Airborne Particulate Exposures: The Environmental & Occupational Perspectives

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Background

- Elevated occupational / environmental dust exposures ongoing concern for sector
- Overexposure to particulates can result in illness or occupational disease
- Chronic exposures of particular concern: May not notice injurious health effects until it is too late
- Permanent or irreversible injury
  - E.g., pneumoconiosis, silicosis, lung fibrosis, COPD (chronic obstructive pulmonary disease), chronic bronchitis, diseases of the small airways, some evidence of cancer link & elevated crystalline silica exposures
- Need to comply with O & E regulatory requirements
Potential Dust Exposures

- Total dust (particles not otherwise specified—PNOS)
- Respirable dust (PNOS)
- Crystalline Silica (quartz & cristobalite)

Other potential constituents of dust:
- Mineral fibres
- Naturally-occurring asbestiform minerals

Constituents of focus in this presentation are total & respirable dust exposure as well as crystalline silica
Dust Definitions

- PNOS are particles that:
  - Are defined in provincial labour regulation (O.Reg.833/90 as amended)
  - Do not have a specific occupational exposure limit
  - Are poorly soluble or insoluble in water
  - Have low toxicity

- Dust:
  - Matter ranging in diameter up to 100 microns & generated through cutting, crushing, detonation, grinding, drilling, sawing and handling of matter (etc.)
  - Particles <10 microns in size classified as respirable; more hazardous as they can reach deep into lung (cannot see)
What is silica & how are you exposed?

- Most common mineral in earth’s crust
- Major component of sand, quartz, rock, & mineral ores
- Sand & granite contain large amounts of crystalline silica
- Crystalline silica is also contained in many concrete & masonry products, wallboard, plaster, tile, mortar, grout, gravel & roofing & siding (etc.)
- Exposure to crystalline silica dust occurs when silica-containing materials are ground, crushed, drilled, rubbed or cut (generally disturbed)
What is the main concern?

- Crystalline silica in respirable form becomes airborne & uncontrolled exposures occur over a long time
- Small particles travel deep into lung & deposit
- Over time, chronic (longterm) overexposures to respirable crystalline silica can lead to silicosis
- Crystalline silica is non-reactive & insoluble & body cannot break it down over time
- Crystalline structure has sharp edges making tiny cuts causing formation of fibrous scar tissue in lung
Silicosis

- Over time scar tissue interferes with oxygen & carbon dioxide exchange between lungs & circulatory system, & flexible expansion / contraction of lungs
- This condition known as *silicosis*
- In more severe cases can lead to incapacitation or death
- Severity of the disease is dependent upon dust concentration, amount of (percent) free silica in a given dust exposure, duration of the exposure & possibly the size of the particles
Chronic or Longterm exposures

- **Chronic exposures** are experienced by workers who work in dusty conditions & have continual exposure to small amounts of silica on a daily basis.

- Symptoms from this type of exposure may develop slowly during one’s career, often taking 15 to 20 or more years to manifest.
### Occupational Exposure Limits (OELs)
(O.Reg.833/90 as amended)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Time-Weighted Average (TWA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dust (PNOS)</td>
<td>10 mg/m³</td>
</tr>
<tr>
<td>Respirable Dust (PNOS)</td>
<td>3 mg/m³</td>
</tr>
<tr>
<td>Crystalline Silica (quartz)</td>
<td>0.1 mg/m³</td>
</tr>
<tr>
<td>Crystalline Silica (cristobalite)</td>
<td>0.05 mg/m³</td>
</tr>
</tbody>
</table>

**Note:** Current ACGIH TWA for crystalline silica is 0.025 mg/m³
Classified as suspected human carcinogen.
Potential Dust Sources of Concern

- Drilling
- Blasting
- Crushing
- Screening
- Roadways (vehicle movements)
- Loading / unloading materials
- Material transfer (in process)
- Transport
- Secondary sources (poor housekeeping)
- Other
Dust Controls

- **Engineering controls:**
  - Enclose at source
  - Enclose at worker such as booth or cab use
  - Use of machinery for material handling
  - Dust suppression & / or dust capture, etc.
  - Control along the path (re barriers)
  - Progressive rehabilitation

- **Administrative controls**
  - Limit time workers spend in dusty conditions
  - Change way work is performed
  - Training in controls & work measures / procedures
  - Roadway & stockpile maintenance
  - Stand upwind to dust sources
Prevention of Dust Generation & Controls

- Reduce drop height of material
- Control vehicle speed
- Control blasting
- Careful location of process equipment & stockpiles
- Enclosure & barrier use
  - Construction of windbreaks, buffer zones, plantings
  - Use of telescopic chutes, dust skirts, covers
- Suppression
  - Treat roadways & piles
- Capture
  - Dust collection on drill rigs & stationary process equipment
Further Controls

- Personal Protective Equipment
- Last resort or interim measure if other controls are not feasible (or to complement controls)
- Must be trained in respiratory protection & fit tested
- NIOSH-approved respiratory protection for the hazard (e.g., respirable crystalline silica requires high efficiency air particle filtration)
Workplace Exposure Monitoring

- Risk assessment, qualitative
- Personal air sampling to quantify dust & silica in air
- Longterm, full shift exposure
- Use NIOSH Methods & AIHA-approved laboratories for analysis
- Report back to workers
- Evaluate controls for effectiveness
- Recommend changes based on results of monitoring
- Monitor under different conditions, want to capture worst case
Industrial Hygiene Program

- Program with stated purpose, scope, responsibilities, measures & procedures, resources
- Training (hazard information, control comprehension / application)
- Engineering & Administrative Controls
- Personal Protective Equipment
- Worker Exposure Assessment
  - Qualitative & Quantitative
  - Control Evaluation
- Medical Monitoring (required for silica control programs)
- Record keeping
Industrial Hygiene Program (cont’d)

- Identify a person responsible to oversee program
- Preliminary dust exposure assessment to identify potentially problematic dust exposures
- Identify suitable dust control measures
- Select, provide & maintain respiratory protection for interim / short term use, if necessary
- Identify dust control areas
- Provide orientation & ongoing training to workers
- Maintain records in an easily understood format & available for inspection (including work site conditions & jobs performed)
Resources

- WSIB
  - Silica documents
- CCOHS
- Ontario Ministry of Labour
  - Silica Guideline
- ACGIH
  - TLV / BEI Booklet & Documentation
Environmental Perspective

- In Ontario, fugitive dust emissions are regulated through various Acts and Regulations.
- Federally, reporting requirements under National Pollutant Release Inventory (NPRI) – *data publically available*.

**Ontario Regulatory Requirements (Fugitive Dust)**

- Aggregate Resources Act (ARA)
- Environmental Protection Act (EPA)
- Environmental Compliance Approvals (ECA)
- Opacity Requirements/Spills
- Adverse Effects
Environmental Compliance Approvals

- Dust emissions regulated under O.Reg.419/05 (point and fugitive sources)
- All facilities must obtain an Environmental Compliance Approval (ECA) for operations at the site
- Compliance determined through dispersion modelling assessment of significant sources, documented in Emission Summary and Dispersion Modelling Report (ESDM)
- Guidance allows OSSGA members to exclude fugitive dust sources (roads and storage piles) if a BMPP is in place
## Current Environmental Limits
(O.Reg.419/05 as amended, AAQCs)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>½ Hour POI Standard/Guideline</th>
<th>24-Hour Standard/AAQC</th>
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<tbody>
<tr>
<td>Suspended Particulate Matter (SPM)</td>
<td>100 µg/m³(G)</td>
<td>120 µg/m³(S)</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>—</td>
<td>50 µg/m³(G)</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>—</td>
<td>25 µg/m³*G(G)</td>
</tr>
<tr>
<td>Silica – respirable (&lt; 10 µm diameter), quartz</td>
<td>15 µg/m³(G)</td>
<td>5 µg/m³(G)</td>
</tr>
<tr>
<td>Silica – respirable (&lt; 10 µm diameter), cristobalite</td>
<td>15 µg/m³(G)</td>
<td>5 µg/m³(G)</td>
</tr>
<tr>
<td>Silica – respirable (&lt; 10 µm diameter), tridymite</td>
<td>15 µg/m³(G)</td>
<td>5 µg/m³(G)</td>
</tr>
</tbody>
</table>

*Single facility emission level
(G) = guideline
(S) = Standard
For ECAs:
- OSSGA Facilities must comply with Schedule 3 standards using advanced dispersion models by February 1, 2020
- Can submit “speed-up request”
- Site specific requests for speciated SPM (e.g. silica) are on the rise
  - The higher the PM$_{10}$ impact, the lower % silica can be present in the stone to comply with the silica standard

<table>
<thead>
<tr>
<th>Modelled PM$_{10}$ Concentration (µg/m³)</th>
<th>Allowable Silica Levels (24-Hour Basis)</th>
<th>Allowable Silica Levels (1/2-Hour Basis)</th>
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<tbody>
<tr>
<td>75</td>
<td>7%</td>
<td>20%</td>
</tr>
<tr>
<td>50</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>25</td>
<td>20%</td>
<td>60%</td>
</tr>
<tr>
<td>10</td>
<td>50%</td>
<td>100%</td>
</tr>
</tbody>
</table>
The Limits

- For non-ECA assessments (e.g. health impact assessments, EAs)
  - All sources must be included regardless of BMPP
  - Advance models are typically used

Best Management Practices Plan (BMPP) for dust reduces potential for non-compliance situations
Required BMPP Elements

Guidance on BMPPs is provided in ESDM Procedure Document

Requirements:

1. **Identify sources of dust**
2. **Review composition and size range of dust (health risk)**
3. **Describe how each dust emissions will be controlled from each source**
4. **Implementation schedule for BMPP, including employee training**
5. **Describe inspection and maintenance procedures**
6. **Describe methods of monitoring and record keeping to verify compliance with the plan**

**MOE is currently updating BMP Guidance**
Successful BMPPs

- A successful BMPP goes beyond MOE required elements
- Must integrate principles of continuous improvement

Why do you need a BMPP?
- Stringent POI/AAQC limits require management of fugitive dust
- To maintain positive community relations through demonstrating proactive management of dust
- Documentation of actions
- Tool to provide better allocation of capital resources

How to Make it work
- Use principles of continuous improvement
- Integrate dust control as part of company culture through education/training at all levels
- Make it a living document
**Additional Elements for Success**

- **Source Ranking**
  - Rank based on emission rate *and* off-property impacts

- **Use a Fugitive Dust Risk Management Tool**
  - Provides risk ranking to sources
  - Allows analysis of various control options
  - Aids in decision making regarding resource allocation to control fugitive dust

- **Sample tool can be found at:**
  - [http://www.miningexcellence.ca/knowledge/reports/Fugitive_Dust/](http://www.miningexcellence.ca/knowledge/reports/Fugitive_Dust/)
Typical BMPP Framework

Mission Statement

Risk Assessment

Objectives & Targets

Dust Improvement Plan

Monitoring and Review

Reporting

Regulatory & Community Input

Tracking

Regulatory Input

Continuous Improvement

Key to Processes

- Planning
- Checking
- Consultation
- Planning

Improvements to Operational Procedures

Improvements Through Incident Reporting

Improvements made to Training
Dust Control Measures

- Three phased approach:
  - Select appropriate **Preventative Measures** - what can you do to prevent the dust?
  - **Reactive Measures** - what do you require in order to accommodate immediate circumstances, unanticipated or expected?
  - **Monitoring and reporting** - what do you have to document and monitor to determine if the BMPP is working?
Opacity/Spills

- Opacity is Regulated under Section 46 of O.Reg 419/05
  - No person shall cause or permit an emission into the air that, during a period of six consecutive minutes, obstructs the passage of light at any point by an average of more than 20 percent

- For fugitive sources this is measured through visible observation:
  - Method 9: Point Sources
  - Method 22: Fugitive Sources

- If an exceedence occurs, notification to MOE required within 24-hours
- If a spill occurs (to air or water) MOE must also be notified
Adverse Effects

- Regulated under Section 45 of O.Reg 419/05

  No person shall cause or permit to be caused the emission of any air contaminant to such extent or degree as may,

  (a) cause discomfort to persons;
  (b) cause loss of enjoyment of normal use of property;
  (c) interfere with normal conduct of business; or
  (d) cause damage to property.

- Often referred to as the “nuisance clause”

- A comprehensive BMPP is the best defence to demonstrate due diligence in controlling fugitive dust
Benefits of Dust Control

- Reduced occupational and community exposures to dust & crystalline silica
- Healthy workforce
- Reduced WSIB costs
- Good Neighbour

Continuous Improvement in controlling Fugitive Dust

Compliance with Occupational Exposure Limits

Compliance with POI/AAQC Limits, Opacity Levels

Positive Community Perception

LICENCE TO OPERATE

BMPP
Questions & Answers