Crystalline Silica in Alberta

Executive Royal Inn, Edmonton
April 3, 2012
Outline

• Silica Project Overview
• Project Outcomes for 2011/2012
• Activities for 2012/2013
Silica Project
Silica Project

• Began April 2010
• Objective: gather information to address challenges related to silica
• Participants:
  – Alberta Human Services (Policy, Delivery, Programs and Occupational Disease)
  – Workers Compensation Board
  – Alberta Health and Wellness
  – Alberta Health Services
  – Various stakeholder associations
Challenges

1. Who is being exposed to silica and where?

2. What are the exposure levels at Alberta work sites? Does the environment contribute to exposure?

3. Are workers getting sick due to silica exposure? Are occupational illnesses due to silica exposure being reported?

4. Are there issues related to the OEL?
5. What is the level of compliance with OHS legislation?
6. Are there issues with legislation or policy that need to be addressed?
7. How can we improve awareness?
Project Tasks for 2011/2012

- Evaluation of occupational disease rates
- Exposure assessments
- Development of an exposure database
- Evaluation of the OEL
- Strategies to address issues and improve awareness
Outcomes 2011/2012
Occupational Disease Rates
Occupational Disease Rates?

• Silica Disease Working Group
  – Look at occupational disease data differences among various agencies
  – Provide recommendations for improved awareness and reporting
Occupational Disease Rates?

- Alberta Human Services
  - From 2002-2009, 2 cases of silicosis were reported to the Director of Medical Services
  - In the same period there were 16 deaths in Alberta due to silicosis

- WCB
  - In the past 10 years, WCB has accepted 29 claims for probable/confirmed silicosis

- AHW
  - Over 850 cases of silicosis from emergency, hospital or physician claims data (10 year period)
Occupational Disease Rates

• Research plan being developed with the University of Alberta
  – Evaluate data from AHW and WCB
  – Identify industries and occupational with increased risk for silicosis and other pulmonary fibrosis
  – Determine why cases are not reported
Silica Exposure
Exposure Assessments

- 2009 Coal Mining
- 2010 Construction
  - Asphalt plants
  - Cement plants
  - Quarries
  - Aggregate crushing
  - New construction
  - Abrasive blasting
- 2011 Construction and Abrasive Blasting
  - Sand and mineral processing
  - Demolition
  - New construction
  - Road building
  - Abrasive blasting
Occupational Sampling

- 248 samples collected (208 workers)
  - 153 samples above applicable OEL (62%)
  - 131 samples above 8-hour OEL (53%)
  - 79 samples above NIOSH REL of 0.05 mg/m³ (32%)
# Alberta Exposure Assessment Results

<table>
<thead>
<tr>
<th>Industry (# work sites)</th>
<th># Samples</th>
<th>Low (mg/m³)</th>
<th>High (mg/m³)</th>
<th>% above OEL</th>
<th>% above 8-hr OEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand and Mineral Processing (2)</td>
<td>16</td>
<td>0.024</td>
<td>1.7</td>
<td>100</td>
<td>94</td>
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<tr>
<td>Aggregate Mining and Crushing (3)</td>
<td>22</td>
<td>ND</td>
<td>0.19</td>
<td>86</td>
<td>82</td>
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<tr>
<td>Demolition (1)</td>
<td>10</td>
<td>0.017</td>
<td>0.065</td>
<td>80</td>
<td>40</td>
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<tr>
<td>New Construction (4)</td>
<td>44</td>
<td>0.015</td>
<td>1.0</td>
<td>80</td>
<td>77</td>
</tr>
<tr>
<td>Abrasive Blasting (5)</td>
<td>37</td>
<td>0.0074</td>
<td>0.34</td>
<td>70</td>
<td>68</td>
</tr>
<tr>
<td>Mining (5)</td>
<td>50</td>
<td>ND</td>
<td>0.21</td>
<td>54</td>
<td>40</td>
</tr>
<tr>
<td>Earth Moving/Road Building (3)</td>
<td>24</td>
<td>ND</td>
<td>0.068</td>
<td>50</td>
<td>25</td>
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<tr>
<td>Asphalt Plant (2)</td>
<td>13</td>
<td>ND</td>
<td>0.074</td>
<td>38</td>
<td>38</td>
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<tr>
<td>Cement Plant (3)</td>
<td>26</td>
<td>ND</td>
<td>0.061</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>Limestone Quarry (1)</td>
<td>6</td>
<td>ND</td>
<td>0.016</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

ND = Below limit of detection
<table>
<thead>
<tr>
<th>Occupation</th>
<th># Samples</th>
<th>Low (mg/m³)</th>
<th>High (mg/m³)</th>
<th>% above applicable OEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick Layer/Mason</td>
<td>3</td>
<td>0.070</td>
<td>0.13</td>
<td>100</td>
</tr>
<tr>
<td>Concrete Cutting, Coring, Finishing</td>
<td>10</td>
<td>0.033</td>
<td>1.0</td>
<td>100</td>
</tr>
<tr>
<td>Welder</td>
<td>1</td>
<td>--</td>
<td>0.13</td>
<td>100</td>
</tr>
<tr>
<td>Blaster (Abrasive Blasting)</td>
<td>11</td>
<td>0.019</td>
<td>0.34</td>
<td>91</td>
</tr>
<tr>
<td>Electrician</td>
<td>5</td>
<td>0.015</td>
<td>0.064</td>
<td>80</td>
</tr>
<tr>
<td>Painter</td>
<td>5</td>
<td>0.0085</td>
<td>0.12</td>
<td>80</td>
</tr>
<tr>
<td>Equipment Operator (mining, underground)</td>
<td>9</td>
<td>ND</td>
<td>0.21</td>
<td>78</td>
</tr>
<tr>
<td>QC/Lab. Technician</td>
<td>4</td>
<td>0.011</td>
<td>0.074</td>
<td>75</td>
</tr>
<tr>
<td>Labourer (non-mining)</td>
<td>61</td>
<td>ND</td>
<td>1.0</td>
<td>72</td>
</tr>
<tr>
<td>Plant Operator</td>
<td>21</td>
<td>ND</td>
<td>1.7</td>
<td>67</td>
</tr>
<tr>
<td>Foreman/Supervisor (mining)</td>
<td>3</td>
<td>ND</td>
<td>0.054</td>
<td>67</td>
</tr>
<tr>
<td>Foreman/Supervisor</td>
<td>15</td>
<td>0.0065</td>
<td>0.12</td>
<td>60</td>
</tr>
<tr>
<td>Carpenter</td>
<td>10</td>
<td>0.013</td>
<td>0.041</td>
<td>60</td>
</tr>
<tr>
<td>Labourer (mining, underground)</td>
<td>4</td>
<td>ND</td>
<td>0.036</td>
<td>50</td>
</tr>
<tr>
<td>Mechanic/Technician</td>
<td>8</td>
<td>ND</td>
<td>0.068</td>
<td>50</td>
</tr>
</tbody>
</table>

Occupation not included in CAREX data.
Worker Exposure: Key Finding

- Additional worker groups were over-exposed
  - Task that was being done at the time
  - Incidental exposure
Use of Controls

• Respiratory Protective Equipment (RPE)
  – RPE provided: 93% (27)
  – Of these, RPE use is mandatory (for some tasks): 52%
  – Of these, RPE was used at time of assessment by some workers: 74%
  – RPE code of practice: 69%

• Personal Protective Equipment (PPE)
  – Coveralls provided: 55% (16)
  – Of these, coveralls laundered by employer: 25%
  – Of these, compressed air used to clean coveralls: 19%
  – Workers take PPE home: 79%
Use of Controls

- **Decontamination**
  - Separate locker/change rooms with showers: 48% (14)
  - Of these, showers used (at least by some workers): 36%

- **Other controls and work procedures:**
  - Ventilation systems: 34%
  - Enclosures: 35%
  - Use of dry sweeping/compressed air: 66%
  - Use of wet cleanup methods: 20%
  - Water used for dust control: 41%
  - Exposure monitoring done: 14%
  - Silica hazard signs: 14%
  - Silica code of practice: 10%
Use of Controls

• Vehicles
  – Companies where heavy equipment/vehicles used: 16
  – Of these, enclosed, pressurized cabs: 75%
  – Of these, pressurized cabs but windows open: 50%

• Health Assessment
  – Yes 66% (19)
  – Of these, full health assessment: 84%
  – Of these, PFT only: 16%

• Training on silica provided: 24%
Controls: Common Themes

- Build-up of dust even where ventilation systems used
- Enclosures and barrier systems mostly ineffective (tied back, damaged or ignored)
- Lack of facilities for hand washing prior to eating, drinking, smoking
- PPE issues
  - RPE not properly cleaned and stored
  - Clothing and other equipment not decontaminated
- Inadequate decontamination (facilities not used even if available)
# Exposure in Abrasive Blasting

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Number of Samples</th>
<th>Silica Exposure (Low) (mg/m³)</th>
<th>Silica Exposure (High) (mg/m³)</th>
<th>% of Samples Above Applicable OEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Ground Glass*</td>
<td>4</td>
<td>0.016</td>
<td>0.18</td>
<td>75</td>
</tr>
<tr>
<td>1</td>
<td>Garnet</td>
<td>10</td>
<td>0.011</td>
<td>0.031</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>Silica sand</td>
<td>9</td>
<td>0.0076</td>
<td>0.069</td>
<td>89</td>
</tr>
<tr>
<td>13</td>
<td>Silica sand</td>
<td>6</td>
<td>0.0074</td>
<td>0.34</td>
<td>50</td>
</tr>
<tr>
<td>14</td>
<td>Nickel slag Vitreous smelter slag</td>
<td>8</td>
<td>0.0014</td>
<td>0.27</td>
<td>88</td>
</tr>
</tbody>
</table>

*Blasters were cleaning concrete.*
## Silica Content of Substitutes

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Quartz Content (w/w%)</th>
<th>MSDS Disclosure of Quartz/Crystalline Silica (%w/w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Glass</td>
<td>0.1-0.5</td>
<td>not disclosed</td>
</tr>
<tr>
<td>Aluminum Oxide</td>
<td>0.09</td>
<td>“crystalline particles: no”</td>
</tr>
<tr>
<td>Garnet*</td>
<td>0.76</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Nickel Slag</td>
<td>0.30</td>
<td>”no crystalline silica”</td>
</tr>
<tr>
<td>Vitreous Smelter Slag</td>
<td>0.28</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Staurelite</td>
<td>0.32</td>
<td>0.5-1</td>
</tr>
<tr>
<td>Garnet</td>
<td>1.64</td>
<td>not disclosed, but silicosis noted as a chronic health effect in Section 3</td>
</tr>
<tr>
<td>Coal Slag</td>
<td>0.18</td>
<td>0-10 (silica as metal silicates)</td>
</tr>
</tbody>
</table>

*Used by company who participated in exposure assessment*
Worker Exposure: Findings

- Most blasters are over-exposed (inside hood)
- Use of a silica substitute in abrasive blasting does not appear to affect exposure
  - Product
  - Item being cleaned
  - Break-down of product when used (does silica content increase?)
  - Contamination of equipment
  - Incidental exposure
Ambient Exposure

OHS legislation does not address ambient dust levels or public safety from dust emissions
Ambient Exposure

- Amount of crystalline silica in dust emissions about 2.5% and 5.2% for PM2.5 and PM10, respectively, but can be higher from specific operations such as quarries and sand pits, mining and power plants (Environment Canada, 2011)

- Actual concentration of silica in ambient dust is usually very low (well below public health standards)
Ambient Exposure: UK Study

- Estimated exposure to respirable dust and respirable silica
- Samples collected around urban construction sites including demolition, general construction, road building and concrete block cutting
- At most sites (9 in 11), respirable silica dust was transported off site and potentially into public areas
Ambient Exposure: UK Study

- The estimated range of values for respirable silica from the urban air samplers was 0.0001 – 0.00044 mg/m³
- Total respirable dust contained at most about 2% silica
- Air concentrations of respirable silica at the boundary of construction sites were low
- An individual living within 50 m of a very large scale project may obtain a measurable but very low exposure to respirable silica
Ambient Exposure: Alberta Data

• In the 2011 study, ambient silica measurements were collected at 7 outdoor work sites (road building, gravel pit, mining, new construction)
• Samples were collected upwind and downwind of the work sites
Ambient Exposure: Alberta Data

• For most of the samples, no silica was detected above OEL.
• Occasionally, silica was detected in the upwind samples above the analytical detection limit, but well below the OEL.
• Concentrations of quartz silica were higher in downwind locations compared to upwind locations, only 3 cases where OEL was exceeded in the downwind location.
Survey

- Industry survey conducted in 2011
- Sent to 20 industry associations representing about 1800 companies as well as 36 individual companies
- Response rate about 4%
- 61% of respondents from manufacturing and oil and gas
- Most (80%) indicated that silica exposure may occur at their work site
- 11% report that they conduct exposure monitoring
Exposure Database

- Human Services has been working with CAREX Canada
- Development of database platform to occur in 2013
- Will be ultimately used for other substances as well as data is collected
- Plan is to make database available to Stakeholders as well
Silica OEL
Silica OEL

• **Issues:**
  – Validity of OEL
  – Can exposure monitoring be done?
  – Is the OEL adjustment method valid?
  – Compliance with the OEL?
Silica OEL

- Current value is 0.025 mg/m$^3$
- Value is based on the 2006 ACGIH TLV
  - High risk for development of silicosis and lung cancer at the former OEL levels of 0.1 mg/m$^3$ and 0.05 mg/m$^3$
  - Even at 0.025 mg/m$^3$ there is an excess risk for silicosis well above that for the normal population
- Department not considering changes to the silica OEL at this time
Monitoring of Exposure

• Issue evaluated in 2010/2011

• Monitoring
  – Can be done, may need to modify the method by increasing volume of air collected

• Regulatory implications: need approval under Section 20(1)(h) of OHS Code
Adjustment of OEL

- 8-hour OEL is 0.025 mg/m$^3$
- For work shifts longer than 8 hours, OELs must be adjusted
- What does this mean?
  - For a 12 hour work shift, the OELs for quartz and cristobalite go down to 0.0125 mg/m$^3$
Is Adjustment Necessary?

• A weekly adjustment, such as the Quebec model, should be used rather than a daily adjustment – when the Quebec model is applied, there is typically little or no adjustment required.

• Where the biological half-life is less than three hours or more than 400 hours, adjustments to the OEL may not be necessary.
OEL Adjustment—Outcome

• Recommendation that the OHS Code be amended as follows:
  – A notation “3” (do not adjust) should be added to the substances interaction column in Table 2, Schedule 1 for crystalline silica.

• The department will, by policy, allow employers to follow this recommendation when assessing workplace exposure to silica until the legislation is amended.
Compliance with the OEL

• Can employers comply?
  – The answer to this depends on why the OEL is being exceeded and how exposure is controlled
## Variability of Exposure within Industries

<table>
<thead>
<tr>
<th>Company</th>
<th># Samples</th>
<th>Low (mg/m³)</th>
<th>High (mg/m³)</th>
<th>% Above OEL</th>
<th>% Above 8-hr OEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>0.033</td>
<td>1.0</td>
<td>100</td>
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<tr>
<td>2</td>
<td>12</td>
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<td>0.52</td>
<td>67</td>
<td>67</td>
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<td>3</td>
<td>13</td>
<td>0.017</td>
<td>0.064</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>0.015</td>
<td>1.0</td>
<td>75</td>
<td>63</td>
</tr>
<tr>
<td><strong>Earth Moving/Road Building</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8</td>
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<td>0.049</td>
<td>63</td>
<td>38</td>
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<td>17</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>0.0056</td>
<td>0.068</td>
<td>50</td>
<td>20</td>
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<tr>
<td><strong>Mining</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>ND</td>
<td>0.21</td>
<td>69</td>
<td>62</td>
</tr>
<tr>
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<td>13</td>
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<td>0.012</td>
<td>8</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>ND</td>
<td>0.064</td>
<td>62</td>
<td>54</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0.015</td>
<td>0.13</td>
<td>100</td>
<td>60</td>
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<tr>
<td>5</td>
<td>6</td>
<td>0.0059</td>
<td>0.054</td>
<td>67</td>
<td>33</td>
</tr>
</tbody>
</table>

ND Not Detected
Other Regulatory Issues
Compliance with Legislation

• Multi-faceted issue
  – Information from exposure monitoring project indicates that there are compliance issues
  – Awareness of hazard
  – Work practices/hygiene issues

• More work is needed to evaluate potential barriers to compliance and develop tools to assist employers and workers
“Restricted Area” Definition

• “An area of the work site where there is a reasonable chance that airborne concentrations of asbestos, silica, coal dust or lead exceeds or may exceed the occupational exposure limit for one or more of the substances”

• Most of the work sites assessed would be partly or entirely classified as restricted areas

• Definition of restricted area to be reviewed
Strategies to Improve Awareness
Improving Hazard Awareness

• Officer training program developed
• Silica page to be developed for website – should go live soon
• Silica poster
What is Next?
2012/2013 Activities

- Review of occupational disease data
- Phase III exposure monitoring in oil and gas and manufacturing
- Development of Alberta exposure database
- Internal training
- Development of tools, best practices, etc. to assist employers and workers – will need to work with Stakeholders
- Consider regulatory changes needed
Questions?