An Integrated Approach For A Diesel Particulate Control Strategy in Metal and Nonmetal Mines

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Background

Diesel Usage: About 4,000 Pieces
200 U/G MNM Mines

Metal and Nonmetal Mine DPM Concentration Limits

- 400 ug/m3 (TC) July 19, 2002
- 160 ug/m3 (TC) Jan. 19, 2006

- Based on technical and economic feasibility for the US mining industry as a whole.

Background

- There is no single fix-all for dpm.
- Most venders can provide information on individual products.
- Need to assess dpm control on a mine-by-mine basis.
- Need a way to integrate the impact of combining the various controls.

Quantifiable Variables - DP is related to:

- 1. Engine emissions, engine size and operating time,
- 2. Ventilation rate,
- 3. Control technology efficiency.

General Relationship

- DP = G x (1-EFF) x 35,317,000 / Q
- DP in ug/m3
- G is engine emissions, gm/min
- Q is airflow, cfm
- EFF is control efficiency, decimal.

1. Engine Emissions

- As engine emissions increases, DP increases.
- DP(2) = DP(1) x G(2) / G(1)

Engine Emissions

- Unit emissions are in gm/hp-hr, From ISO Test
- Multiply by horsepower and 60 for gm/hr
- Weighted Emissions = 0.65 x Rated Emissions

Engine Design

- Indirect Injection - 0.3 - 0.5 gm/hp-hr
- Old Direct Injection - 0.5 - 0.9 gm/hp-hr
- Electronic Injection - 0.1 - 0.4 gm/hp-hr

Emission Control Consideration

- Loader
  - 275 hp 100% use 0.2 gm/hp-hr
- Haul Truck
  - 350 hp 50% use 0.2 gm/hp-hr
- Transport
  - 300 hp 25 % use 0.1 gm/hp-hr

Emission Control Consideration

Vehicle-	gross gr/hr	net gr/hr	filtered gr/hr	
• LHD	35.75	35.75	7.15	F
• HT	45.50	22.75	18.20	O
• Trans	19.50	4.87	3.90	O
• Total	100.75	63.37	29.25	

(54 % Reduction)

2. Ventilation Rates

- 100 - 200 cfm/hp (M/NM)
- Particulate Index -
  - Airflow to dilute dpm to 1 mg/m3

Ventilation

- As ventilation increases, DP decreases.
- DP(2) = DP(1) x Q(1) / Q(2)

3. Control Technology Effect

- DP varies with amount of emissions remaining.
- DP(2) = DP(1) x (1 - Efficiency)
- (1-EFF1) x (1-EFF2) x (1-EFF3)...

Control Technology

Filters Environmental Cabs

Control Technology Efficiencies

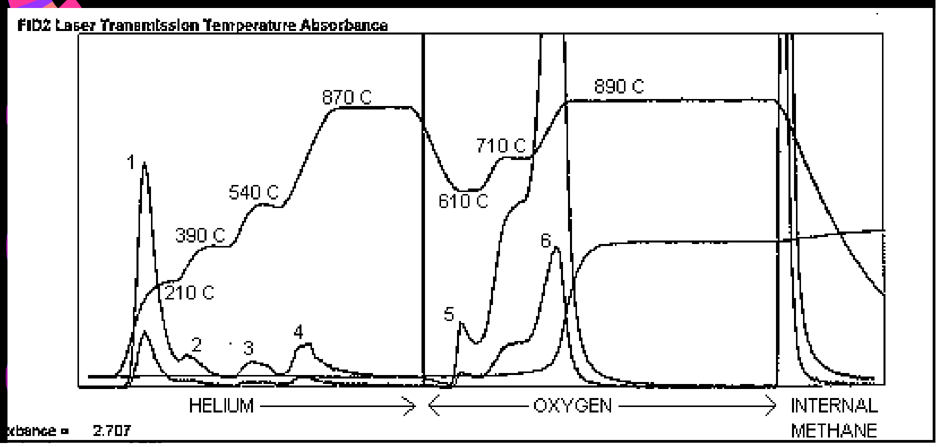
- Low Sulfur Fuel - 10 percent
- Oxidation Catalytic Converters - 0 to 20 percent
- Exhaust Filter - 65 to 95 percent
- Cabs - 50 to 80 percent

Combined Control Efficiency

- Fuel OCC Filters
- (1-0.1) x (1-0.2) x (1-0.8)
- 0.9 x 0.8 x 0.2 = 0.14
- Total Efficiency = 86%

DPM Sampler

Thermogram for a Respirable Dust with DPM Sample



Sample Locations

- Exhaust (Area)
  - Airflow and concentration give area emissions.
  - Used to establish emission control strategy.
- Personal / Occupation / Area
  - Shows whether local controls are adequate.

Control Technology

- C2 = C1 x Q1 x (1 - e) / Q2

or

- e = 1 - [(C2 x Q2) / (C1 x Q1)]

Control Technology

For an area exhaust of 600 ug/m3:

For 400 ug/m3 & 160 ug/m3

e = 33% and 73% @ same airflow

e = 0% and 60% @ 1.5 x airflow

Summary

- Provide airflow for gaseous emissions. Consider using PI.
- Use low sulfur fuel.
- Provide environmental cabs for production equipment.
- Filter highest emission / highest use vehicles.
- Use OCC's on other equipment.
- Keep drilling operations upwind of production equipment.

Summry

- Sample Wisely
- $100 US - Sampler + Analysis
- Sample Equipment
- Time