Silica Dust in Construction: Real Case Studies in Exposure Assessment and Hazard Control

Xavier Alcaraz, CIH, CSP
Principal Consultant

Michael Peterson, CIH, CSP
Senior Consultant
Webinar Logistics

- All participants are muted
- 50 minute presentation
- 5 minutes Q&A session
  - Use the Questions box on your sidebar to submit questions
  - We'll respond to as many questions as we can in the Q&A session so we can end on time!
- Web/Phone Conference Issues or Concerns
  - If you are having difficulty seeing/hearing the presentation, please submit a question using the Questions box or
  - Call / text 503.267.1698
- A short evaluation survey will be sent after the session – please help us by providing your feedback!
- All attendees will receive a link to the recorded webinar and presentation slides within a day or two of the webinar

Copyright © 2017 BSI. All rights reserved.
Agenda

Welcome/Introductions
- Holly Wilkalis

Speaker Bios
- Holly Wilkalis

Silica Dust Standard Overview
- Xavier Alcaraz

Case Studies in Sampling and Exposure Control
- Michael Peterson

Short Video
- Xavier Alcaraz

Questions
- Holly Wilkalis - Facilitator

Additional Resources
- Holly Wilkalis
About the Presenters

**Xavier Alcaraz, CIH, CSP**

- Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP)
- 20 years of experience consulting in industrial hygiene and environmental, health, and safety
- Has performed and managed hundreds of industrial hygiene and safety assessments including many for the construction industry
- Supports a multitude of other industries including municipal agencies, electronics, semiconductor, government, traditional manufacturing, life sciences, insurance, schools, etc.
- Based in Northern California
About the Presenters

Michael Peterson, CIH, CSP

• Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP)
• 10 years of experience consulting in industrial hygiene and environmental, health, and safety
• Has a wide range of experience managing projects such as; classical industrial hygiene and safety projects (e.g., chemical exposure assessments, ventilation evaluations, noise evaluations, etc.) as well as emerging building science issues (e.g., indoor air quality evaluations, microbial evaluations, and microbial remediation oversight), and environmental permitting
• Based in Portland, OR
Crystalline Silica Dust Overview
Silica Dust Exposure in Construction
Common Construction Activities Causing Silica to Become Airborne

- Concrete (block) grinding/cutting/chipping
- Concrete coring/drilling
- Sandblasting
- Rock drilling
- Cement board cutting
- Stone cutting
- Jack hammering
- Demolition
- Asphalt paving/manufacturing
- Tunneling
Silica Basics

Sand

Silica

Soils

Granite,

Minerals

Quartz

Cristobalite, Trydymite

Copyright © 2017 BSI. All rights reserved.
Safety Data Sheets

- Review product SDS for silica:
  - Crystalline Silica
  - SiO₂
  - Silica dust
  - Silicon Dioxide
  - Silica
  - Quartz
  - Sand

SECTION II - HAZARD IDENTIFICATION

 Hazard-determining components of labeling: Silica, Portland cement

2.1 Classification of the substance or mixture
- Carcinogen – Category 1A
- Skin Corrosion – Category 1B
- Skin Sensitization – Category 1B

2.2 Signal word DANGER!
- May cause cancer through chronic inhalation
- Causes severe skin burns and serious eye damage
- Causes damage to lungs through prolonged or repeated inhalation
- May cause respiratory irritation

SECTION III - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components
- Sand, Silica, Quartz
- Portland Cement
- Fly Ash

<table>
<thead>
<tr>
<th>Material</th>
<th>CAS No.</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>14808-60-7</td>
<td>60-100*</td>
</tr>
<tr>
<td>Silica</td>
<td>65997 15 1</td>
<td>10-30*</td>
</tr>
<tr>
<td>Quartz</td>
<td>68131-74-8</td>
<td>5-10*</td>
</tr>
</tbody>
</table>

Copyright © 2017 BSI. All rights reserved.
Long-Term Health Effects of Silica Exposure

• Silicosis - scarring around the particle
  — Acute (weeks to 4-5 years)
  — Accelerated (5-10 yrs)
  — Chronic (>10-20 yrs)

• Shortness of breath, cough, weakness

• COPD
  — Bronchitis, Emphysema

• Kidney, Immune System Diseases

• Tuberculosis

• Lung Cancer
OSHA Construction Standard for Crystalline Silica
## History of OSHA Regulations for Silica

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>Initial OSHA PELs enacted</td>
</tr>
<tr>
<td>1994</td>
<td>OSHA lists silica as a priority for rulemaking</td>
</tr>
<tr>
<td>2003</td>
<td>OSHA Published draft rule</td>
</tr>
<tr>
<td>2009-2010</td>
<td>Peer review of health effects &amp; risk assessment-Completed peer review</td>
</tr>
<tr>
<td>2011</td>
<td>Notice of proposed rule making (NPRM)</td>
</tr>
<tr>
<td>2011</td>
<td>Hearings delayed; executive order review extended</td>
</tr>
<tr>
<td>2013</td>
<td>Proposed Rule published in Federal Register</td>
</tr>
<tr>
<td>2014</td>
<td>OSHA begins public hearings on proposed rule</td>
</tr>
<tr>
<td>4/2017</td>
<td>OSHA delays enforcement of Construction Standard to September 23, 2017</td>
</tr>
</tbody>
</table>
# State OSHA Programs

<table>
<thead>
<tr>
<th>Alaska</th>
<th>Arizona</th>
<th>Virginia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>California</td>
<td>Vermont</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Iowa</td>
<td>Washington</td>
</tr>
<tr>
<td>Kentucky</td>
<td>Maryland</td>
<td>Wyoming</td>
</tr>
<tr>
<td>Michigan</td>
<td>Minnesota</td>
<td></td>
</tr>
<tr>
<td>Nevada</td>
<td>New Jersey</td>
<td></td>
</tr>
<tr>
<td>New Mexico</td>
<td>New York</td>
<td></td>
</tr>
<tr>
<td>North Carolina</td>
<td>Oregon</td>
<td></td>
</tr>
<tr>
<td>South Carolina</td>
<td>Tennessee</td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>Vermont</td>
<td></td>
</tr>
</tbody>
</table>

Copyright © 2017 BSI. All rights reserved.
Construction Standard Requirements 29 CFR 1926.1153

Employers are required to limit worker exposures to respirable silica through:

- Designating a competent person
- Using prescriptive exposure control methods and respiratory protection (where applicable) or by measuring workers’ exposure to silica and independently selecting exposure controls
- Establishing and implementing a written exposure control plan
- Restricting housekeeping practices that expose workers to silica
- Offering medical examinations to workers who wear a respirator for more than 30 days/yr
- Providing training with regards to hazard communication and work practices to reduce exposure
- Strict recordkeeping
1926.1153 Table 1 – Specified Exposure Control Methods

• List of 18 tasks with equipment descriptions
  ― Use of handheld power saws
  ― Use of walk-behind saws
  ― Use of jackhammers and powered chipping tools
  ― Use of masonry saws

• Defines specific engineering controls needed for each task
  ― Power saw: “Use saw equipped with integrated water delivery system that continually feeds water to blade”

• Prescribes respiratory protection requirement based on duration of task
  ― Less than or greater than 4 hrs.
  ― Examples of tasks requiring respiratory protection under certain conditions: use of power saws, jackhammers, concrete drill rigs
### Table 1: Specified Exposure Control Methods

**When working with materials containing crystalline silica**

<table>
<thead>
<tr>
<th>Equipment / Task</th>
<th>Engineering and Work Practice Control Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</td>
</tr>
<tr>
<td>(x) Jackhammers and handheld powered chipping tools</td>
<td>Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.</td>
</tr>
<tr>
<td></td>
<td>- When used outdoors.</td>
</tr>
<tr>
<td></td>
<td>- When used indoors or in an enclosed area.</td>
</tr>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td>Use tool equipped with commercially available shroud and dust collection system.</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain tool in accordance with manufacturer’s instructions to minimize dust emissions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment / Task</th>
<th>Engineering and Work Practice Control Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</td>
</tr>
<tr>
<td>(iv) Walk-behind saws</td>
<td>Use saw equipped with integrated water delivery system that continuously feeds water to the blade.</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain tool in accordance with manufacturer’s instructions to minimize dust emissions.</td>
</tr>
<tr>
<td></td>
<td>- When used outdoors.</td>
</tr>
<tr>
<td></td>
<td>- When used indoors or in an enclosed area.</td>
</tr>
</tbody>
</table>
For tasks not listed in Table 1 or when the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection as outlined in Table 1:

- **Exposure Assessment** - The employer shall assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica above the action level
  1. **“Performance Option”** - The employer shall assess the 8-hr TWA for each employee using any combination of air monitoring data or objective data sufficient to characterize exposure
  2. **“Scheduled Monitoring”**
     - Initial monitoring (each shift, each job classification, each work area)
     - If initial monitoring < action level, no additional monitoring needed
     - If initial monitoring > action level and < PEL, repeat monitoring within 6 months
     - If most recent exposure monitoring is > PEL, repeat within 3 months
     - If most recent exposure monitoring is below action level, repeat within 6 months until 2 consecutive measurements taken more than 7 days apart are below the action level
   - Reassessment required when a change in production, process, control equipment, personnel, or work practices may change exposure
Federal OSHA Exposure Limits for Crystalline Silica

<table>
<thead>
<tr>
<th>Permissible Exposure Limit (PEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREVIOUS PEL</strong></td>
</tr>
<tr>
<td>~250 µg/m³ Construction</td>
</tr>
<tr>
<td>~100 µg/m³ General Industry</td>
</tr>
<tr>
<td><strong>NEW PEL</strong></td>
</tr>
<tr>
<td>50 µg/m³ (or 0.05 mg/m³) averaged over an 8-hour day</td>
</tr>
<tr>
<td><strong>ACTION LEVEL TRIGGER</strong> - 25 µg/m³</td>
</tr>
</tbody>
</table>
Methods of Compliance

• Provide proper engineering and work practice controls
  — The employer shall use engineering and work practice controls to reduce and maintain employee exposure at or below the PEL unless the employer can demonstrate this is not feasible

• Provide respiratory protection
  — Where specified in Table 1
  — For tasks not outlined in Table 1 or where needed based on exposure assessment

• Housekeeping
  — No dry sweeping or dry brushing
  — No compressed air to clean clothing or surfaces unless ventilated or alternative system is not available
Cutting fiber cement board using circular saw with HEPA Vac
Photo credit: NIOSH

Worker milling granite floor indoors with milling machine and dust collection system
Photo credit: OSHA

Worker drilling into concrete with a rotary hammer equipped with shroud and dust collection system. Note the shroud around drill bit, silver and black hose, and dust collector are attached conveniently to the drill
Photo credit: DeWalt & OSHA

Walk-behind saw with water delivery system
Photo credit: OSHA

Jackhammering with water-spray control to reduce dust
Photo credit: NIOSH
In Summary: Roadmap to Compliance

1. Determine if the silica standard applies to your employees.
   Could employees be exposed to respirable crystalline silica at or above 25 μg/m³ as an 8-hour TWA under any foreseeable conditions, including the failure of engineering controls, while performing construction activities?

No: No further action is required under the silica standard.
Yes: Choose to comply with the standard using either the:

• Specified exposure control methods in Table 1, or
• The alternative methods of compliance

Source: OSHA publication “Small Entity Compliance Guide for the Respirable Crystalline Silica Standard for Construction”
In Summary: Roadmap to Compliance - continued

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Must the Employer Follow this Requirement?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If Fully and Properly Implementing Table 1</td>
</tr>
<tr>
<td>PEL</td>
<td>No</td>
</tr>
<tr>
<td>Exposure Assessment</td>
<td>No</td>
</tr>
<tr>
<td>Methods of Compliance</td>
<td>No</td>
</tr>
<tr>
<td>Respiratory Protection</td>
<td>Yes, if respirator use is required by Table 1</td>
</tr>
<tr>
<td>Housekeeping</td>
<td>Yes</td>
</tr>
<tr>
<td>Written Exposure Control Plan</td>
<td>Yes</td>
</tr>
<tr>
<td>Medical surveillance</td>
<td>Yes, for employees who must wear a respirator under the silica standard for 30 or more days a year.</td>
</tr>
<tr>
<td>Communication of Hazards</td>
<td>Yes</td>
</tr>
<tr>
<td>Recordkeeping</td>
<td>Yes, for any employees who are getting medical examinations</td>
</tr>
</tbody>
</table>
Important Compliance Dates

• Compliance Dates for Final Construction Rule 29 CFR 1926.1153

  — September 23, 2017 – Comply with all requirements of the standard except laboratory evaluation of exposure samples

  — June 23, 2018 - Comply with the methods for air sample analysis
Pop Quiz

Based on the worker’s activities, what would his employer be required to do?

A. Nothing. Worker is wearing a respirator and hearing protection

B. Consult Table 1 of the standard for walk-behind grinding/milling machines to verify control methods

C. Contact the equipment manufacturer to request options for dust suppression engineering controls and upgrade the employee to a half-mask respirator with goggles or a full-face respirator
Case Studies in Sampling and Exposure Control
Real World Example 1
<table>
<thead>
<tr>
<th>Equipment / Task</th>
<th>Engineering and Work Practice Control Methods</th>
<th>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</th>
</tr>
</thead>
</table>
| (vii) Handheld and stand-mounted drills (including impact and rotary hammer drills) | Use drill equipped with commercially available shroud or cowling with dust collection system.  
Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.  
Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.  
Use a HEPA-filtered vacuum when cleaning holes. | None | None |
## Sampling Results

<table>
<thead>
<tr>
<th>Employee</th>
<th>Airborne Contaminant</th>
<th>Sampling Results (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Respirable Dust</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>Respirable Crystalline Silica</td>
<td><strong>25</strong></td>
</tr>
<tr>
<td>#2</td>
<td>Respirable Dust</td>
<td>310</td>
</tr>
<tr>
<td></td>
<td>Respirable Crystalline Silica</td>
<td>21</td>
</tr>
</tbody>
</table>

*Respirable Dust and Respirable Crystalline Silica concentrations are measured in ug/m³.*
What Happens at AL

- Company already following Table 1 (Section vii) but still ≥ AL
- The Silica Standard 1926.1153 applies at ≥ AL
- Respiratory protection is not required per Table 1 Section vii or in situations at < PEL
- Repeat sampling is required within 6 months or if practices change
- Written exposure control plan now required
- Designate a competent person
- Employee Training
- Recordkeeping
What Happens at PEL

- Company already following Table 1 (Section vii) but still ≥ PEL
- The Silica Standard 1926.1153 applies at ≥ AL
- **Respiratory protection is not required per Table 1 Section vii but is in situations at ≥ PEL**
- Repeat sampling is required within 3 months or if practices change
- Additional engineering controls required unless proven not feasible
- Written exposure control plan required
- **Medical surveillance if Employees wear respirators > 30 days per year**
- Designate a competent person
- Employee Training
- Recordkeeping
Hierarchy of Hazard Controls

- *Elimination / Material substitution*
- *Engineering Controls*
  - Enclose source
  - Modify the process
  - Local ventilation/Dust-collecting systems
  - Wet Methods
- *Administrative controls*
- *Personal protective equipment*
Beyond Just the Standard

1. Why was the employee at the AL when they followed Table 1?
2. What could have been done to prevent it?
Real World Example 2
<table>
<thead>
<tr>
<th>Equipment / Task</th>
<th>Engineering and Work Practice Control Methods</th>
<th>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(vi) Rig-mounted core saws or drills</td>
<td>Use tool equipped with integrated water delivery system that supplies water to cutting surface.</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</td>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>≤ 4 hours /shift</th>
<th>&gt; 4 hours /shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Quiz

What would you guess is the sampling result?
A. ND, <25 ug/m³
B. Between 25 and 50 ug/m³
C. >50 ug/m³
# Sampling Results

<table>
<thead>
<tr>
<th>Employee/ Area</th>
<th>Airborne Contaminant</th>
<th>Sampling Results (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee # 1</td>
<td>Respirable Dust</td>
<td>2,700</td>
</tr>
<tr>
<td></td>
<td>Respirable Crystalline Silica</td>
<td><strong>150</strong></td>
</tr>
<tr>
<td>Area – 5’ From Saw</td>
<td>Respirable Dust</td>
<td>920</td>
</tr>
<tr>
<td></td>
<td>Respirable Crystalline Silica</td>
<td><strong>27</strong></td>
</tr>
<tr>
<td>Area – 25’ From Saw</td>
<td>Respirable Dust</td>
<td>880</td>
</tr>
<tr>
<td></td>
<td>Respirable Crystalline Silica</td>
<td><strong>28</strong></td>
</tr>
<tr>
<td>Area – 50’ From Saw</td>
<td>Respirable Dust</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>Respirable Crystalline Silica</td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>
Handheld Grinder – 21 ug/m³
Hammer Drill with Vacuum – ND, <15 ug/m³
Wire Saw Cutting – 260 ug/m³
Remote Chipping – 850 ug/m³
In Closing.....
Short Video

- [https://www.youtube.com/watch?v=HAByIIzQSuU](https://www.youtube.com/watch?v=HAByIIzQSuU)
Thank You!
Resources for Crystalline Silica Dust Compliance

OSHA

• Controlling Silica Exposures in Construction: http://www.osha.gov/Publications/3362silica-exposures.pdf
• http://www.osha.gov/dsg/topics/silicacrystalline/index.html
• https://www.osha.gov/silica/index.html

NIOSH

• http://www.cdc.gov/niosh/topics/silica/

Accredited Laboratories

• Galson Labs: www.sgsgalson.com
• ALS Labs: www.alsglobal.com
BSI EHS Services and Solutions

**General Services**
- Construction EHS
- Industrial Hygiene
- Training
- Ergonomics
- Healthcare EHS
- Responsible Supply Chain
- Sustainability
- LEED
- Management Systems

**Contact Info**
- Michael Peterson, CIH, CSP
  Senior Consultant
  831-233-2119
  michael.peterson@bsigroup.com
- Xavier Alcaraz, CIH, CSP
  Principal Consultant
  408-790-9216
  xavier.alcaraz@bsigroup.com