Respirable Crystalline Silica (RCS)

The Dust Hazard the Flooring Industry Doesn't Want You to Know About

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FAQ

What is Respirable Crystalline (Concrete) Silica (RCS)?

Crystalline silica is a common mineral found in many naturally occurring materials like sand, concrete, stone, brick and mortar. When these materials are sawed, shot-blasted or ground, crystalline silica dust is produced. For thousands of years we have known the hazards of breathing crystalline silica dust (RCS). 2500 years ago the Ancient Greek physician Hippocrates recorded how miners became breathless as a result of inhaling silica dust. RCS is one of the oldest workplace hazards on earth and kills hundreds of thousands of people across the world every year. RCS refers to that portion of airborne crystalline silica dust that is capable of entering the gas-exchange regions of the lungs if inhaled; this includes particles with aerodynamic diameters less than approximately 10 micrometers (µm) [NIOSH 2002]. A micrometer Is 1/millionth of a meter.

What are the hazards of RCS?

Around 2.3 million workers are exposed to crystalline silica on the job in the US alone. However, simply being near sand or other silica-containing materials is not hazardous. The hazards exist when specific activities create respirable dust that is released into the air. Inhaling very small ("respirable") crystalline silica particles causes multiple diseases including silicosis, an incurable lung disease that can lead to disability and death. RCS will also cause lung cancer, chronic obstructive pulmonary disease (COPD), and kidney disease. **Children, older adults and people with respiratory diseases are especially at risk.** Since children have smaller airways than adults and breathe more air on a body weight basis, penetration and deposition of particles in the airways and alveoli in children is likely greater than that in adults exposed to the same concentration. In aerodynamic terms, only about 1% of 10-mm particles gets as far as the alveolar region, so 10 microns (10 millionths of a meter) is usually considered the practical upper size limit for penetration to this region. In 1996, the International Agency for Research on Cancer reviewed the scientific evidence and concluded that crystalline silica in the form of quartz or cristobalite dust is carcinogenic to humans. RCS is classified as a Group 1 carcinogen meaning, a definitive cause of cancer in humans.

How does RCS act in the lung tissue?

RCS is so small it can reach the epithelium of the alveolar deep tissue region of the lung. This area of the lung is not ciliated; as a result the lung will typically remove foreign material by engulfing the particle with macrophage cells (phagocytes), the encapsulated particle can then be transported (1) to the ciliated epithelium and finally moved upwards and out of the respiratory system; or (2) remain in the pulmonary space; or (3) enter the lymphatic system. However, certain particles such as silica-containing dusts or RCS are cytotoxic and kill the macrophage cells upon contact preventing their translocation to the ciliated epithelium. RCS remains in the deep tissue eventually becoming shrouded with scar tissue. The scar tissue is dead to oxygen take up and the condition is irreversible.

The largest inhaled particles, with aerodynamic diameter greater than about 30 microns, are deposited in the airways of the head, or the air passages between the point of entry at the lips and the throat. The respirable particulate fraction is that fraction of inhaled airborne particles that can penetrate beyond the terminal bronchioles into the gas-exchange (alveolar) region of the lungs.

Is RCS visible to the naked eye?

RCS particulate is less than 10 microns in diameter and **invisible to the naked eye**. Visible dust particles usually in the size range from about 100µm in diameter settle (terminal velocities of 7cm/sec) under the influence of gravity. On the other hand, RCS dust particles (<10µm) are so small and light that their respective terminal velocities are to low for gravitational effects – so you can have relatively high airborne concentrations of RCS and not even know it.

Does RCS gradually fall and collect?

Dust particles spend most of their time falling at terminal velocity. the velocity itself varies significantly with particle diameter. For RCS particles of maximum 10 microns, the terminal velocity in still air is approximated at about 0.03mm/sec. At this velocity it can take days to weeks for fine particulate dust to settle just a few meters. Gravitational effects on particles less than 1 micron are negligible and will remain airborne indefinitely.

Controlling a dust source may not be obvious or control may be impossible. For instance, even if dust is controlled by means of alocal exhaust ventilation system, there may be leaks that allow fine (possibly invisible) respirable dust back into the work space. Additionally, side drafts may disturb the capture efficiency of the control system.

The appearance of a dust cloud may be misleading.
The interaction of electromagnetic radiation (e.g. visible light) with a system of airborne particles is very complex. So the visual appearance of a dust cloud will be strongly dependent on the wavelength of the light and the angle of viewing with respect to the light source, as well as particle size, shape, refractive index and, of course, dust concentration. With this in mind, and depending on the conditions, it is usually fair to assume that a dust cloud that is visible to the naked eye may represent a hazard. However, it should not be assumed that the lack of a visible cloud represents “safe” conditions. A respirable particle is simply too small to be seen.

A dust release can be localized and only affect the immediate worker.
RCS may spread throughout the workplace and affect all occupants if the release is large enough and uncontrolled. Airborne dust poses initially an inhalation hazard. However, after it several weeks it can create a problem through contact with the skin and ingestion. Concrete shot-blast or grind can potentially contaminate a space for weeks, even months. If this process is conducted uncontrolled in nursing home or school room situations then the exposure to those most affected is definite and assured.

A dust source may not be obvious, or control may be inadequate.
For instance, even if dust is controlled by means of a local exhaust ventilation system, there may be leaks that allow fine, possibly invisible, respirable dust back into the workroom. Side drafts may disturb the capture efficiency of the system. Therefore, even
if there is the impression that the situation is under control because ventilation systems are in place, a periodic check to insure proper operation is recommended. One type of emission source, often overlooked, is the transportation of collection bags, or containers with dusty materials. This may constitute a potential lethal moving dust source, particularly if bags have holes, or containers are not properly closed. Disposal of even empty bags can be problematic, especially if the bags are manually compressed to save space. These secondary exposure routes will probably not be listed as specific operations in the plant. Consequently, disregarded transportation and exposure paths should be carefully observed.

Can the air in an active construction space be monitored for RCS?
Several methods exist:

- A laser particle counter (dust measuring device) for measuring the concentration of particles in air is ideal for monitoring respirable crystalline silica dust (RCS) and other harmful air pollutants. These devices work by drawing the dusty air into an enclosed chamber and measuring the intensity of light scattered by the dust. Many such instruments can be hand held, and some are small enough to be carried by the workers. Because the amount of light scattered is not directly dependent on mass, it’s necessary to calibrate such instruments, and even then, a change in size distribution or particle composition can change the relation between light scattered and mass concentration. Therefore, these are usually only rough measurements, but the fast response of these instruments makes them very useful for comparative evaluations.
- Cyclones are another wearable device that uses centrifugal force to remove dust from air samples. A particle in a rotating air stream is subjected to a centrifugal force that accelerates it towards a surface where it will impact and lose momentum, thus being removed from the air stream. These cyclones are typically small in size, from 10mm to no more than 50mm in diameter. They’ve been widely used since the 1960s to collect a respirable dust fraction. In a typical cyclone pre-collector, the air enters tangentially at its side and swirls around. Particles above a certain size are thrown to the cyclone walls and collected at its b se (“grit-pot”). The air containing the respirable dust leaves through the central exit in the top of the cyclone, and the air is filtered.

What is the relationship between RCS exposure and lung cancer?
The World Health Organization’s International Agency for Research on Cancer – the leading international voice on cancer causation and the National Institutes of Health's National Toxicology Program have conducted extensive reviews of the scientific literature and have concluded by designating respirable crystalline silica (RCS) as a known human carcinogen.

More than 50 peer-reviewed epidemiological studies that OSHA evaluated for its rulemaking process have examined the link between silica exposure and lung cancer in at least 10 industries. In particular, several studies of workers in specific industrial sectors support the link between exposure to respirable crystalline silica and lung cancer.

What is the current OSHA Rule Requirements pertaining to RCS?

Employers must use engineering controls and work practices as the primary way keep exposures at or below the PEL.

- Engineering controls include wetting down work operations or using local exhaust ventilation (such as vacuums) to keep silica- containing dust out of the air and out of workers' lungs. Another control method that may work well is enclosing an operation (”process isolation").
- Examples of work practices to control Silica exposures include wetting down dust before sweeping it up or using the water flow rate recommended by the manufacturer for a toll with water controls.
- Respirators are only alloqwed when engineering and work practise controls cannot maintain exposures at or below the PEL.

Major Provisions of the OSHA Construction Standard

The standard for construction includes provisions for employers to:

- Measure the amount of silica that workers are exposed to if it may be at or above an action level of 25 µg/m3 (micrograms of silica per cubic meter of air), averaged over an 8-hour day;
- Protect workers from respirable crystalline silica exposures above the PEL of 50 µg/m3 (0.05mg/m3), averaged over an 8-hour day;
- Limit workers access to areas where they could be exposed above the PEL;
- Use dust controls to protect workers from silica exposures above the PEL;
- Provide respirators to workers when dust controls cannot limit exposures to the PEL;
- Offer medical exams-including chest X-rays and lung function tests-every three years for workers exposed above the PEL for 30 or more days per year;
- Train workers on work operations that result in silica exposure and ways to limit exposure; and
- Keep records of workers' silica exposure and medical exams.

What is the time frame for compliance?

Both standards contained in the Final Rule taeffect on June 23,2016. after which te construction industry (including flooring) has 1 year to comply. Construction - June 23, 2017, one year after the 2016 effective date.

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