

# DIESEL PARTICULATE FILTERS USED IN UNDERGROUND COAL MINES

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## PARTICULATE FILTRATION THEORY



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## 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

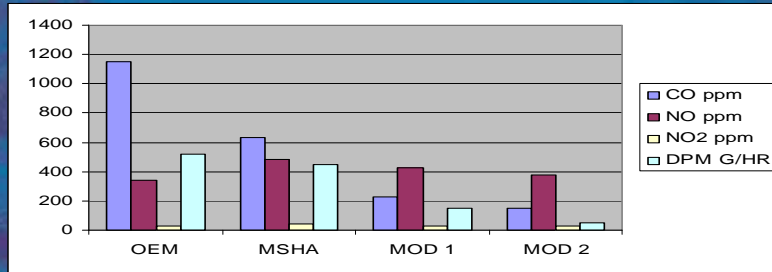
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## HOW BIG OF DIFFERENCE CAN MAINTENANCE MAKE?

- In 1997 CFC’s fleet average concentrations of gases in raw exhaust were
  - 1597 ppm carbon monoxide
  - 997 ppm NO<sub>x</sub>
- In 2003 CFC’s fleet average concentrations of gases in raw exhaust are
  - 158 ppm carbon monoxide
  - 458 ppm NO<sub>x</sub>

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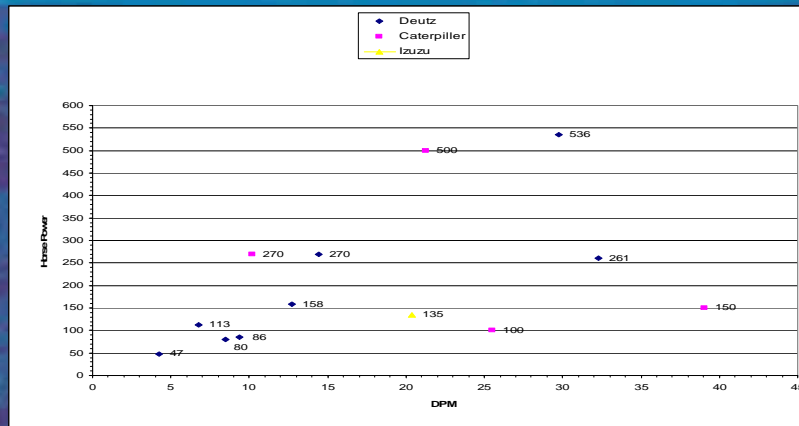
## THE EFFECTS OF ENGINE TUNE ON THE EMISSIONS



	OEM	MSHA	MOD 1	MOD 2
CO ppm	1152	632	230	150
NO ppm	340	480	428	380
NO2 ppm	28	45	30	28
DPM G/HR	52	45 ?	14	5.3

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## Cleaner Engines



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## PASSIVE “Highly Catalyzed” SOOT TRAP

- The trap should regenerate itself
- The systems needs to be monitored for back pressure
- NO<sub>2</sub> might be a problem
- Relatively low cost

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## PASSIVE “Highly Catalyzed” SOOT TRAPS



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## PASSIVE “Highly Catalyzed” SOOT TRAPS

- PIB 02-04 warning about NO<sub>2</sub> 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<sub>2</sub> emissions

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## Clean Air Lightly Catalyzed With Fuel Catalyst



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Clean Air Lightly Catalyzed  
With Fuel Additive



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ECS Base Metal “Cat Trap”



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## ACTIVE SOOT TRAP

- No NO<sub>2</sub> 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

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## Active On-Board DCL



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## Active Off-Board ECS



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## Active Off-Board ECS



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## DCL New On-Board Design



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## DCL New On-Board Design



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## EVALUATION OF DPF SYSTEMS IN COAL MINES

- Passive systems “Highly Catalyzed”
  - High NO<sub>2</sub>
- Active systems
  - No NO<sub>2</sub> problems
  - Needs some way of regeneration
  - Can be used for one shift only
  - Need a place for regeneration

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## 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

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



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



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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

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## 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

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## Disposable synthetic filters

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

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## Wet system (Cooled Exhaust) Permissible



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## Un-cooled Exhaust Heavy-Duty Out by



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## Disposable Synthetic Filter



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## Disposable Synthetic Filter



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## RETROFITTING 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

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## 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.

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QUESTIONS?

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