Escalation of Black Lung in the US and a Systematic Approach for Controlling Respirable Dust

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Minerals Council South Africa
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Presentation topics

- coal workers pneumoconiosis (CWP)
- impact on mine workers in US
- a systematic approach for controlling respirable dust
- importance of dust control maintenance
- sources of additional information

CWP or “black lung”

- results from inhalation of respirable coal mine dust (<10 µm in size)
- damages/destroys lung tissue
- simple and complicated forms (Progressive massive fibrosis – PMF)
- International Labour Office (ILO) standards are used to determine severity
- **cannot be cured, so preventing respirable dust exposure is the key**

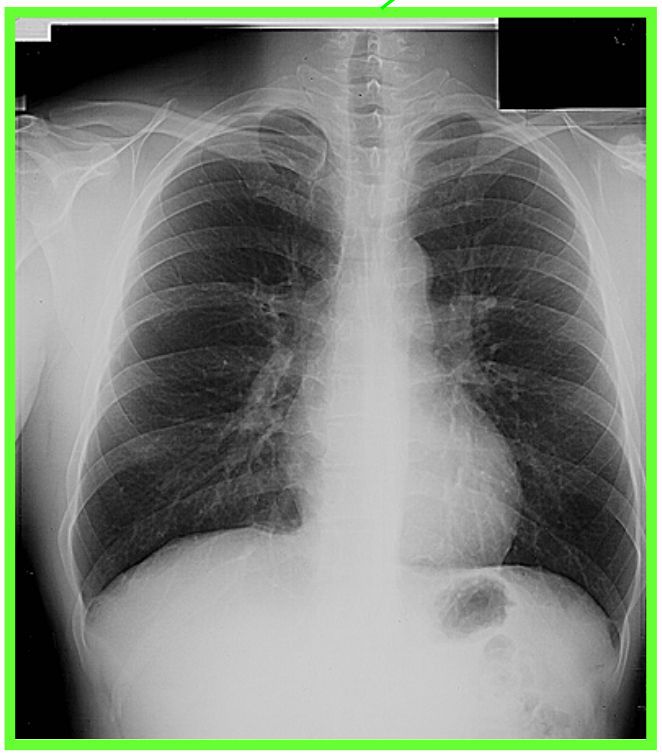
Lung sections

ILO classification of radiographs

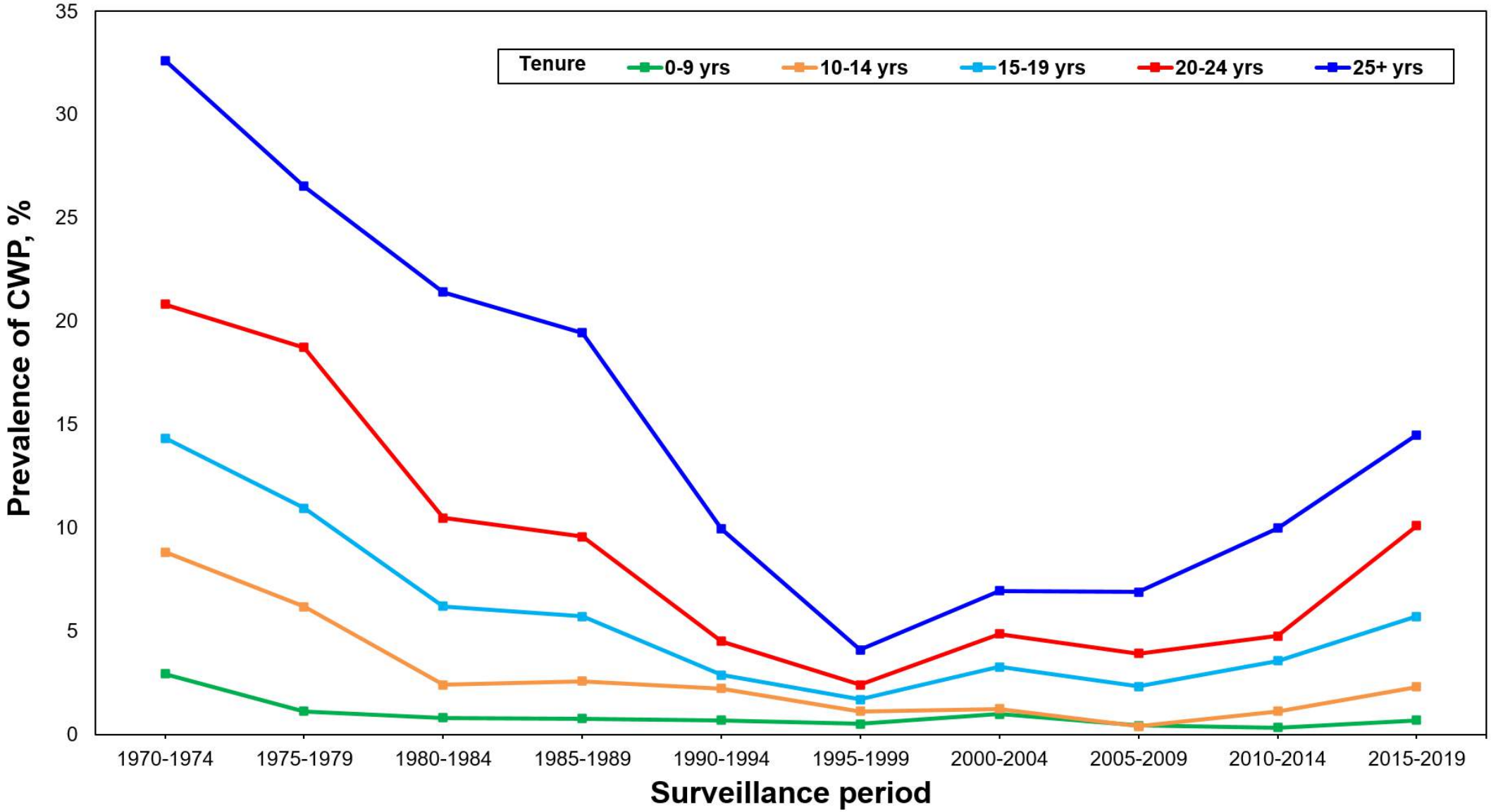
ILO classification scale

|---------- simple CWP ----------| |----- PMF -----|

0/- | 0/0 | 0/1 | 1/0 | 1/1 | 1/2 | 2/1 | 2/2 | 2/3 | 3/2 | 3/3 | 3/+ | A | B | C



Percentage of miners examined by NIOSH with CWP Category 1 or greater by tenure in mining



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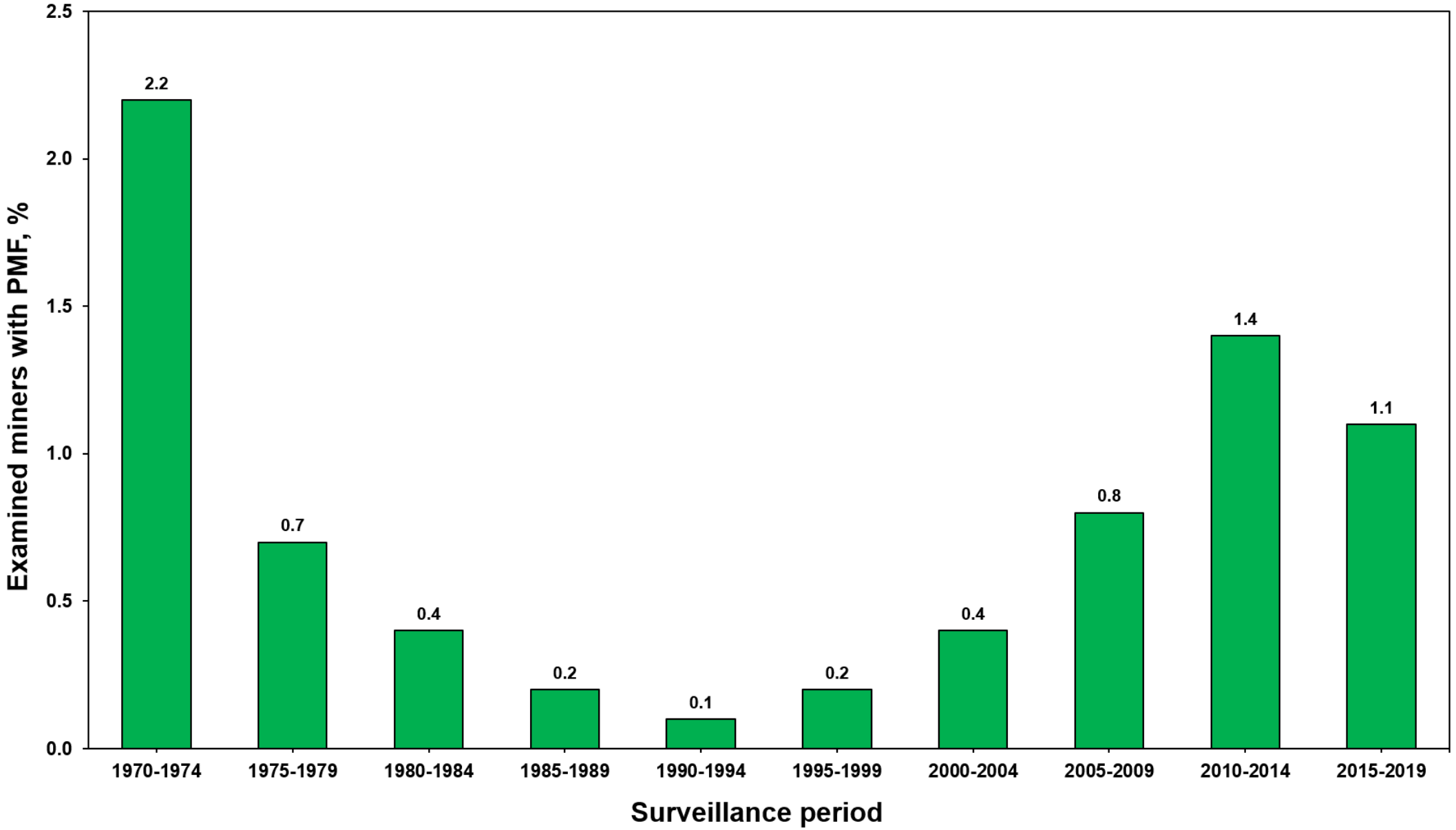

Dust control approach

1. **minimize the quantity of respirable dust generated**
   a. efficient cutting *(drum and bit design, bit sharpness, cutting method)*
2. **prevent respirable dust from getting airborne**
   a. wet dust at generation point *(water sprays, foam)*
   b. enclose dust sources *(stageloader, belt transfer, drill shroud)*
3. **remove respirable dust from the ventilating air**
   a. flooded-bed scrubbers *(continuous miners, stageloaders)*
   b. dry dust collectors *(roof bolters, air curtains)*
   c. water sprays *(nozzle type, location, operating parameters)*
4. **dilute remaining airborne respirable dust**
   a. ventilation quantity
   b. distance from source *(shield advance, CM cuts)*
5. **prevent respirable dust from reaching workers' breathing zones**
   a. ventilation velocity and direction
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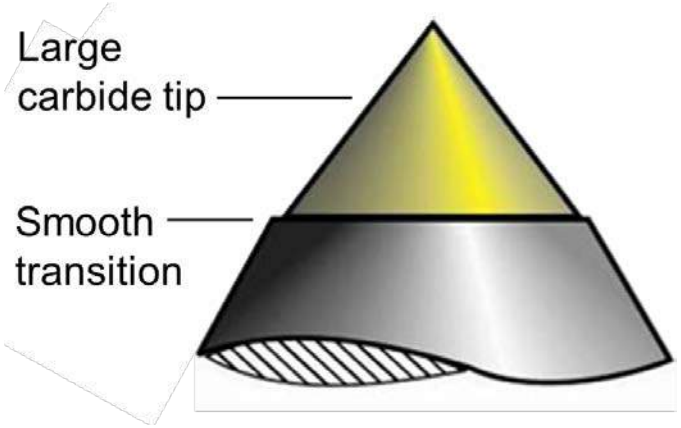
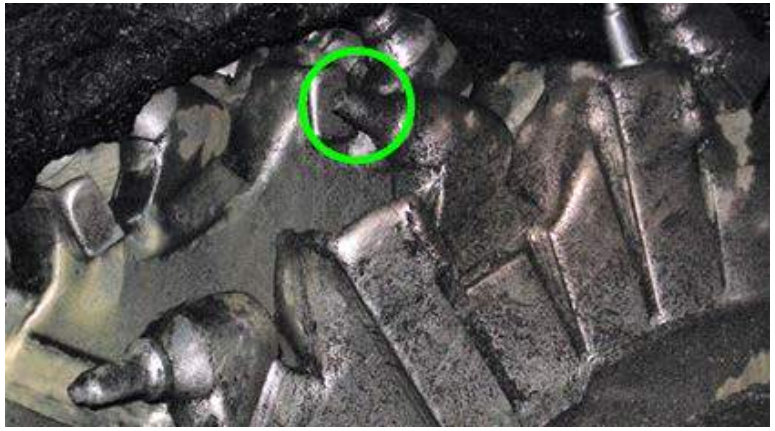
6. **stress importance of maintaining dust controls**

Efficient cutting reduces respirable dust generation

Bit selection

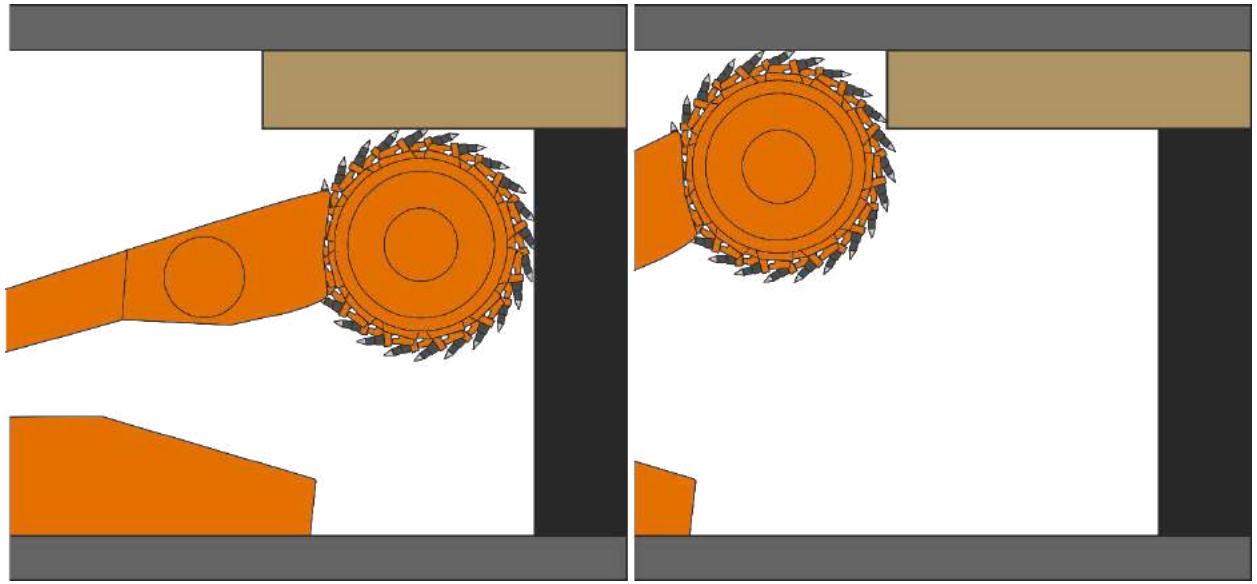


Replace worn bits



Cutting drum design

Undercut roof rock



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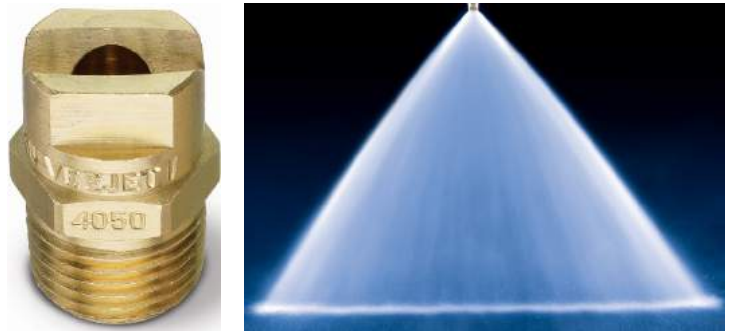
Impact of water sprays for dust control

- suppression (S) – prevent dust from getting airborne
- capture (C) – remove dust from ventilating air
- redirect airflow (R) – direct dust away from workers

Hollow cone (C, R)

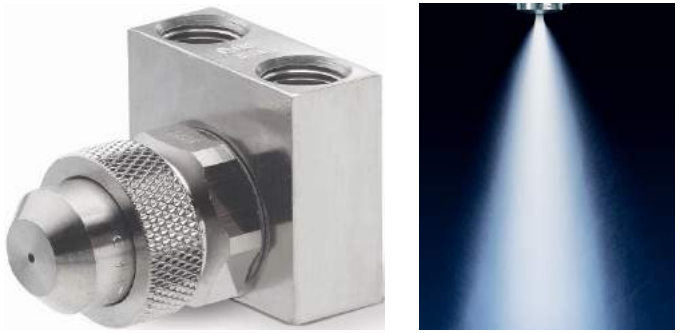
Full cone (S)

Flat fan (S, R)

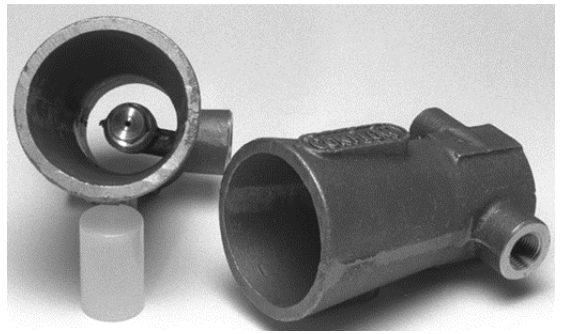


Solid stream (S)

Air atomizing (C)



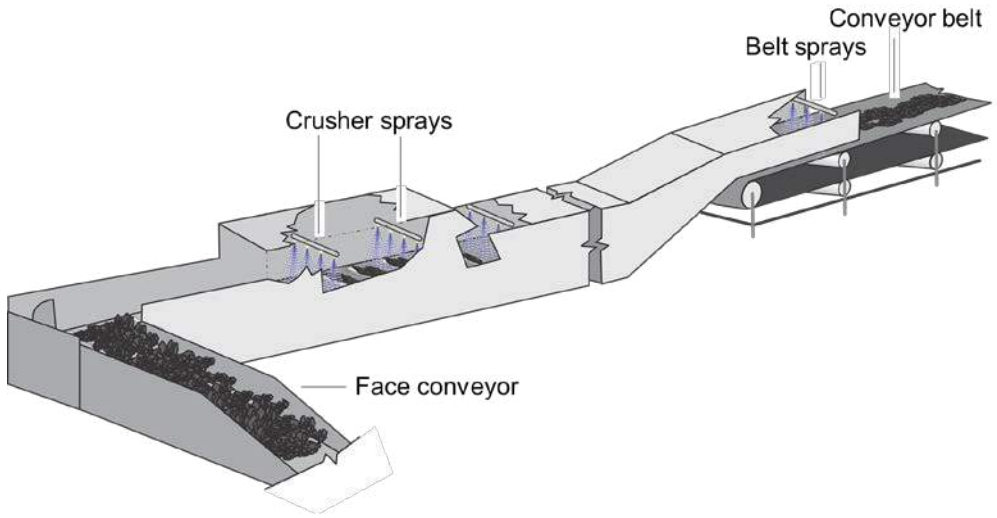
Venturi (C, R)

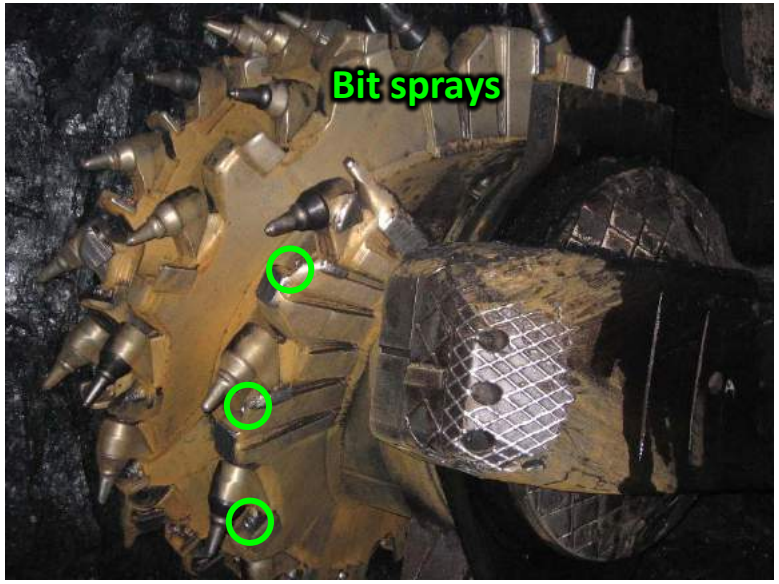


Photos by Spraying Systems Co., Lechler, and Conflow

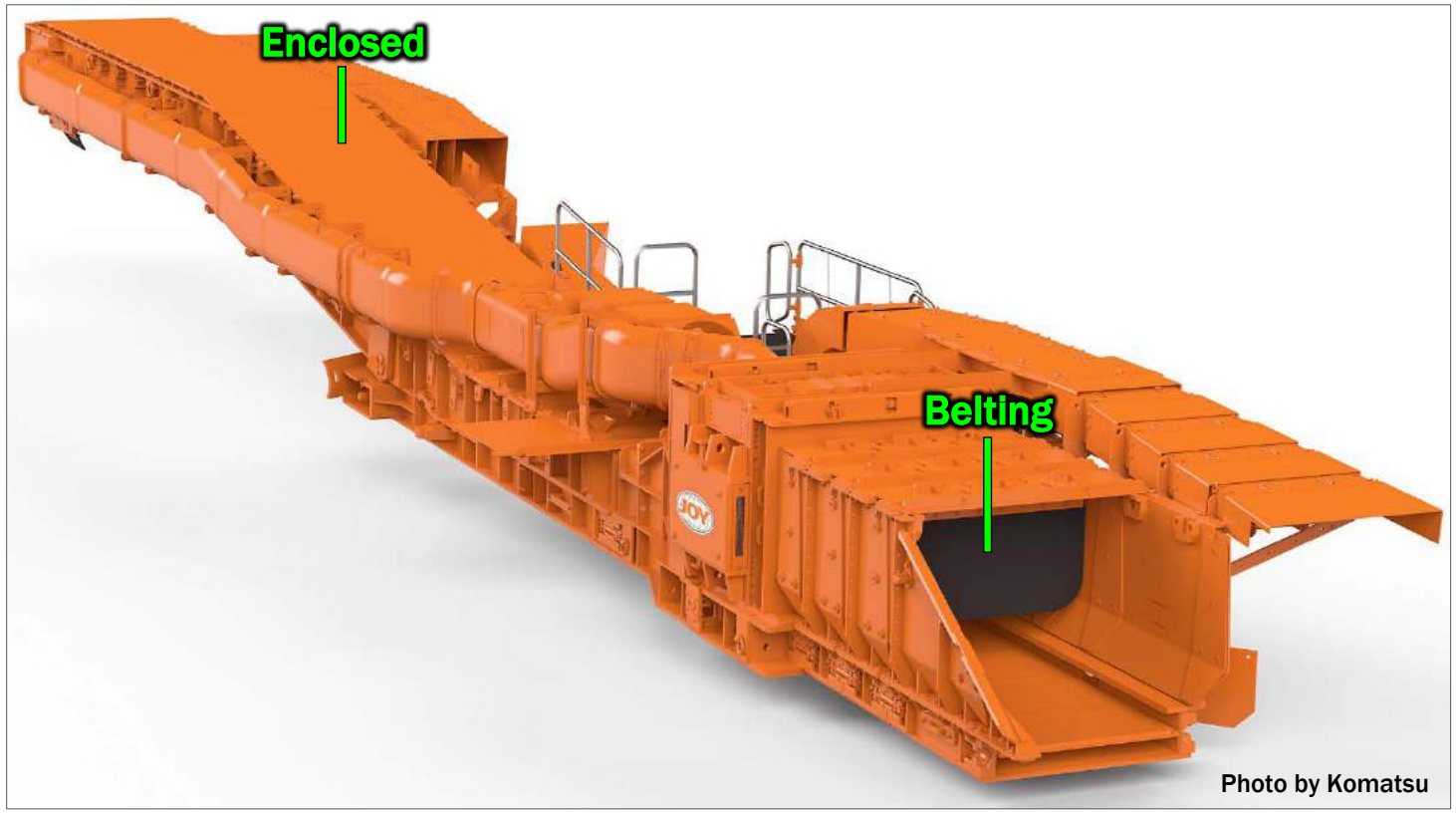
Water sprays for suppressing dust

- water quantity and full coverage are key
- place sprays near dust generating source
- full cone, flat fan, or solid stream sprays





Enclose the dust source



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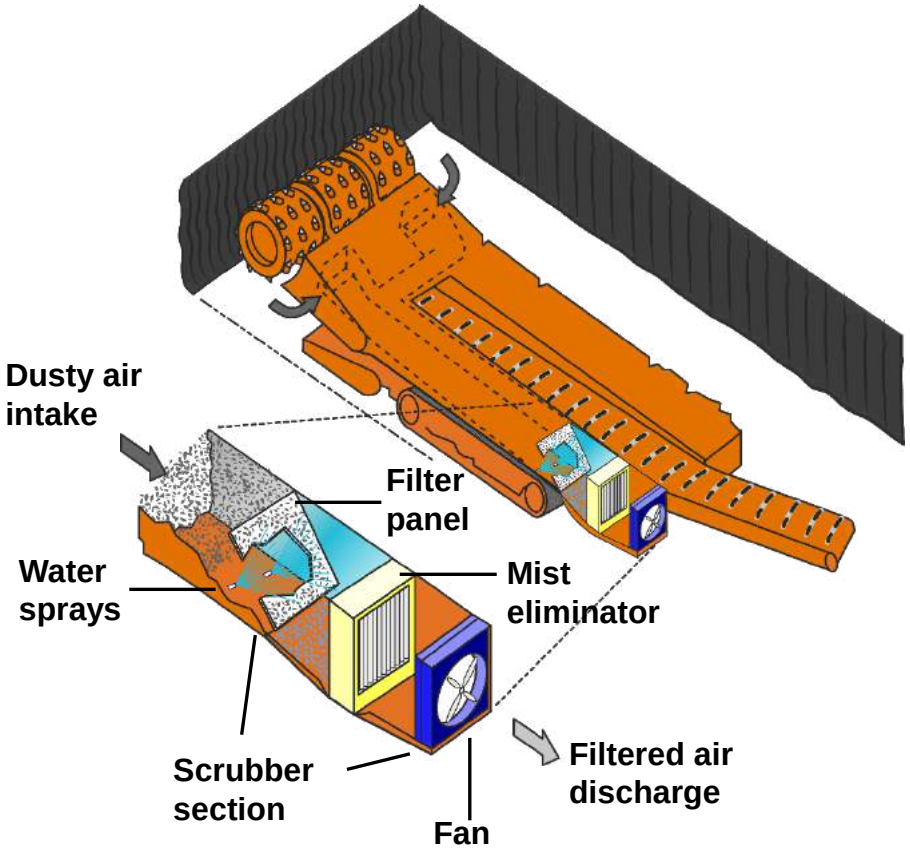
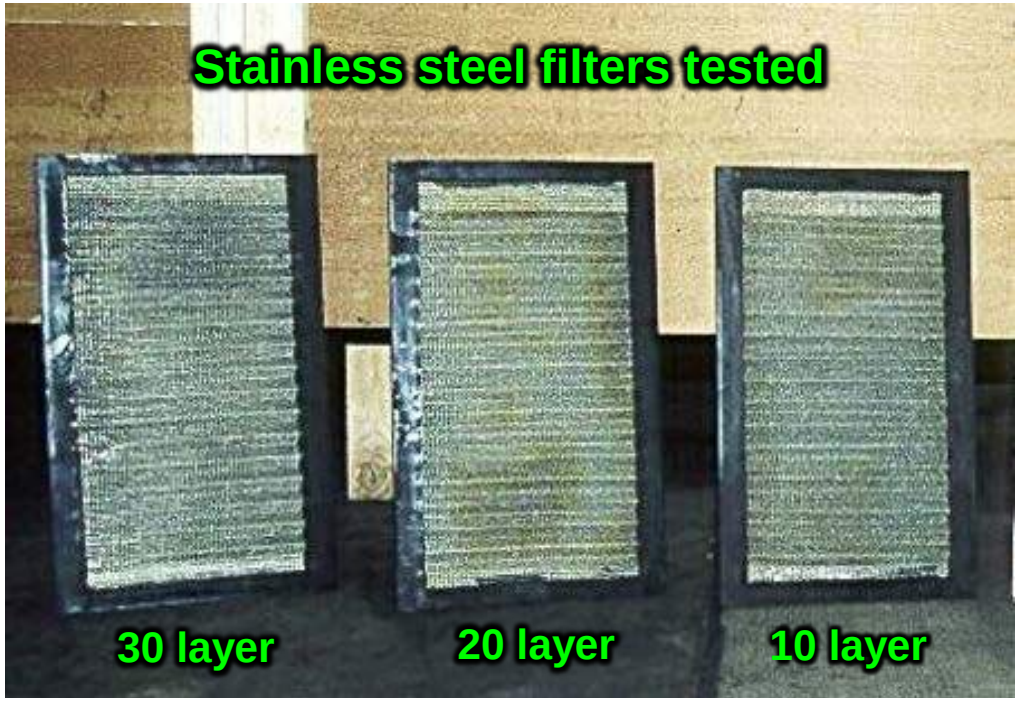
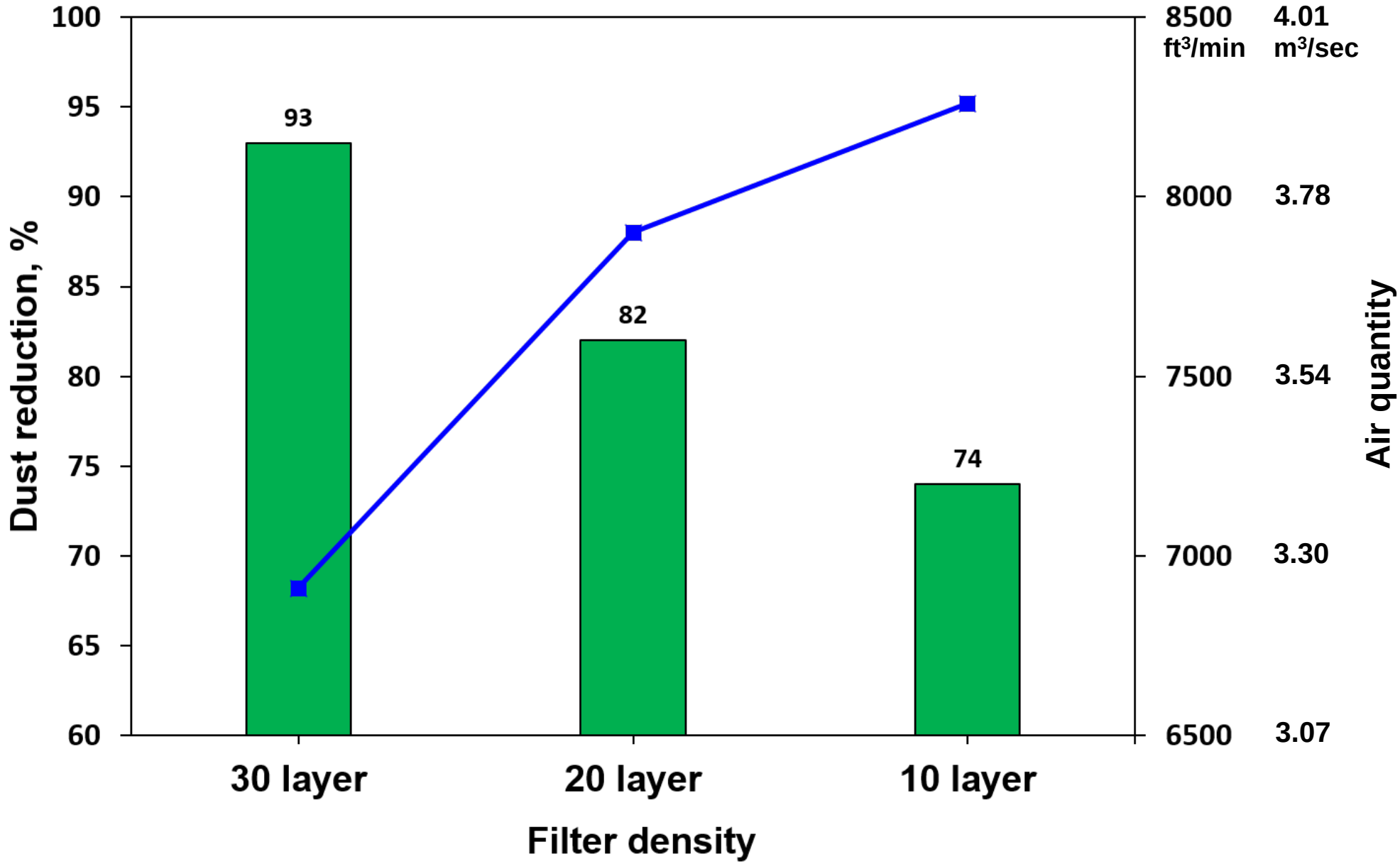
Flooded bed scrubbers (FBS) on continuous miners

- very effective for removing airborne dust (+ 90% collection efficiency)
- overall efficiency = capture efficiency and collection efficiency
- ≈ 90% of CMs in US are equipped with FBS





FBS respirable dust collection efficiency and airflow



Dry dust collector on roof bolters

(approximately 60 ft^3/min (0.028 m^3/sec) at 12" Hg (30.5 cm Hg) vacuum at drill head)

Bit

Steel

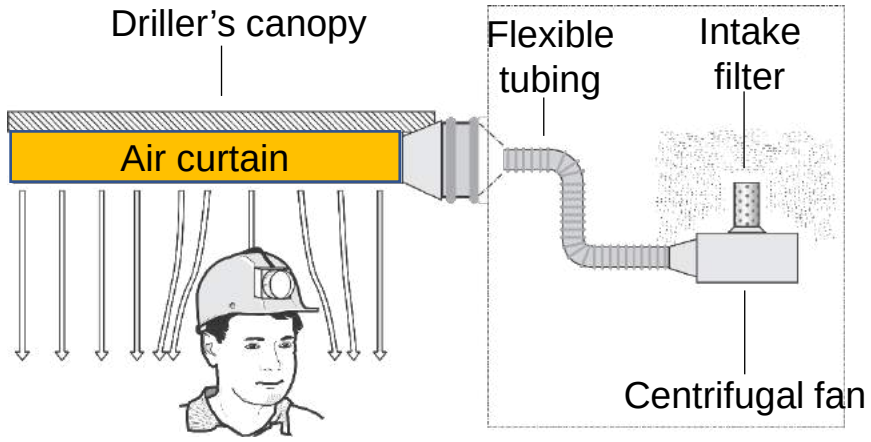
Drill head

Pre-cleaner

Collector box

Muffler

Canopy air curtain

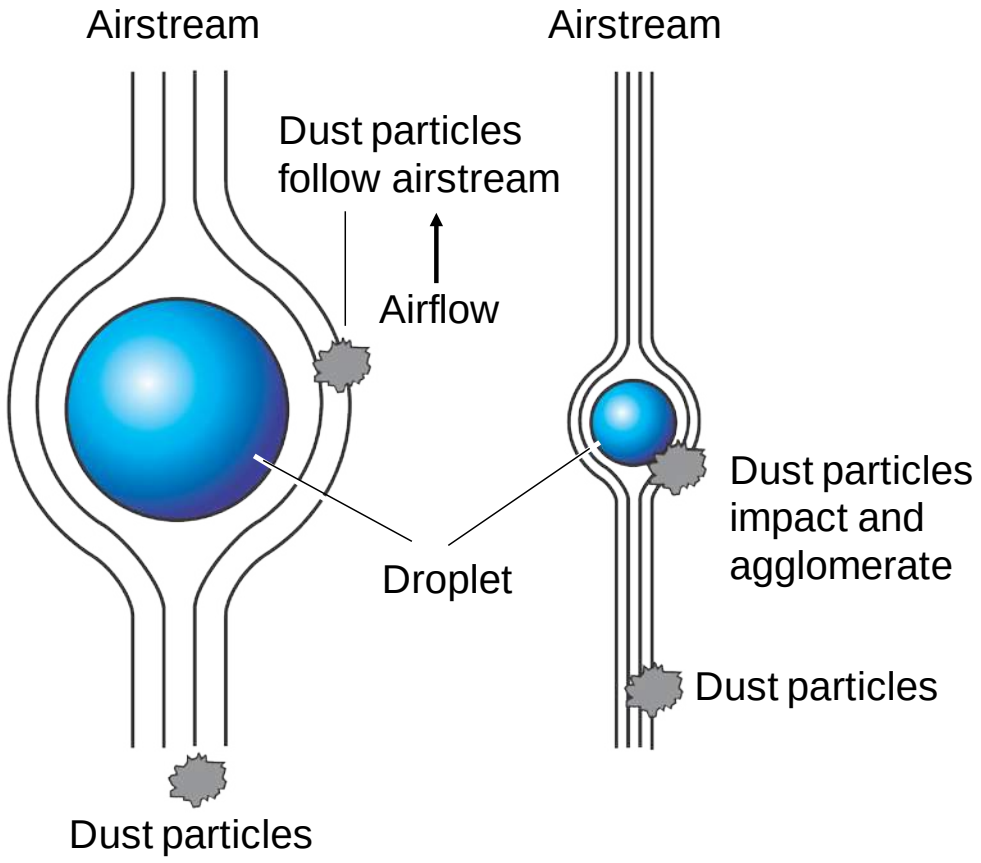


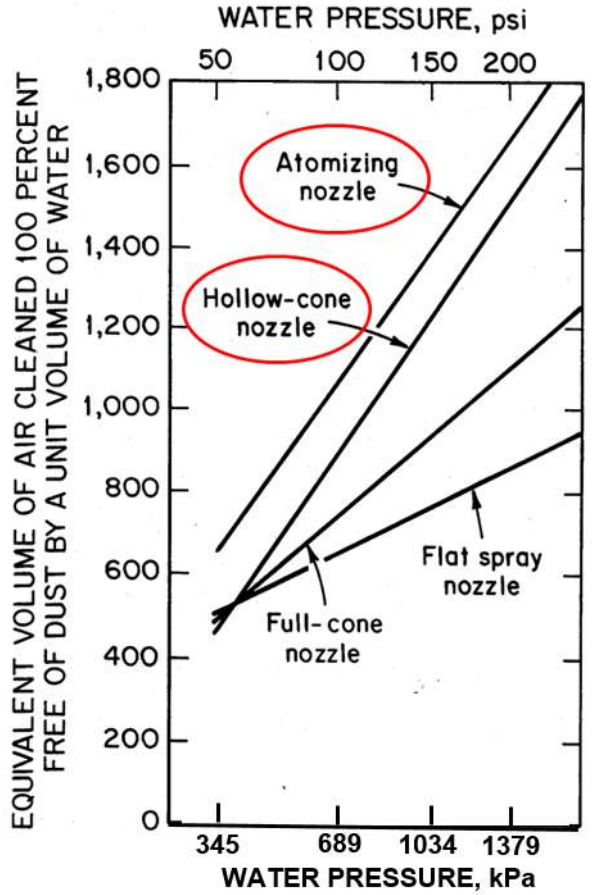
(*not to scale*)

- initial air curtain design reduced roof bolter operator dust levels by up to 53%
- ≈ 50 roof bolters are equipped with canopy air curtains
- also tested on ram car with 65% dust reduction when loading behind continuous miner

Water sprays for airborne dust capture

- smaller and higher velocity droplets are better for airborne respirable dust capture
- benefit obtained through nozzle selection and increased pressure





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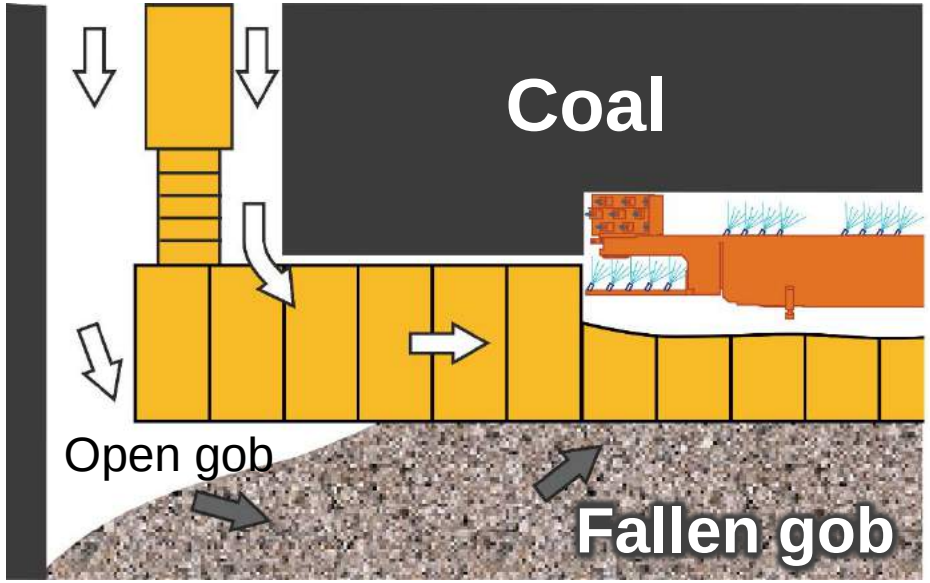
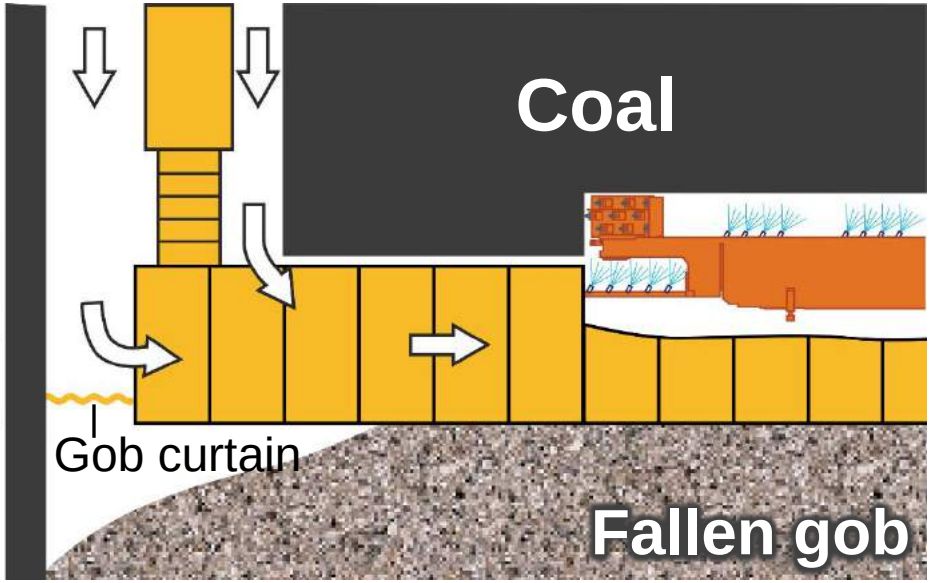
Maximize air quantity down longwall face

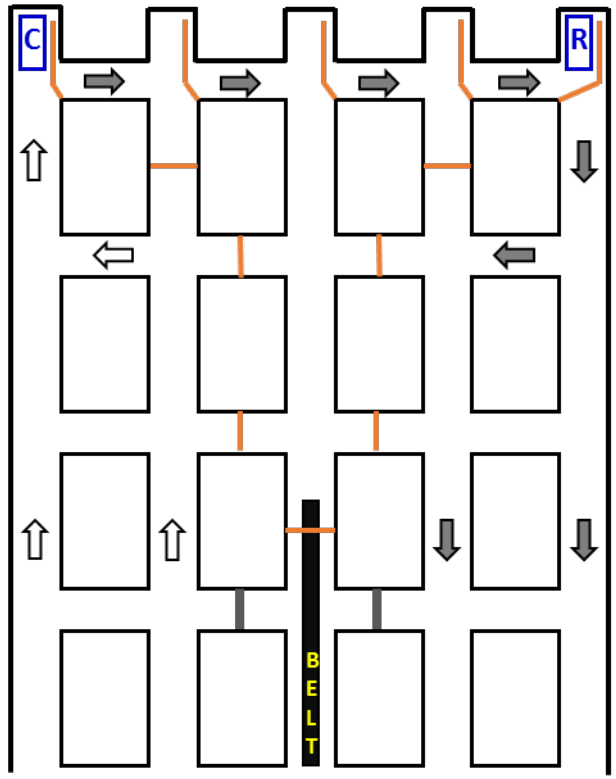
Install and maintain a tight gob curtain to turn airflow down the face.





Increase distance from dust source to lower exposures

- automated shield advance is much closer to shearer operators reducing time for mixing/dilution
- advance shields as far upwind of HG operator as possible on head-to-tail passes
- increase distance from the continuous mining machine when workers are downwind for dilution



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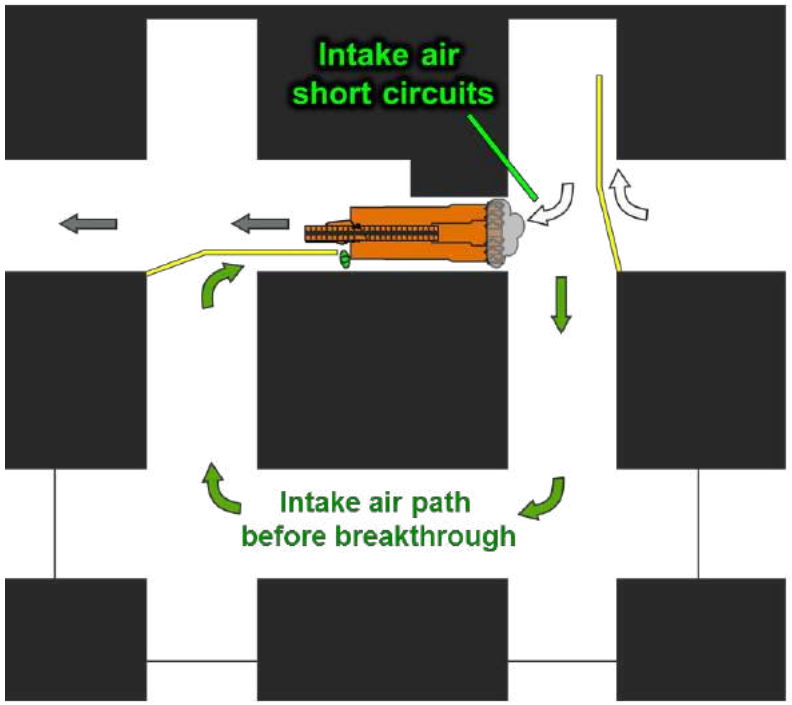
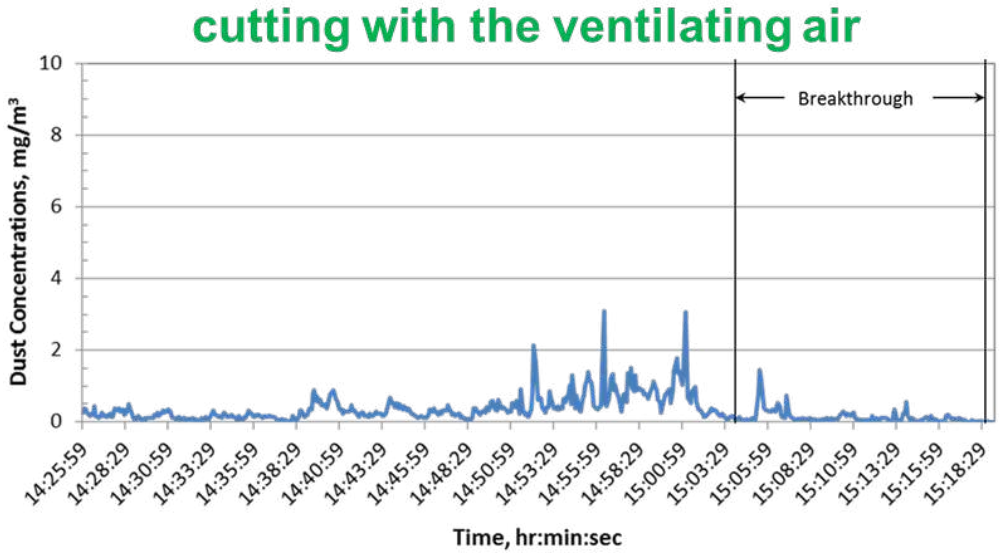
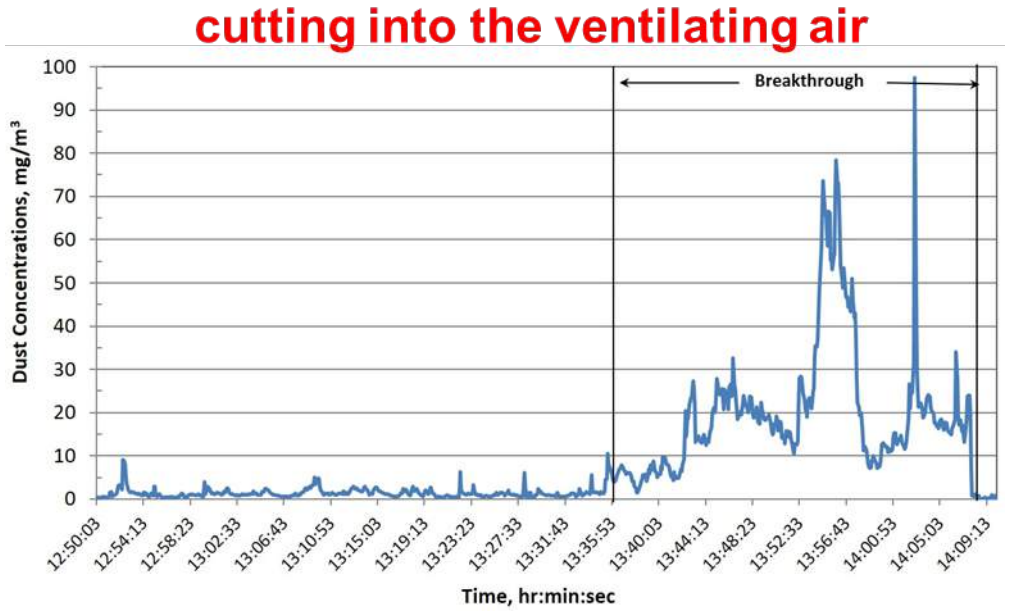
CM operator dust levels in crosscut breakthroughs



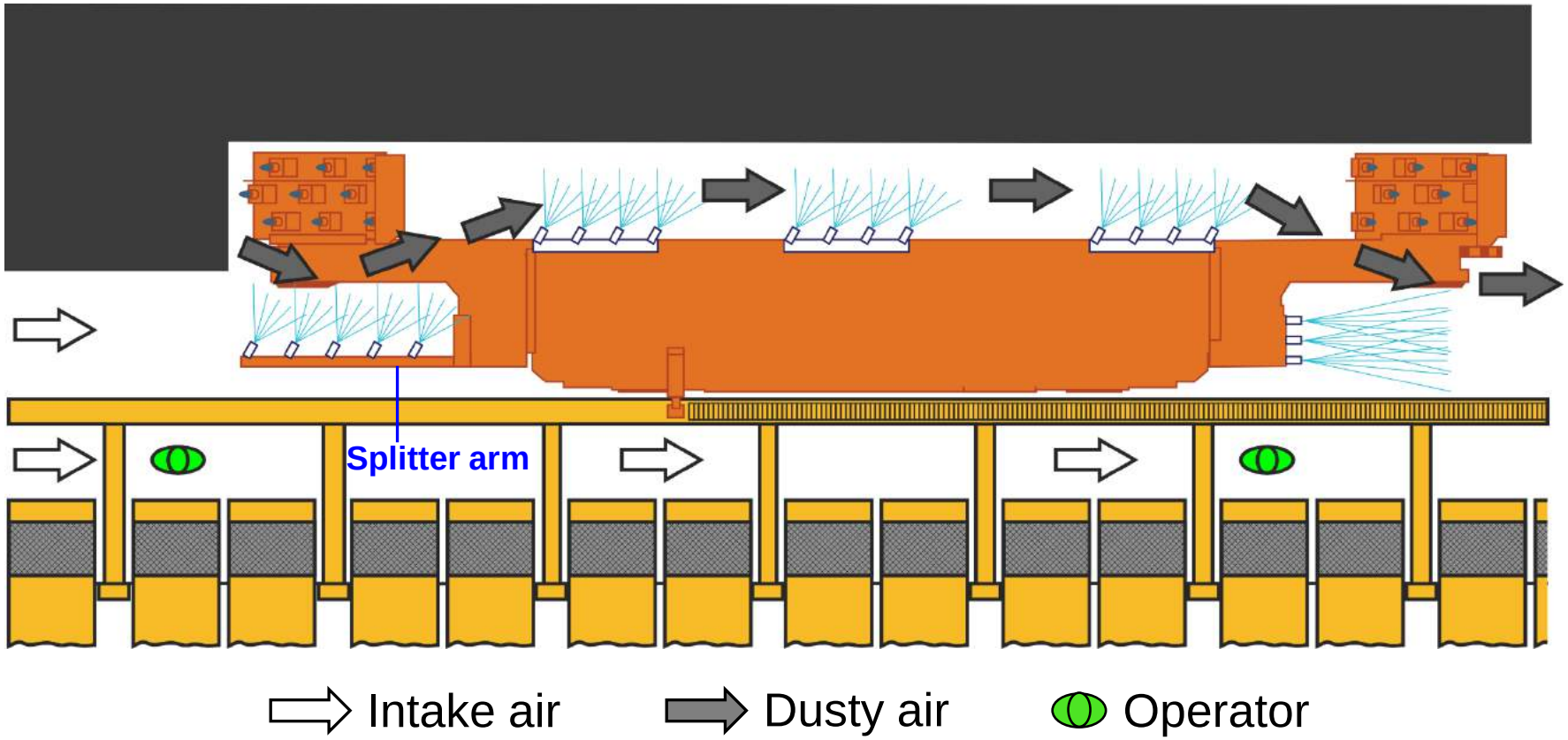




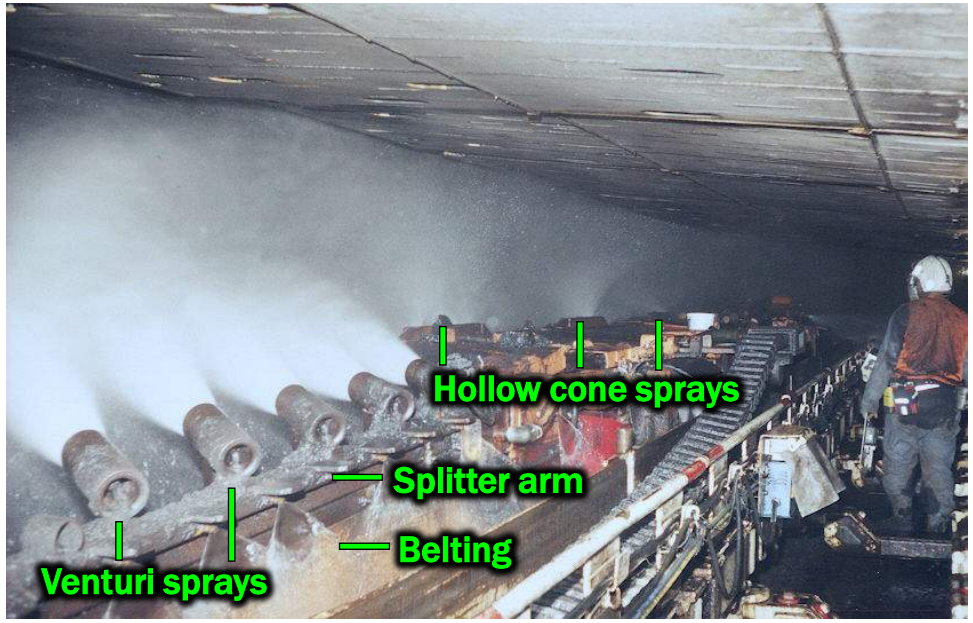
- mine crosscuts in the direction of face airflow when possible
- mining crosscuts against the direction of airflow; minimize the breakthrough time by leaving a portion of the box cut and breakthrough on the slab cut

Directional spray system (shearer-clearer system)

- shearer-mounted sprays that are oriented downwind
- headgate splitter arm designed to split the face airflow at the shearer
  - splitter arm sprays induce airflow movement toward face
  - belting on splitter arm provides physical barrier to confine dust



Directional spray system



Enclosed cabs with filtration and pressurization systems

Factory installed

Retrofit

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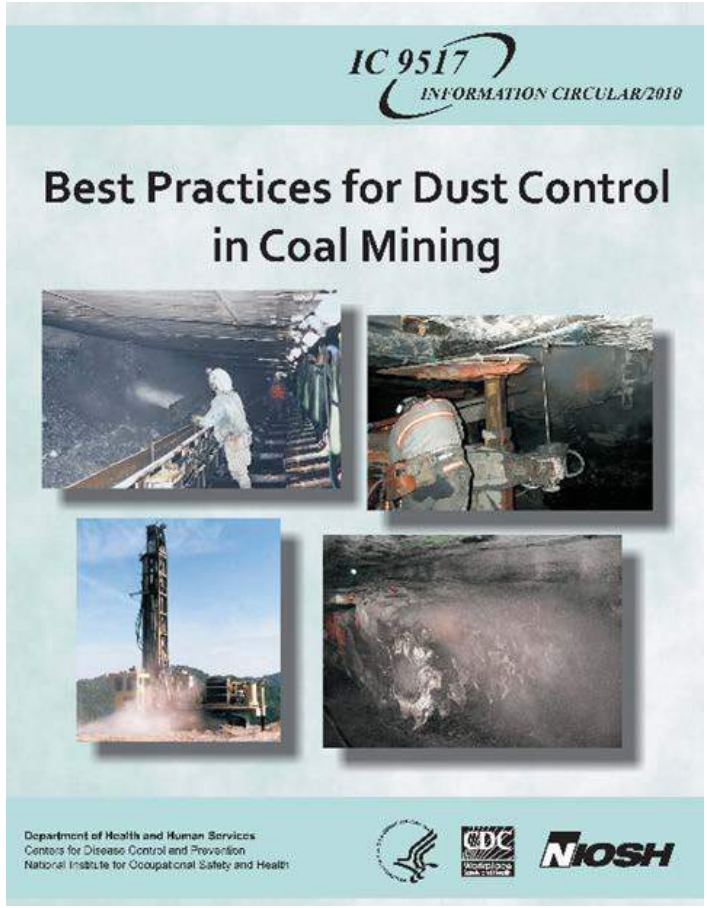
Stress importance of maintaining dust controls

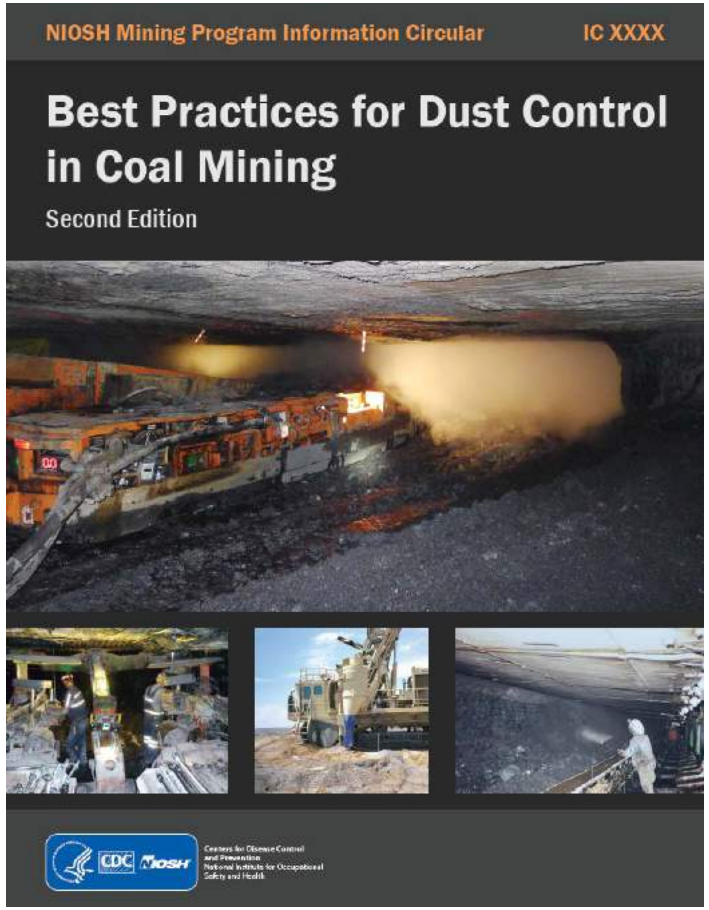
- safety is an immediate threat (roof rock) while health is long term (worn bits): same sense of urgency needed for dust controls
- maintenance of controls is critical for sustaining successful dust control

35% reduction in FBS airflow after one cut

Additional information



https://www.cdc.gov/niosh/mining/works/coversheet861.html



To be published in 2021

https://www.cdc.gov/niosh/docs/video/2020-109d/default.html

Questions??

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