MINE VENTILATION BEST PRACTICES AND REGULATIONS IN THE USA

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DNIPRO, UKRAINE
12 JUNE 2019
WORKSHOP ON BEST PRACTICES IN COAL MINE METHANE CAPTURE AND UTILIZATION

Global Methane Initiative

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U.S. COAL MINE VENTILATION REGULATIONS AND PRACTICES

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MINE VENTILATION—KEY CONCEPTS

- Ventilation systems are established to delivering breathable fresh air
- Controls the temperature and humidity
- Protects the miner by evacuating hazardous gases from the coal mine.
- Methane is diluted to non-explosive concentrations and evacuated from the mine by supplying sufficient quantities of fresh air by blowing or exhausting fans
- The effectiveness of mine ventilation ultimately limits the productivity of the coal mine

History of Regulation of Coal Industry

U.S. Public demands health and safety regulations after disasters

- US Bureau of Mines
- Federal Coal Mine Health and Safety Act 1969-"Coal Act" followed No. 9 Mine, WV 78 of 99 miners underground were killed in gas and dust explosion
  - Mine Enforcement Safety Administration (MESA)
  - Inspections
  - No smoking or flame sources
  - Ventilation plans
  - Training of miners
  - Separate splits of air
  - Air changes essential personnel only
  - Permissible equipment

History of Regulation of Coal Industry

- Federal Mine Safety and Health Act 1977
  - Coal, metal and non metal mines under single legislation
  - Separate health and safety standards for coal mining
  - MESA becomes MSHA
  - Mandating of miner training
  - Mine rescue teams for all underground mines
  - Increased involvement of miners
- Miner Act of 2006
  - Communications and tracking
  - Civil penalties

U.S. Regulations
Mine Safety Health Administration (MSHA)

- 30 CFR Part 75 Mandatory Safety Standards for Underground Coal
  - Separate split of air to each section exhaust to return §75.332
  - Main fan on surface, explosion proof installation NO BOOSTER
  - Face ventilation installation §75.330
  - Minimum quantities §75.325
  - Methane limits and actions §75.323
  - Intrinsically safe
  - All face equipment built and maintained to be permissible
  - Atmospheric monitoring certified personnel, monitors
  - Fire suppression, combustible materials
  - Seals

U.S. Regulations
Mine Safety Health Administration (MSHA)

- 30 CFR Part 75 Mandatory Safety Standards for Underground Coal
  - Ventilation plan approved by district manager §75.370
  - Escapeways
  - Nearby mines
  - Combustible materials
  - Communications and tracking

U.S. Regulations
Mine Safety Health Administration (MSHA)

§75.325 prescribes the required minimum air quantity for different coal types and mine locations. This information is summarized in Table 1. It should be noted that, in order to meet the mandatory methane and dust control standards, it is usually necessary to maintain higher airflow quantities than these minimum values. In addition to the required minimum air quantities, §75.326 mandates that a mean entry air velocity of at least 60 feet per minute must reach each working face where coal is being cut.

Type of Coal Mine	Bituminous/Lignite Mines	Anthracite Mines
Location within the Mine	Minimum Air Quantity (cubic feet per minute)	Minimum Air Quantity (cubic feet per minute)
Working face where coal is being cut	3,000	1,500
Last open crosscut or end of pillar line	9,000	5,000
Longwall or Shortwall mining systems	30,000*	30,000*

VENTILATION DESIGN AND REDUCING HAZARDS

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BALANCING AIR FLOW TO MEET SAFETY NEEDS

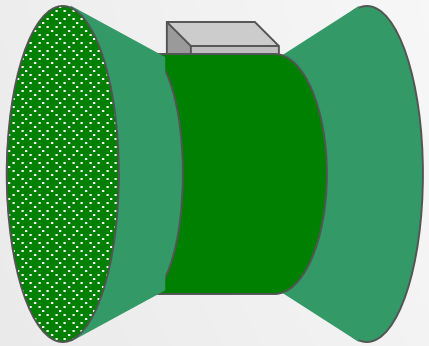
- Low air velocities can lead to poor mixing between methane and air.
- Poor mixing leads to fluctuations in methane concentration that makes ignition more likely.
- High air velocities are better for mixing, but if it is too high, more dust is entrained creating safety and health hazards
- US Mine safety regulations are designed with these competing requirements in mind

VENTILATION DESIGN CRITERIA FOR MAKING GASSY MINES SAFE

- Adequate if:
  - Ample dilution of to safe levels. Methane emitted at high concentration levels reduced to as far below LEL as soon as possible.
  - Main ventilation system circulates air from the portal to sections. Main entries to circulate air at least one for intake and one for return. No duct work or booster fans in mains. Large quantities long distances.
  - Face ventilation system last hundred meters to face where coal is broken and removed.

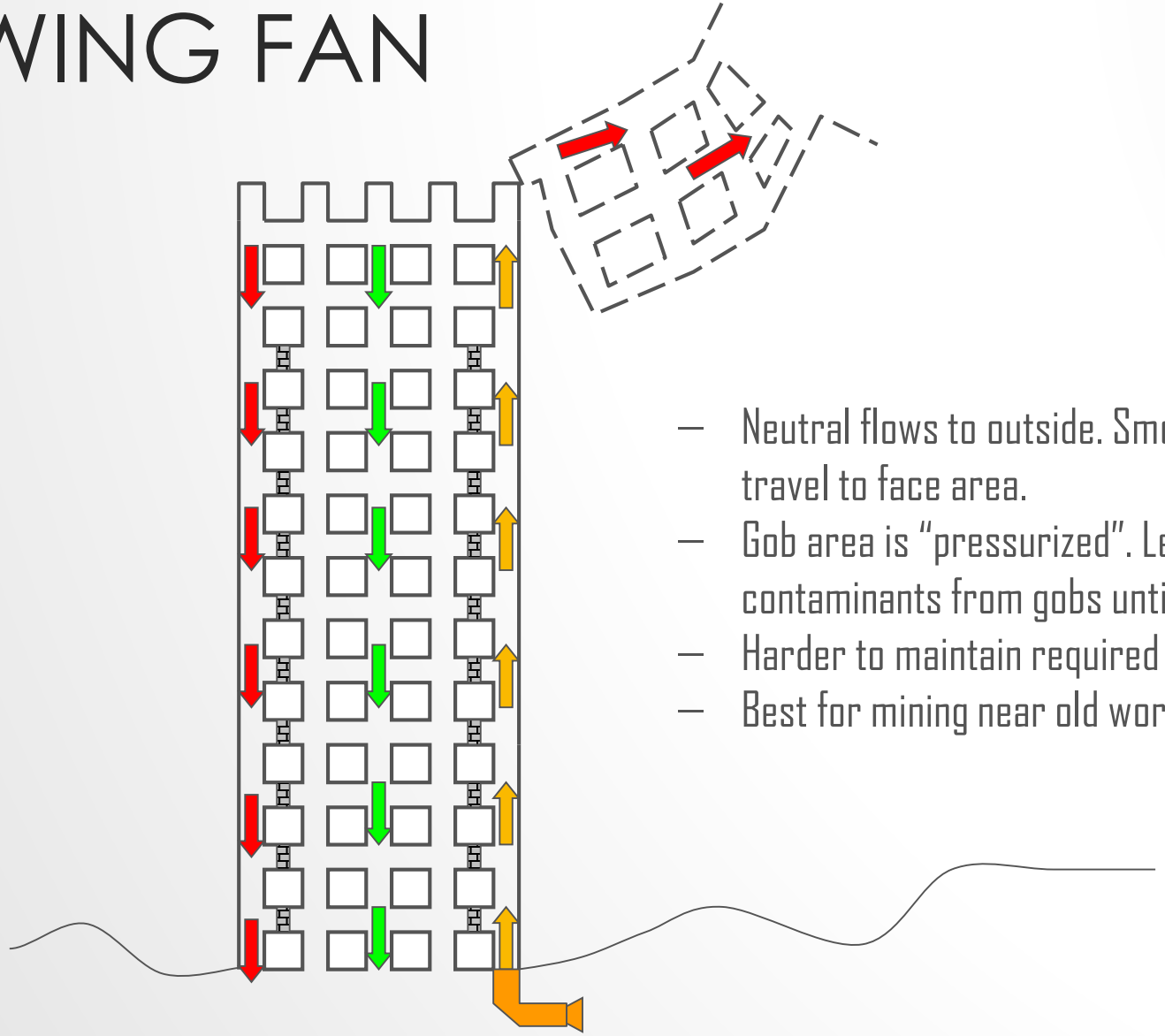
AIR FLOW

- Air always flows from a point of higher pressure to lower pressure



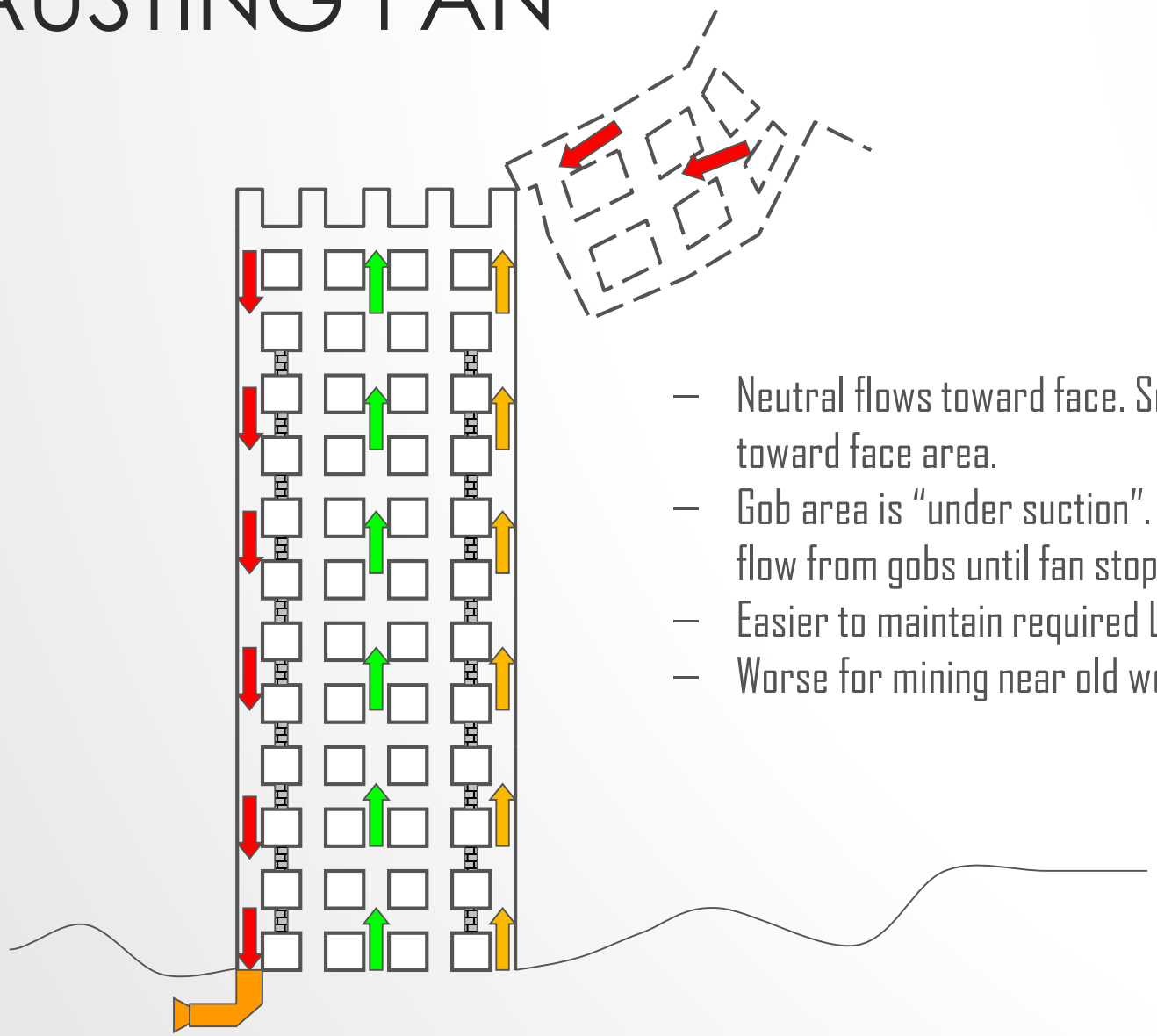
- **Blowing fans** create a high pressure point immediately inby the fan. Air travels from this high point through the mine to the surface.
- **Exhausting fans** create a low pressure point immediately inby the fan. Air travels from the surface through the mine to this low pressure point.

BLOWING FAN



- Neutral flows to outside. Smoke will not travel to face area.
- Gob area is "pressurized". Less influx of contaminants from gobs until fan stops.
- Harder to maintain required LOC quantities.
- Best for mining near old workings

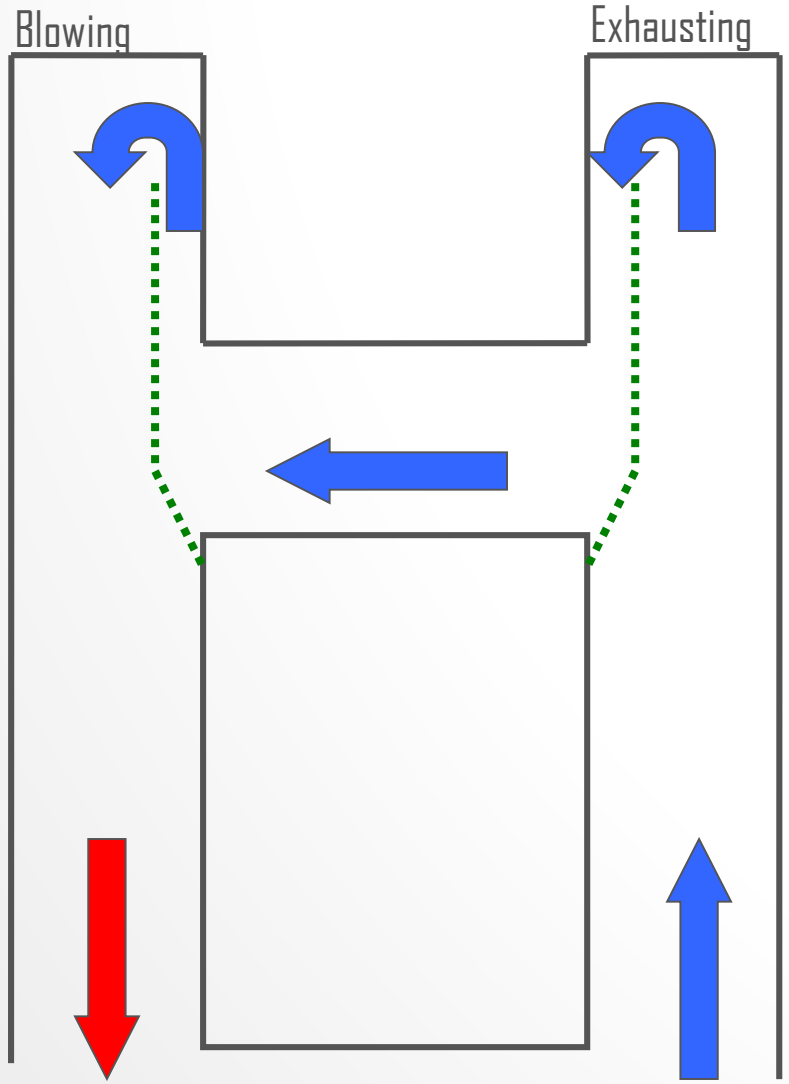
EXHAUSTING FAN



- Neutral flows toward face. Smoke will travel toward face area.
- Gob area is "under suction". Contaminants flow from gobs until fan stops.
- Easier to maintain required LOC quantities.
- Worse for mining near old workings

FACE VENTILATION

- Higher velocity at face.
- Best for gas.
- Worse for dust.



- Lower velocity at face.
- Worse for Gas.
- Good for Dust.

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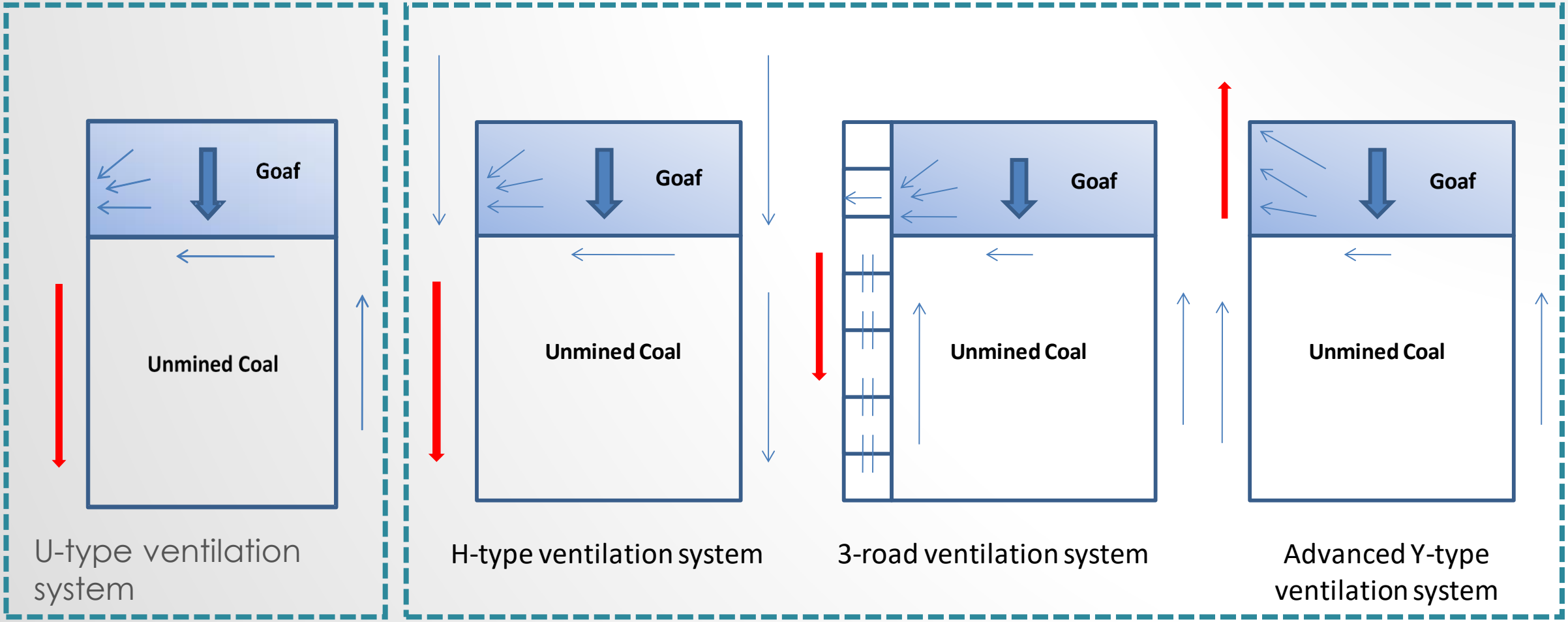
TYPES OF VENTILATION SYSTEMS USED IN GASSY MINES

Most commonly used

Used for gassy mining conditions



U-type ventilation system

H-type ventilation system

3-road ventilation system

Advanced Y-type ventilation system

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OPTIMIZING VENTILATION AND REDUCING CH_4 EMISSIONS

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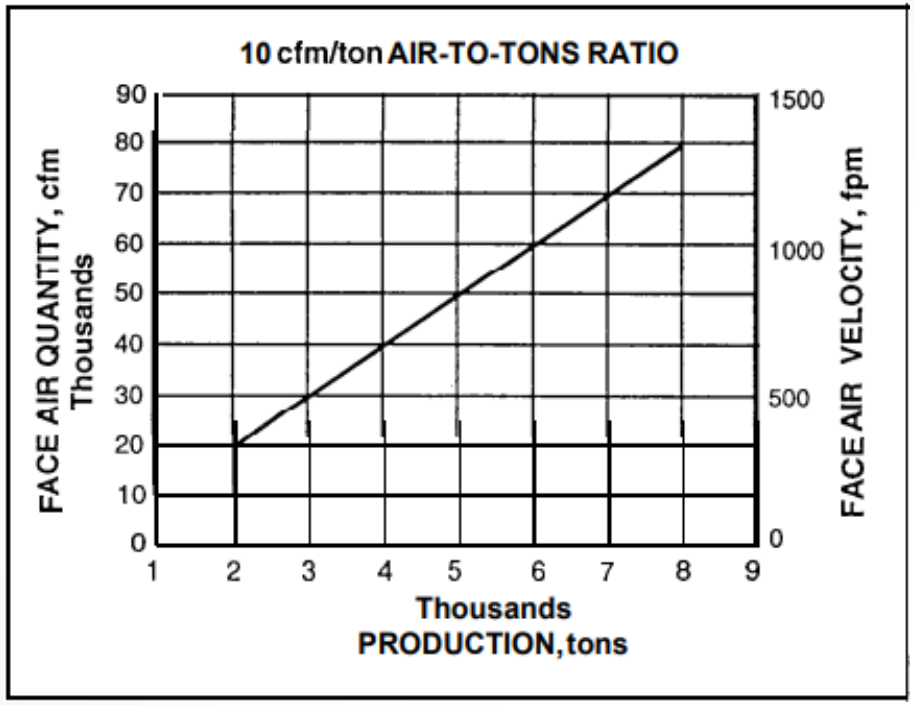
AIR FLOW MUST BE CONTROLLED TO MINIMIZE DUST TRANSPORT

REGULATIONS RELATED TO DUST CONCENTRATION IN AIR

- Was 1 mg/m^3
- Became 0.5mg/ m^3 in 2016

CHART TO CALCULATE AIR FLOW



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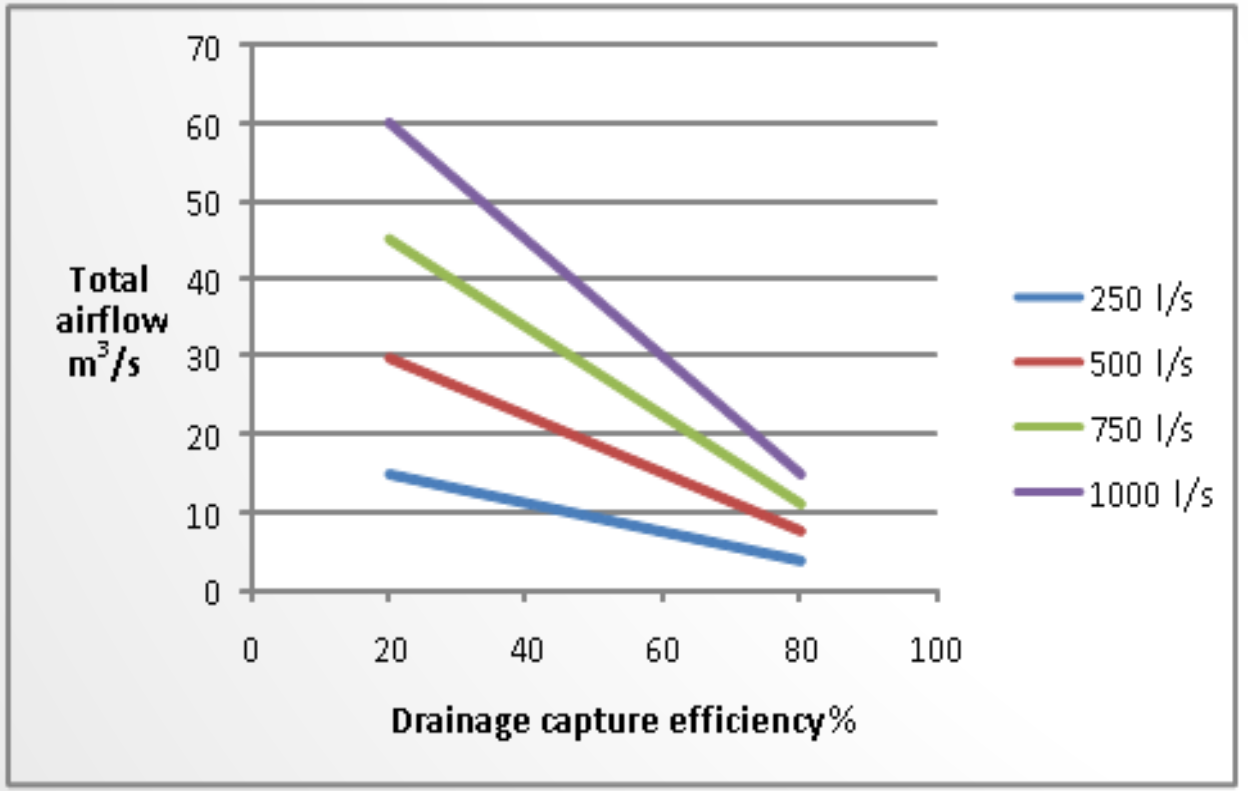
AIRFLOWS REQUIRED FOR DILUTING LONGWALL METHANE EMISSIONS TO 2%



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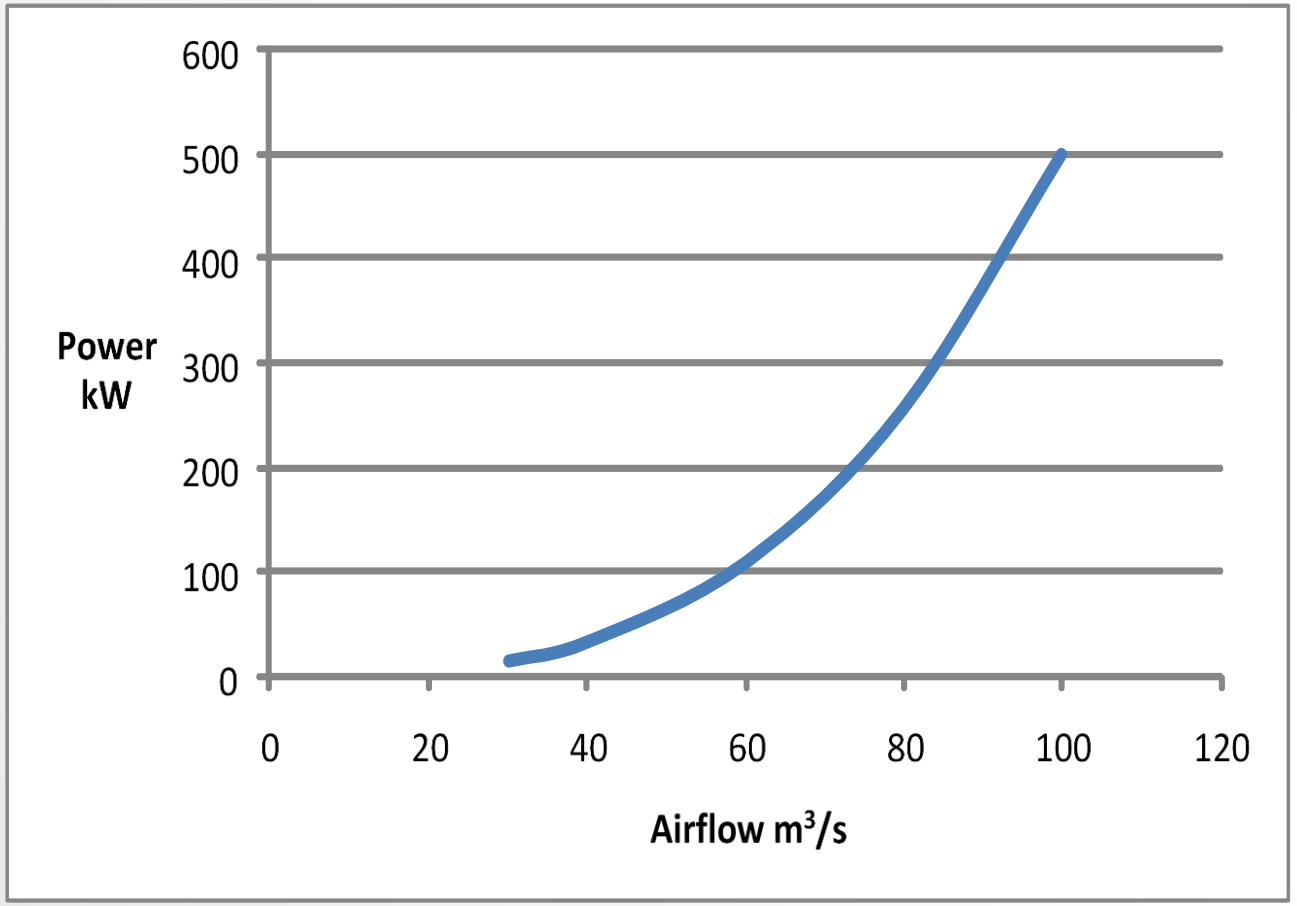
EXAMPLE OF POWER REQUIREMENTS FOR VENTILATION AIR



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AUGMENT VENTILATION WITH GAS DRAINAGE

- Implementing gas drainage can reduce the load on the ventilation system
- Lowers power consumption and electricity costs
- Allows air volume and velocity to be lowered
- Reduces entrained dust
- Drained gas can be used, ventilation air methane is costly to use or abate

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