SILICA UNDER ASSAULT - AGAIN
AN INDUSTRY PERSPECTIVE

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OVERVIEW

A. What is Silica?
B. Importance
C. Health Implications
D. Investigations and Outcomes
E. Industry Implications
F. Concluding Thoughts
A. What is silica sand?

1. COMPOSITION

• Silica sand consists of the two most common elements in the earth’s crust, Si & O representing ~75% of its composition.

• Quartz is the pure mineral form of silica and the second most common mineral on earth.

• The most common form of crystalline silica.
2. PRINCIPAL SOURCES OF SILICA SAND

- Silica sand is formed from all rock types.
- Pegmatite Veins – igneous
- Sandstone - sedimentary
- Quartzite - metamorphic
- Glacial Deposits – surficial, from any of the above rock types.
3. SILICA SAND PROPERTIES

**Cleanliness.** refers to sand with negligible silt, clay and organic content.

**Color.** a property related to mineral composition and is indirectly, an index of purity.

**Refractoriness.** a property associated with a material’s ability to withstand high temperatures without fusing or breaking down.

**Shape.** a textural property that includes the concept of grain roundness (a measure of the relative sharpness of grain corners) and sphericity (the degree to which a sand grain approaches the shape of a sphere).
3. SILICA SAND PROPERTIES

**Soundness.** refers to the grain toughness or durability in handling and processing. Grains should be hard and resistant to fracture. Compressive strength and abrasion tests are methods used to determine this property.

**Specific Gravity.** the specific gravity of pure quartz grains is 2.65. Other results may indicate the presence of impurities or grain porosity.

**Durability.** refers to the sands’ ability to resist chemical attack and is an indication of the amount of undesirable contaminants present.

**Grain Size.** the range of particle sizes that make up a deposit and is determined by screening into specific size ranges as determined by markets.
1. SILICA SAND USES

Silica sand specifications vary with the many end uses. These uses can be broadly categorized as follows:

UNALTERED SILICA SAND USES

Building products. Bricks, interlocking blocks, roofing tiles

Construction. Road beds, building pads, fill

Construction Materials. Concrete, concrete blocks and slabs, asphalt

Glassmaking. Bottles, dishes, plate glass, fiberglass

Oilfield. Hydraulic fracturing of petroleum wells
1. SILICA SAND USES

**Refractory Agent.** In foundry and mold sands and manufacture of refractory brick

**Abrasive Sand.** Very effective as a scouring agent to remove paint, rust, scale and other impurities from metal, concrete and wood.

**Filtration.** Used to remove impurities from water for potable use and for maintaining good permeability in wells and drainage beds.

**Recreational.** Placed in sports fields, playgrounds, golf courses, ball fields, horseshoe pits.
1. SILICA SAND USES

**Industrial Manufacturing.** used as an additive for the manufacture of ferrosilicon and silicon carbide.

**ALTERED SILICA SAND USES**

**Cement.** used in the manufacture of cement and as an additive for concrete

**Fillers.** For paint, cleaning compounds, soap, insecticides, fertilizers, paper.

**Ceramics.** Ingredient for insulators, porcelain china, sanitary ware, earthenware.
2. ECONOMIC IMPORTANCE

- Many industries developed around it because of these many uses.
- Is readily abundant in most regions of the earth.
- Economical to use.
- Inert and harmless in its natural state.
1. ISSUE

• Silicosis, an occupational lung disease caused by the inhalation of crystalline silica dust with scar tissue forming in the lungs reducing the ability to extract oxygen from the air.

• Respirable refers to the <5/10 μm size.
• Illness onset typically takes decades to develop after long term exposure to high concentrations of respirable dust.
2. COMPARING EXPOSURE LIMITS

- Silica OEL’s of 40 jurisdictions/countries range from 0.025 to 0.20 mg/m³.

- In US, OSHA limit is 0.1 mg/m³. NIOSH & ACGIH recommend 0.05 mg/m³ and 0.025 mg/m³ respectively with neither federally legislated.

- In 2009, AB legislation at 0.025 mg/m³ OEL without industry input or scientific basis.
### 2. COMPARING EXPOSURE LIMITS

<table>
<thead>
<tr>
<th>Industry (No of Employers)</th>
<th>No of Samples</th>
<th>Low (mg/m³)</th>
<th>High (mg/m³)</th>
<th>% Over OEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Mining, Surface (2)</td>
<td>27</td>
<td>ND</td>
<td>0.064</td>
<td>33</td>
</tr>
<tr>
<td>Coal Mining Underground (1)</td>
<td>13</td>
<td>ND</td>
<td>0.21</td>
<td>69</td>
</tr>
<tr>
<td>Abrasive Blasting* (1)</td>
<td>4</td>
<td>0.016</td>
<td>0.18</td>
<td>75</td>
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<tr>
<td>Asphalt Plants (2)</td>
<td>13</td>
<td>&lt;0.0060</td>
<td>0.074</td>
<td>38</td>
</tr>
<tr>
<td>New Construction (3)</td>
<td>38</td>
<td>&lt;0.019</td>
<td>1.0</td>
<td>81</td>
</tr>
<tr>
<td>Cement Plants (3)</td>
<td>30</td>
<td>&lt;0.0061</td>
<td>0.061</td>
<td>29</td>
</tr>
<tr>
<td>Limestone Quarry (1)</td>
<td>6</td>
<td>&lt;0.0063</td>
<td>0.016</td>
<td>0</td>
</tr>
<tr>
<td>Aggregate Crushing Operations (2)</td>
<td>14</td>
<td>&lt;0.0055</td>
<td>0.19</td>
<td>75</td>
</tr>
</tbody>
</table>
2. COMPARING EXPOSURE LIMITS

- Wood dust: In 2005 ACGIH & NIOSH recommend 1 mg/m³. BC has 1 mg/m³ for hardwood and 2.5 mg/m³ for softwood. Quebec is 5 mg/m³ for both. WCB compensating at 3.5 mg/m³, an exposure level many jurisdictions consider appropriate.

- Titanium dioxide ultrafine OEL is 0.3 mg/m³
## 3. RISK OF DEATH

<table>
<thead>
<tr>
<th>Event</th>
<th>Annual Death Rate (Per million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Term Smoking</td>
<td>1200</td>
</tr>
<tr>
<td>Home accidents (1-14 years)</td>
<td>60</td>
</tr>
<tr>
<td>Drowning (5-14 years)</td>
<td>27</td>
</tr>
<tr>
<td>Fires (5-14 years)</td>
<td>16</td>
</tr>
<tr>
<td>Bicycling (10-14 years)</td>
<td>14</td>
</tr>
<tr>
<td>High school football</td>
<td>10</td>
</tr>
<tr>
<td>Peanut butter allergy</td>
<td>8</td>
</tr>
<tr>
<td>Aircraft accidents</td>
<td>6</td>
</tr>
<tr>
<td>Floods</td>
<td>2</td>
</tr>
<tr>
<td>Asbestos in schools</td>
<td>0.03</td>
</tr>
<tr>
<td>Silicosis</td>
<td>0.006</td>
</tr>
</tbody>
</table>
4. COMPARING OTHER PRODUCTS

• NIOSH studied products included slags, minerals and manufactured products to determine their potential for respiratory disease. Dust from these sources resulted in an illness called pulmonary fibrosis and some exhibited carcinogenic conditions similar to silica sand. ([www.cdc.gov/niosh/Abrpt946.html](http://www.cdc.gov/niosh/Abrpt946.html))

• Other products less regulated (hardwood, some zeolites, titanium) are known carcinogens but not under the same government scrutiny.
1. CONTRIBUTING FACTORS TO REGULATION

- Little knowledge of silicosis prevention
- Inadequate medical surveillance
- Limited appreciation of the health risk, especially for smokers
- Poor work practices
- Inadequate equipment/safety programs
- Lack of engineering controls, safety equipment.
2. MORTALITY

Silicosis Mortality Rate.
Number of silicosis death and age-adjusted mortality rate*, by year – National Occupational Respiratory Mortality System, United States, 1968-2002

*Per million persons aged ≥15 years.
SOURCE: National Institute for Safety & Health Center for Health Statistics
2. MORTALITY

- Deaths from silicosis has declined by 93% from 1968 to 2002, a result of awareness and improved safety practices. That figure continues to decline to 94% by 2007.
3. US SILICA LITIGATION

- Started in the US in 1975.

Claims 1975 - 1997
3. US SILICA LITIGATION

- Number of cases remained relatively constant until 2000 where they increased exponentially until 2004 – legal professions saw it as another asbestos or tobacco type financial windfall.

Claims 1998 - 2006
3. US SILICA LITIGATION

• 20,000 cases ($3.0 billion claim) but no alert issued by CDC or NIOSH – a phantom epidemic.

• Application made to NYSE

• In 2005 MDL court case to investigate accuracy of silicosis diagnoses.

• Findings showed asbestos x-rays used for silicosis in plaintiffs, untrained secretaries prepared medical reports, unqualified screening companies scoured the US for clients in likely silica use locations, doctors made diagnoses without meeting patients.
3. US SILICA LITIGATION

- Judge found lawsuits solely for entrepreneurial litigation, no purpose other than to make money for legal profession. Class action suit was overturned.

- Although not widely reported, was a major turning point in resurrecting silica industry.
4. ALBERTA AND BC ABRASIVE REVIEW

- In 1998 BC enacted OH&S legislation to replace silica abrasives with less toxic materials when practicable, lack of approved alternatives diminished impact. Silica acceptable under proper engineering controls.

- Alberta was less restrictive; in 2001 implemented policy to consider alternatives based on technical, economic and availability factors.

- OH&S inspectors provide misinformation to users; improper training?
Starting in 2006, investigated whether crystalline silica should be added to the list of Toxic Substances under the Canadian Environmental Protection Act.

Focus was on a substance or product, mixture or manufactured item containing >5% quartz that was intended for use within a residence.

In 2011, concluded that crystalline silica is not entering the environment in a quantity or concentration that constitutes a danger to human life or health.
6. ALBERTA EMPLOYMENT & IMMIGRATION PROGRAM

- Worker exposure evaluation study commenced in 2010 to evaluate worker exposure to crystalline silica at Alberta work sites.
- Study expanded 2011 to include more construction and aggregate production facilities. We trust it will be objective.
- Initiated after legislation enacted to lower the AB occupational exposure limit (OEL) from 0.10 mg/m$^3$ to 0.025 mg/m$^3$
1. ECONOMIC VALUE

• Construction (residential, non-residential, commercial) makes up a large segment of the AB economy and sand and gravel is a major component of that industry.
1. ECONOMIC VALUE

ALBERTA ECONOMY
(GDP $ billions)

ALBERTA CONSTRUCTION SPENDING
1. ECONOMIC VALUE

ALBERTA SAND & GRAVEL PRODUCTION
(annual tonnes in millions)

ALBERTA SAND & GRAVEL PRODUCTION
(annual $ millions)
1. ECONOMIC VALUE

- A 2009 US Study (ACC 2011) indicates industry compliance from 0.1 mg/m$^3$ to 0.05 mg/m$^3$ will cost $5.45$ billion for engineering controls, respirators and accessories etc. Annual revenue loss projected at $1.1$ billion / yr and 17,350 lost jobs. In AB, this translates to a potential compliance cost of $82$ million, annual revenue loss of $17$ million and 200 lost jobs.
2. PERSPECTIVE

- Manufacturers and contractors were not involved in any dialogue or notified of Alberta OEL change.

- Unilateral actions, without advance consultation, have significant economic impact on companies.

- The construction and aggregate industry has potential for dust overexposure, yet it has done an excellent job of preventing silicosis through voluntarily controlling dust emissions.
2. PERSPECTIVE

• US companies have demonstrated that silicosis can be prevented when exposures are maintained below the 0.10 mg/m³ PEL.

• Having an OEL/PEL below this level is not justified.
F. CONCLUDING THOUGHTS

- Silica Sand is one of the most common, useful and essential minerals on earth that provides a foundation for numerous industries and manufacturers.

- Silicosis is preventable through education, proper protective equipment, employee monitoring and dust control through good workplace practices.
F. CONCLUDING THOUGHTS

- Alberta companies who handle and use silica products have good safety programs and are actively engaged in and promote safe work practices.

- There is no evidence of increased silicosis cases in Alberta – no justification for lower limit.

- Folly to implement policies based on academic studies without verifiable data.
F. CONCLUDING THOUGHTS

- Steps for Industry to take to minimize financial risk of silica related issues:
  - Identify, assess and understand risks to your company.
  - Establish a high level group to respond to these issues.
  - Participate in, support and encourage trade associations to respond to industry wide issues.
  - Be aggressive in seeking solutions for the long term; don’t be seduced by short term inexpensive compromises.
“If you put the federal government in charge of the Sahara Desert, in five years there’d be a shortage of sand.”

Milton Friedman

Thank you. Questions?