Emerging Respirable Dust Control Technologies for Continuous Mining Sections

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Presentation Outline

• Quartz in underground coal mine samples
• Roof bolter control technologies
  – dry scrubber
  – wet collector box
• Shuttle car control technologies
  – canopy air curtain
• Best Practices handbook
### MSHA inspector samples analyzed for quartz
(January 1, 2000 – July 31, 2014)

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Occupation Code(s)</th>
<th>Total number of samples</th>
<th>Number with &gt; 5% quartz</th>
<th>Percent with &gt; 5% quartz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof bolter operator</td>
<td>012, 014, 019, 046, 048</td>
<td>2,458</td>
<td>1,510</td>
<td>61.4</td>
</tr>
<tr>
<td>Designated Area (DA)*</td>
<td>Entity Number 9xxx</td>
<td>15,822</td>
<td>11,965</td>
<td>75.6</td>
</tr>
<tr>
<td>Roof bolter operator (all)</td>
<td>RBO + DA</td>
<td>18,280</td>
<td>13,475</td>
<td>73.7</td>
</tr>
<tr>
<td>Continuous miner operator</td>
<td>036</td>
<td>29,239</td>
<td>11,726</td>
<td>40.1</td>
</tr>
<tr>
<td>Jacksetter</td>
<td>041</td>
<td>717</td>
<td>263</td>
<td>36.7</td>
</tr>
<tr>
<td>Tailgate shearer operator</td>
<td>044</td>
<td>1,852</td>
<td>434</td>
<td>23.4</td>
</tr>
</tbody>
</table>

* Per MSHA, DA samples with an entity number beginning with a 9 represents a roof bolter operator sample

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Concern: roof bolter operators’ dust exposure when downwind of continuous miner

Research goal: provide filtered air to bolter operators

Awarded contract to J.H. Fletcher to develop a stand-alone dust scrubber.

Test unit specifications:
• remote controlled
• crawler trammed
• 30 hp vane axial fan with VFD control
• 3,000 to 9,000 cfm capacity
• 4 ft wide x 4 ft high x 16 ft long
• dual 28-inch O.D. disposable filters rated at 99% efficiency for 2 µm particles
Roof bolter control technologies – dry scrubber

Lab tests at PMRD dust gallery
- scrubber desired airflow set to 3,000 and 9,000 cfm
- measured airflow = 2,982 and 8,868 cfm
- after 8 hours of dust testing, airflow = 8,500 cfm
- forced all dust-laden airflow through the scrubber
- respirable dust reduction > 95% at each airflow

Dust sampling:
- upwind
- downwind
Roof bolter control technologies – dry scrubber

UG test results
• testing conducted on right side of two super sections
• blowing face ventilation with flooded-bed scrubber on CM
• dry scrubber placed in last open crosscut at last entry, 90° discharge adapter utilized
• scrubber collection efficiency similar to lab performance – mid 90s
• face dust levels reduced by 50%
Roof bolter control technologies – dry scrubber

Underground testing of dry scrubber and potential applications

DS1 – location of dry scrubber for underground testing
S – sampling locations used to determine dust reduction at face of 50%
DS2 – sampling location to reduce dust for roof bolter operators
DS3 – sampling location to reduce dust for everyone downwind of continuous miner
Roof bolter control technologies – wet collector box

Concern: roof bolter operators’ dust exposure when cleaning dust collector box

Short duration dust exposure event but:
- released close to operator’s breathing zone
- often high silica content
- occurs multiple times per shift
- contaminates clothing – rerelease of dust

Research goal: reduce dust exposure during collector box cleaning

Potential solutions
- dust collector bags
- wet collector box
Roof bolter control technologies – wet collector box

**Wet collector box**

- utilizes same vacuum system to pull dust to collector box
- remove pre-cleaner (outside of the box) and cyclone (inside the box)
- install drain hole, rotary valve at drain, angled side walls
- install water spray directed at dust inlet
- spray operated at 0.5 – 2.0 gpm and 100 psi during testing
- rotary valve was activated with control lever at operator’s work position to drain sludge from box
- water resistant filter substituted for normal cartridge filter
- tapped into CM water line to supply water to bolter
Roof bolter control technologies – wet collector box

Underground testing

- compared wet collector (left side) and dry collector (right side)
- collector bags were not used on dry side
- sampled 3 shifts with a total of over 300 bolts installed
- bolter operators wore dust sampling vest during box clean out
- dust exposure during wet box cleaning was 80% lower than dry box cleaning, while average quartz in the sampled dust was 7.4% for the dry box and 0.0 for the wet box
- collector box should be opened and remaining material hosed out after bolting a face
- bottom photo shows more than usual material remaining in wet box... operator did not fully open the discharge valve
Shuttle car control technologies – canopy air curtain

Concern: shuttle car operators are in return air when blowing face ventilation is used

NIOSH sampling showed average of 0.85 mg/m³ higher dust levels and up to 2.0 mg/m³ with blowing ventilation

Research goal: adapt canopy air curtain technology from roof bolters for use on shuttle cars

Awarded contract to Marshall University and J.H. Fletcher
Shuttle car control technologies – canopy air curtain

Laboratory testing at PMRD dust gallery

- 18 x 18 x 2.5-inch air curtain with 4208 discharge holes (3/32-inch in diameter)
- internal honeycomb flow straightener to provide more uniform flow
- powered by hydraulically driven blower
- evaluated dust levels in simulated center and end drive cabs
- at 120 fpm entry air velocity, 74% dust reduction for center drive cab and 83% reduction for end drive cab
Shuttle car control technologies – canopy air curtain

Underground testing on super section

- blowing face ventilation with scrubber on CM
- scrubber discharge on same side as ram car operators
- air curtain mounted under the canopy on a ram car
- blower and MERV 11 filter temporarily positioned on top of ram car
- provided airflow of over 300 cfm through air curtain

MERV 11: 65 – 79% efficient on 1 – 3 µm particles and ≥ 85% on 3 – 10 µm particles
Shuttle car control technologies – canopy air curtain

Underground test results
• compare dust levels outside of cab to ram car operator dust levels
• light-scattering dust sampling (2 seconds) corrected with gravimetric references
• time study conducted at continuous miner and feeder to define operating segments
Updating Best Practices handbook
Thank you.

Questions?

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