Respirable Crystalline Silica

a Regulatory and Sampling Update/Review

Chesapeake/Potomac Health and Safety Conference

Edward Stuber, CIH, ROH, FAIHA | March 16, 2023

OSHA Silica Standard

OSHA Silica Standard

- Expected to prevent 1,000X of deaths from silicosis, lung cancer, other respiratory disease
  - 600 deaths per year attributed to silica exposure
  - 900 new cases of silicosis per year
- Affects 2.3 million workers
  - 2 million in Construction Industry
  - 0.3 million in General Industry

- NOTE SILICOSIS is 100% preventable but 100% incurable or irreversible

U.S. Department of Labor Press Release March 24, 2016

Where is Silica Found?

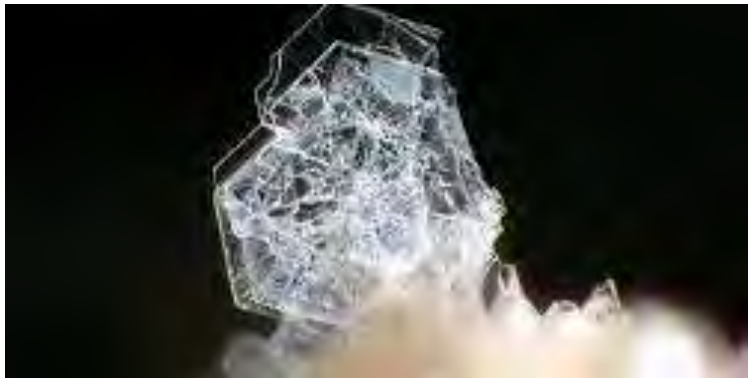
Better question is where is not found

- Quartz glass
- Vitreous glass
- Fused silica
- Opals
- Sand
- Mortar
- Concrete
- Abrasive
- Porcelain
- Paints
- Bricks

Crystalline Silica Polymorphs

- α-Quartz
  - Most common

- Cristobalite
  - formed at high temps 1400^{o}C
  - foundry processes, brick
  - manufacture, ceramics



- Tridymite
  - Common in volcanic rock
  - Very rare in the workplace

SiO2 – silica

O- most abundant element on earth - 46%

Si – second most abundant element – 28%

Industries with Potential Silica Exposures

Industries with Potential Silica Exposures

- General Industry
  - Abrasive blasting
  - Manufacturing
  - Cement and brick
  - Asphalt/pavement
  - China and ceramics
  - Counter-top mfg. and installation
  - Gypsum dry wall panels
  - Steel and foundry industries
- Construction Industry
  - Abrasive blasting
  - Tuck Pointing
  - Jackhammering
  - Rock/well drilling
  - Concrete mixing and drilling
  - Brick and concrete cutting
  - Quarry work and tunneling

Exposure Hazards

Exposure Hazards

- Pneumoconiosis
  - Occupational lung disease caused by inhalation of dust
  - 2,600 US deaths recorded in 2013, includes asbestosis, silicosis, coal workers' pneumoconiosis, byssinosis
- Silicosis
  - Primary health effect associated with inhalation of respirable crystalline silica
  - Progressive fibrosis caused by deposition of respirable particles
  - Irreversible
  - ~600 US deaths attributed in 2013
- Lung cancer
- Chronic obstructive pulmonary disease (COPD)
- Kidney disease
- Increases the risk of contracting tuberculosis and other infections

OSHA Silica Standards

Two OSHA Silica Standards

- General Industry and Maritime 29CFR 1910.1053

- Construction 29CFR 1926.1153

Both take effect June 23, 2016

General Requirements

old standard – moving target – 10/%quartz + 2

- 8-hour Time Weighted Average (PEL)
  - 50 micrograms/cubic meter (µg/m3)
- Action Level (AL)
  - 25 micrograms/cubic meter (µg/m3)
- Requirements for
  - Exposure assessment
  - Limiting access to areas of potential silica exposure
  - Engineering controls and work practices
  - Medical exams
  - Training

General Industry and Maritime

- Compliance within 2 years (June 23, 2018)
- Hydraulic Fracturing within 2 years and 5 years to implement engineering controls (June 23, 2021)

Construction

- Compliance within 1 year (June 23, 2017)
  - Methods of sample analysis by June 23, 2018
- Written Exposure Control Plan
  - Competent person to implement plan
  - Restrict access to work areas
- 18 Exposure Control methods
  - Specified Exposure Control Methods
  - Required unless not feasible
  - New in exposure prevention tactics

Construction Specified Exposure Control Methods

- Stationary masonry saws
- Handheld power saws
- Handheld power saws cutting fiber-cement board
- Walk-behind saws
- Drivable saws
- Rig mounted core saws or drills
- Handheld and stand mounted drills
- Dowel drilling rigs concrete
- Vehicle mounted drilling rigs rock and concrete
- Jackhammers and handheld chipping tools
- Handheld grinders for mortar removal
- Handheld grinders for other uses
- Walk behind milling machines and floor grinders
- Small drivable milling machines
- Large drivable milling machines
- Crushing machines
- Heavy equipment used for abrading or fracturing
- Heavy equipment for grading and excavating

Exposure Assessment

Exposure Assessment
Initial Compliance

- Initial exposure monitoring of employees who are, or may reasonably be expected to be, exposed to crystalline silica
- Satisfy initial monitoring requirements provided exposure was assessed within 12 months of Final Rule
- Determine employee exposure levels
  - >50 µg/m3 (PEL)
  - <50 µg/m3 and >25 µg/m3 (between PEL and Action Level)
  - <25 µg/m3 (Below Action Level)
- Compliance to construction employers through specified controls in lieu of exposure monitoring

Exposure Assessment Ongoing

- Engineering and work practice controls are REQUIRED to control exposure
  - Exceptions for technical feasibility
- If above Action Level – scheduled Exposure Assessment Program at least every 6 months
- If above PEL – scheduled Exposure Assessment Program at least every 3 months
  - Respiratory protection is required
- Discontinue ongoing exposure assessment when 2 consecutive measurements, taken at least 7 days apart, are less than Action Level

Exposure Sampling

Exposure Sampling

Samplers must meet ISO 7708:1995 specifications
- 4 µm 50% Cut Point (Previous OSHA Standard 3.5 µm)

However, Dorr-Oliver cyclones can still be used
Cyclones selected based on several factors

Higgins Dewel Cyclone

Dorr-Oliver Cyclone

SKC Aluminum

Exposure Sampling

- Samplers must meet ISO 7708:1995 specifications

  NEW and IMPROVED

- Alternative to Cyclone – SKC Parallel Particle Impactors (PPI) Sampler
  - Meets Standard Requirements
  - Single use or Re-Usable
  - 2, 4, or 8 LPM Models

- Pros:
  - Removes some problems associated with cyclones
  - Availability of High-Flow Personal Sampling Pumps
- Cons:
  - Single use adds cost

Exposure Sampling

- Samplers must meet ISO 7708:1995 specifications

NEW and IMPROVED
IMPROVED

- Alternative to Cyclone and SKC Parallel Particle Impactors (PPI) Sampler

The DRS is a Disposable Respirable Sampler

  - Meets Standard Requirements
  - Single use
  - 2 LPM Model

- Pros:
  - Removes some problems associated with cyclones
  - Availability of High-Flow Personal Sampling Pumps
- Cons:
  - Single use adds cost – but not as much as the PPI

Sample Analysis

Sample Analysis

- Laboratory Qualification
  - Laboratory Accredited to ISO 17025

    (AIHA LAP Accreditation meets this requirement)
  - Analytical Methods
    - OSHA ID-142 (X-ray Diffraction)
    - NIOSH 7500 (X-ray Diffraction)
    - NIOSH 7602 (Infrared)
    - NIOSH 7603 (Infrared)
    - MSHA P-2 (X-ray Diffraction)
    - MSHA P-7 (Infrared)
- X-ray Diffraction
  - Capable of separating the three polymorphs of crystalline silica (SiO_2)
    - α-Quartz
    - Cristobalite
    - Tridymite
- Infrared Spectrophotometry
  - Analysis of **total crystalline silica**
  - Relies on molecular structure and chemical bonds for identification
  - Cannot determine the polymorphs of crystalline Silica

What if exposure levels are >PEL (50 µg/m3)

What if exposures are >PEL (50 µg/m3)

- Exposure reassessment
  - Re-assessment required at least every 3 months. Discontinue if 2 consecutive exposure measurements at least 7 days apart show exposures <25 µg/m3
- Employee notification
  - Written employee notification within 15 days of exposure assessment with description of corrective action plan to reduce exposures below PEL
  - Required, in writing, for all monitored workers
    Must include the corrective actions
  - As an alternative, can be posted in an area where all workers have access
- Establish either a Regulated Area or Access Control Plan

Additional Requirements if >PEL

- Respiratory protection program
- Implement engineering and/or work practice controls
- Specific housekeeping requirements
- Written exposure control plan
- Medical surveillance for exposed workforce
- Employee training
- Recordkeeping

More About the Regulated Area Requirement

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- Regulated Area
  - Demarcation from the rest of the workspace
- Control Plan to Access Regulated Area
  - Competent person
  - Authorized persons
  - Respirators (along with Respiratory Protection Program)
  - Protective clothing (coveralls)
    Changing areas
  - Written access control plan (annual update)
    Employee notification of controlled access areas

Posting of Regulated Area

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

Written Exposure Control Plan

Written Exposure Control Plan

- Written exposure control plan must be available to employees and reviewed annually and updated, as necessary. Must include:
  - A description of the tasks in the workplace that involve exposure to respirable crystalline silica;
  - A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task;
  - A description of the housekeeping measures used to limit employee exposure to respirable crystalline silica.

Housekeeping Requirements

- No dry sweeping or dry brushing unless wet sweeping or HEPA vacuums are not feasible

- No compressed air to clean clothing or surfaces unless used in conjunction with a ventilation system that captures the dust
  - Personnel cleaning booths are commercially available

Medical Surveillance

- By June 23, 2018, required to be offered to employees with occupational exposure to respirable crystalline silica above the PEL for 30 or more days per year.
- By June 23, 2020, required to be offered to employees with occupational exposure to respirable crystalline silica at or above the action level for 30 or more days per year.
- For Construction, medical surveillance requirements begin June 23, 2017, for workers that must wear respirators for 30 or more days each year.

Training Topics

- Health hazards
- Specific tasks in the workplace that could result in exposure to respirable crystalline silica
- 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
- The contents of the standard
- Identity of the competent person
- Medical surveillance program

Recordkeeping

- The date of measurement for each sample taken
- The task monitored
- Sampling and analytical methods used
- Number, duration, and results of samples taken
- Identity of the laboratory that performed the analysis;
- Type of personal protective equipment worn by the employees monitored
- Name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were monitored

What if exposures are between the Action Level and PEL

What if exposures are between the Action Level and PEL?

- Establish exposure assessment program schedule of at least every 6 months

- Discontinue if 2 consecutive exposure measurements at least 7 days apart show exposures <25 µg/m3

What if exposures are <Action Level

What if exposures are <Action Level?

- No action necessary
- Re-assess with changes to production, equipment, materials, or personnel

Cost Avoidance and Cost of Compliance

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- OSHA estimates annual monetary benefits of $8.7 billion/year based on reduced mortality and morbidity
- Projected annual costs of compliance are ~ $1 billion

OSHA's Projected Annualized Costs

Engineering Controls	$661,456,736
Respirators	$32,884,224
Exposure Assessment	$96,241,339
Medical Surveillance	$96,353,520
Familiarization & Training	$95,935,731
Regulated Area Access Control	$2,637,136
Written Exposure Control Plan	$44,273,091
Total Annualized Costs	**$1,029,781,777**

Thank you!

Do you have any questions?
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