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)

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

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

Data source: MSHA Data Set – 16. Quartz Samples https://arlweb.msha.gov/OpenGovernmentData/OGIMSHA.asp

Roof bolter control technologies – dry scrubber

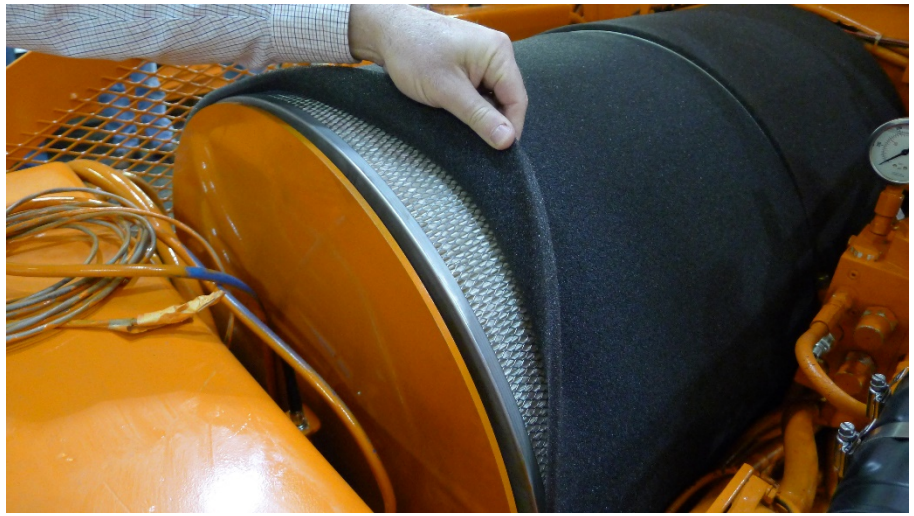
Concern: roof bolter operators' dust exposure when downwind of continuous miner

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

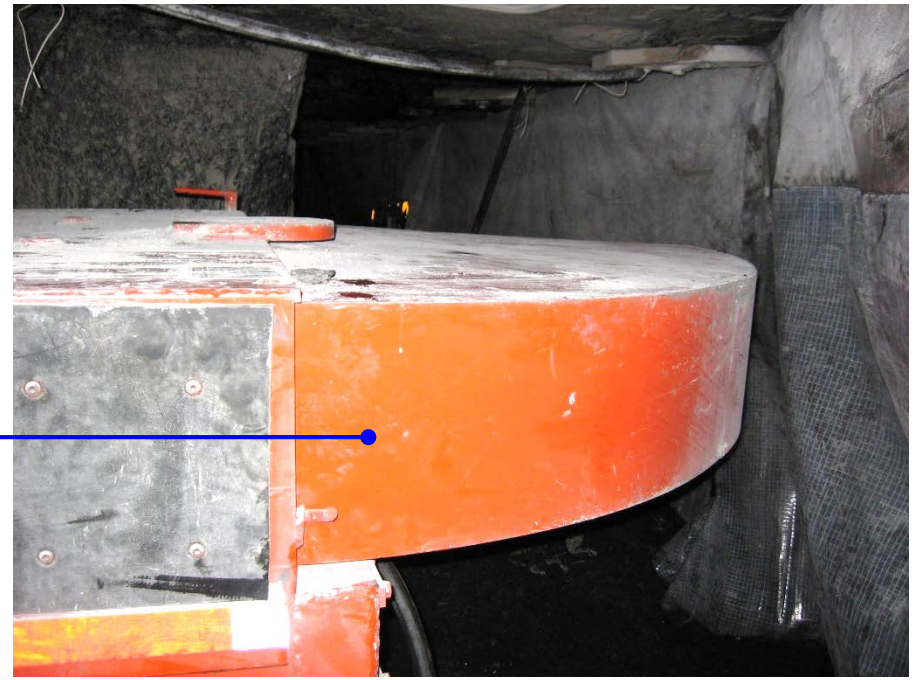
- scrubber desired airflow set to 3,000 and 9,000 cfm
- measured airflow = 2,982 and 8,868 cfm
- after 8 hours of dust testing, airflow = 8,500 cfm
- forced all dust-laden airflow through the scrubber
- respirable dust reduction > 95% at each airflow

Dust sampling:
upwind
downwind

Roof bolter control technologies – dry scrubber

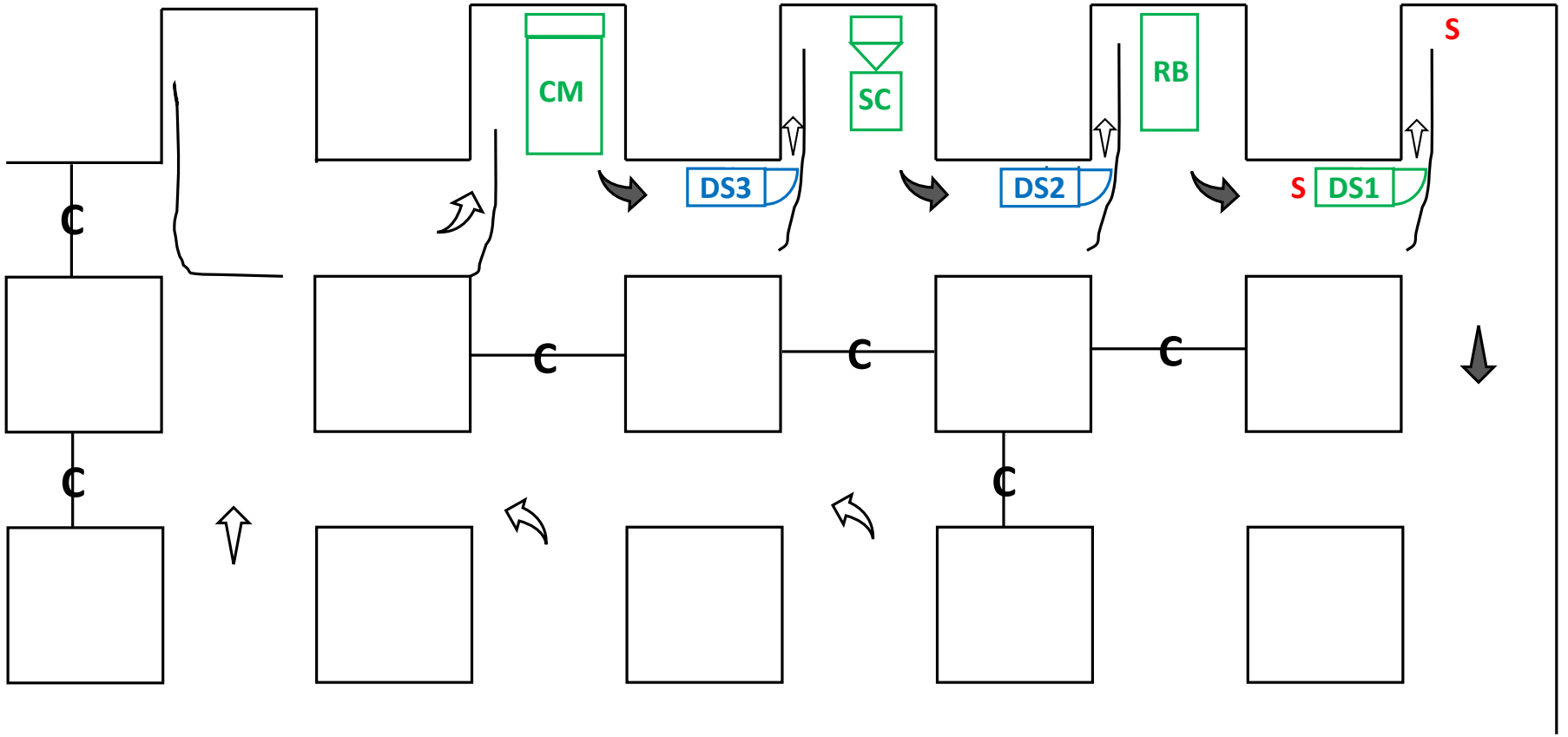
UG test results

- 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:

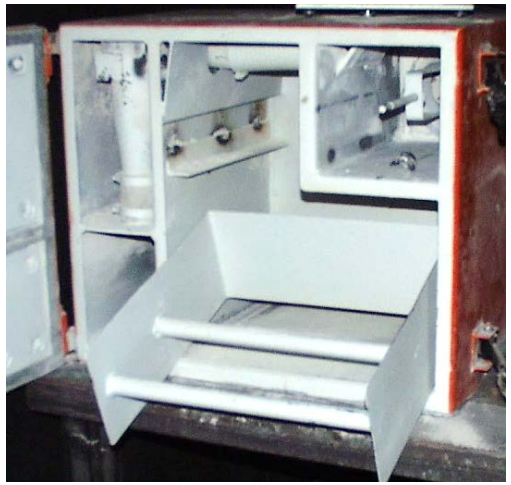
- released close to operator's breathing zone
- often high silica content
- occurs multiple times per shift
- contaminates clothing – rerelease of dust

Research goal: reduce dust exposure during collector box cleaning

Potential solutions

- dust collector bags
- wet collector box

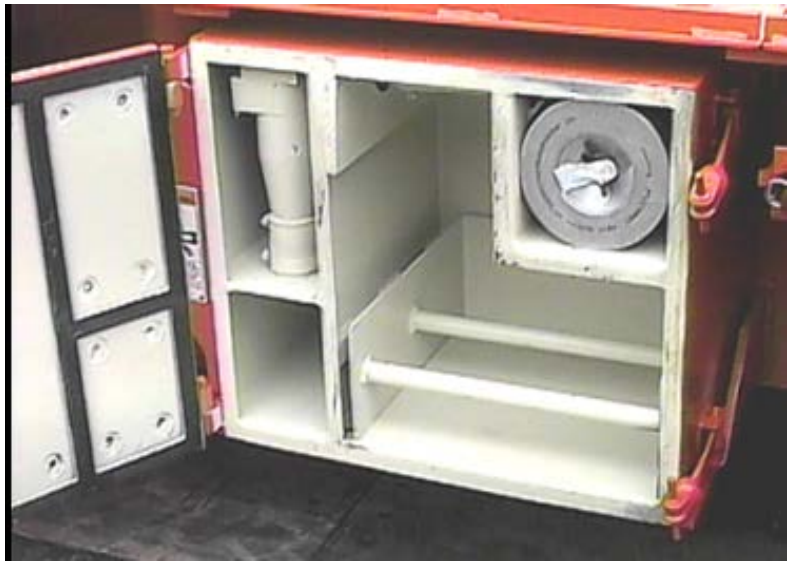


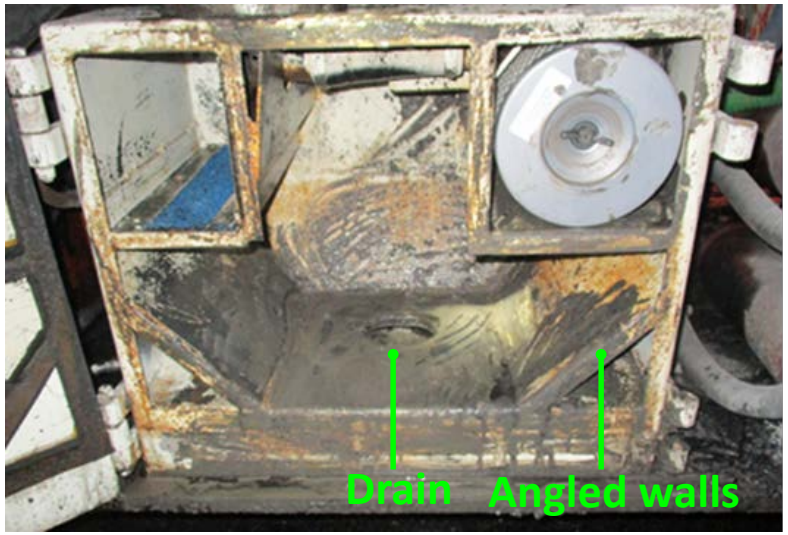



Roof bolter control technologies – wet collector box

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

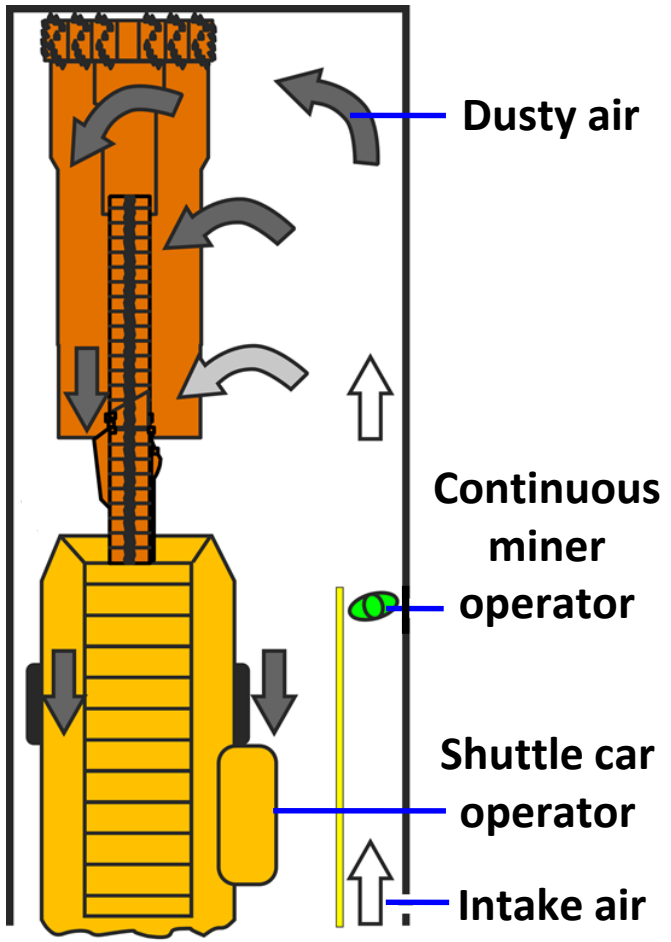
Shuttle car control technologies – canopy air curtain

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

NIOSH sampling showed average of 0.85 mg/m^3 higher dust levels and up to 2.0 mg/m^3 with blowing ventilation

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

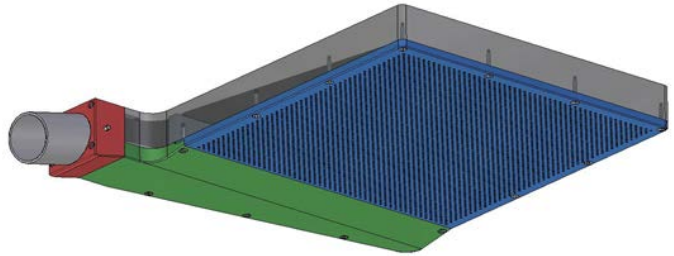
Awarded contract to Marshall University and J.H. Fletcher

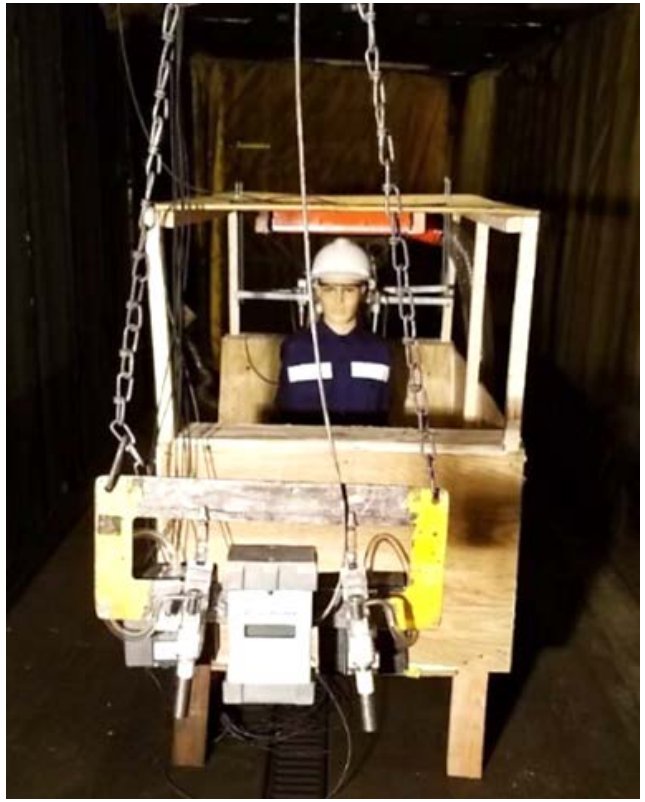


Shuttle car control technologies – canopy air curtain

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

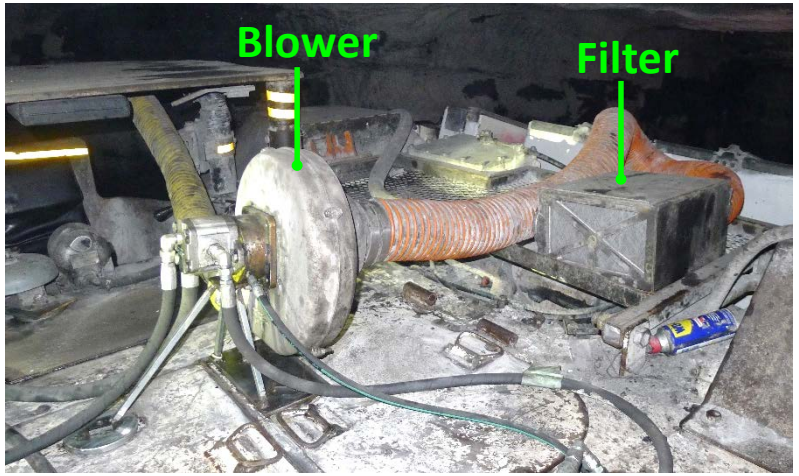




Shuttle car control technologies – canopy air curtain

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

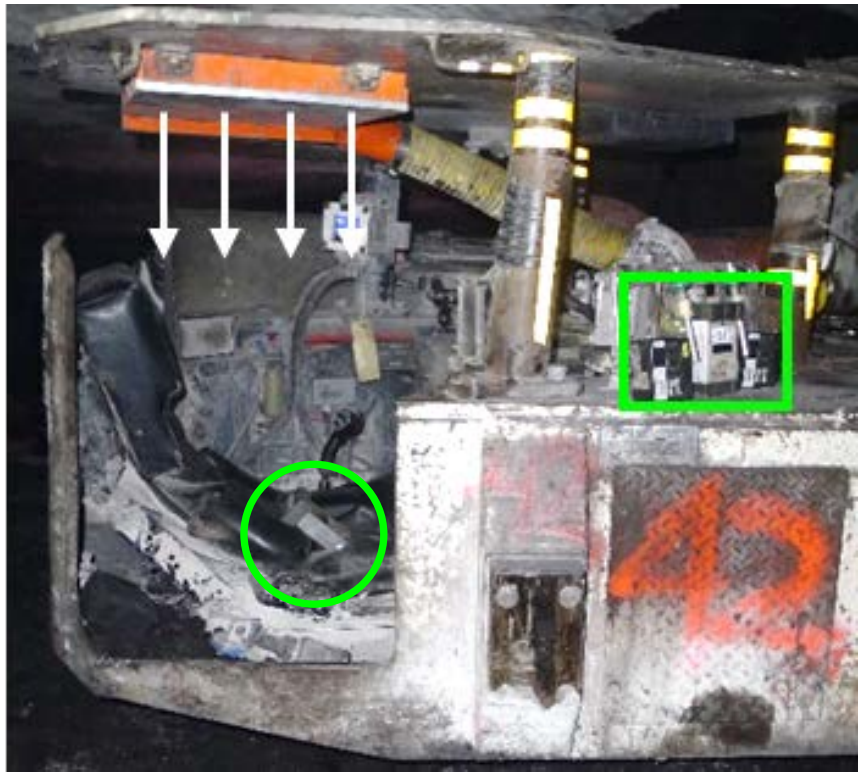


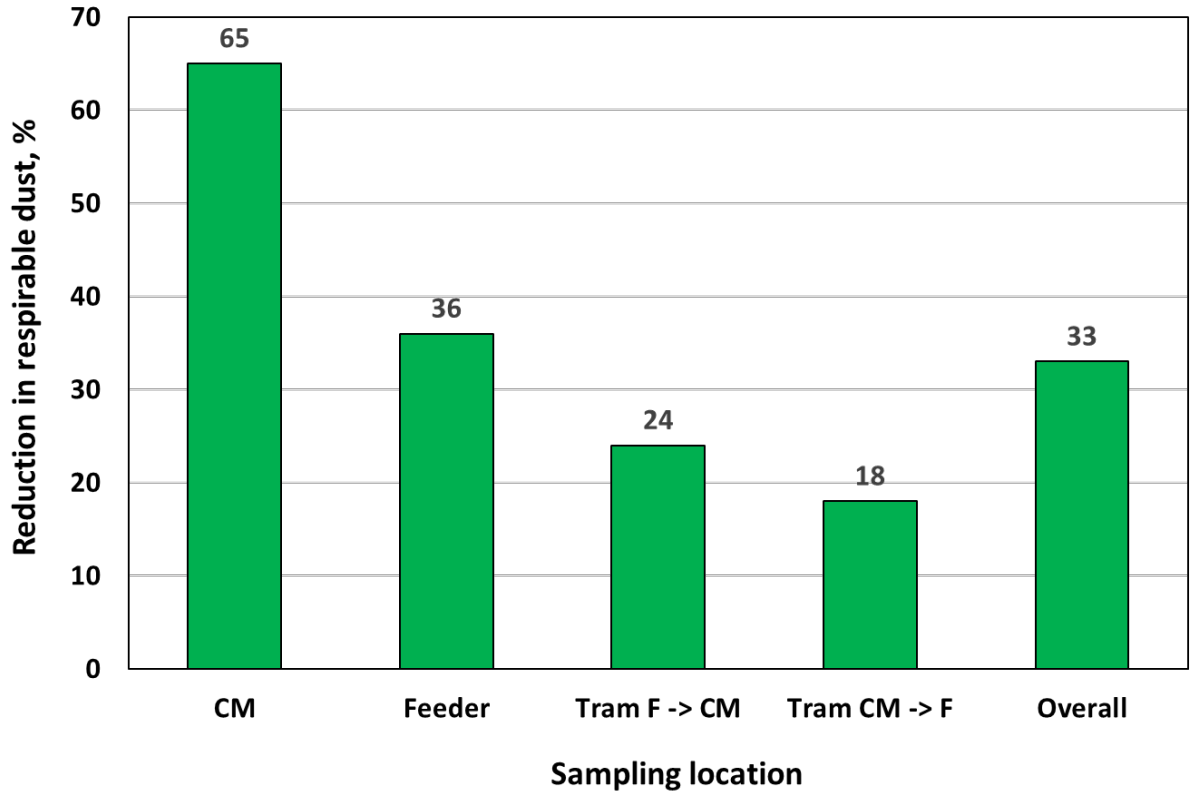
MERV 11: 65 – 79% efficient on 1 – 3 µm particles and ≥ 85% on 3 – 10 µm particles

Shuttle car control technologies – canopy air curtain

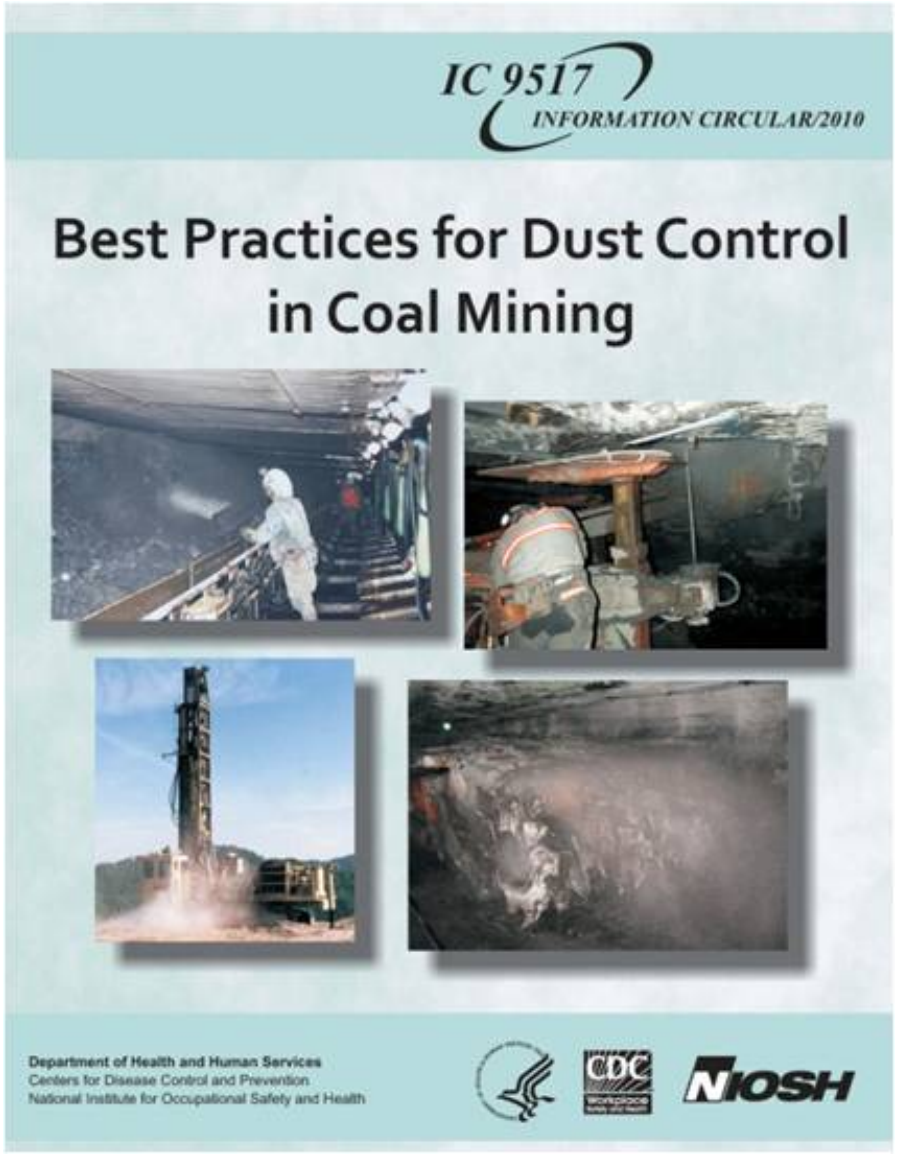
Underground test results

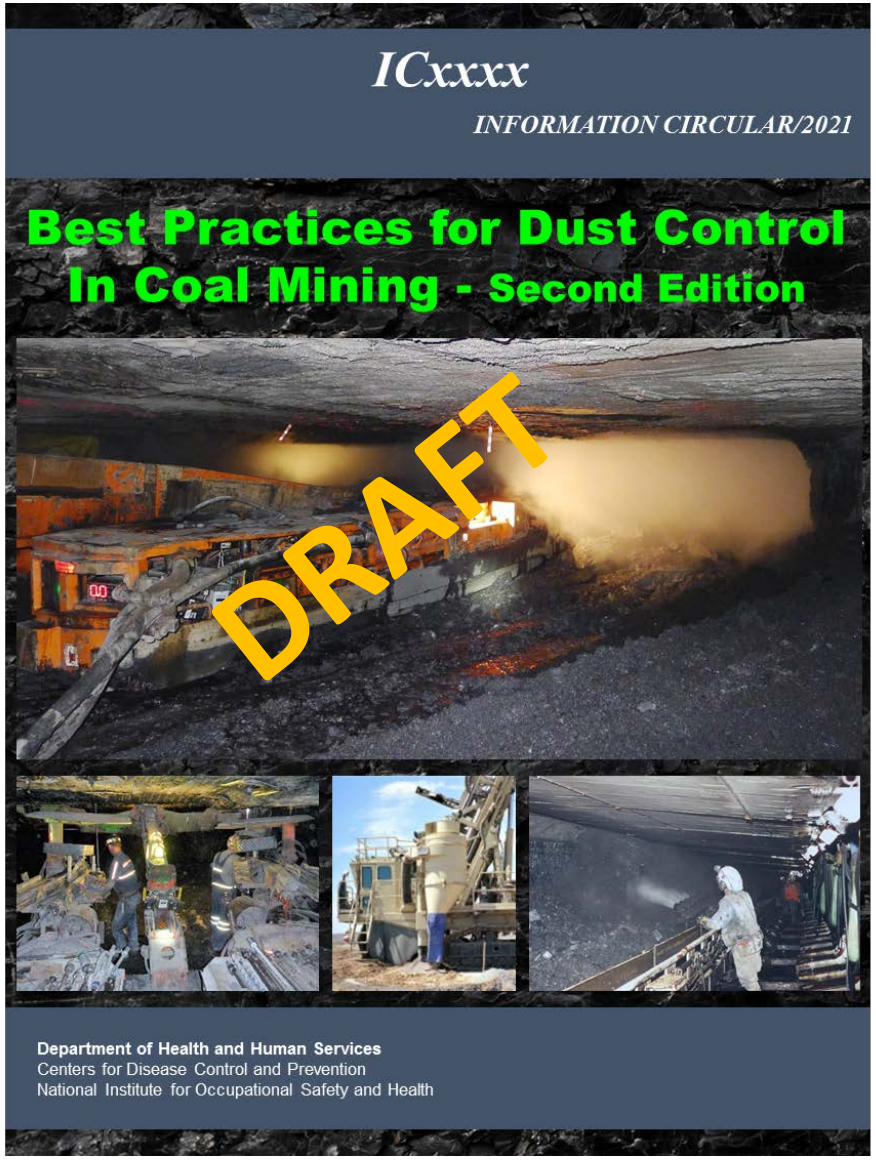
- compare dust levels outside of cab to ram car operator dust levels
- light-scattering dust sampling (2 seconds) corrected with gravimetric references
- time study conducted at continuous miner and feeder to define operating segments





Updating Best Practices handbook





Thank you.

Questions?

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