

Alternative Fuels Effects on DPM

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Alternative Fuels – Workshop Topic Overview

- ✱ Available diesel fuels
- ✱ NIOSH results from in-mine test
- ✱ Overview of biodiesel characteristics
- ✱ Biodiesel fuel supplier experience
- ✱ Experience with synthetic petrodiesel
- ✱ Discussion of mining industry experiences, issues, and solutions

General Features

- ✦ As a control alternative, fuel affects all vehicles
 - Mine- or section-wide deployment
 - Emissions reduced for ALL vehicles
 - No need to select target vehicles
- ✦ Engine brand-specific fuel system modifications might be necessary (doubtful)
- ✦ Storage and distribution system modifications may be needed
- ✦ High "business as usual" factor
- ✦ Issues with availability and cost



Available fuels

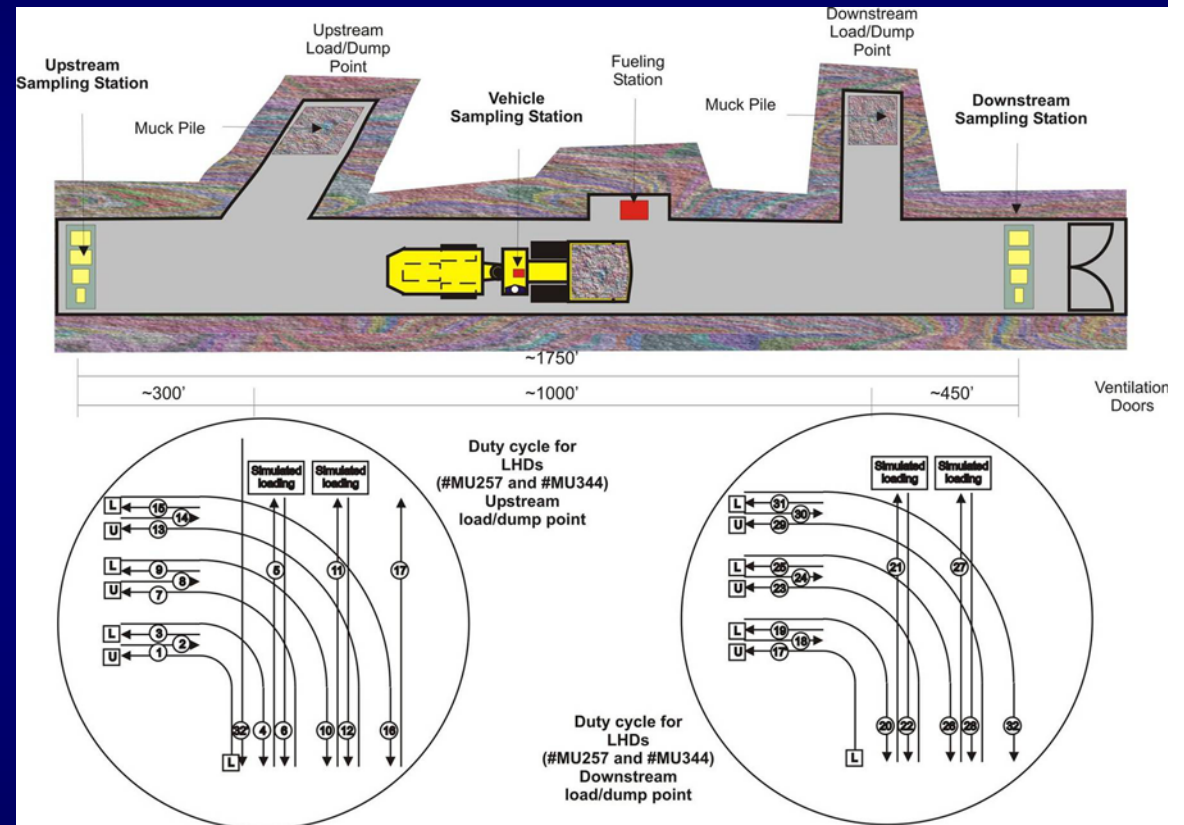
- ✦ Common diesel (petrodiesel) fuels
 - Dyed D2 or D1
 - Becoming ULSF if not already
 - Low in aromatics?
 - Must use additive (1% biodiesel) for lubricity
 - Jet fuels
- ✦ Synthetic “petrodiesel” fuel
 - ULSF, low or no aromatics
- ✦ Biodiesel (methyl esters)
 - B100
 - Blends with D2, B5 & B20
 - Variety of feedstocks
 - “Green” fuel
- ✦ Fuel-water emulsions
 - Lubrizol’s PuriNox no longer available

Fuel Additives

- ✦ In general avoid unnecessary fuel additives - unless
 - ✦ They contain no metals (excepting fuel borne catalysts to assist filter regeneration – a filter must always be used)
 - ✦ The claims are supported by rigorous experimental data – testimonials are not adequate
 - ✦ Have been “Okayed” by MSHA
 - ✦ Are EPA listed (but the listing does not guarantee health or effectiveness)

Fuel effects on DPM – In-mine test results

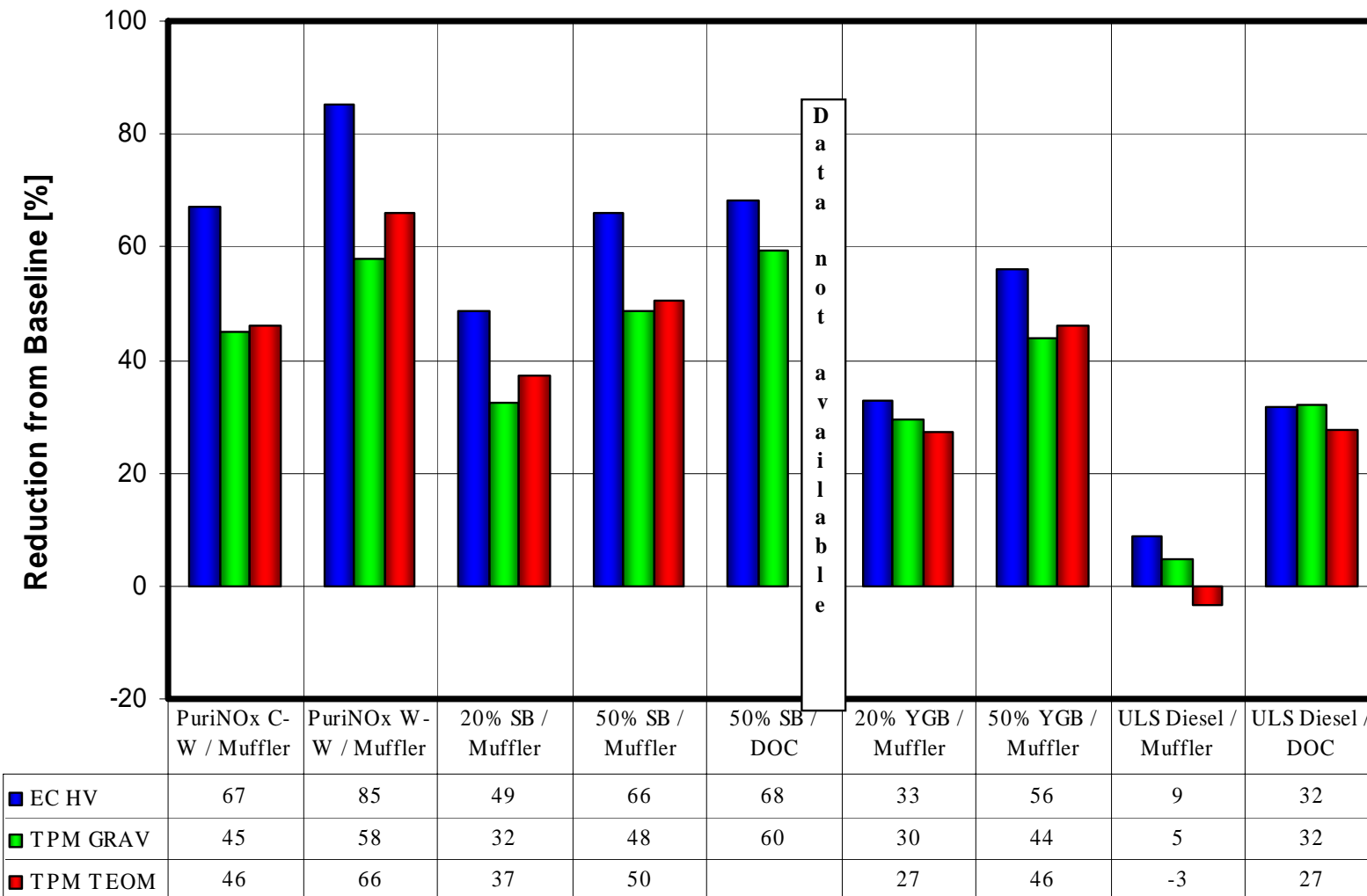
- NIOSH conducted isolated zone tests in 2004
- Realistic, repeatable operation of a single vehicle
- Fresh air contaminated only by test vehicle operation
- Simple & sophisticated measurements of DPM



Alternative Fuel Formulations Tested

- ✱ Biodiesel as B20 and B50:
 - ✱ Yellow grease;
 - ✱ Soy biodiesel.
- ✱ Water-in-diesel-fuel emulsions:
 - ✱ Hot-weather emulsion (77% #2 diesel, 20% water, 3% emulsifying agent).
 - ✱ Cold-weather emulsion (86% #2 diesel, 10% water, 2% methanol, 2% emulsifying agent).
- ✱ Synthetic ULSF diesel (GTL):
 - Extremely low sulfur content
 - Extremely low content of aromatics
 - High Cetane number

Effects of Alternative Fuels on Concentrations of EC and DPM – Stillwater August/September 2004 Study



Fuel Formulation Test Results – EC reductions

- ☀ Biodiesel as B20 and B50:

- Yellow grease, 33%, 56%
- Soy biodiesel, 49%, 66% (68% with DOC)

DPM loss results from the decrease in the number of larger, more massive particles with little or no increase small particle number.

- ☀ Water-in-diesel-fuel emulsions:

- Hot-weather emulsion, 85%
- Cold-weather emulsion, 67%

- ☀ Synthetic ULSF diesel

- 9%
- 32% with DOC

Summary

- ✿ Some alternative fuels can significantly reduce tailpipe emissions of DPM.
- ✿ The remaining presentations will address biodiesel and synthetic fuels.
- ✿ A discussion forum will follow the presentations.