

# The DPM Estimator for Metal and Nonmetal Mines



# Metal and Nonmetal Diesel Particulate Rule

- Personal exposure limit:  
 $TC = OC + EC$  or,  
 $TC = 1.3 \times EC$
- Based on technological and economic feasibility

# Estimator Background

- Developed and published in proposed rule.
- Peer reviewed and published April 2000 in *SME Journal*.
- Posted on MSHA home page January 2001.
- Used by NIOSH to estimate technical feasibility of dpm level.

# Estimating Effect of DPM Controls Using Estimator

- Concentration is related to:
  - Engine Emission Rate
  - Ventilation
  - Operations (HP, Hours, Duty Cycle)
  - Filtration Efficiency

# How The Estimator Calculates DPM Concentrations After Controls Are Implemented

- Ventilation

$$DPM_{\text{AFTER}} = DPM_{\text{BEFORE}} \times [Q_1 / Q_2]$$

- Engine Emission Rate

$$DPM_{\text{AFTER}} = DPM_{\text{BEFORE}} \times [e_2 / e_1]$$

- Filter

$$DPM_{\text{AFTER}} = DPM_{\text{BEFORE}} \times (1 - n\%)$$

# Estimator Calculations

- Estimator simultaneously does the calculations for multiple controls on multiple pieces of equipment.
- Considers emissions, airflow, after-treatment (filtration or OCC) and cabs.

# General Design

- Excel Spreadsheet
- Two Input Options
  - In-mine DPM Concentration Data Available
  - Laboratory Tailpipe Emission Data Available

# General Design

- Excel Spreadsheet
- **Column A Option - Concentration Data**
  - Works well. The measurement works as a "calibration point".
  - MSHA analysis for 31 mines is based on concentration.
- **Column B Option - Emission Data**
  - Alternative when concentration data is not available.
  - Operational data must be estimated.
- Both enable "what if" simulations.

# Estimator Operation

- Input - Engine Emissions
- Input - Ventilation
- Input - Operations Data (HP, Hours, Duty Cycle)
- Input - Efficiency of Controls
- Output - Concentration of dpm based on controls applied.
- *Change controls and repeat until desired dpm concentration is achieved*

# Estimator Methodology

- Highest sample result used as basis for simulation
- Identify equipment involved (immediate vicinity and “upstream”)
- Three simulations for mine:
  - Baseline - existing conditions
  - Controls for 400 ug/m<sup>3</sup>
  - Controls for 160 ug/m<sup>3</sup>

# Diesel Control Strategies

- Performance oriented rule
- Operators wanted ability to pick and choose controls from “toolbox” that best suits operation
- Estimator gives flexibility to assess multiple control scenario
- MSHA made prudent choices when selecting DPM controls based on available data
- *MSHA doesn't claim they are the best or optimum choices !*

- Notes: 1. Several portable free-standing booster fans positioned as necessary  
2. Various low-HP maint. and support vehicles

