Silica Sand, Understanding the New OSHA Requirements

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Silica

• Existing OSHA PEL until June 23, 2018 (1910.1000 Table Z-3)
  – Resp. PM PEL = \( \frac{10}{\left(\%\text{ Quartz} + 2\right)} \) [MSHA still to use this]
  – Cut in half for Cristobalite and Tridymite
    ▪ Example Results: 0.80 mg/m\(^3\) respirable PM; 18% Quartz or 0.14 mg/m\(^3\) of Quartz
    ▪ PEL Calculation =
      Resp. PM PEL = \( \frac{10}{(18 + 2)} = 0.5 \text{ mg/m}^3 \)
      Result of 0.80 mg/m\(^3\) is greater than 0.5 mg/m\(^3\) and is over the existing PEL

New Silica Rule

• Removes formula, new PEL would be 0.050 mg/m$^3$; action level would be 0.025 mg/m$^3$ as Silica, not Respirable PM

• Laboratories expressing concern of accurate readings at the action level.

• Initial Monitoring, Periodic Monitoring, Regulated Areas, Respiratory Protection, Engineering Controls, Written Exposure Control Plans, Housekeeping, Medical Surveillance, and Training
Initial Monitoring

- **Initial exposure assessment** either through Air Monitoring or a new Performance Option
  - Identify activities that have potential silica exposure (Crystalline Silica – Quartz, Cristobalite, Trydimite) Amorphous Silica is **not** part of this rule.
  - Conduct 8-hour employee exposure sampling to determine if any positions are above the new PEL or Action Level
  - Performance Option – Can be tricky, can look at historical data and process configurations to make assessment. OSHA may sample anyway.
Initial Monitoring

• If positions are found to be below the Action Level, those positions drop out of the standard.

1910.1053(a)(2) Respirable Crystalline Silica

“This section does not apply where the employer has objective data demonstrating that employee exposure to respirable crystalline silica will remain below 25 micrograms per cubic meter of air (25 μg/m3) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.”
Periodic Sampling

- Required every 3 months for exposures above the PEL; every 6 months for exposures above the action level, but below the PEL (Requirement Starts June 23, 2018)
- Need two consecutive sampling rounds with passing results, at least 7 days apart to modify schedule
Notes on Sampling

• 1968 ACGIH Criteria cut point of ~3.5 µm
• New ISO/CEN Definition cut point of ~4.0 µm

“particle size collection criteria are also often described by their 50-percent respirable “cut size” or “cut point.” This is the aerodynamic diameter at which 50 percent of the particle mass is collected, i.e., the particle size that the sampler can collect with 50-percent efficiency. Particles with a diameter smaller than the 50-percent cut point are collected with an efficiency greater than 50 percent, while larger-diameter particles are collected with an efficiency less than 50 percent. The cut point for the 1968 ACGIH specification is 3.5 µm and for the ISO/CEN convention is 4.0 µm”

pg. 16438 Federal Register / Vol. 81, No. 58 / Friday, March 25, 2016 / Rules and Regulations
Silica Sampling

- Existing rule (and OSHA) uses Dorr-Oliver nylon cyclones, new rule opens it up for other cyclone usage as well.

- SKC Cyclone ~4 um cut point at 2.5 L

- Dorr Oliver Cyclone ~3.5 um cut point at 1.7 LPM
Regulated Areas

• Areas Above the PEL to be Demarcated
  – Signage at Entrances
  – **All** who enter required to have respirators on

DANGER
RESPIRABLE CRYSTALLINE SILICA
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
WEAR RESPIRATORY PROTECTION IN
THIS AREA
AUTHORIZED PERSONNEL ONLY
Engineering & Work Practice Controls

• The employer shall use engineering and work practice controls to reduce and maintain employee exposure to respirable crystalline silica to or below the PEL, unless the employer can demonstrate that such controls are not feasible
  – Due June 23, 2017 for Construction Activities
  – Due June 23, 2018 for Industry
  – Due June 23, 2021 for Fracking Industry

• Ventilation Recirculation Scrutinized (See OSHA’s Dust Control Handbook – Chapter 7)
  https://www.osha.gov/dsg/topics/silicacrystalline/dust/dust_control_handbook.html
  *Allow time for any necessary air permitting with EPA or DNR agencies
Employers Must Implement a Written Exposure Control Plan and Review Annually for all tasks that involve potential exposure to crystalline silica. Plans require:

- (i) A description of the tasks in the workplace that involve exposure to respirable crystalline silica;
- (ii) a description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task;
- (iii) a description of the housekeeping measures used to limit employee exposure to respirable crystalline silica;
- (iv) for construction, a description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed to respirable crystalline silica and their level of exposure, including exposures generated by other employers or sole proprietors.
Housekeeping

- Housekeeping provisions in the rule to apply to situations where dry sweeping, dry brushing or use of compressed air could contribute to employee exposure to respirable crystalline silica.
  - (i) The employer shall not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.
  - (ii) The employer shall not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:
    - (a) The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or
    - (b) No alternative method is feasible

Courtesy of www.mysafetysign.com
Medical Surveillance

• Required for each employee who will be occupationally exposed to respirable crystalline silica at or above the action level for **30 or more days** per year.
  - Due June 30, 2018 for those above the PEL
  - Due June 30, 2020 for those above the Action Level and below the PEL
  - New employees or new assignments; baseline examination due within the first 30 days of Initial Assignment

Photo courtesy of [www.eurosil.eu](http://www.eurosil.eu)
• The employer shall ensure that each employee covered by this section can demonstrate knowledge and understanding of at least the following:
  – (A) The health hazards associated with exposure to respirable crystalline silica;
  – (B) Specific tasks in the workplace that could result in exposure to respirable crystalline silica;
  – (C) Specific measures the employer has implemented to protect employees from exposure to respirable crystalline silica, including engineering controls, work practices, and respirators to be used;
  – (D) The contents of this section; and
  – (E) The purpose and a description of the medical surveillance program.

• The employer shall make a copy of this section readily available without cost to each employee covered by this section.
Strategies

- Define your exposures [Know the Source]
  - Compliance Monitoring
  - Real-Time Task Assessment
- Minimize Regulated Areas
  - Map areas
- Define Feasible Engineering Controls
  - Get in front of this, the ACGIH Ventilation Manual is a valuable resource
Mapping Dust Levels

Total Particulate Matter (mg/m³)
Case Study #1

- Production Issues – Arc Electrode Life Span Shortened
  - Original Theories
    - Silica in air reducing Arc Furnace Electrodes Life Spans.
    - Not sure where the main source of silica is coming from. Suspected charge area as main source.
  - Real-Time Method Used
    - DataRAM for plant wide grid analysis.
    - B&K Model 1302 Gas Analyzer for tracer gas grid analysis.
    - Sulfur Hexafluoride used as tracer gas.
Case Study #1

• Grid Analysis Approach
  – Establish Grid Throughout Desired Area
    ▪ Typically columns
    ▪ Mark the grid in the plant and on plant layout
    ▪ Numerous data points collected to establish baseline
    ▪ Correlate to production data
  – Tracer Gas Dispersion
    ▪ Dispense at suspected sources of silica
    ▪ Collect readings on grid with DataRAM and Gas Analyzer
Case Study #1
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Case Study #1
• Conclusions
  – Foundry air not balanced between makeup air and exhaust.
  – Didion drum main source of silica (nearly 1,000 feet from melt department). DataRAM readings indicated leak in dust collector venting inside area.
  – Melt department high amounts of exhaust
    ▪ Acted as a vacuum or a sump for other areas of foundry.
    ▪ Pulled indoor fugitive emissions from other areas of foundry including Didion drum and nearby charge yard.
Case Study #2 – Work Practices

- More Information Needed Before Moving Forward – Employees in Blast Booth Area Exceeding OSHA PEL
  - Original Theories
    - Is the background air causing exceedance?
    - What is the impact of material on the castings?
    - Shot leaking from areas of blast booth, is that causing the exceedance?
  - Real-Time Method Used
    - DataRAM synchronized with video tape.
Real-Time Task Monitoring

- Initial thoughts were the blast booth, sweeping turned out to be the culprit. Engineering dollars would have been spent on the wrong source.
Case Study #2 Conclusions

• Conclusions
  – Background concentrations low.
  – Blast booth shot leak negligible affects.
  – Material on castings main source.
  – Approximately 90% of shift activities within acceptable limits. Remaining shift cleanup activities (i.e., sweeping, shoveling, etc.) high enough to cause overexposures.
  – Video useful in illustrating cause and effect to management decision makers.
Case Study #3 - Recirculation

• Recirculating Air through a Dust Collector Back Inside of the Facility. Any issues?
• Using Real-Time Instruments in Conjunction with Employee Samples
  – Historical Sample Results in Compliance – Last Round Out of Compliance with Silica. Why?
  – Approach: Reviewed notes and historical employee TWA data. Utilized a pDR-1200 as a stationary area sample.
Figure 1
Real Time Respirable Particulate Matter Readings
ABC Company - December 18, 2007

- Shakeout Period: Average 1.34 mg/m³
- Lunch Break
- Sweeping in Area
- Afternoon Activities for Melting, Pouring, and Moldmaking: Average 1.23 mg/m³
- Battery Change on pDR
Case Study #3

Figure 3
Historical Silica as Quartz Results Comparison (mg/m³)

Employee Location

- Shakeout
- Osborne Mold-Making
- Wheelabrator
- Sand Muller

Date

- 8/16/2006
- 11/16/2006
- 12/18/2007

Respirable Quartz (mg/m³)
Case Study #3 - Conclusions

- Conclusions
  - pDR-1200 illustrated lack of general ventilation.
  - pDR-1200 graph also illustrated similar dust levels during shakeout and melting. Why? Led to bar graph.
  - Bar graph of historical results indicated better capture at shakeout, however recirculation back inside providing mixing and silica exposure to other employees. Implicating the baghouse.
  - Baghouse was opened up and found to be plugged. Guilty.
Case Study #4
Control Efficiency Testing

• Ventilation Design – Grinding Booth Pilot Study (AFS/OSHA Alliance)
  – Purpose – Need to get grinders in compliance with OSHA PEL for silica.
  – Questions to Answer
    ▪ How much exhaust air is needed per booth?
    ▪ Will we have enough baghouse capacity?
    ▪ Do we need makeup air with the booth?
  – Real-Time Method Used
    ▪ Personal DataRAM in active mode synchronized with video tape.
    ▪ Varied damper makeup air settings on booth.
    ▪ Varied damper exhaust settings on booth.
Case Study #4
Case Study #4 Conclusions

• Conclusions
  – Optimum Exhaust Rate for this booth is 4,000 cfm.
  – Makeup air is important for overall effectiveness of booth (Figure 2E).
  – Amount of makeup air determined.
  – Video and corresponding graphs make communication of ideas clear.
Case Study #4

FIGURE 2A
CASE STUDY #4

Exhaust - 6,250 cfm
Makeup Air - 2,684 cfm

4" Flanges

TWA (0.813 mg/m³)

Respirable PM (mg/m³)

Time

8:32:04 AM  8:33:30 AM  8:34:57 AM  8:36:23 AM  8:37:49 AM  8:39:16 AM  8:40:42 AM  8:42:09 AM  8:43:35 AM  8:45:01 AM
Case Study #4

FIGURE 2B
CASE STUDY #4

Exhaust - 2,016 cfm
Makeup Air - 1,554 cfm

4" Flanges

TWA (0.754 mg/m3)

Respirable PM (mg/m3)

Time

Case Study #4

Figure 2C

CASE STUDY #4

4" Flanges
Exhaust - 4,032 cfm
Makeup Air - 2,190 cfm

TWA (0.551 mg/m³)

Respirable FPM (mg/m³)

Time

Case Study #4

**FIGURE 2D**

CASE STUDY #4 - CONTROL EVALUATION TASK EXPOSURE IMPACT

Overall Average for the 10 Castings TWA (0.551)

- Exhaust - 4,032 cfm
- Makeup Air - 2,190 cfm

- Grinding On Top and Sides of Casting
- Chimney Effect While Grinding Downward
- Grinding Downward with Casting Flipped - No Chimney Effect

Time:
- 9:21:01 AM
- 9:21:10 AM
- 9:21:19 AM
- 9:21:27 AM
- 9:21:36 AM
- 9:21:45 AM
- 9:21:53 AM
- 9:22:02 AM

Respirable PM (mg/m³)
Case Study #4

**FIGURE 2E**
CASE STUDY #4

TWA (0.885)

Exhaust - 4,788 cfm

Resp. PM (ng/m3)

Time

1:56:30 PM 1:57:56 PM 1:59:23 PM 2:00:49 PM 2:02:15 PM 2:03:42 PM 2:05:08 PM 2:06:35 PM 2:08:01 PM 2:09:27 PM
Questions?

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