Instrumentation and Methods for Monitoring Concentrations of Particulates Emitted by Diesel Engines

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Why should we sample for DPM in underground mines?
Rules regulating exposure of underground miners to DPM

- Underground metal and nonmetal mines
  - 30 CFR Part 57.5060 - Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners;
  - Personal exposure limit, performance rule
- Underground coal mines
  - Emissions standard, prescribed solution
DPM sampling can help with estimating effectiveness of DPM control methodologies

<table>
<thead>
<tr>
<th>Method</th>
<th>DPF</th>
<th>DFE 1</th>
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<tr>
<td>EC HV</td>
<td>92</td>
<td>92</td>
<td>70</td>
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<td>TPM GRAV</td>
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<td>TPM TEOM</td>
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DPM sampling can help ensure the DPM control methods are working properly.
Form a sampling strategy prior to collecting any samples

- What question do you want answered?
- What type of samples do you need to collect?
- Where should you collect samples?
- Should you collect area or personal samples?
Choose the proper sampling instrumentation

- EC, TC, Total DPM

- Real time or time integrated

- Are gas measurements necessary?
What is Diesel Particulate Matter (DPM)?

- EC is solid carbon (measured by 5040)
- Total DPM includes all components (measured by mass)
Time integrated NIOSH 5040 samples

- Set pump flowrate for 1.7 lpm for 0.8 μm cutpoint
- It is important to check flowrate both before and after sampling.
- Probably use this methodology when checking to ensure compliance.
High Volume Sampling for total diesel particulate matter

- Uses a flowrate up to 11 lpm
- Gravimetric analysis of filter
Some monitors are currently available to measure particulate matter in real time

- Personal Data-Ram – Thermo Environmental
  - Light scattering technology (effective for 0.1 -10 μm particles)
Some monitors are currently available to measure particulate matter in real time

- Haz-dust 1004 – Environmental Devices Corporation
  - Allows real time and gravimetric sample collection
  - Real time measurements use a light scattering technology
Personal dust monitor (PDM) is currently being tested to measure diesel particulate in almost real time

- Thermo Environmental
- Measures total particulate matter as mass. Not EC
- Belt wearable combination cap lamp and diesel particulate monitor
- Displays on monitor
- Stores data in memory for several weeks
Personal EC Monitor is currently being tested to measure EC in almost real time

- Uses laser adsorption as a measure of EC concentration
Form a sampling strategy prior to collecting any samples

- What question do you want answered?
- What type of samples do you need to collect?
- Where should you collect samples?
- Should you collect area or personal samples?
DPM concentrations are a result of DPM entering mine plus DPM emitted in mine

- Background samples will measure the amount of DPM entering the working face
- Samples collected at the face will measure the amount of DPM to which miners are exposed.
- DPM emitted from the diesel equipment is the difference between background and working face measurements
Where should the samplers be located?

- Working face sampling
- Ventilation
- Intake
- Background sampling
What conclusion would we draw if we only did working face samples?
Is it better to collect personal or area samples?

- What question needs answered?

- To check for compliance a personal sample may be necessary.
  - Need shift information on a particular miner

- To check for effectiveness of control technologies than an area sample may be better choice
  - Need information on DPM concentrations in work area
Where should the samplers be located?

- Working face
- Area sample
- Ventilation
- Intake
- Background sampling
- Area sample
An example of an area sample
Personal monitoring
It is possible to measure DPM with currently available instrumentation

- Choose the reason for sampling.
  - Why is it necessary to sample for DPM?

- Develop a sampling strategy
  - What instruments?
  - Where to locate the samplers?
  - When to collect the samples?

- Implement the strategy with proper QA/QC
  - Calibrate
Thank you for your attention!!!

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