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The Silica Story – Exposure Assessment and Exposure Management

A Presentation to:
The Potomac Section of the American Industrial Hygiene Association (AIHA)

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March 2017





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Agenda

- What is Silica? Why does it pose a health hazard?
- History of silica
- Why is it a hot topic today?
- Silica exposure sources and sampling techniques
- Case studies

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What is silica?

- Oxide of the metal silicon (SiO_2)
- Crystalline and amorphous forms
- Silica is everywhere; quartz is the most common crystalline form found in sand, granite, etc.






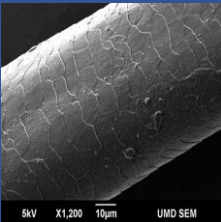

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Size and Structure Matter!

- Crystalline structure – scars the lungs, irreversible
- Smaller the size – deeper into the lungs
- Respirable fraction - broadly defined as particles having a diameter of $10\ \mu\text{m}$ or less; other criteria
- Main concern - **RCS**

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History of Silica

- Silica and silicosis - late B.C./early A.D., 17th to 19th century
- Field research - mining, granite, cement industries - 1914 through the 1920s
- Hawks Nest Tunnel Tragedy - early 1930s
 - 764 died from acute silicosis
 - Additional 1500 died later from silicosis
- Late 1940s - ACGIH - TLV based on silica content (0.5 to 5 mg/m³)



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RCS Regulation

- First federal regulation established in 1971 after OSHA was formed
- Established for construction, shipyard and general industry
- General industry: $PEL = 10 / (\text{silica}\% + 2)$
~ 0.1 mg/m³
- Construction and shipyards (based on now-obsolete particle counting method)
~ 0.25 mg/m³

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RCS Regulation, contd.

- New OSHA silica rule - general industry/maritime/construction
 - PEL 0.05 mg/m³
 - AL 0.025 mg/m³
 - Specific requirements under standard
 - Exposure Monitoring
 - Employee Notification
 - Medical Monitoring
 - Control Measures
- Differences in control measures


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OSHA Hazard Communication

- Previously
 - Listed crystalline silica as an ingredient if ≥ 0.1%
 - If there was no potential for exposure to RCS in the way product was used; not listed in MSDS/Product Label
- Current - SDS and Product Label
 - **DANGER**
 - May cause cancer by inhalation.
 - Causes damage to lungs, kidneys and autoimmune system through prolonged or repeated exposure by inhalation.



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Potential Sources of RCS Exposure

- Construction
- Steel industry - foundries
- Mining - granite, limestone, sand & gravel, etc.
- Hydraulic fracturing (fracking)
- Utility - coal, flyash
- Abrasive blasting
- Other unique exposures



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Direct Read Instruments

- Instantaneous Size-Selective Particulates Monitors (PDR, Dustrak, Sidepak)
 - Measures aerosol concentration - dust, smoke, mists, fumes
 - Need silica concentration in the dust being measured
 - Multiple assumptions
 - Screening



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Traditional Air Sampling Equipment

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Silica Concentration Measurement

- Poly vinyl chloride (PVC) filters analyzed in laboratories
 - Gravimetric Analysis – Respirable Dust (mg)
 - X-ray Diffraction – Respirable Silica (mg)
- Total Air Volume (Flow rate x Sampling Time)
- Concentrations calculated in mg/m^3

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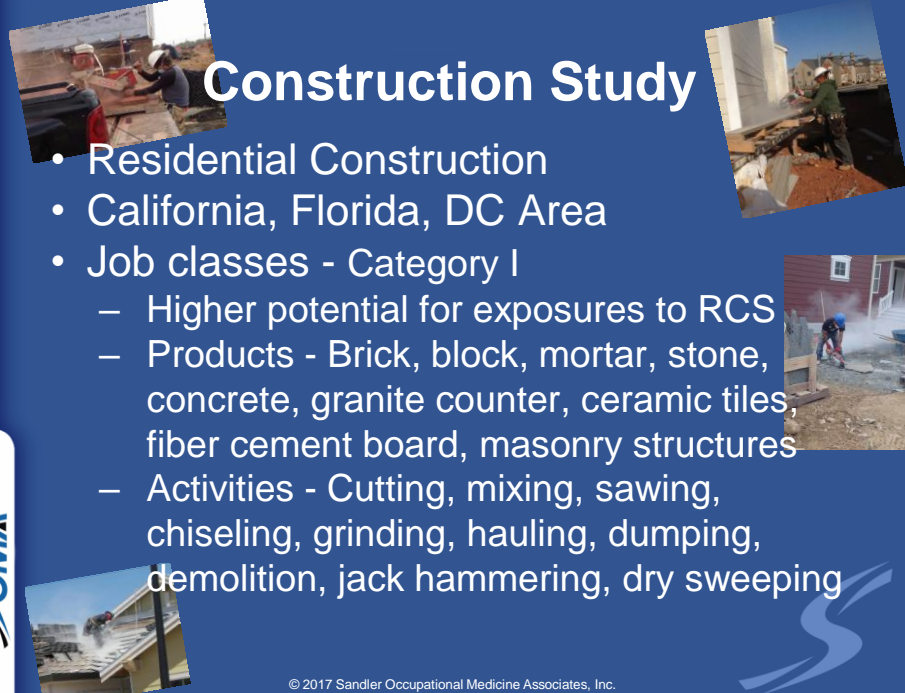
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Construction Study

- Residential Construction
- California, Florida, DC Area
- Job classes - Category I
 - Higher potential for exposures to RCS
 - Products - Brick, block, mortar, stone, concrete, granite counter, ceramic tiles, fiber cement board, masonry structures
 - Activities - Cutting, mixing, sawing, chiseling, grinding, hauling, dumping, demolition, jack hammering, dry sweeping

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Construction Study, contd.

- Job classes - Category II
 - Lower potential for exposures to RCS
 - Installation Tasks (No/Limited Disturbance of Materials)
 - Grout and Stucco
 - Brick, Block and Stone
 - Ceramic tiles
 - Drywall Work
 - General Site Clean-Up

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Sample Results by Product/Silica Content

% Weight Crys. Silica	Samples (N)	Mean	Range
Low: < 10 %	16	0.025	0.008 – 0.093
Medium: 10 – 30%	17	0.633	0.010 – 2.631
High: > 30%	37	0.204	0.010 – 1.689

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Sampling Results by Category

Category	No. of Samples (N)	Mean (mg/m³)	Range (mg/m³)
Category One	48	0.349	0.008 – 2.631
Category Two	26	0.081	0.003 – 0.675

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Dust Suppression Methods

- Wet Cutting/Grinding
- Vacuum Dust Collection Systems
- Ventilation Booths
- Remote Cutting Devices
- Fans (supplementary use)

OSHA's Publication 3362-04 *Controlling Silica Exposures in Construction;*
Table 1 in new OSHA Silica Standard

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Wet Spray Application



Wet Saw



Dry Vacuum

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Challenges

- Decentralized; multiple supervisors; many sub-contractors
- NO unified exposure control approach
- Frequently changing workforce
- Respirator Protection Program management and medical monitoring - very challenging
- Multiple tasks were above the OSHA PEL

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Mining Overview

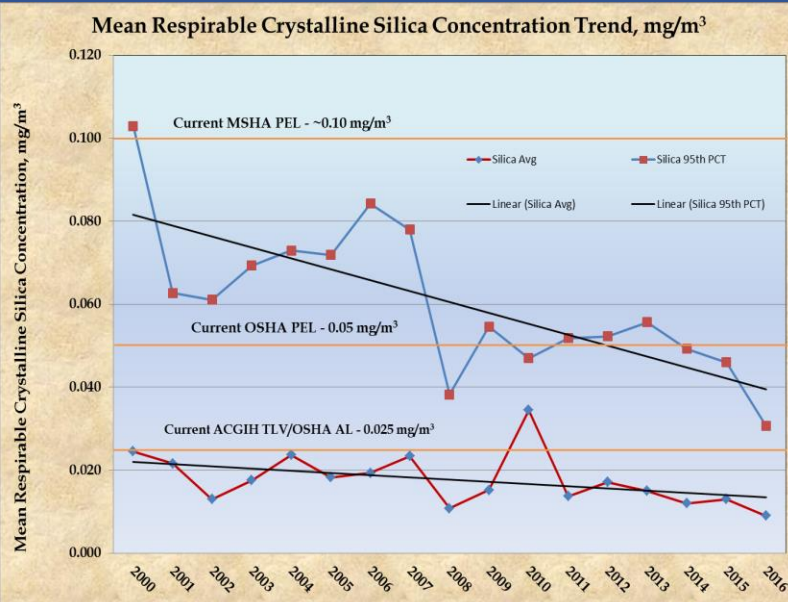


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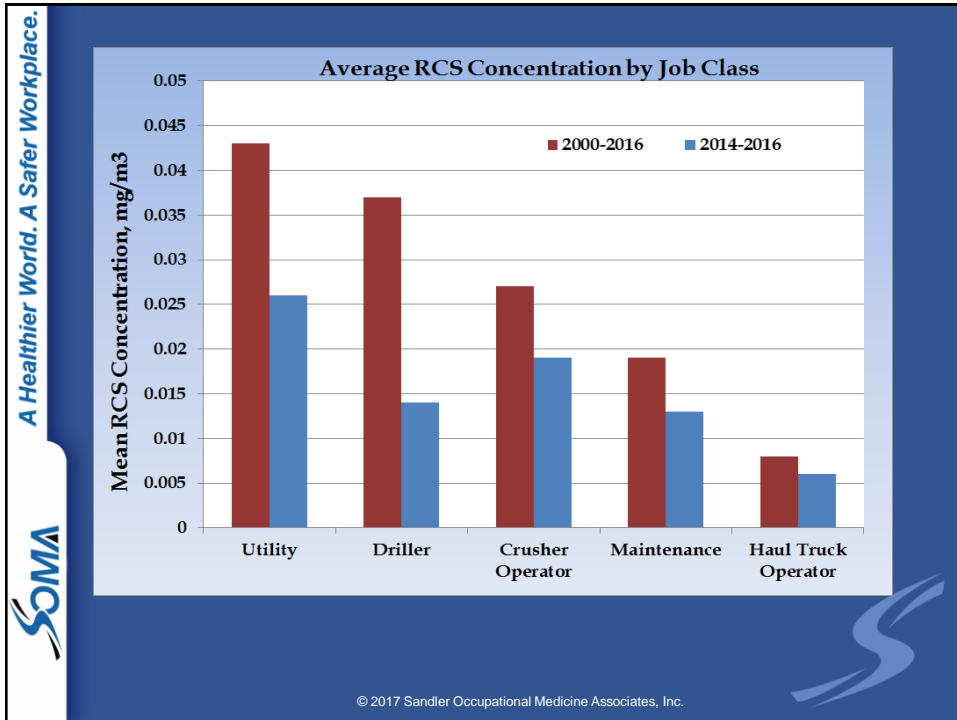
IH Monitoring Program for Aggregate Industry

- Geology - limestone, granite, sandstone
- Job classes
 - Control operators
 - Heavy equipment operators
 - Maintenance crew
 - Clean up activities
- Control measures in-place

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Control Measures

- Water suppression
 - Water sprays in the crusher area, conveyor system
 - Water trucks
 - Water hoses prior to maintenance work
- Regular maintenance
- Enclosed work areas - control rooms, heavy equipment cabs
- Scheduling of cleanup work before or after plant operation
- Regular and consistent follow-up

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The Main Take Aways

- Silica is almost everywhere - significant health risk in its crystalline form
- Smaller the size - more toxic
- Challenges of control of RCS exposure
 - Silica content in source material
 - Industry and management
 - Tasks being performed

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The Main Take Aways, contd.

- Compliance with the new OSHA silica standard is achievable, given the right resources
- Characterization of silica exposure is critical
 - Regular monitoring
 - Recordkeeping of sampling results
 - Consistent follow-up of exposure management

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Brace Yourself.....



.....Questions Are Coming!!!

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