

Laboratory Investigations of DPM Control Devices

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TOPICS TESTS

- LABORATORY & ASSISTANCE
- PAPER/SYNTHETIC FILTERS
- CERAMIC TRAPS & DOCs
- RENTAR – INLINE FUEL CATALYST
- ECOMAX – MAGNETIC TREATMENT
- FUEL PREPARATOR
- MAGANAS – CATALYTIC CONVERTER

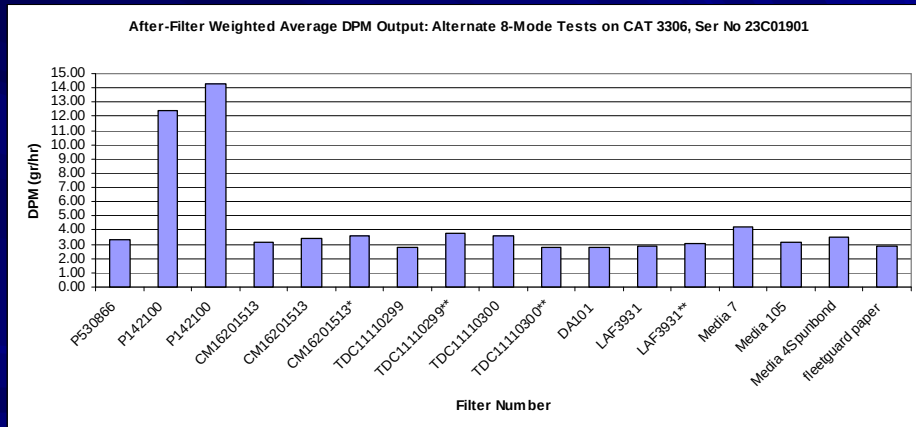
LAB & ASSISTANCE

- MSHA LAB
 - 1000 HP CAPABILITY – STEADY STATE
 - HORIBA GAS ANALYSIS
 - SIERRA BG2 – DPM GRAVIMETRIC ANAL.
 - HIGH ALTITUDE SIMULATIONS
- NIOSH – NIOSH 5040 ANALYSIS
- MSHA PITTSBURGH RESEARCH CTR
 - DUST ANALYSIS
 - BAG SAMPLES

Disposable Filters: Testing Setup



Paper/Synthetic Filter Tests

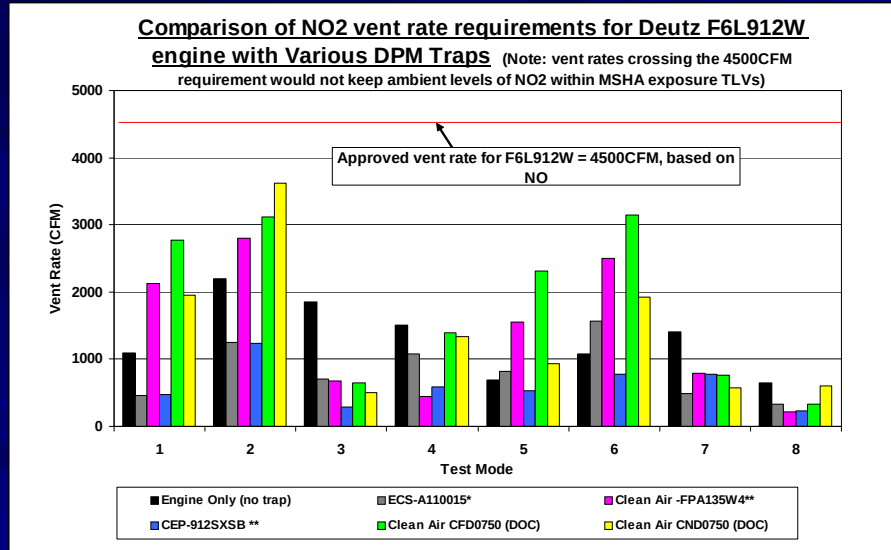


DPM Traps: Testing Setup

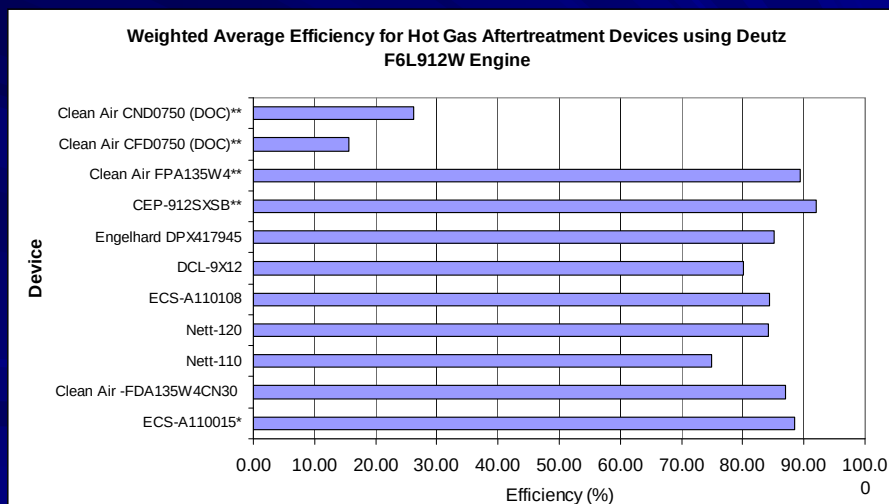


NO₂ Emission from Pt Traps

"Low" Lev of No₂ Emissions (light Pt, Base metal, uncatalyzed, DOCs)



DPM Efficiency from Hot Gas Devices



Paper/Synthetic Filter & Ceramic Trap Availability

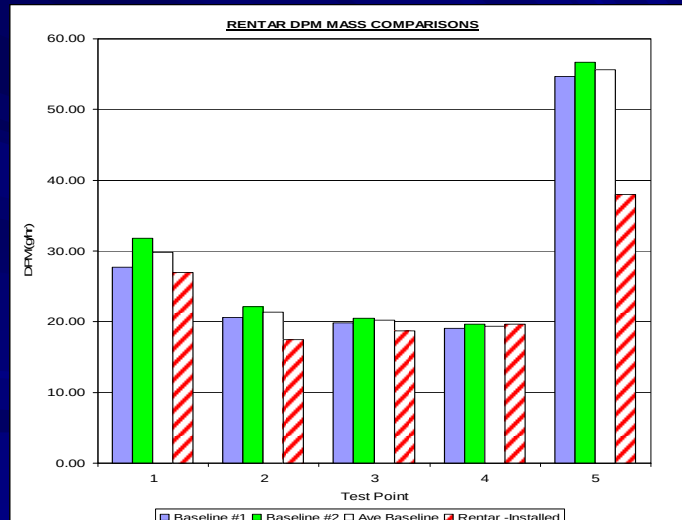
- <http://www.msha.gov/01-995/Coal/DPM-FilterEfflist.pdf>
- 10 Filter Mfgs/vendors – 2 Dozen plus models
- 6 ceramic Traps Mfgs – 1 Dozen plus models

Rentar Inline Fuel Catalyst

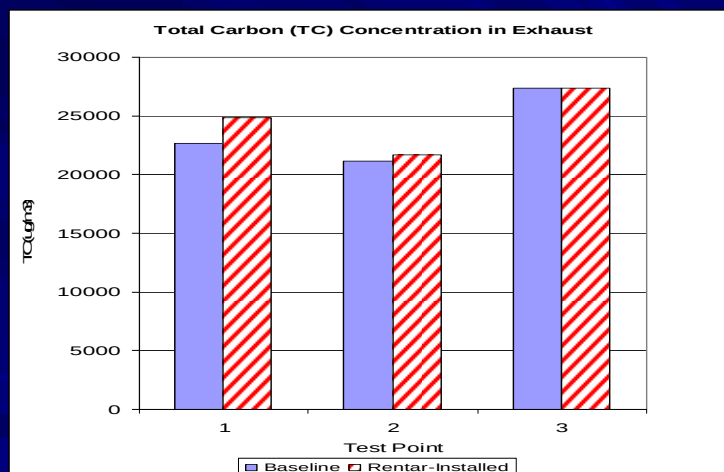


- Tested at full throttle
 - 100 % load
 - 75 % load
 - 50 % load
 - 30 % load
 - 10 % load
- 225 KW Genset

Rentar – dpm Gravimetric Results



Rentar – NIOSH 5040

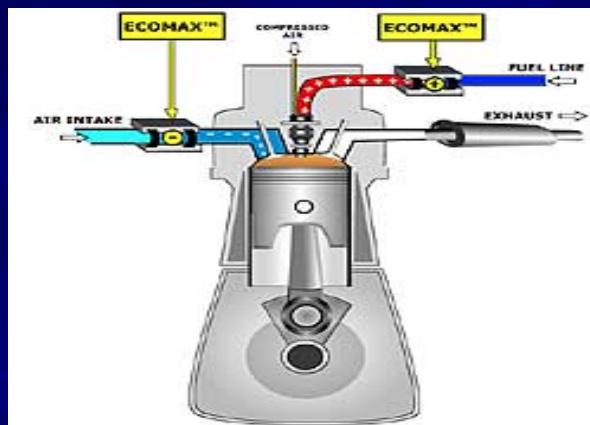


Rentar Summary Results

- No significant change to dpm
- No significant change to gaseous emissions
- No significant change to fuel consumption

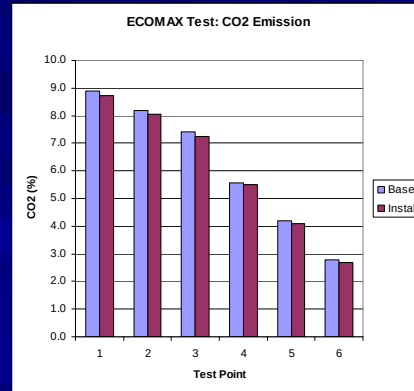
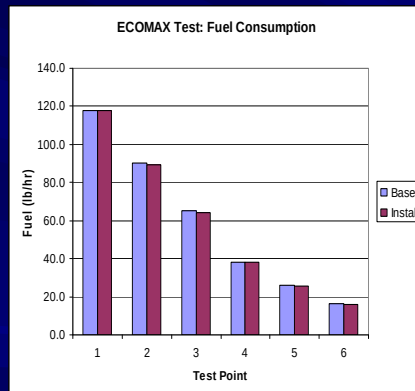
Ecomax

http://www.ecomaxtm.com/Download/MSHA_Brochure.pdf

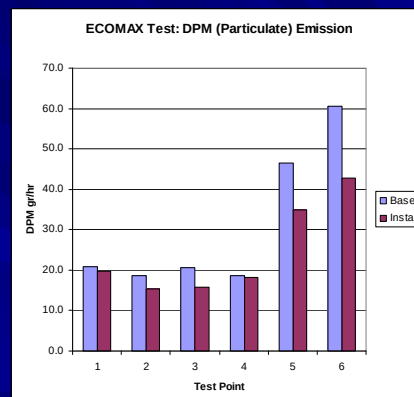
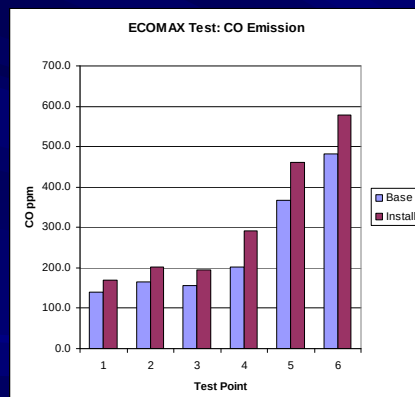


- Tested at full throttle
 - 100 % load
 - 75 % load
 - 50 % load
 - 25 % load
 - 10 % load
 - 0 % load
- 225 KW Genset

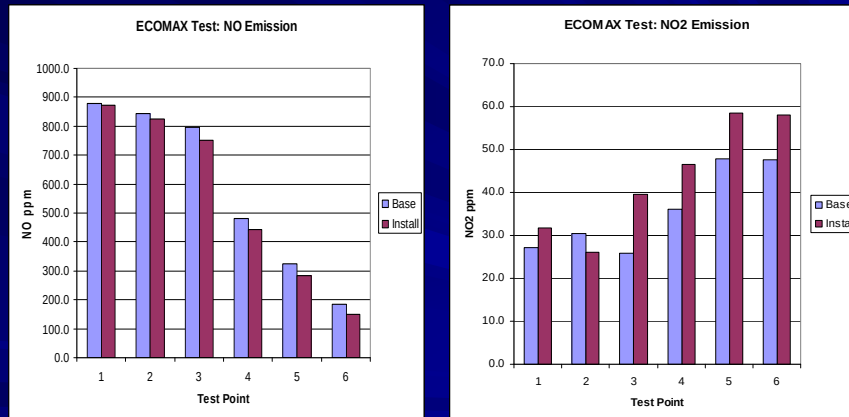
Ecomax Fuel & CO2 Results



Ecomax – CO & dpm Results



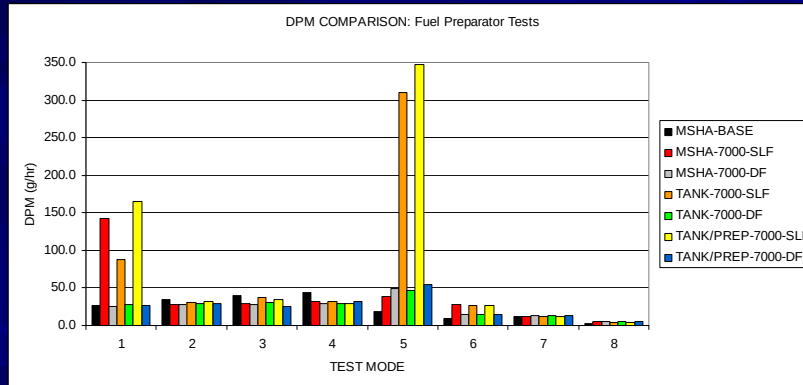
Ecomax NO/NO2 Results



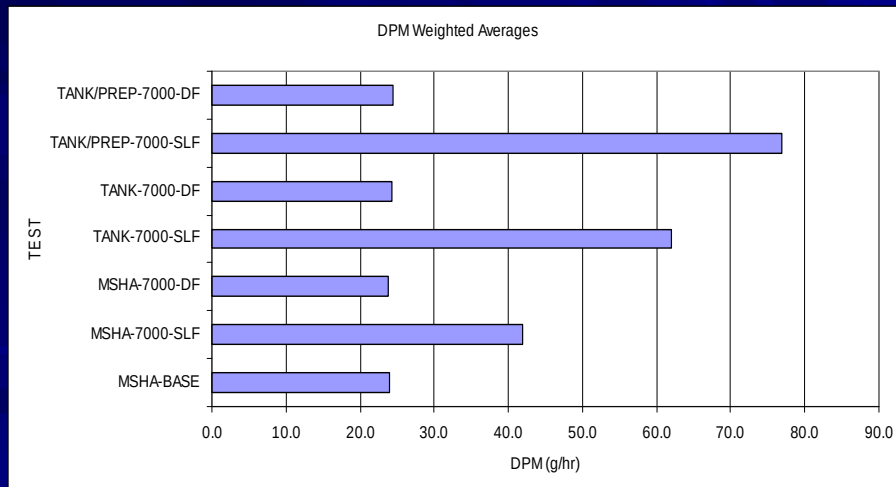
Fuel Preparator

- Added to fuel inlet line to filter and remove air and vapor bubbles from fuel
- Tested on dynamometer using ISO 8178 tests
- Tested baseline at 1000 ft elevation and simulated 7000 ft elevation with and without fuel deration
- Mfg installed extra pump in fuel tank to simulate use in machine

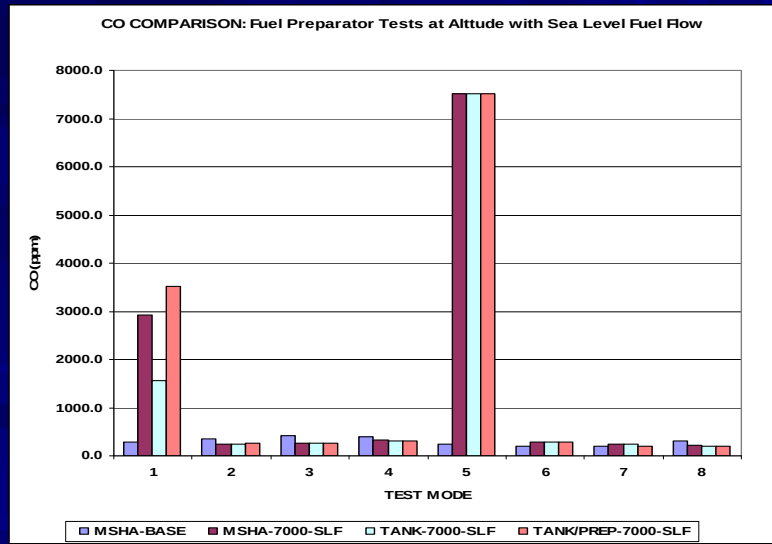
Fuel Preparator – dpm Results



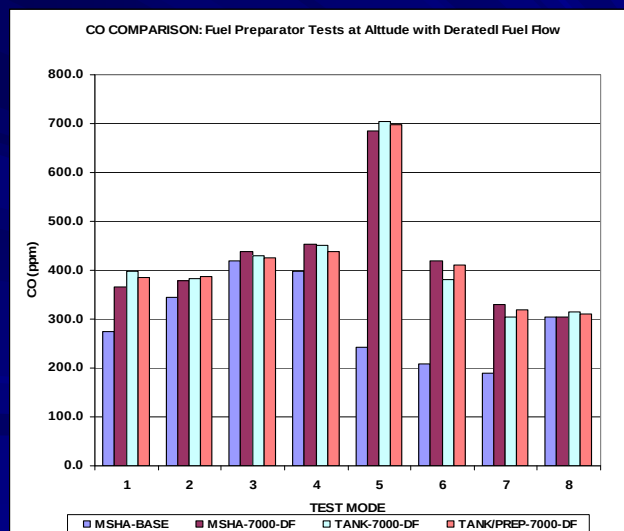
Preparator – dpm wgt avgs.



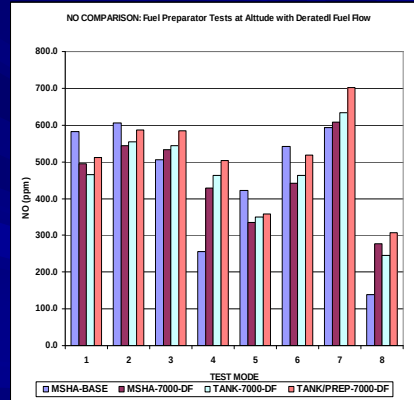
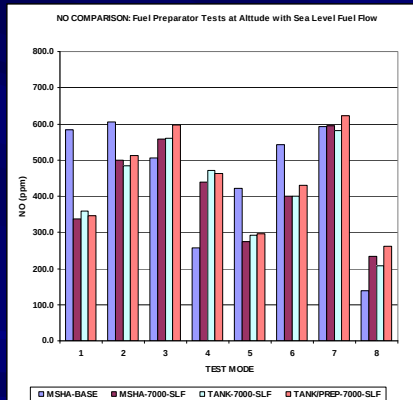
Preparator – CO Results



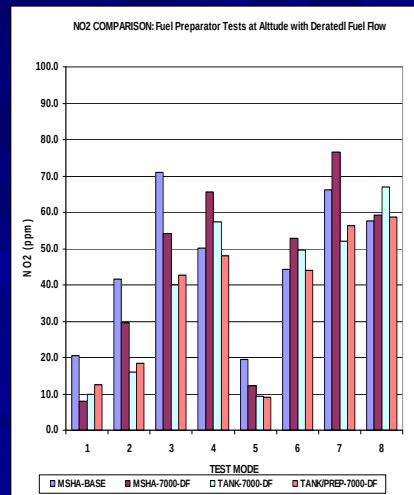
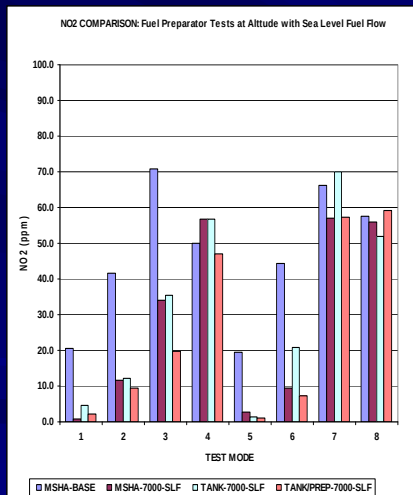
Preparator – CO Results



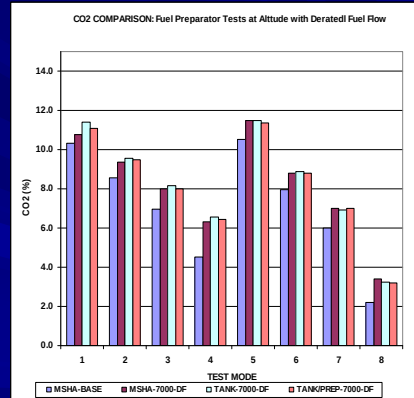
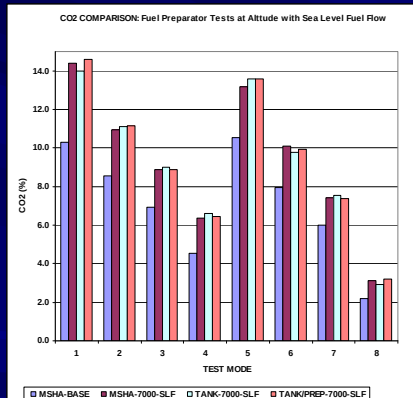
Preparator – NO Results



Preparator – NO2 Results



Preparator - CO2 results



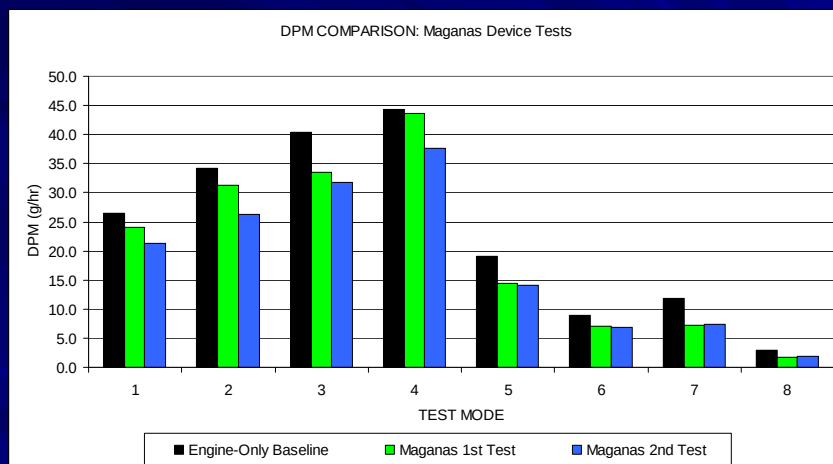
Preparator

■ No significant effect on diesel emissions

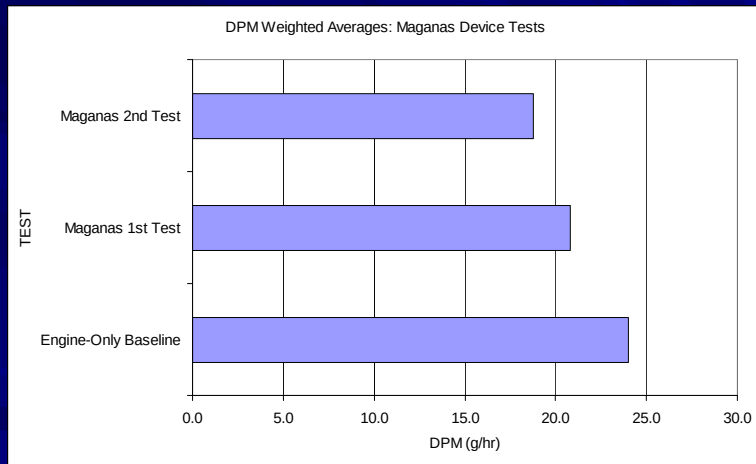
Maganas Catalytic Converter Fluidized Bed



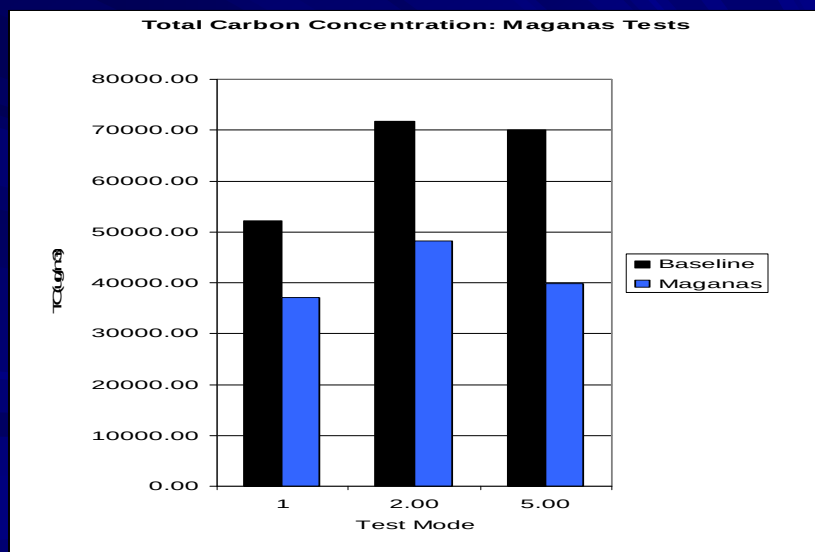
Maganas dpm Results



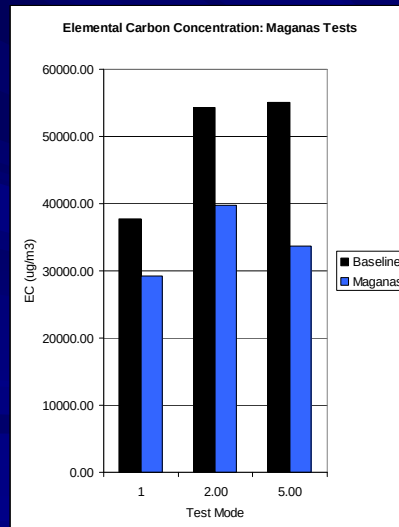
Maganas dpm Results



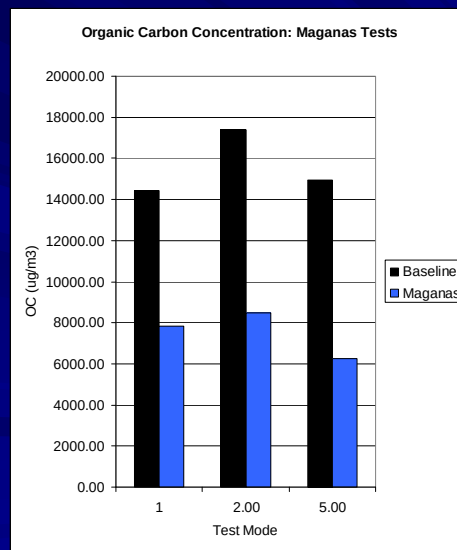
Maganas – NIOSH 5040 Total Carbon results



Maganas – NIOSH 5040 Elemental Carbon Results



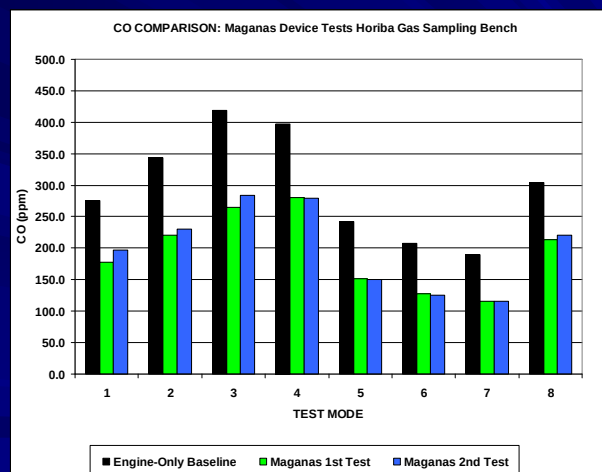
Maganas – NIOSH 5040 Organic Carbon Results



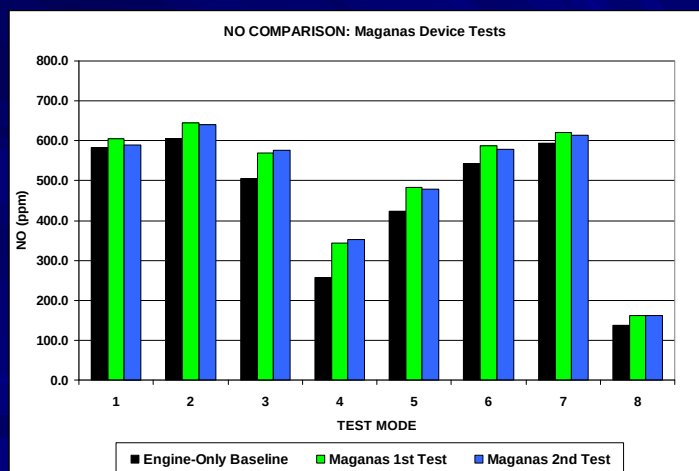
Summary Maganas

- Using weighted average mass output of the engine-only and the engine with the device installed, DPM filtering efficiencies were 13.3% and 21.7%. EC/OC analysis showed organic carbon reduction averaging around 50%, while the element carbon reduction averaging around 29% (total carbon reduction averaged ~35%)

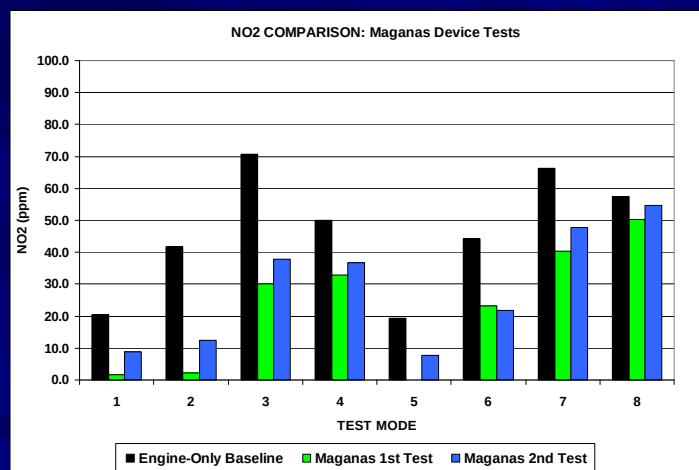
Maganas – CO Results



Maganas – NO Results



Maganas – NO₂ Results



Summary

- Paper/Synthetic Filters reduce dpm 85 – 95%
- Ceramic Traps reduce dpm 85 – 90%
- Pre-treatment device test results showed little or no improvement in emissions
- We will be posting reports discussed on MSHA.gov in future
- Email – setren-robert@msha.gov
- Questions