The New OSHA Silica Standard and Its Impact on the Steel Industry

Hazards are ever-present in the steel plant environment, and a heightened awareness and emphasis on safety is a necessary priority for our industry. This monthly column, coordinated by members of the AIST Safety & Health Technology Committee, focuses on procedures and practices to promote a safe working environment for everyone.

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Comments are welcome. If you have questions about this topic or other safety issues, please contact safetyfirst@aist.org. Please include your full name, company name, mailing address and email in all correspondence.

Within the steel industry, silica (crystalline) has been used extensively for decades, primarily in production processes such as coking (i.e., oven wall lining, oven door lining, door and lid sealant material), foundries (i.e., molds), iron producing (i.e., furnace, stove, runner, bottle car linings), steel producing (i.e., furnace, ladle, tundish, mold linings) and finishing (i.e., annealing oven lining) as a refractory product to insulate elevated temperatures from the process structural equipment, the conservation of energy and the quality of product. In addition to the potential production use and exposure, high-risk exposure potential activities, including construction and outage activities handling silica-containing refractory products, add to the overall exposure risk potential.

Silica-containing refractory products are available in various forms and quality of brick; ram material; sand; and as a grit-blasting material.

Crystalline silica is a basic component of soil, sand and other minerals found throughout the world. The most common form of crystalline silica is quartz and two other less common forms of cristobalite and tridymite.

The health hazards of crystalline silica have been documented for decades as a respiratory system hazard and classified as a human lung carcinogen. Exposure to the respiratory system potentially results in a condition known as silicosis, which can occur from 5 to 25 years of exposure. A potentially disabling and fatal disease, silicosis occurs when respirable-sized crystalline silica particles are breathed in and scar tissue forms, thus reducing the ability of the lung to transfer oxygen to the blood cells, and making a person more susceptible to infections like tuberculosis. Smoking adds additional risk of damage to the lungs when exposed to crystalline silica.

According to the U.S. Occupational Safety and Health Administration (OSHA), about 2.3 million workers are exposed to respirable crystalline silica in their workplaces. The majority of these workers, about 2 million, are in the construction industry. And approximately 676,000 workplaces will be affected by this exposure, including in the construction, general industry and maritime spheres.

Prior to 2016, OSHA and some state plans did not have a specific health standard for crystalline silica. Silica exposure was based on a calculation utilizing the percent silica as quartz as well as other silica forms (cristobalite, tridymite) for each sample, or exposure monitored as it relates to the respirable particulate (dust <10 µm) exposure. This approach created various permissible exposure limits (PEL) due to percent and/or forms of crystalline silica, and has been misunderstood or interrupted by health and safety professionals and non-professionals.

However, on 25 March 2016, OSHA published its new rule, a specific health standard for crystalline silica, which took effect on 23 June 2016. The rule established a PEL of 0.05 mg/m^3, 8-hour total weight average (TWA) (50 µg/m^3, 8-hour TWA), as well as an Action Level (a defined concentration level that necessitates certain required actions) of 0.025 mg/m^3, 8-hour TWA (25 µg/m^3, 8-hour TWA) regardless of the percent and form of crystalline silica. This approach provides a consistent exposure limit for comparison; however, it also lowers the exposure limit significantly and regulates the actions required by employers.

After 23 June 2016, companies categorized as General Industry will have two years to comply with the requirements and Construction Industry companies will have one year. States with OSHA-approved state plans have 6 months to adopt standards that are at least as effective as federal OSHA standards. Many state plans adopt standards identical to OSHA, but some state plans may have different or more stringent requirements.

Employers are required to comply with all obligations of the standard, except the medical surveillance Action Level (AL) trigger, whereas the employer is required to offer medical examinations to employees exposed at or above the OSHA PEL for more than 30 days a year beginning on 23 June 2018, and to employees exposed at or above the OSHA AL for more than 30 days a year beginning on 23 June 2020. Medical examination results are only provided to the employee and not the employer, except for the physicians or other licensed health care professional's recommended limitations on respirator use. Other findings of the medical examination are only provided to the employee, due to OSHA citing physicians' and employees' testified fear that employers would use other results to discriminate or retaliate. This aspect may interfere with or cause complications to current medical surveillance programs and to programs promoting worker health.

Many of the obligations for exposure assessment are similar to other specific health standards such as lead. The two approaches permitted by OSHA are the "performance" option and "scheduled monitoring:"

- Performance monitoring can be a combination of air monitoring and objective data. Objective data can be an industry-wide survey or calculations of worker exposure based on the composition of the material containing silica for a particular process task or activity.
- The scheduled monitoring option requires worker exposure monitoring of a representative number of employees performing for each shift and job classification. Employees with the greatest risk of exposure should be selected for sampling.

Construction employers do not need to perform the exposure assessment if they fully implement the engineering controls, work practices and respiratory protection.

If initial monitoring results exceed the AL, monitoring must be repeated every 6 months. When initial monitoring results exceed the PEL, monitoring must be repeated every 3 months.

Additional monitoring is also required following any change in processes, control equipment, work practices, or personnel that could result in new or additional exposures above the AL.

As with other specific health standards, exposure monitoring can be discontinued when two consecutive sampling results, representative of a given class of employees, are below the AL. Each of the sampling results must monitored at least 7 days apart. And within 15 days of receipt of the results employers most notify each employee individually in writing of the results or post the results in a location accessible to all of the employees.

Monitoring devices (sampling train) must be capable of collecting "respirable" dust (International Standards Organization/Comité Européen de Normalisation (ISO/CEN) criteria of 4 µm 50% cut-point) capable of reaching deep into the gas exchange regions of the lungs. The ISO/CEN criteria aligns OSHA with the National Institute for Occupational Safety and Health (NIOSH) the American Conference of Governmental Industrial Hygienists (ACGIH) and most other global occupational hygiene organizations. Common sampling devices (cyclones) accepted under the OSHA sampling method include the Dorr Oliver 10-mm nylon cyclone and SKC aluminum cyclone, SKC GS-3 cyclone (Fig. 1).

In addition, reusable or disposable personal impactors are available that have been shown to closely conform with the ISO/CEN criteria, such as the SKC reusable aluminum or disposable plastic parallel particle impactor (PPI) (Fig. 2).

Samples must be analyzed using OSHA Method ID 142; NIOSH Method(s) 7602, 7603, or 7500; or Mine Safety and Health Administration (MSHA) Method P-2 or P-7. These methods use either x-ray diffraction (XRD) or infrared (IR) analytical instrument. Before collecting samples, a company should contact the testing lab to determine what sampling method it recommends. For example, if the material causing worker exposure contains silicates, the laboratory may recommend XRD as it is less prone to interference from silicates.

Laboratories must be accredited in accordance to ANS/ISO/IEC Standard 17025:2005. Laboratories accredited

Figure 1

Common sampling device: Dorr-Oliver 10-mm nylon cyclone (a), SKC aluminum cyclone (b), and SKC GS-2 cyclone (c).

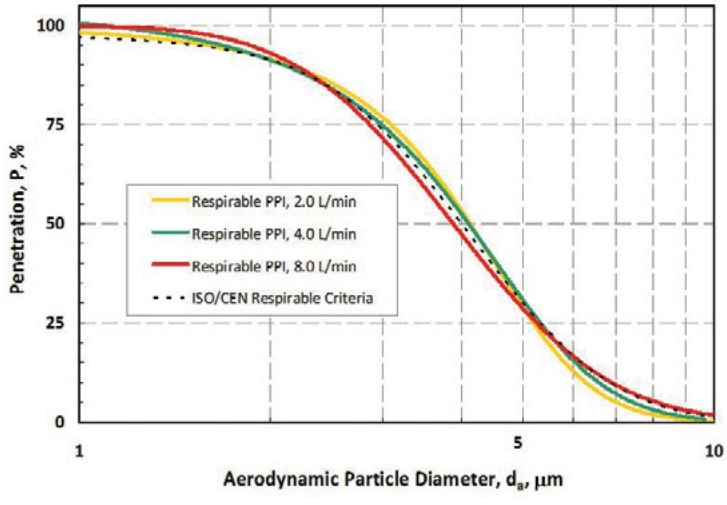
by the American Industrial Hygiene Association (AIHA) Industrial Hygiene Laboratory Accreditation Program would meet this requirement.

Monitoring is generally performed for the full shift the employee works, typically 8 hours; however, this may be 10 or 12 hours depending on work schedules. Since the OSHA exposure limits are based on an 8-hour time weighted average (8-hour TWA), if a work schedule is greater than 8 hours, OSHA states two approaches in the OSHA Technical Manual Section II: Chapter 1(III)(E): (1) monitor the "worst" continuous 8-hour period of that extended shift, or (2) collect multiple samples over the entire work shift (i.e., a 10-hour shift, ten 1-hour samples or five 2-hour samples), then add together the "worst" samples to equal 8 hours (i.e., eight 1-hour samples or four 2-hour samples). However, the second approach has drawbacks due to the minimum sample collection and volume of air required for analysis by the laboratory, the time OSHA is present in the facility and the time devoted to escorting OSHA rather than addressing other potentially more pressing or urgent matters.

Figure 2

Reusable or disposable personal impactors. Reusable aluminum parallel particle impactor (PPI) (a) and disposable anti-static plastic PPI (b).

Figure 3



PPI sampler performance compared to ISO/OSHA criteria.

Based on 675 actual respirable crystalline silica exposure data collected from within the steel/metals and related industries from 2010 to 2016, exposures were as follows:

- Total No. exposures: 657.
- Exposure range: <0.003–3.5 mg/m^3.
- Exposures >PEL (0.05 mg/m^3): 66 (~10%).
- Exposures >AL (0.025 mg/m^3) but <PEL (0.05 mg/m^3): 76 (~11.5%).

In contrast, based on 964 (pre-OSHA Silica Standard) actual respirable particulate/crystalline silica exposure data collected from within the steel/metals and related industries from 2010 to 2016, exposures were as follows:

- Total No. exposures containing <1% silica and non-silica (as respirable particulate (resp. part.)): 964.
- Exposure range (as resp. part.): <0.006–21 mg/m^3.
- Exposures >PEL (5.0 mg/m^3, as resp. part. if <1% silica): 15 (~1.5%).
- Total No. exposures (as resp. part. >1% silica): 292 (~30%).
- Exposures >PEL (calculated): 71 (~7.3%/24%).

What can be generally assumed or reasoned from this exposure data is there is an estimated potential 22% PEL to 26% AL increase of the number respirable crystalline silica exposures exceeding the new OSHA Silica Standard exposure limits. However, when compared to the actual overexposures utilizing pre-OSHA Silica Standard criteria (calculated PELs) and the new OSHA Silica Standard PEL, there would appear a increase of approximately 7% [(No. exposures > OSHA new PEL)/(No. exposures > pre-standard individual PELs) x 100].

Obviously, increases or decreases in exposures are highly dependent on processes and the general use of silica-containing materials and activities performed by employees monitored, company safety and health culture, engineering controls and administrative controls utilized, substitution of materials, or forms of the material (i.e., pre-engineered/sized brick vs. extensive use of brick needing cut or use of ram material as fill).

Employers are required to offer medical examinations to employees exposed at or above the OSHA PEL for more than 30 days a year beginning on 23 June 2018, and to employees exposed at or above the OSHA AL for more than 30 days a year beginning on 23 June 2020.

As with most OSHA standards, preferred actions or methods of abating or minimizing potential exposures follow a well-established hierarchy: (1) engineering controls (i.e., local exhaust ventilation, isolation of equipment or the employee), (2) administrative control (i.e., housekeeping, substitution of material, work practices, training), and (3) personal protective equipment (i.e., respiratory protection). Employee rotation is not an acceptable method of controlling employee exposures.

In addition, consulting OSHA's Silica in Construction Standard §1926.1153 Table 1: Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica[1] may be appropriate and enforceable if the following conditions are experienced in general industry:

1. Performing similar to construction work.
2. Performing the work routinely.
3. Performing the work in similar conditions/ area.
4. No objective exposure data available.

The table, similar to the lead in construction standard, specifically lists engineering and work practices controls methods as well as respiratory protection requirements for performing specific activities or using specific equipment (i.e., handheld grinders, stationary masonry saws, heavy equipment fracturing silica-containing material such as refractory materials).

There are challenges to the new standard; however, it is unlikely there will be any significant changes. According to OSHA, the rule is estimated to provide average annual net benefits over the next 60 years of US$3.8 to US$7.7 billion. The total annualized cost of the new regulations is just over US$1 billion dollars. The rule is expected to result in annual costs of about US$1,524 for the average workplace covered by the standard. The annual cost to a firm with fewer than 20 employees will be less, averaging about US$560.

Acknowledgments

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Reference

1. Occupational Safety and Health Administration, "§1926.1153 Respirable Crystalline Silica," https://www.osha.gov/silica/SilicaConstructionRegText.pdf. ✦