may inhale respirable crystalline silica and provide the same protection for all workers covered.

Q: What type of air monitors are used to measure crystalline silica exposure and at what level of crystalline silica exposure should a respirator protection program be enforced?

A: The type of air monitor used to measure crystalline silica exposure and the level of crystalline silica exposure requiring respiratory protection is dependent on the size of the crystalline silica particles being generated. The parameters of determining how to monitor for crystalline silica exposure can be found in in 29 CFR 1910.1053 Appendix A.

Q: Can I use a disposable respirator for protection during abrasive blasting?

A: Disposable filtering facepiece respirators (dust masks) will not protect the worker from crystalline silica exposure during sandblasting. Effective engineering controls such as substitution, automation, enclosed systems, local exhaust ventilation and wet methods should be used. In addition, a properly operated and maintained approved abrasive blasting respirator may provide adequate protection to the wearer.

Sources

Occupational Safety and Health Administration (OSHA) Silica Worker Page, 2016

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