DIESEL PARTICULATE FILTERS USED IN UNDERGROUND COAL MINES

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PARTICULATE FILTERATION THEORY

CHOICES FOR DPM REDUCTION

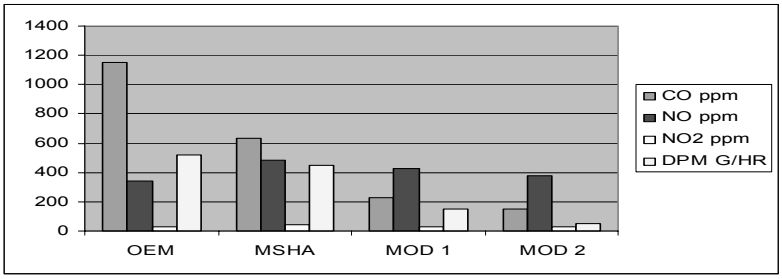
"THERE IS NO SILVER BULLET"

- Maintenance
- Cleaner Engines
- Diesel particulate filters (soot traps)
  - Passive
  - Active
- Disposable diesel particulate 'paper' filters
- New synthetic media filters

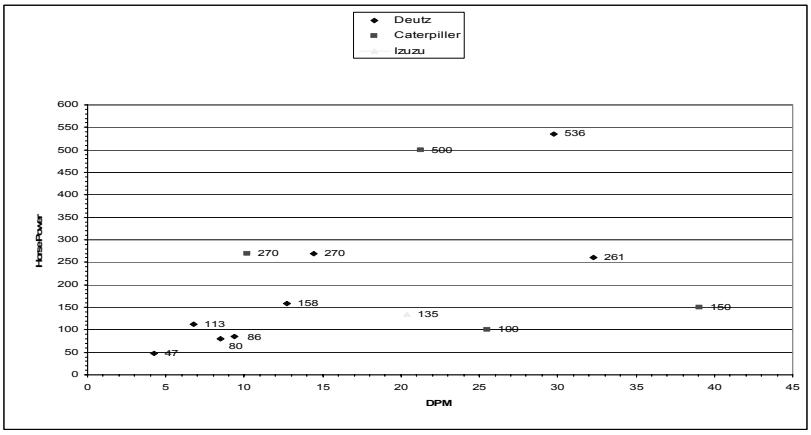
HOW BIG OF DIFFERENCE CAN MAINTENANCE MAKE?

- In 1997 CFC's fleet average concentrations of gases in raw exhaust were
  - 1597 ppm carbon monoxide
  - 997 ppm NO_x
- In 2003 CFC's fleet average concentrations of gases in raw exhaust are
  - 158 ppm carbon monoxide
  - 458 ppm NO_x

THE EFFECTS OF ENGINE TUNE ON THE EMISSIONS



Cleaner Engines



PASSIVE "Highly Catalyzed" SOOT TRAP

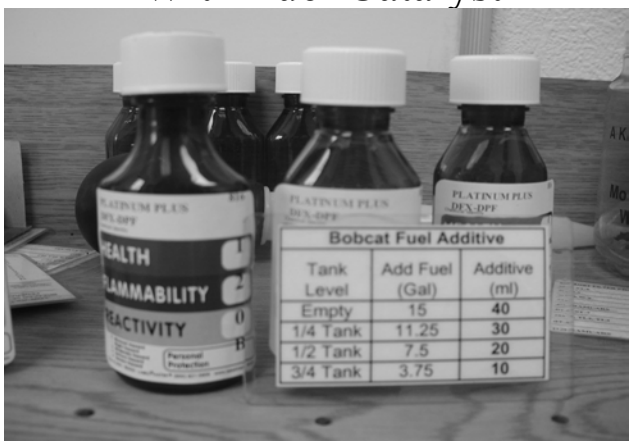
- The trap should regenerate itself
- The systems needs to be monitored for back pressure
- NO_2 might be a problem
- Relatively low cost

PASSIVE "Highly Catalyzed" SOOT TRAPS

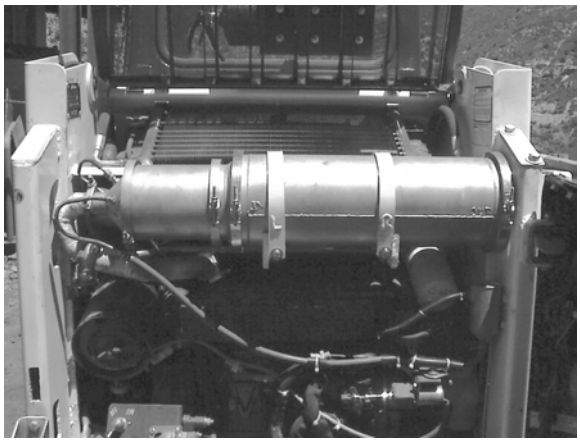
PASSIVE "Highly Catalyzed" SOOT TRAPS

- PIB 02-04 warning about NO_2 production from platinum catalyzed soot traps for both metal/non metal and coal mines
- PIB 02-07 notice for coal only! Traps shall not increase NO_2 emissions

Clean Air Lightly Catalyzed With Fuel Catalyst



Clean Air Lightly Catalyzed With Fuel Additive



ECS Base Metal “Cat Trap”

ACTIVE SOOT TRAP

- No NO_2 production
- Require space where filters can be regenerated safely
- Some systems will need a power supply
- Designed to trap soot during one or more shifts
- Relatively high cost

Active On-Board DCL

Active Off-Board ECS

Active Off-Board ECS

DCL New On-Board Design

DCL New On-Board Design

EVALUATION OF DPF SYSTEMS IN COAL MINES

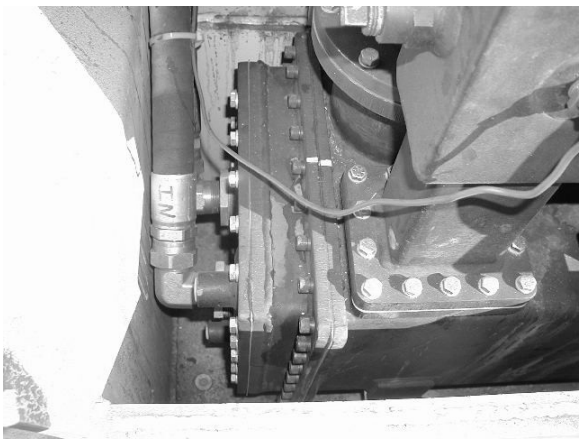
- Passive systems “Highly Catalyzed”
  - High NO2
- Active systems
  - No NO2 problems
  - Needs some way of regeneration
  - Can be used for one shift only
  - Need a place for regeneration

DISPOSABLE DIESEL PARTICULATE ‘PAPER’ FILTERS

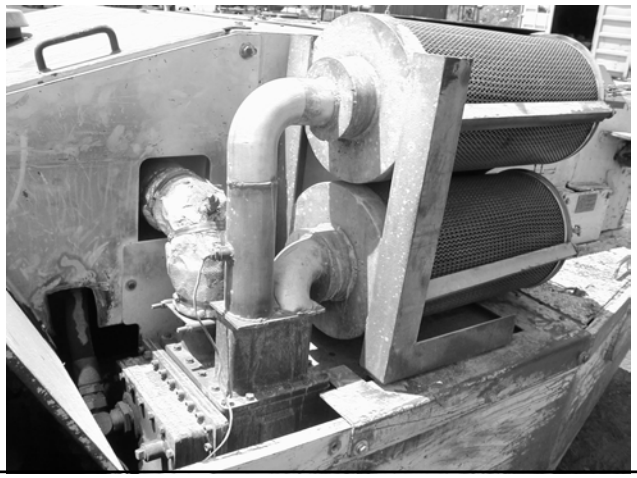
- Heat exchanger
  - Wet (water scrubber and make-up tank)
  - Dry (air-to-water)
- Filter holder + ‘paper’ filter element
- Water separator (optional)
- Designed for in-by coal vehicles
  - Exhaust temp. Requirements (cooled exhaust)
  - Surface temp. Requirements (water jacketed exhaust manifold)
- High installation cost

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS - DRY SYSTEM "DST"

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS – DRY SYSTEM "Getman"



DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS – DRY SYSTEM "Getman"



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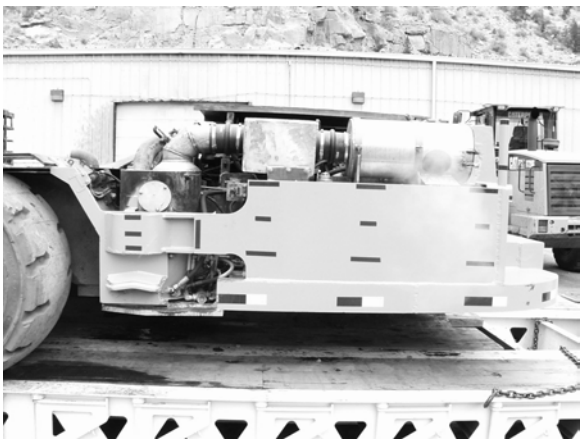
DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS - WET SYSTEM



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DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS

- Advantages
  - Relative simple to replace filter
- Disadvantages
  - Complex and expensive
  - Potential for fire
  - Short filter life
  - Wet system require maintaining water level in scrubber
  - Dry system require frequent heat exchanger cleaning

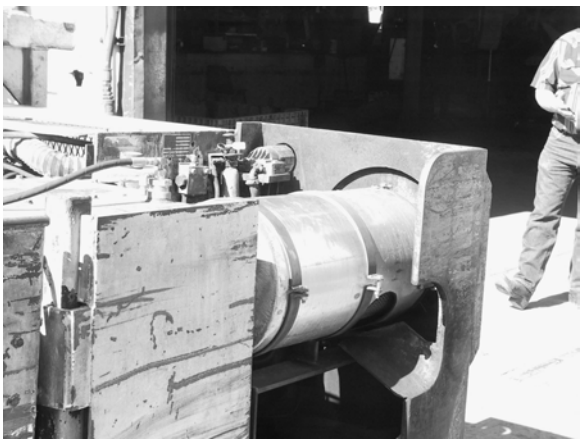
EVALUATION OF DISPOSABLE FILTERS

- Not all media has adequate properties
  - Most of the filters available on market are designed as air intake filters
- Tests showed low efficiency of certain filter media
  - Confusion
  - Use only verified media
- Fire hazard

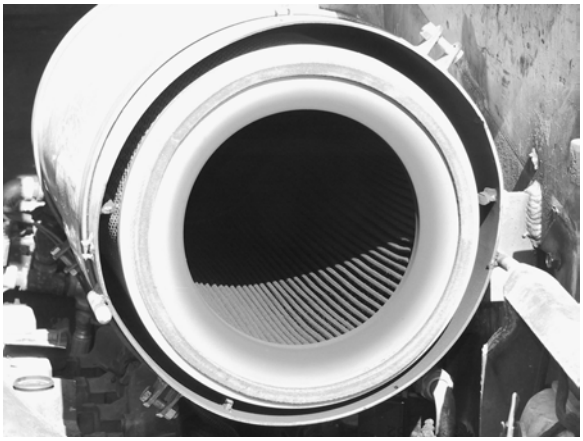
Disposable synthetic filters

- Non Combustible
- Not effected by water
- Cleanable
- Can be used in both in-by and out-by

Wet system (Cooled Exhaust) Permissible



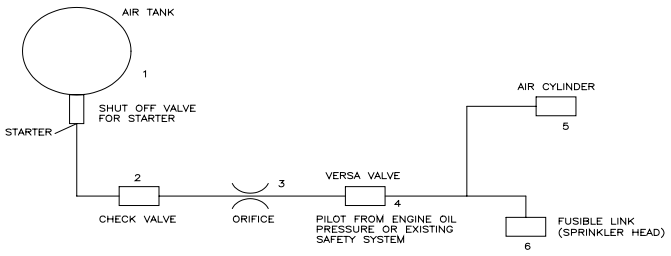
Un-cooled Exhaust
Heavy-Duty Out by



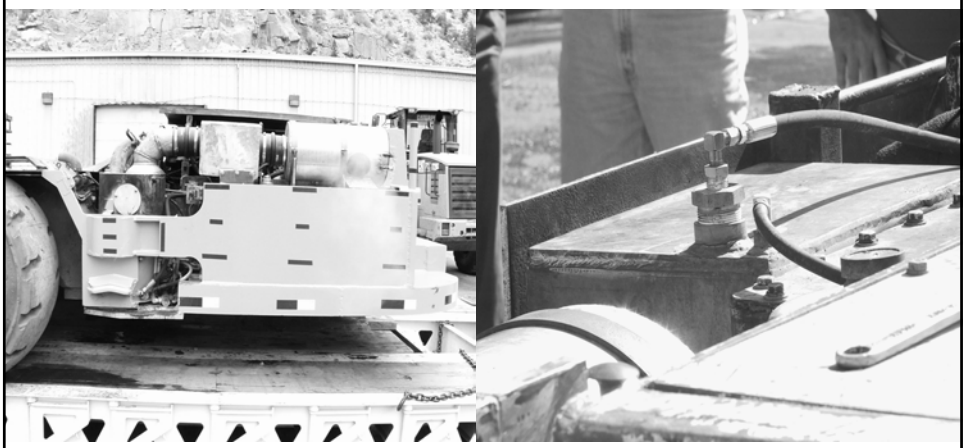
Disposable Synthetic Filter

Disposable Synthetic Filter

Secondary shut down system



Fusible Link shut down valve



RETROFITING DIESEL ENGINES OPERATED ON HIGH ELEVATIONS WITH DPFs

- **Naturally aspirated engines should be adjusted for altitude prior to retrofitting them with DPFs**
  - DPM and gaseous emissions are significantly affected by altitude
  - DPF system will be overwhelmed by DPM

Effect of Elevation on Electronic Controlled and Turbo Charged Engines

The jury is out. Will there be a derated and at what elevation and how much. Or does the ECM and turbo truly adjust for elevation. How much support if any will be given by the engine builders.

QUESTIONS?