Controlling Respirable Dust on Longwall Mining Operations

Impact of Overexposure to Respirable Coal Dust

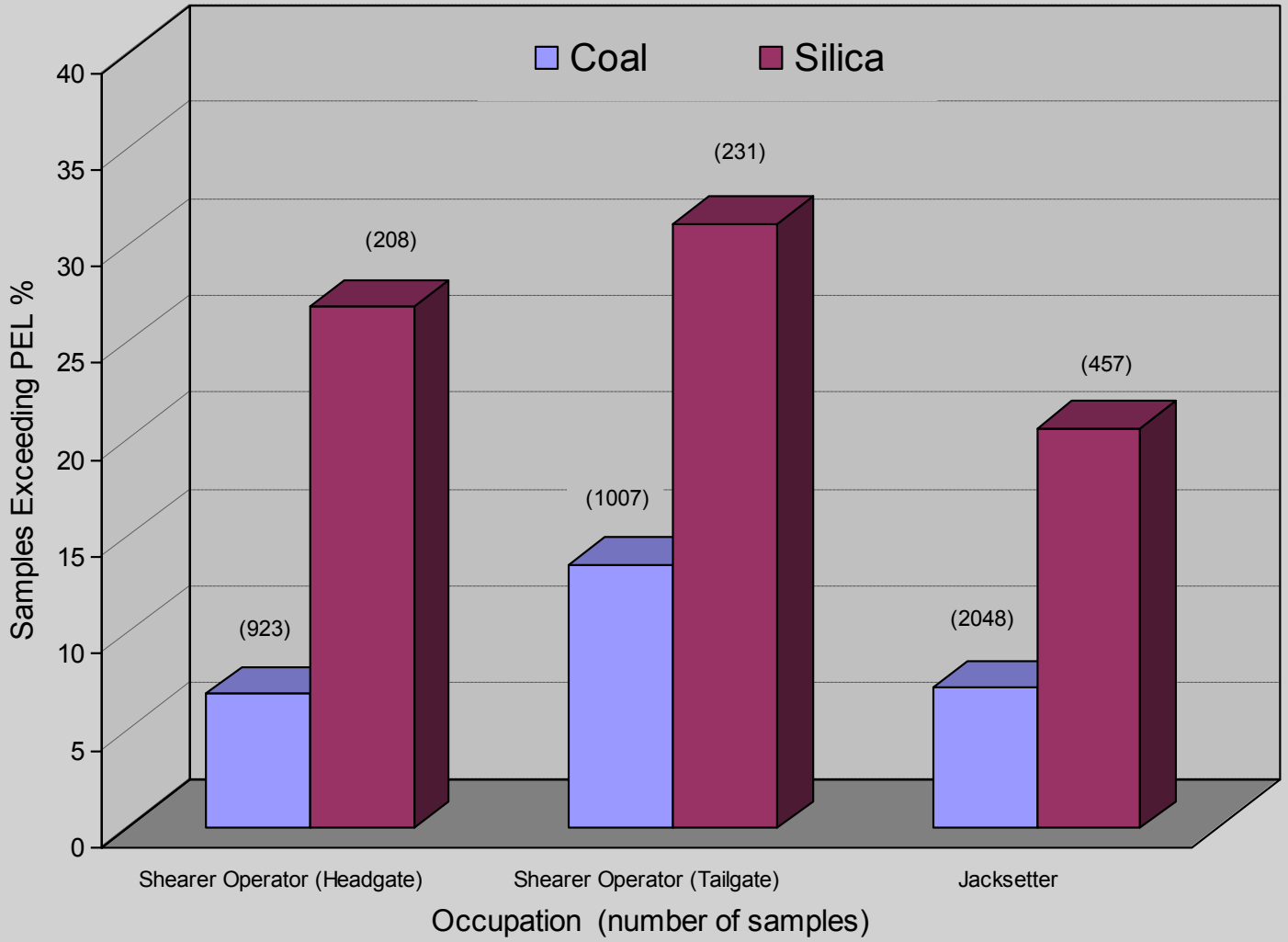
1970 – 2004

Direct or contributing cause of death for 69,377 underground miners

1980 – 2005

Over $39,000,000,000 in CWP benefits paid to miners and their families

MSHA Inspector Samples Exceeding PEL, 2004 - 2008



Longwall Production

2004 – 187.9 million tons

2005 – 188.1 million tons

2006 – 180.5 million tons

2007 – 176.1 million tons

2008 – 179.2 million tons

Longwalls

Panel Widths

1994 -- 750 ft

2002 -- 940 ft

2007 -- 984 ft

2008 -- 1043 ft

Panel Lengths

1994 -- 7000 ft

2002 -- 10,000 ft

2007 -- 10,206 ft

2008 -- 10,749 ft

Controlling Respirable Dust on Longwall Mining Operations

Topics of Discussion

- Controlling Dust On Intake Roadways
- Controlling Dust from the Belt Entry
- Stageloader/Crusher Dust Control
- Dust Control in the Headgate Entry
- Controlling Shearer Dust
- Controlling Shield Dust
- Alternate Dust Control Technology
- Summary - Guidelines

Controlling Dust on Intake Roadways

Air Quantity

Average – 67,000 ft^3/min

65 % increase when compared to the 1995 longwall study

Last Open Crosscut

Average – 0.2 mg/m^3

Maximum – 0.42 mg/m^3

Controlling Dust on Intake Roadways

Limit support activities during production shifts

- Vehicle movement
- Removal of stoppings
- Delivering / unloading of supplies

Controlling Dust on Intake Roadways

Apply water or hydroscopic compounds to control road haulage dust

- Moisture content - Approximately 10 %
- Operators - Diligent in monitoring moisture content
- Hydroscopic compounds such calcium and magnesium chloride increase surface moisture

Controlling Dust on Intake Roadways

Utilize Surfactants

- Beneficial in maintaining proper moisture content
- Decrease surface tension
- Better and more uniform wetting of the dust particles

Controlling Dust from the Belt Entry

Complements Intake Air – Provides for the potential for better dust and methane dilution

Recent Longwall Surveys

- 40 % utilized belt air
- Average - .47 mg/m^3
- Maximum - .72 mg/m^3

Controlling Dust from the Belt Entry

Belt Maintenance - Missing rollers, belt slippage, and worn belts can cause belt misalignment and create spillage

Controlling Dust from the Belt Entry

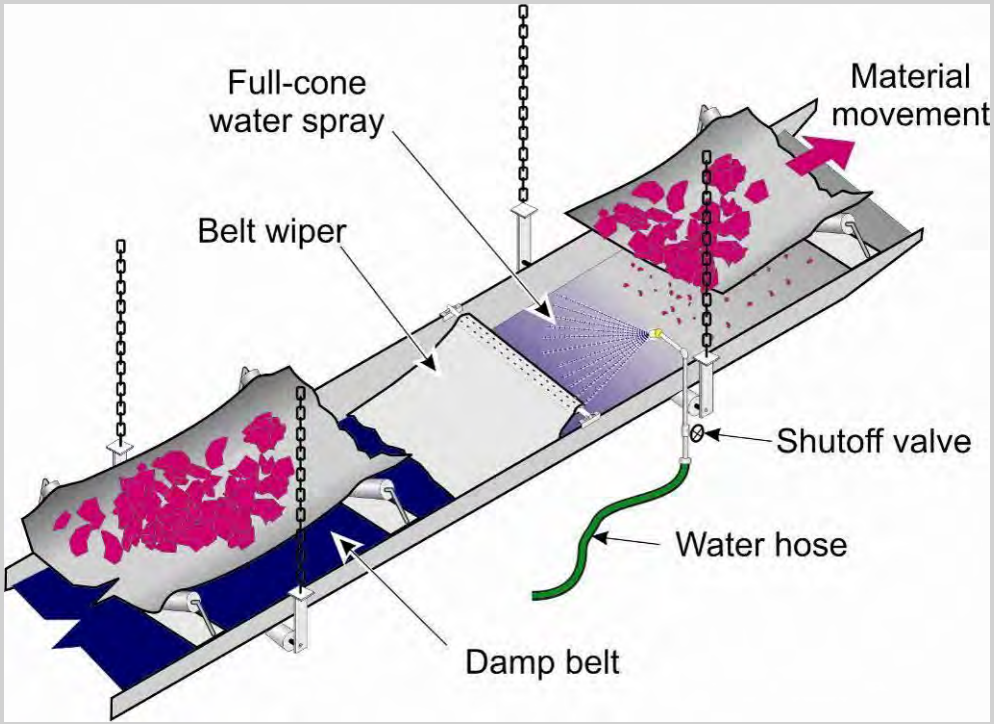
Wetting of the Coal Product - With the substantial increase in airflow rewetting of the coal may be necessary along the belt

- Flat or full cone sprays
- Quantity - 1 to 4 gpm
- Pressure - 50 psi

Controlling Dust from the Belt Entry

Wetting of the Belt

- Full cone spray on top surface of non-conveying side belt followed by material to wipe belt and remove dust fines



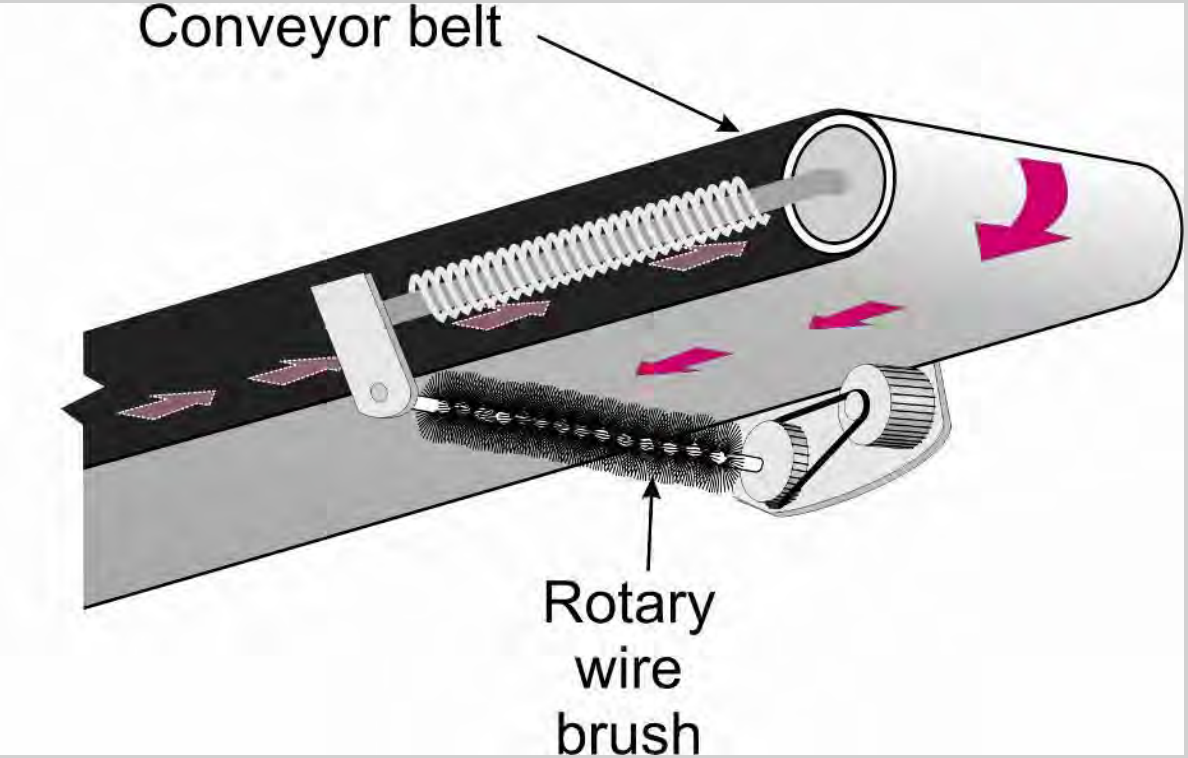
Controlling Dust from the Belt Entry

Belt Cleaning – The top and bottom of the belt should be cleaned with spring-loaded or counter-weight scrapers

- Slightly moisten belt with low quantity sprays to complement the scrapers
- Waters sprays in conjunction with scrapers have the potential to reduce dust level along the belt

Controlling Dust from the Belt Entry

Rotary Brush – Clean the conveying side of the belt



Stageloader/Crusher Dust Control

Recent Longwall Surveys - 0.26 - 0.99 mg/m^3 from outby sources

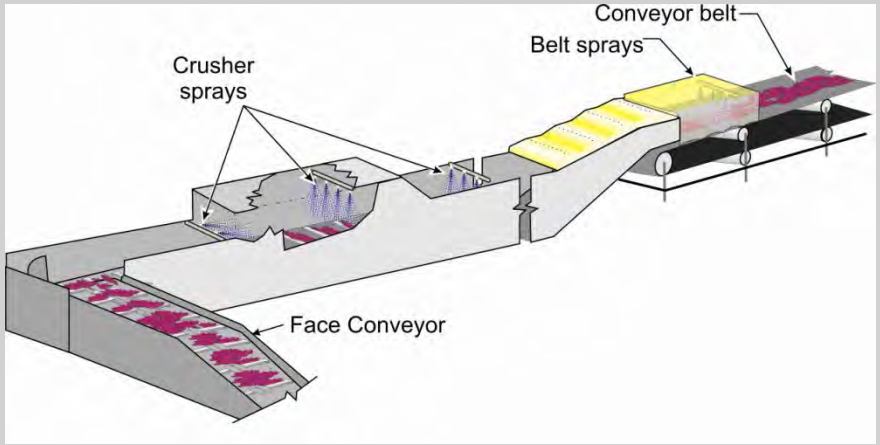
Stageloader/Crusher Dust Control

- Stageloader/crusher are fully enclosed
- No universally applied technique
- Combination of steel plates
- Conveyor belting at entrance and discharge area
- Imperative that seals and skirts be maintained
- Scrubber technology

Stageloader/Crusher Dust Control

Crusher and Belt Transfer Sprays

- Typical spray locations
  - Entrance
  - Above crusher hammer
  - Discharge area
  - Belt transfer area
- Spray bar spans the width
- 3-4 full cone sprays
- 8-10 gpm
- Water quantity over pressure
- Water pressure <= 60 psi



Stageloader/Crusher Dust Control

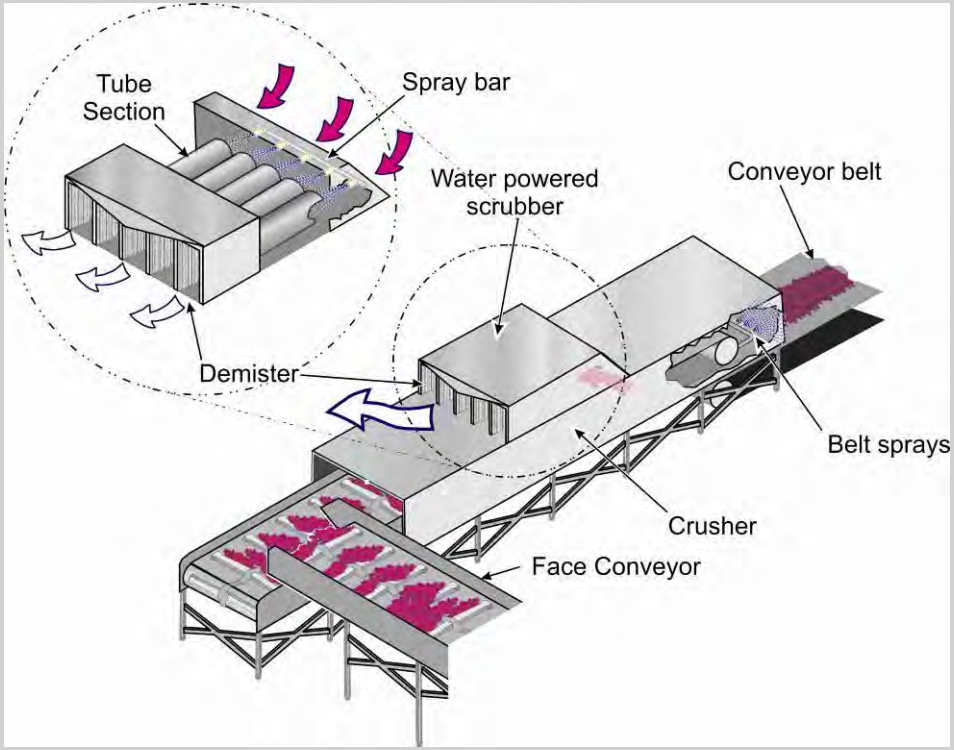
Scrubbers

- Crusher discharge
- Belt transfer area
- Capacity – 6500 – 8500 ft^3/min
- Potential to create negative pressure in the stageloader/crusher to minimize dust from leaking out

Stageloader/Crusher Dust Control

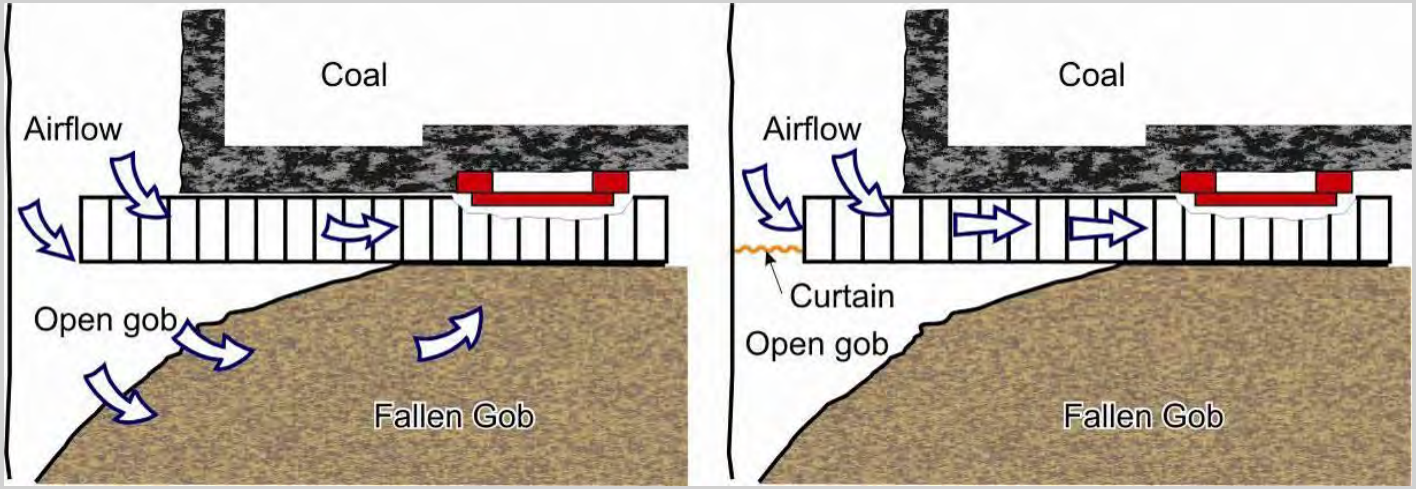
High Pressure Water-Powered Scrubber

- Alternative to fan-powered scrubber
- Contaminated air drawn through five tubes with sprays attached
- Demisted through a wave blade demister
- Operating pressure at least 1000 psi
- Water powered therefore intrinsically safe and minimal maintenance



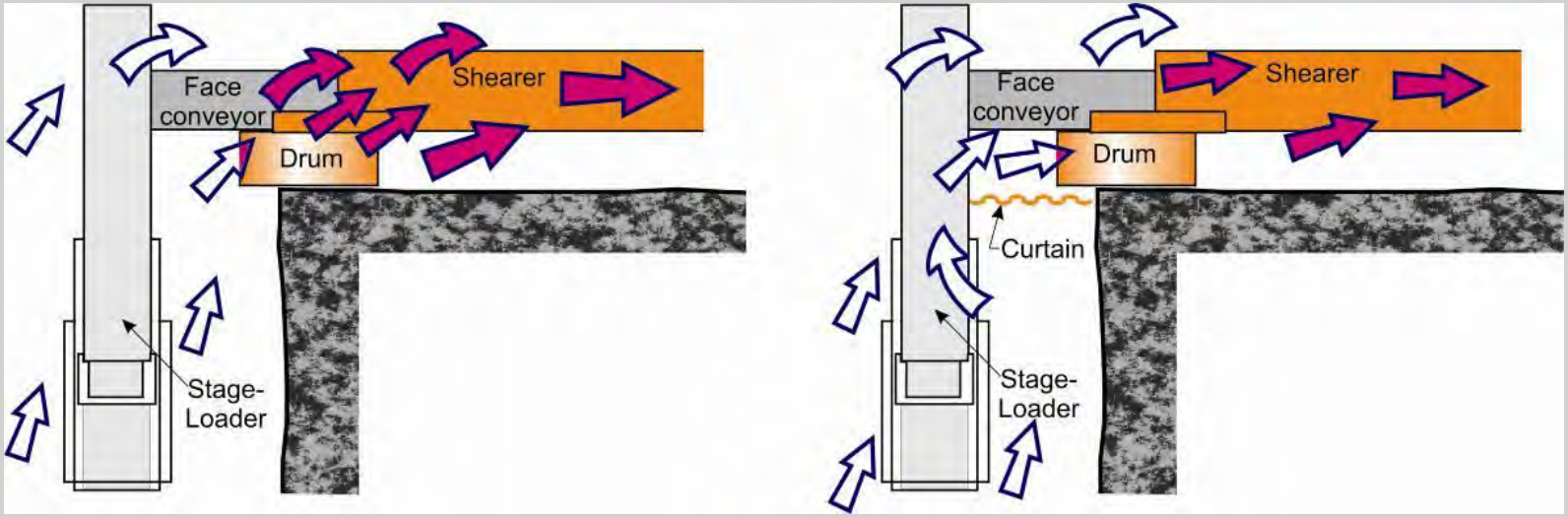
Dust Control in the Headgate Entry

Installation and maintenance of a gob curtain



Dust Control in the Headgate Entry

Installation of a wing or cut-out curtain between the panel-side rib and the stageloader



Dust Control in the Headgate Entry

Position face personnel outby as headgate drum cuts out into headgate entry

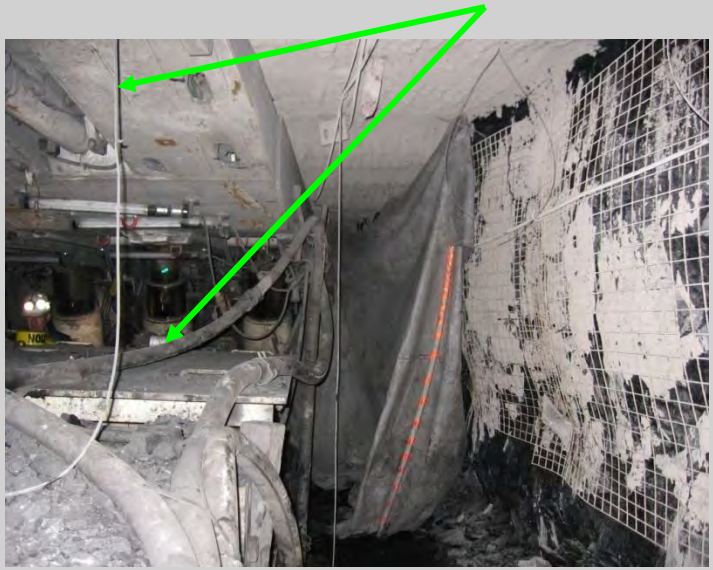
- Drum is exposed to the primary airstream
- Dust levels as high as 20 – 30 mg/m^3 for a short duration
- Position face personnel near shields 1 and 2 and further outby
- Recent surveys – Concerted effort to move outby cutout area

Dust Control in the Headgate Entry

Deflection barriers in headgate area

- Belting attached to underside of shields 1-4
- Belting attached to top of conveyor drive motors
- Aids in turning air down the face
- Protects face personnel from flying rock

Location of deflection barriers



Controlling Shearer Dust

Face Ventilation – Principal method of controlling respirable dust on longwall faces

Previous studies :

- 400 - 450 ft/min minimum velocity to control respirable dust
- 700 – 900 ft/min velocity shown to be effective when moisture content of dust is 5 to 8 %

Controlling Shearer Dust

Drum Mounted Water Sprays

- Dust suppression directly at the point of coal fracture
- Adds moisture to minimize dust liberation
- Optimum pressure 80 -100 psi
- Full cone or solid stream spray pattern
- Larger orifices increase water quantity while decreasing pressure

Controlling Shearer Dust

Drum Mounted Water Sprays

- Observed spray pressure ranged between 100 – 160 psi
- Number of sprays per drum ranged between 35 - 62
- Water spray pressure greater than 100 psi can increase dust levels as much as 25 %

Controlling Shearer Dust

Cutting Drum Maintenance

- Bits with large carbon inserts and a smooth transition between shank and carbide reduce dust levels
- Replacing damaged, worn or missing bits can not be over-emphasized
- Dull bits result in shallow cutting and greatly increases dust generation

Controlling Shearer Dust

Crescent Sprays

- Located on the top and end of ranging arms
- Sprays oriented toward face
- Observed on 50% of recently surveyed longwalls
    - 8 – 10 sprays

Controlling Shearer Dust

Crescent Sprays

- Use caution if sprays are utilized on the headgate ranging arm
- Sprays on the end of ranging arm are oriented into the face airflow
- Can create turbulence that forces dust toward the walkway

Controlling Shearer Dust

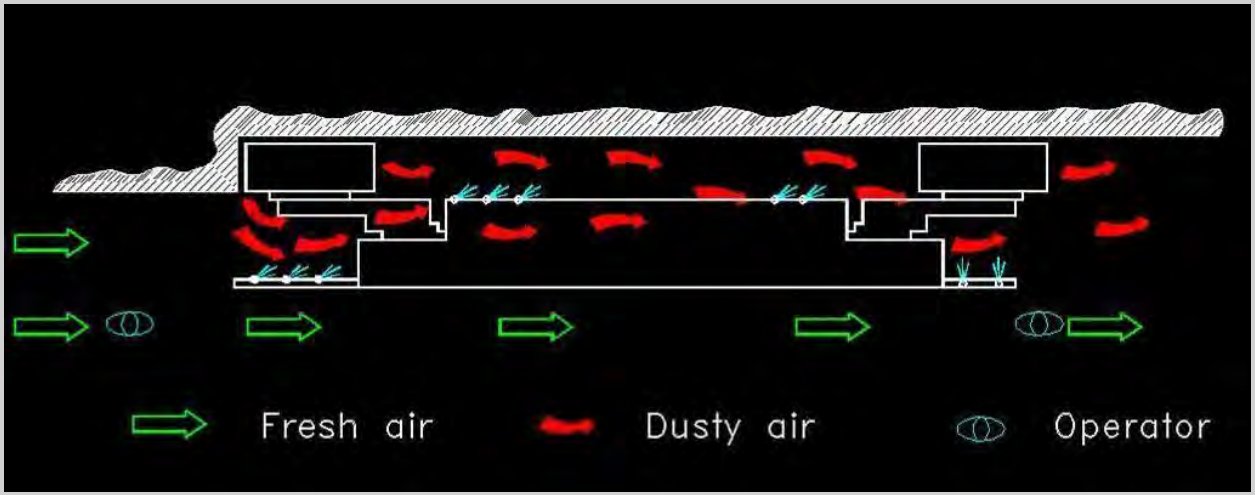
Directional Water Spray Systems

- Water sprays are very effective air movers
- If applied properly can compliment primary airflow to reduce shearer-generated dust
- Spray systems with nozzles directed upwind may force dust away form the face and into the walkway

Controlling Shearer Dust

Initial directional spray system→ shearer clearer spray system

- Shearer mounted sprays oriented downwind
- One or more passive barriers the split the airflow around the shearer
  - Air split initiated by the splitter arm
  - Splitter arm sprays induce airflow and dust toward face
  - Conveyor belt forms a physical barrier



Controlling Shearer Dust

Splitter Arms

- Extend as far beyond the headgate drum as possible
- Sufficient number of sprays to prevent dust from migrating into walkway
- Hollow cone or venturi sprays
- Water pressure at least 150 psi

Controlling Shearer Dust

Splitter Arms (recent surveys)

- Unique to each mine operation
- Length – 5 to 14 ft
- 3 – 20 sprays
- 2 splitter arms utilized venturi sprays
- Spray orientation
    - Perpendicular
    - 30 - 45 degrees toward panline
    - 30 – 45 degrees up

Controlling Shearer Dust

Splitter Arms (recent surveys)

- Built to withstand coal and rock impact from face spalls
- Splitter arm extensions oriented at a 30 - 45 degrees toward face
  - Length – 2 to 4 ft
  - 3 – 5 sprays

Controlling Shearer Dust

Splitter Arm Belting

- Belting should be suspended the length of the splitter arm
- Provides a physical barrier

Controlling Shearer Dust

Splitter Arm Belting

- Tears and gaps in the conveyor belting greatly compromise the effectiveness of the splitter arm

Controlling Shearer Dust

Splitter Arm Gob-Side Spray Bar

- Locate sprays on the walkway side of splitter arm
- Direct sprays down the side of the belt
- High capacity low pressure flat-fan sprays evenly spaced the length of the splitter arm

Controlling Shearer Dust

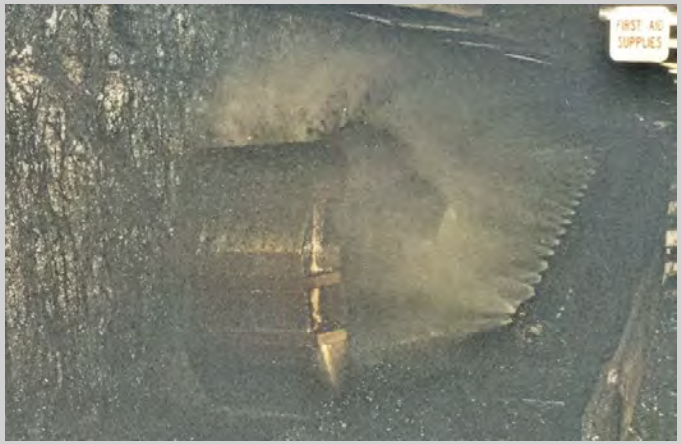
Splitter Arm Underside Sprays

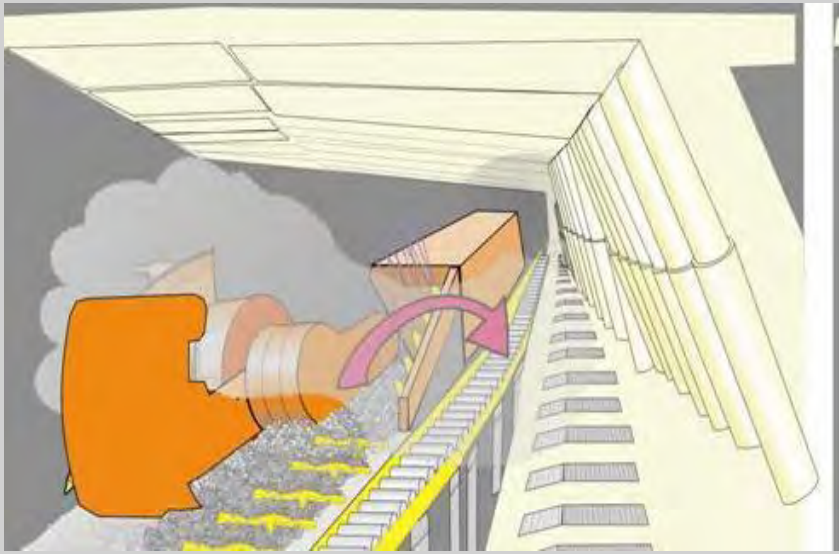
- Locate sprays on underside of the splitter arm
- Direct sprays down the face side of the belt
- Reduce dust rolling under or through the splitter arm
- Adds more water to the coal to reduce conveyor dust
- Because of turbulence in the area spray pressure is critical

Controlling Shearer Dust

Positioning of the Splitter Arm

- Position of the splitter arm may allow dust to migrate into the walkway
- Maintaining the splitter arm near parallel is critical to keep dust from boiling into the walkway





Controlling Shearer Dust

Shearer Sprays

- Spray manifolds positioned between the drum
- Promotes movement of dust-laden air close to the face and prevents migration toward the walkway
- Oriented with airflow

Controlling Shearer Dust

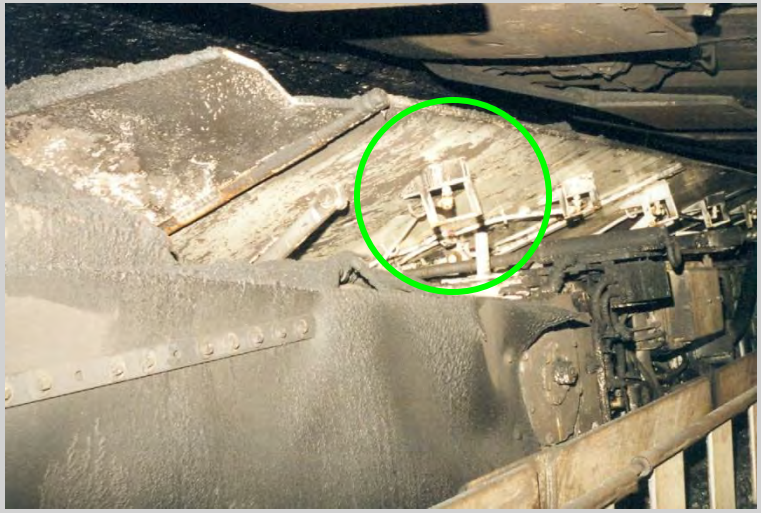
Shearer Sprays

- 3 or 4 manifolds evenly spaced the length of the shearer
- 3 to 5 sprays per manifold
- Manifolds location
    - Face side of shearer
    - Top of shearer

Controlling Shearer Dust

Deflector Plates

- Observed at western mines
- Primary function is to protect operators from flying debris
- Provide a physical barrier that can enhance the effectiveness of the directional spray system
- Equipped with water sprays
  - Evenly spaced the length of the deflector plate



Controlling Shearer Dust

Deflector Plates

- Operators have to be diligent in turning off the sprays when in the down position
- If sprays operational, spray plume is directed upward, strikes the underside of the shields creating turbulence
- Potentially allowing dust to migrate into the walkway

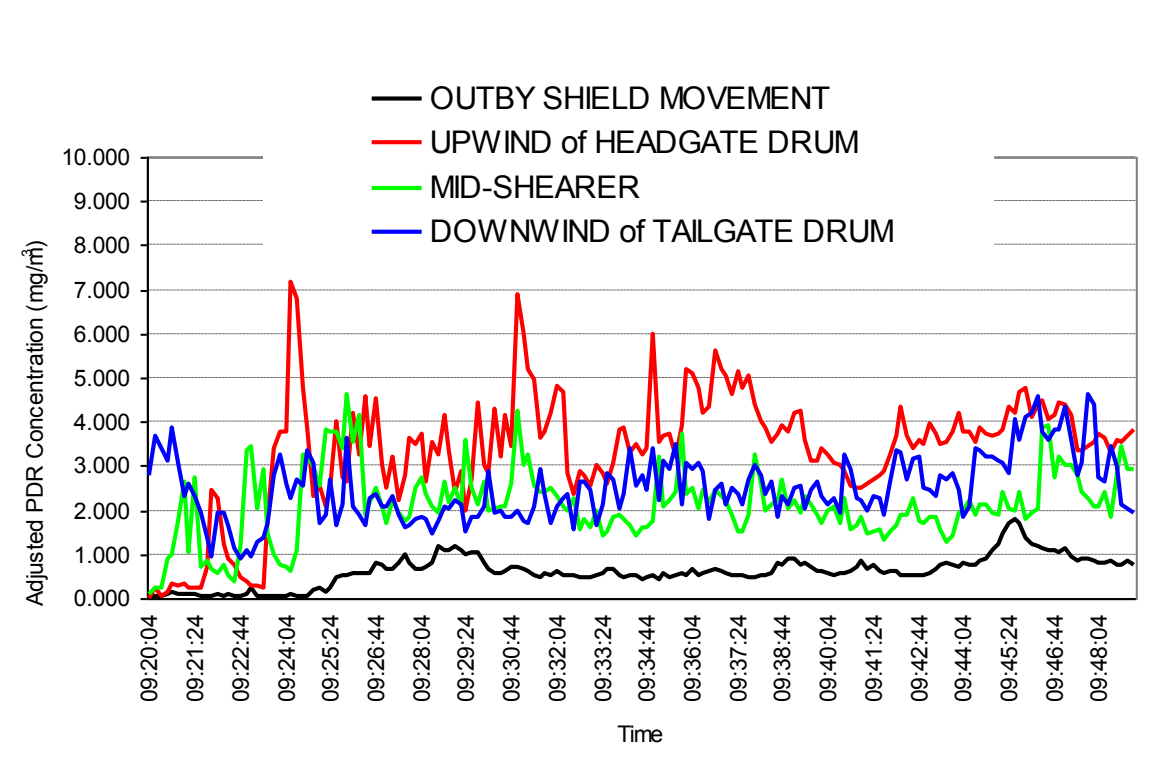
Controlling Shearer Dust

Tailgate Side Sprays

- Spray manifold mounted on tailgate end of shearer
- Oriented parallel to ranging arm and angled slightly toward drum
- Confines dust-laden air to face and carries it beyond the tailgate drum

Controlling Shield Dust

- Automated and usually are initiated within 3-5 shields of trailing drum
- Can be a significant source of dust exposure when shields are advanced upwind of shearer
- Concerted effort to rotate jacksetter operators outby



Controlling Shield Dust

- Canopy-Mounted Sprays Systems
  - Activated on top of shields
  - Hard to maintain
- Air Dilution
  - High velocities should increase dilution of shield dust
  - Has the potential to entrain more dust because of the relatively dry shield dust
  - Advance as far upwind as possible when advancing shields on head to tail cuts
  - May allow for dilution
- Depending on roof conditions consider using uni-directional cutting sequence

Controlling Shield Dust

Shield Sprays on the Underside of the Canopy

- Observed on recent longwall surveys
- Automatically activated by shearer to create a moving water curtain
- 1 or 2 rows of sprays per shield
- Located between the tip of the shield to an area above the spill plate
- Spray activation and de-activation sequencing was mine specific

Controlling Shield Dust

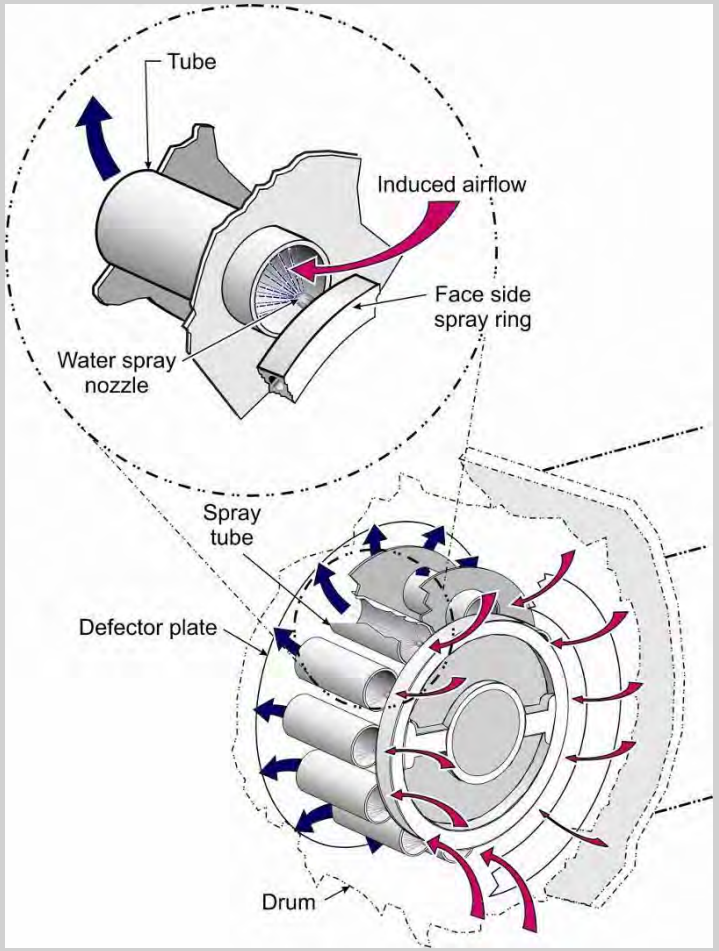
Shield Sprays on the Underside of the Canopy

- Proper sequencing is critical
- Observed shield sprays interacting with splitter arm sprays creating turbulence
- Dust and mist cloud rolled into walkway
- Properly aligned sprays directed toward the face with sufficient water pressure and volume have the potential to be an effective method at controlling dust levels

Alternate Dust Control Technologies

Ventilated Drums

- Design to reduce dust at the fracture point
- 12 water-powered capture tubes built into the hub of the shearer
  - High pressure water (at least 1000 psi) released from face side ring manifold
  - Induces dust laden-air
  - Deflector plate attached to the cowl prevent water from operator



Foam Discharge from Shearer Drum

- Discharge compressed-air foam through 10 to 12 large diameter nozzles located in the shearer drum

Control Guidelines - Outby

- Minimize intake/belt dust
- Confine stageloader/crusher dust
- Quantity of water in crusher
- Gob curtain at HG and beyond
- Locate face personnel outby during HG cutout
- Shield advance/cutting sequences to minimize exposures of high risk workers

Control Guidelines - Shearer

- Optimize cutting parameters (bits, rpm)
- Maximize water quantity to drums (larger orifice nozzles)
- Drum spray pressures @ 100 psi or less
- External sprays @ 150 psi or higher
- Caution using crescent sprays on HG drum

Control Guidelines - Shearer

- HG splitter arm
  - Extend beyond HG as possible
  - Align sprays with airflow
  - Maintain belting
  - Splitter arm parallel with HG drum
- Maintain shearer sprays
- Deflector plate as high as possible
- Utilize TG side manifold sprays
- Shearer operators positioned as far upwind as possible

Control Guidelines - Shields

- Underside canopy shield sprays
  - Potential to be an effective method at reducing shearer dust
  - Proper sequencing of sprays
  - Proper alignment
  - Spray water pressure and volume
- Advance shields as far away from shearer as possible depending on roof conditions
- Consider uni-directional cutting sequence
- Concerted effort to rotate jacksetter operators outby

Commitment to Dust Controls

- **Worker and management involvement**
  - Knowledge and attitude
  - Safety => immediate / Health => long term

Maintenance is critical

Questions?

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