Crystalline Silica Exposure in the Workplace

The Occupational Safety and Health Administration's ruling likely will materially change practices in the concrete and construction industries

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ASPIRE™ rarely ventures into health and safety issues involving concrete manufacturing or jobsite construction. However, a ruling published by OSHA in the Federal Register on March 25, 2016, requires rapt attention by every company engaged in ready-mixed or precast concrete production and conducting operations on concrete and certain other materials on jobsites. Construction engineers, agency personnel, and consultants will experience new procedures and restrictions on jobsites. This action by OSHA will impact normal operations of a long list of different kinds of businesses and industries. This article focuses on the ruling and its implications to both manufacturing and construction activities related to concrete bridges.

Abbreviations Used in this Article

- $\mu g/m^3$ – micrograms of silica per cubic meter of air
- AL – action level (25 $\mu g/m^3$ averaged over an 8-hour day)
- APF – assigned protection factor
- COPD – chronic obstructive pulmonary disease
- CT – computed tomography (CAT scan)
- HEPA – high-efficiency particulate air—an air filter that is at least 99.97% efficient in removing particles 0.3 microns (0.001 mm) or larger in diameter
- HRCT – high-resolution computed tomography
- OSHA – Occupational Safety and Health Administration
- PEL – permissible exposure limit (50 $\mu g/m^3$ averaged over an 8-hour day)
- PLHCP – physician or other licensed health care professional
- PPE – personal protective equipment
- RCS – respirable crystalline silica
- SSN – social security number

Background

Crystalline silica is one of the most common minerals on earth. It is found in sand, stone, concrete, brick, block, and mortar. "Respirable" silica consists of very small particles capable of reaching the lungs, less than 10 microns in aerodynamic diameter—hundreds of times smaller than "sand." Prolonged exposure has been shown to sometimes lead to silicosis, COPD, lung cancer, and kidney disease.

Prior to this ruling, the applicable standards for exposure were established in 1971, when OSHA was created. The government claims that this standard does not adequately protect workers. The government website documents show the projected numbers of affected workers, cost savings, and benefits to workers related to the new ruling. The new rule PEL is roughly 50% of the previous PEL for general industry and roughly 20% of the previous PEL for the construction industry.

The two new crystalline silica rules are: 29 CFR 1910.1053 pertaining to general industry (for example, precast concrete manufacture) and maritime and 29 CFR 1926.1153 that pertains to construction. The effective date of this ruling is June 23, 2016. The mandatory dates for compliance are given at the end of this article. These regulations and additional information may be obtained at www.osha.gov/silica.

Effects on Operations

The means of compliance for construction and manufacturing are slightly different but many are the same. The differences are that construction practices are intermittent, occurring at indiscriminate locations, while plant operations are usually repetitious and in more determinant locations. The standards are intended to provide equivalent protection for all workers while accounting for the different work activities, anticipated exposures, and other conditions in these sectors.

There are numerous specific details that pertain to many of the requirements. This article is not all inclusive. The regulations should be consulted.

In general, the standards contain the AL, the PEL, and other requirements including:

- employee exposure assessment,
- regulated areas,
- methods of compliance,
- respiratory protection,
- medical surveillance,
- communication of silica hazards to employees, and
- recordkeeping.

For ease of understanding, the ruling on construction (1926.1153) is taken up first. Any differences will be explained. The construction standard includes a lengthy "Table 1—Specified Exposure Control Methods When Working With Materials

Containing Crystalline Silica." The table lists 58 different "Equipment and Tasks" with "Engineering and Work Practice Control Methods" for each and the "Required Respiratory Protection and Minimum APF" for each. The APF refers to OSHA's respiratory standard for general industry (29 CFR 1910.134) that defines the required level of employee protection, which must be complied with when employees are required to use respirators for protection against crystalline silica exposure. The table differentiates the APF by 4 hours or less of exposure per shift and more than 4 hours of exposure. For construction, it is assumed that for all tasks in Table 1, employees are exposed at or above the AL, and for all operations that requires a respirator, the employee is exposed above the PEL. Employers with approved compliance with Table 1 are not required to measure workers' exposure and are not subject to the PEL. Rather than complying with Table 1, workers' exposure may be measured to determine dust control strategies.

Employers must implement "written exposure control plans" for all tasks that involve exposure. The standard for construction also includes a provision for a competent person (that is, a designated individual who is capable of identifying crystalline silica hazards on the jobsite and who possesses the authority to take corrective measures to address them) to implement the written exposure control plan.

For industry, employers must measure the amount of RCS if it "may" be at or above the AL. Workers must be protected for exposures above the PEL.

The industry standard does not apply if the task is indistinguishable from one listed in Table 1 and will be repeated regularly in the same environment and in the same conditions.

Mitigation

The objective of the standards is to limit exposures to or below the PEL. The employer must use "engineering controls and work practices" first to accomplish this. A respirator must be used only after all feasible engineering and work practice controls have been implemented.

For processes that generate RCS above the PEL, regulated areas must be established separate from other work areas. Boundaries must be demarcated to limit access. Warning signs are required.

A significant level of demarcation is whether employees are exposed above the PEL for 30 or more days per year. For exposures of less than 30 days, engineering controls need not be used but respiratory protection is required.

Engineering and Work Practice Controls

These controls include the design and implementation of new tools, crafting processes, and methods to control RCS. There are four categories of control:

1. Substitution—replace materials containing silica with those that do not.
2. Isolation—employ an enclosure, for example, a physical barrier to isolate the silica dust. Equipment cabs must be sealed. Dust contained within an enclosure must be captured and disposed of properly.
3. Ventilation—capture the contaminant at or near the source or dilute the contaminant with large quantities of air.
4. Suppression—one of three systems can be applied to many different operations such as material handling, rock crushing, abrasive blasting, and operation of heavy equipment:
   a. Wet dust suppression, in which a liquid or foam is applied to the surface of the dust-generating material
   b. Airborne capture, in which moisture is dispensed into a dust cloud, collides with particles, and causes them to drop from the air
   c. Stabilization, which holds down dust particles by physical or chemical means (lignosulfonate, calcium chloride, and magnesium chloride are examples of stabilizers)

Accumulations of Silica

Accumulations must be cleaned by HEPA filtering or wet methods. Water contaminated with RCS must be cleaned before it dries since the residue might contribute to exposure. Dry sweeping or brushing is not permitted unless wet sweeping, HEPA-filtered vacuuming, or other methods are not feasible.

Use of Respirators

Respirators are required in four situations:

1. Periods necessary to install or implement feasible engineering and work practice controls
2. Work operations such as maintenance and repair activities where meeting the PEL with engineering and work practice controls is not feasible
3. Work operations where all feasible engineering and work practice controls have been implemented but do not reduce exposures to the PEL (examples include some tuckpointing and abrasive blasting operations)
4. In a regulated area, or, for construction, during periods when the employee is in an area where respirator use is required under Table 1. Also, respiratory protection is required for tasks not listed in Table 1.

Sources of RCS

Manufacturing Plant and Jobsite

- *Operations on hardened concrete*
  - *Abrasive blasting*
  - *Chipping, grinding, drilling, polishing, rubbing, and patching*
- *General operations*
  - *Operating wheeled equipment*
  - *Working near traveled lanes and roadways*
  - *Dumping and conveying aggregates*
  - *Handling cements and supplementary cementitious materials*
  - *Cleaning concrete trucks or placement machinery*
  - *Wind-blown dust*
  - *Screening patching sand*

Medical Surveillance

For construction, surveillance must be made available to employees who are required by the standard to use respirators for 30 days or more per year. For industry, surveillance is required for employees exposed at or above the AL for 30 days or more per year. The employer must bear the cost of the examination, travel, and time away. Exams must be performed by a PLHCP. A baseline medical exam must be made within 30 days of the initial assignment. The exam must include the following:

- Medical and work history; history of respiratory system dysfunction
- Physical examination with special emphasis on the respiratory system
- Chest X-ray or an equivalent diagnostic study such as a digital

chest radiograph or CT or HRCT scans
- Pulmonary function test
- Testing for latent tuberculosis infection

The employer will receive only the following information unless the employee provides written authority:

- Date of the examination
- Statement that the examination has met the requirements of this rule
- Any limitations on the employee's use of respirators

There are numerous additional details concerning medical surveillance. They may be found in the written rule.

Communication of the Hazards

The standard includes a cross-reference to OSHA's Hazard Communication Standard (29 CFR 1910.1200). It requires the following that are not new:

- Include RCS in the hazard communication program
- Implementation must include labels, material safety data sheets, and information and training
- Ensure access to labels on containers of respirable crystalline silica and material safety data sheets
- Provide access to copies of the standard without cost to employees
- Address at least the hazards of cancer, lung effects, immune system effects, and kidney effects

Training

Training must be conducted in accordance with the standards, tailored to operations at the work site, information on health impacts associated with silica exposure, and must include at least the following:

- Operations that could result in exposures exceeding the PEL
- Principles of safe handling of silica materials
- Methods used to minimize exposure
- Specific procedures implemented to protect employees from exposure, including appropriate work practices and use of PPE such as respirators and protective clothing
- Description of the medical surveillance program
- Demonstrable knowledge of these components of training through discussion, written tests, or oral quizzes

Recordkeeping

The extent of employer records required to be compiled and maintained may be onerous. These records include: air monitoring, objective data, and medical surveillance. The first two are considered employee exposure records and all must be maintained for the duration of employment plus 30 years (in compliance with 29 CFR 1910.1020).

For records of exposure measurements, required records include: date of sample; identification of operation of exposure; sampling and analytical method; number, duration, and results of samples; identity of laboratory; type of PPE used; name, SSN, and job classification of employees.

Records for employees covered by medical surveillance include: name and SSN; written opinion of PHLCP; copy of information furnished to PLHCP.

Dates of Compliance

For construction, all obligations for compliance start June 23, 2017, except certain requirements for laboratory analysis start on June 23, 2018.

In industry, employer obligations to comply begin June 23, 2018. This time period following the effective date this year is designed to allow for initial exposure assessments, establish regulated areas, provide initial medical examinations, and comply with other provisions.

Engineering controls need to be in place by June 23, 2018. This is to allow affected employers sufficient time to design, obtain, and install the necessary control equipment. Early indications are that equipment and tool manufacturers will design new products that will help eliminate or reduce RCS and assist with disposal. During the period before engineering controls are implemented, employers must provide prescribed respiratory protection to employees.

Medical surveillance starts June 23, 2018, for employees exposed above the PEL and June 23, 2020, for employees exposed at or above the AL.

Industry Support

It is expected that industry groups and affected ancillary businesses will begin to offer help to individual manufacturers and contractors. For construction, the contractor associations should be consulted. A web search has also yielded relevant information provided by major industrial insurers.

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