

Impact of Fuel-Borne Catalysts on Diesel Aftertreatment

David Human

DEER Conference
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A thick yellow horizontal line spans the width of the slide near the bottom.

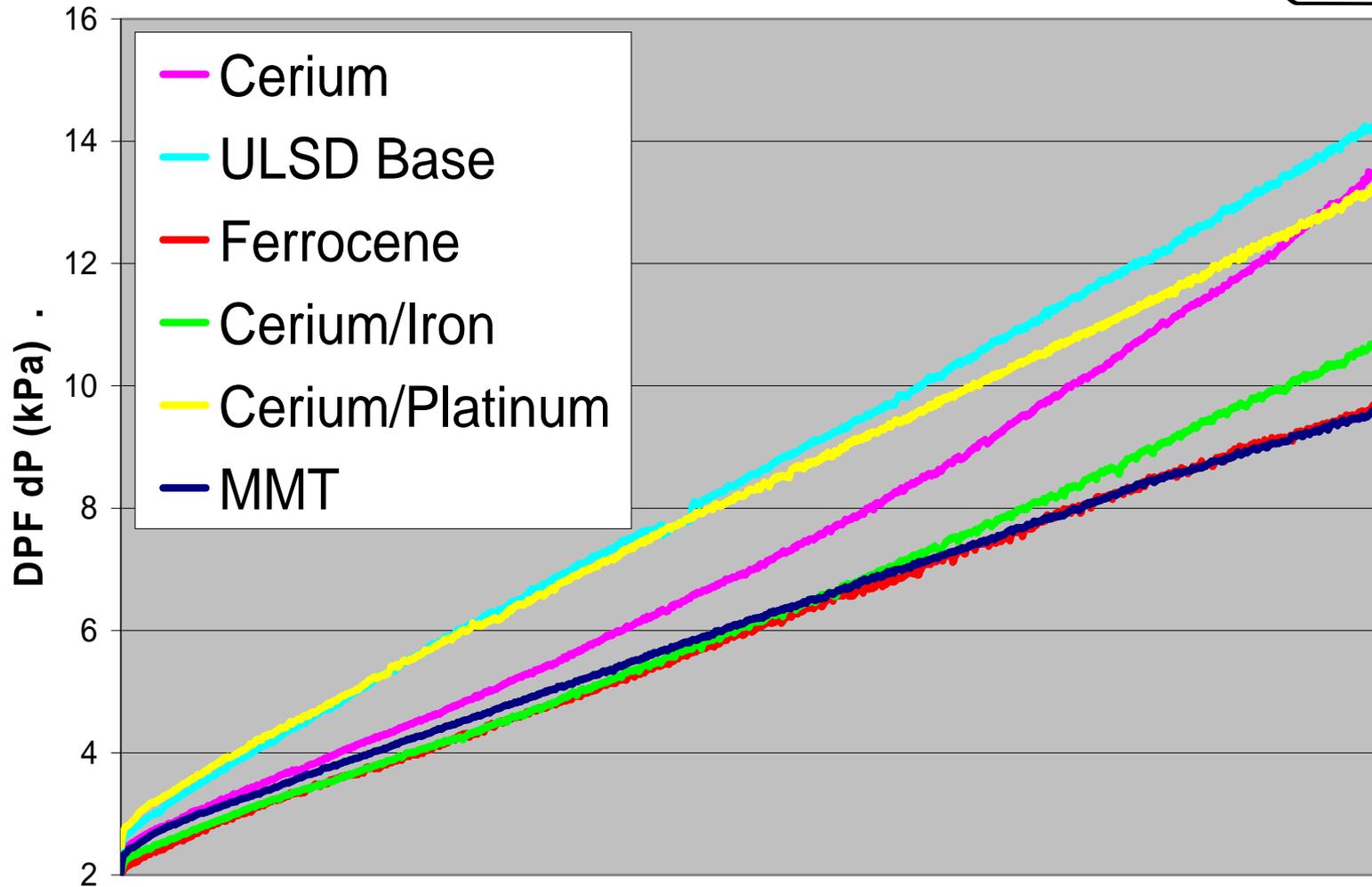
MMT Additive for Improved Performance of Diesel Aftertreatment Systems

Ethyl

- Diesel Particulate Filter (DPF) with Several Fuel-Borne Catalysts
- Catalyzed DPF Project with Cummins
- Field Test Data
- Diesel NOx Adsorber Catalyst (NAC)
- Summary

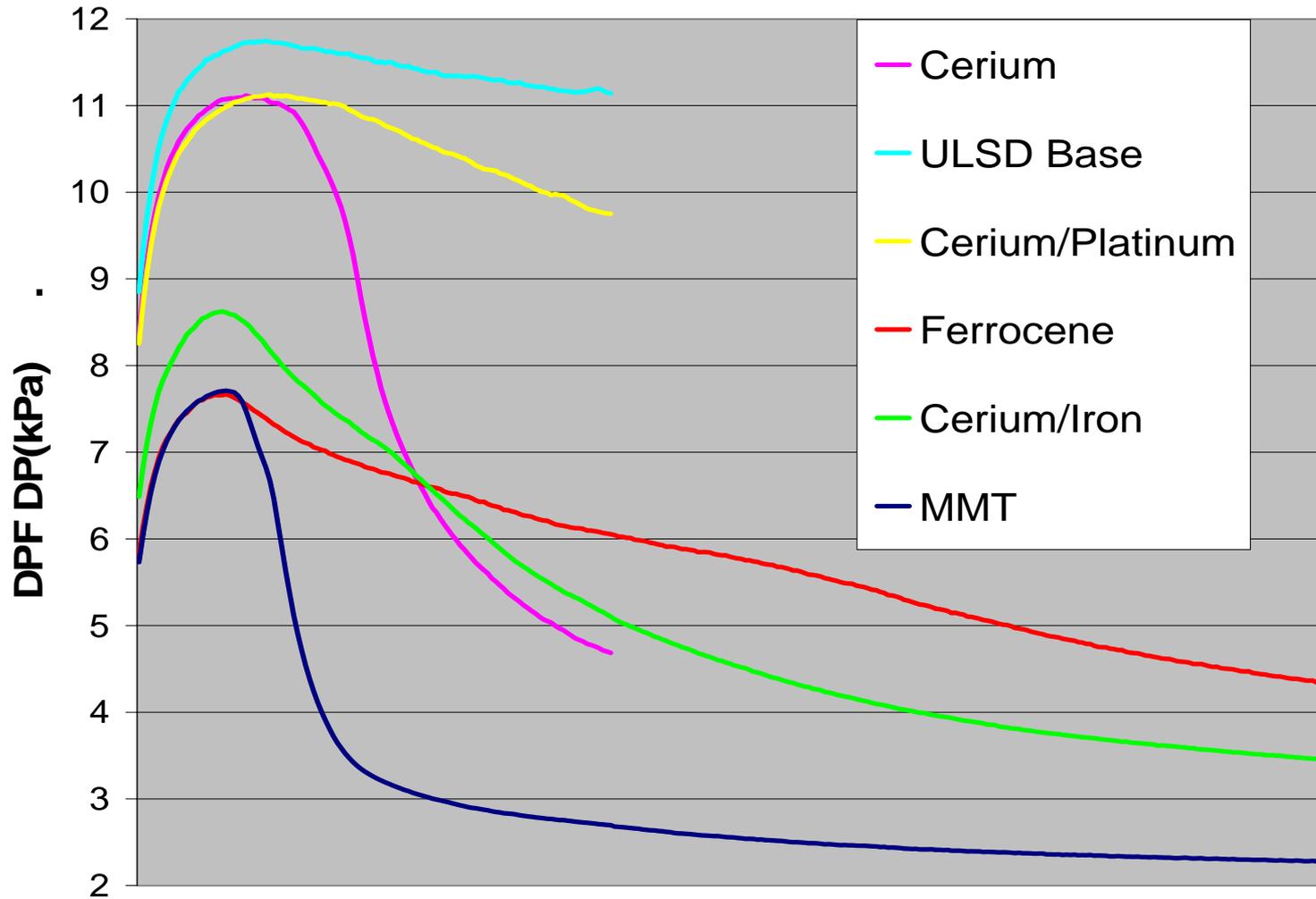
M11 Steady-State Load-up Mode

Ethyl



M11 - 380C Regeneration Mode

Ethyl



Cummins ISB 5.9 in Test Cell

Ethyl

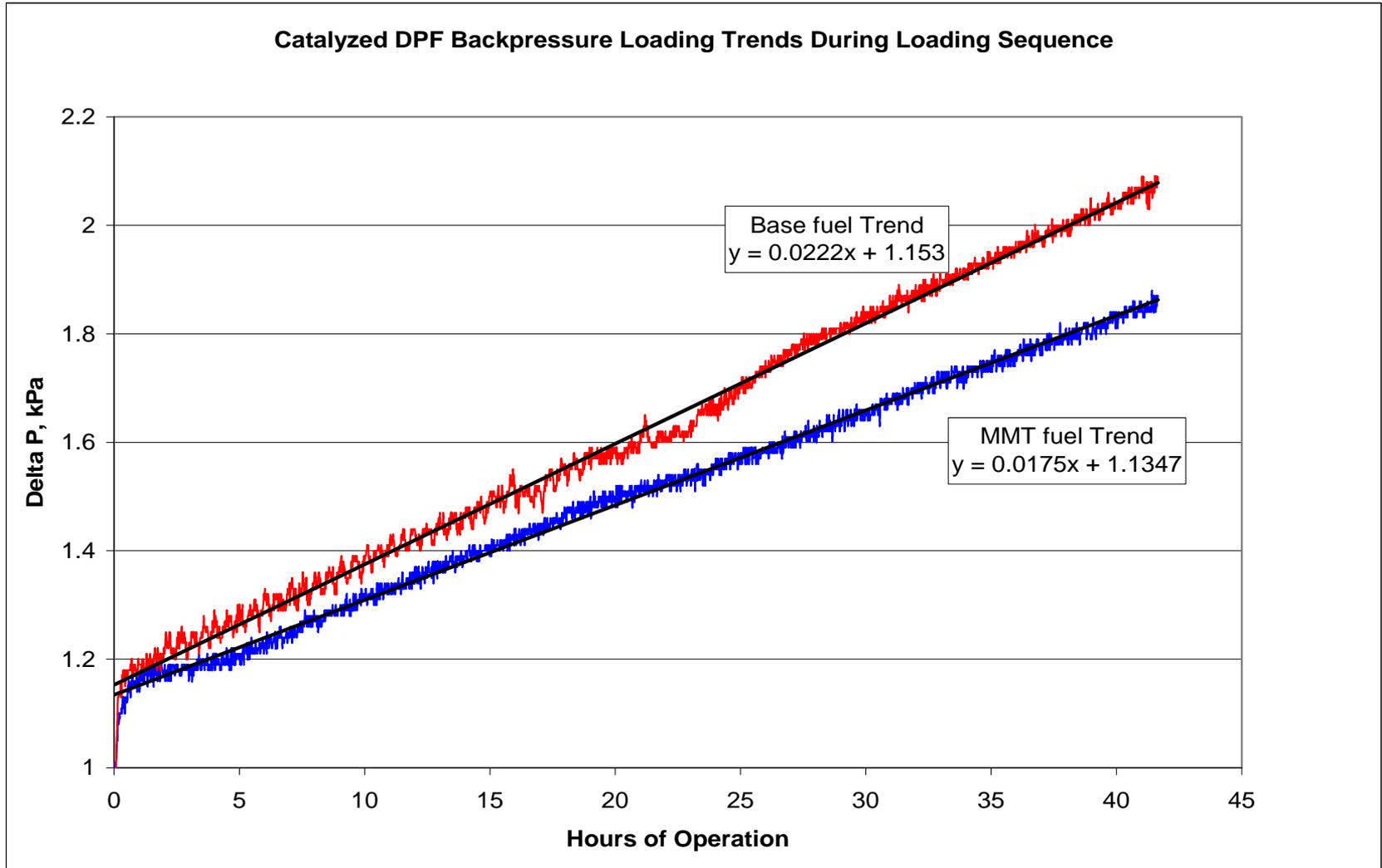


Diesel Aftertreatment Rack

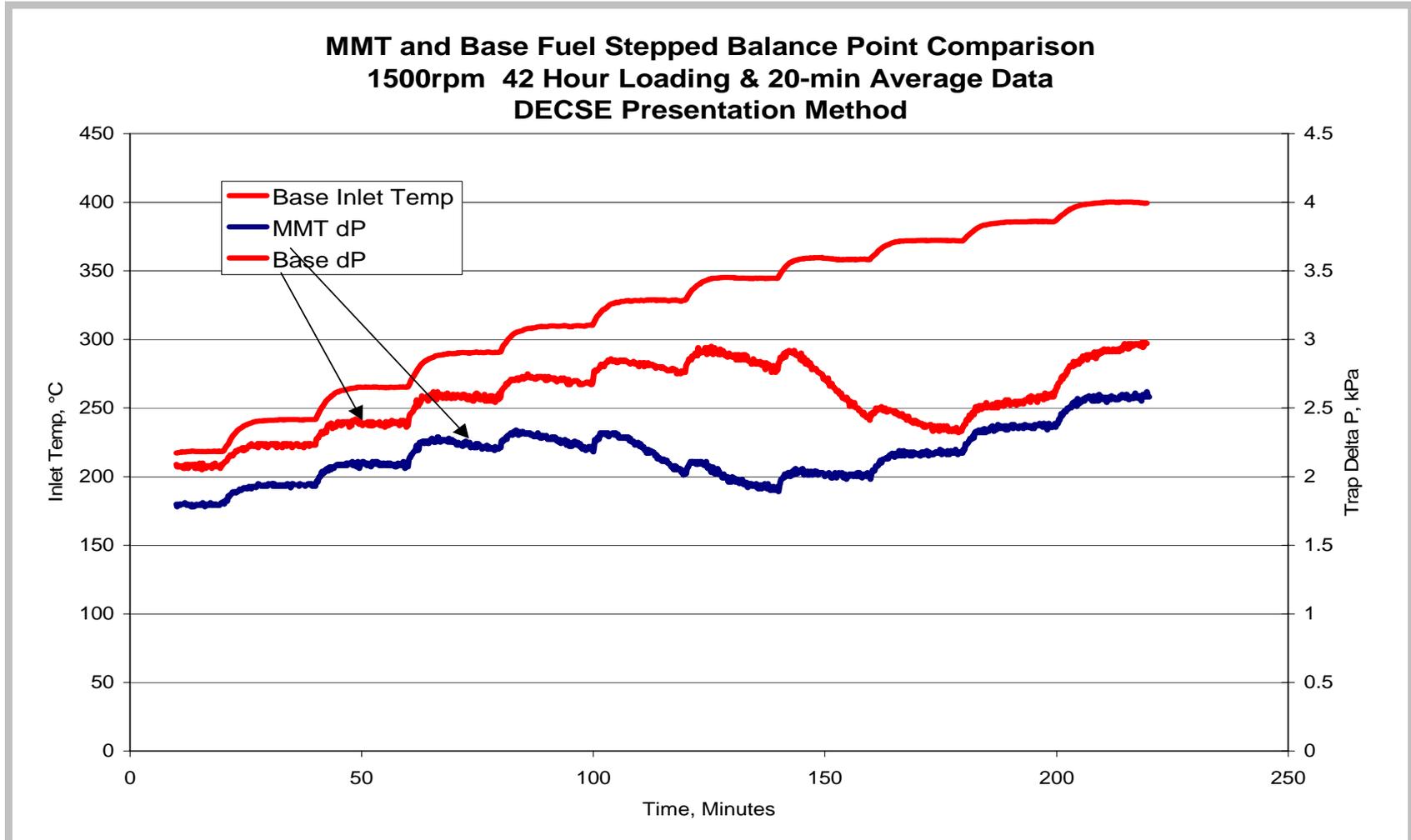
Ethyl



Cummins ISB Steady-State DPF Loading



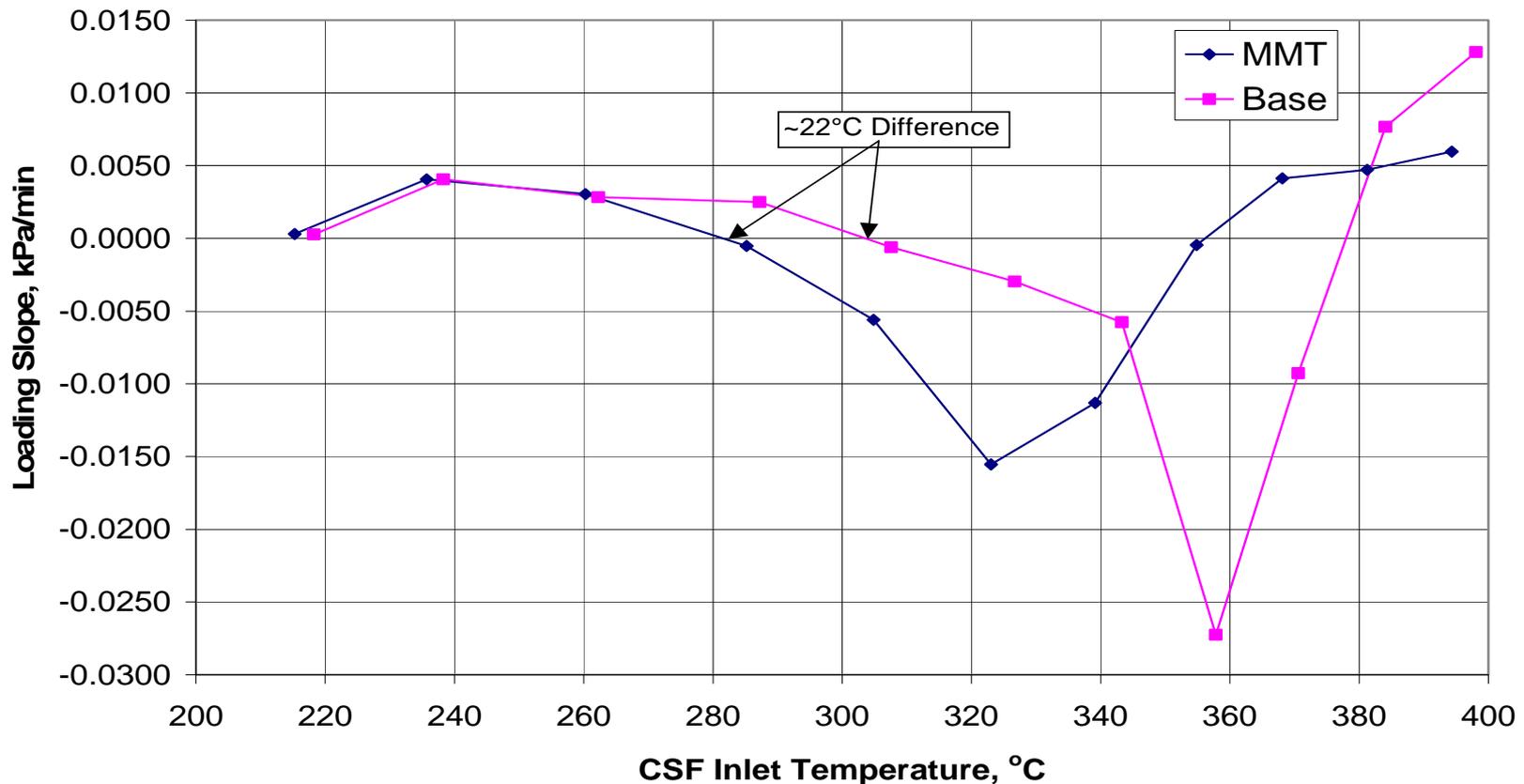
Stepped Balance Point Temp Test



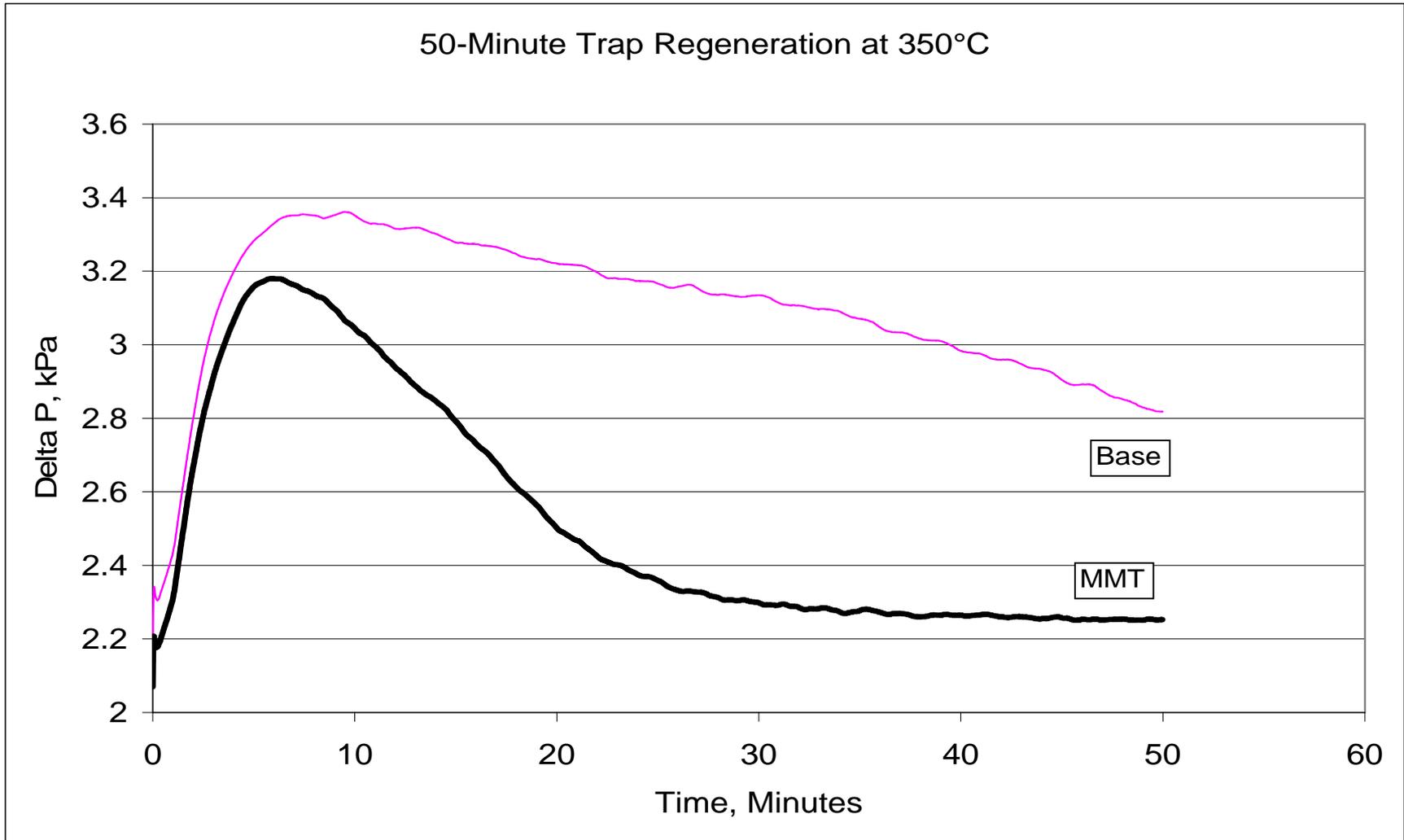
Balance Point Slope Plot

Ethyl

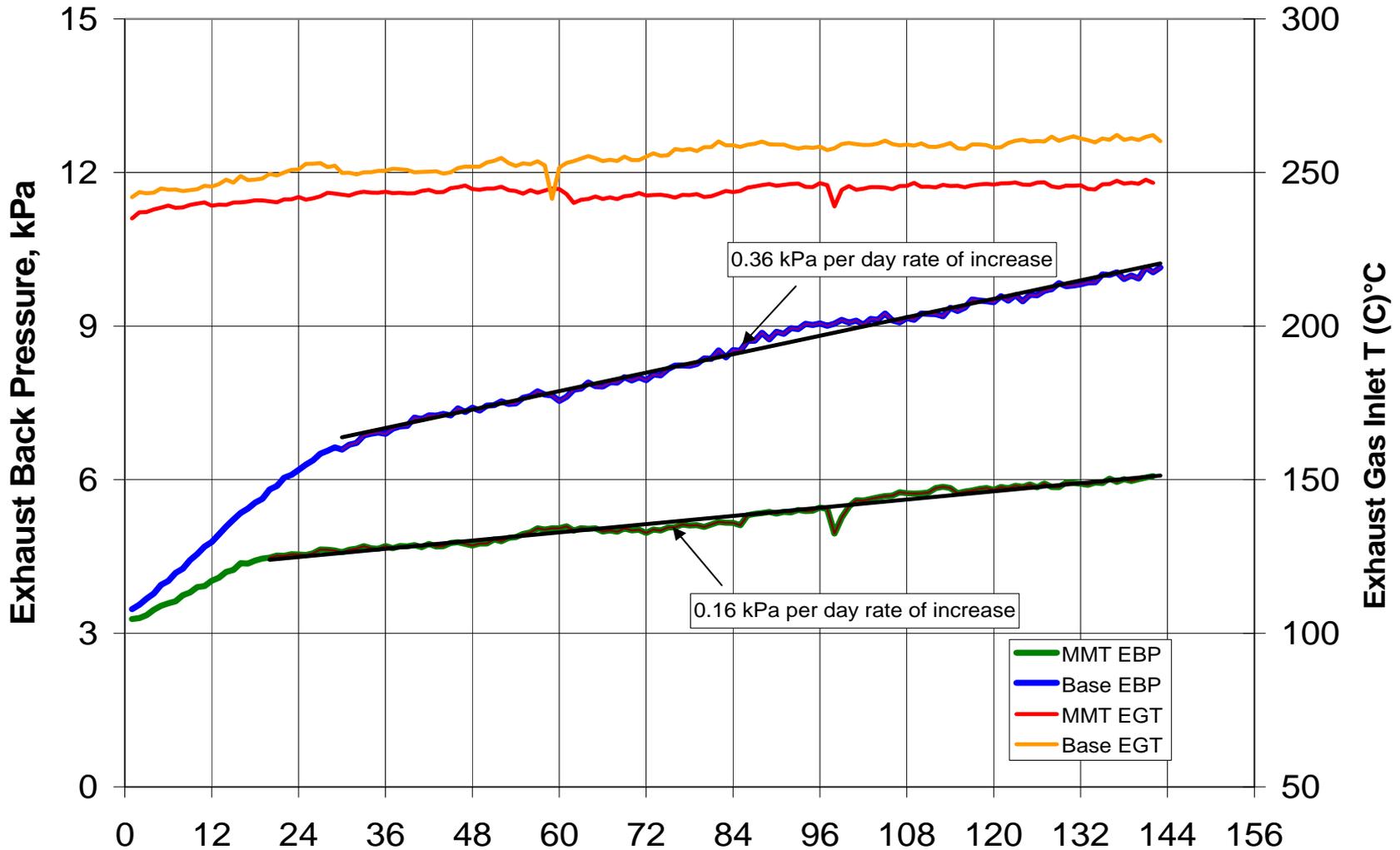
MMT and Base Fuel Stepped Balance Point Comparison
1500rpm 42 Hour Loading & 20-min Average Data
Cummins Differential Presentation Method



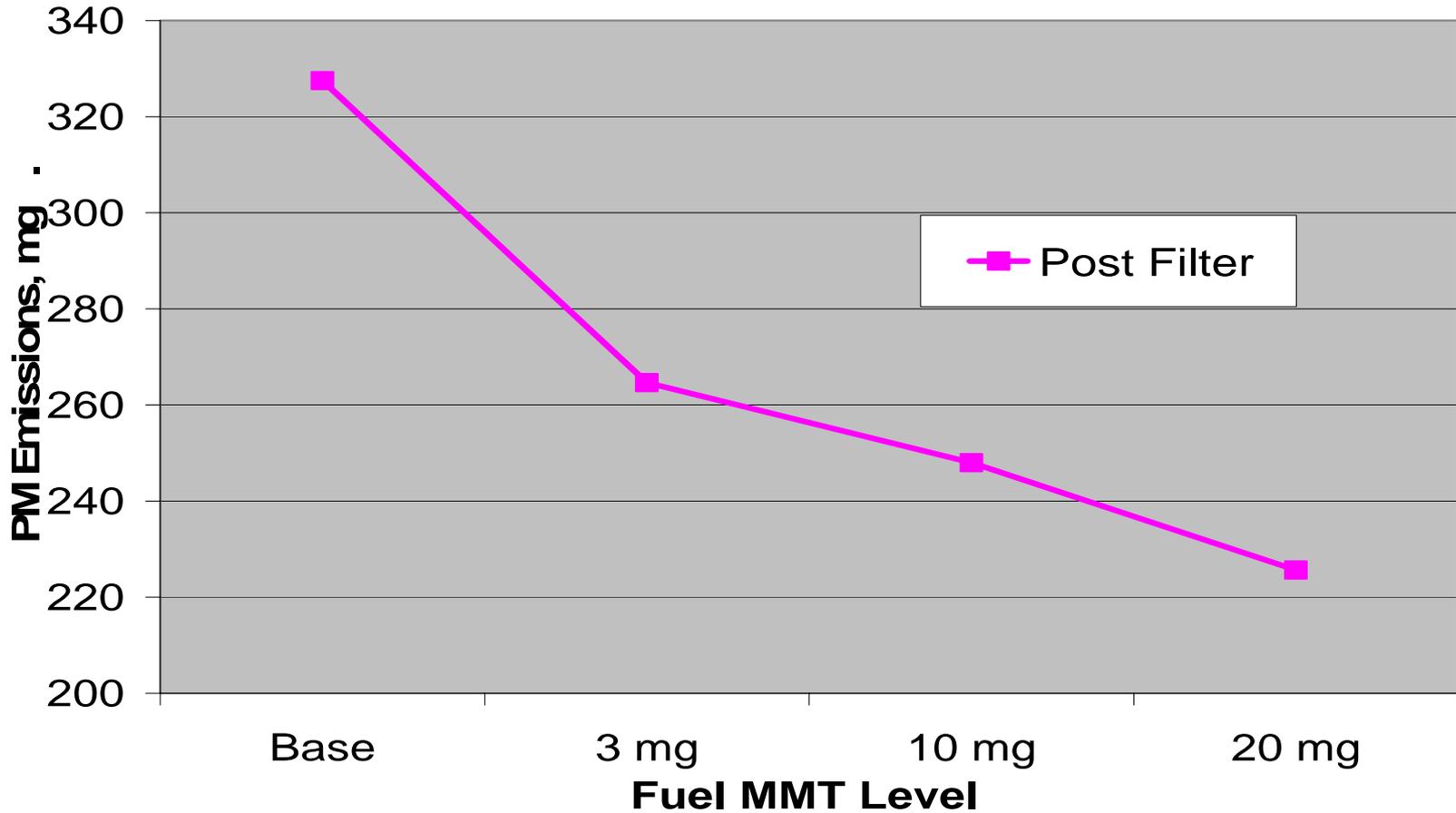
Steady-State Regeneration Mode



Cummins (Bus) Transient Cycle Loading



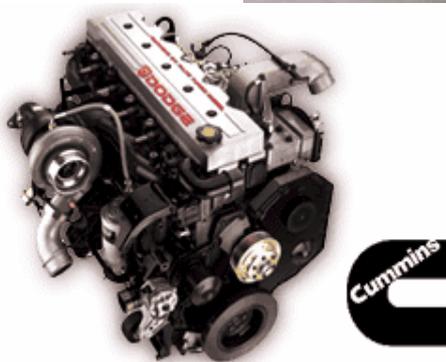
PM Emissions – Transient Cycles



No Mn is emitted at the tailpipe when using MMT with a DPF

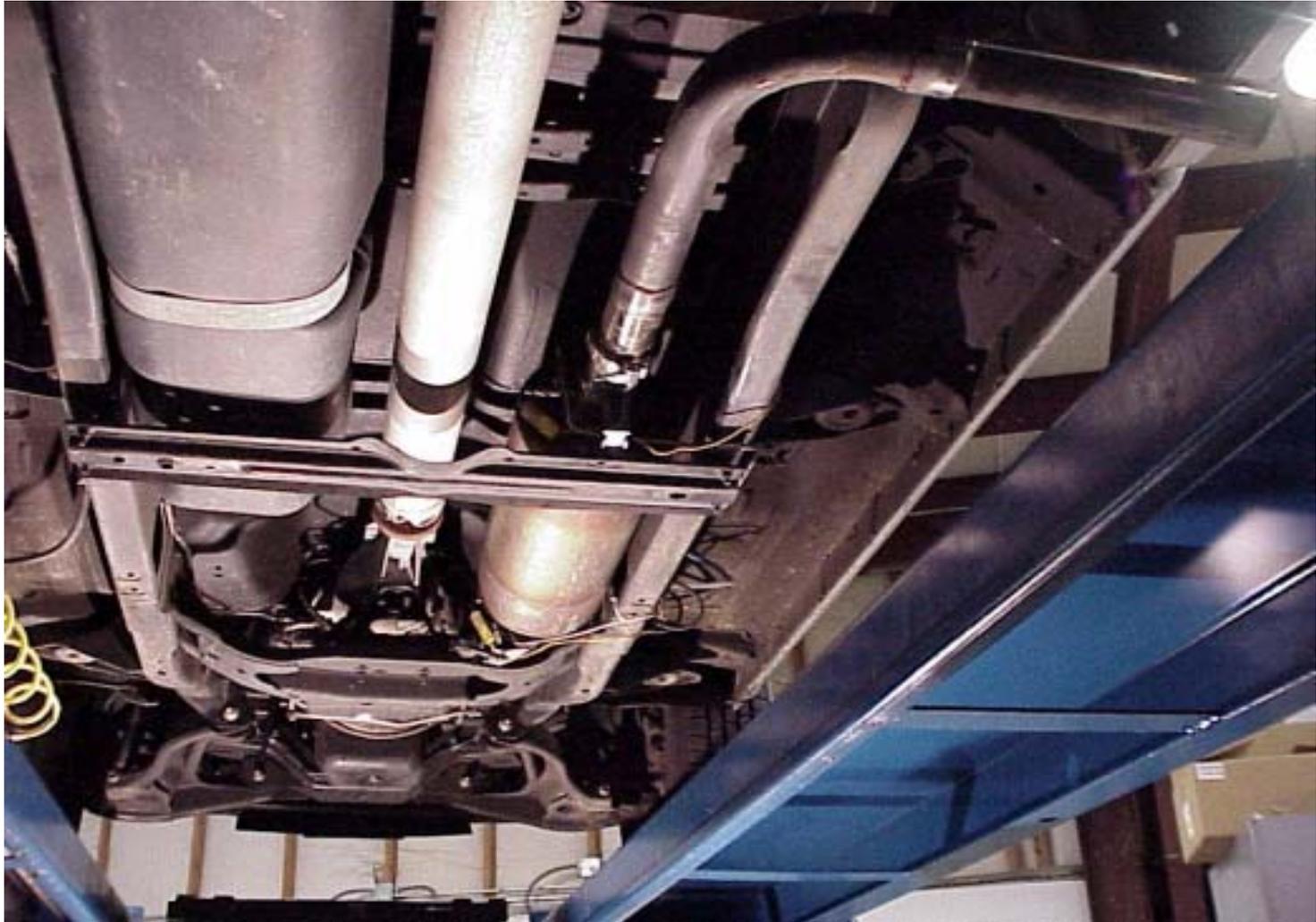
Dodge Ram Field Test

Ethyl

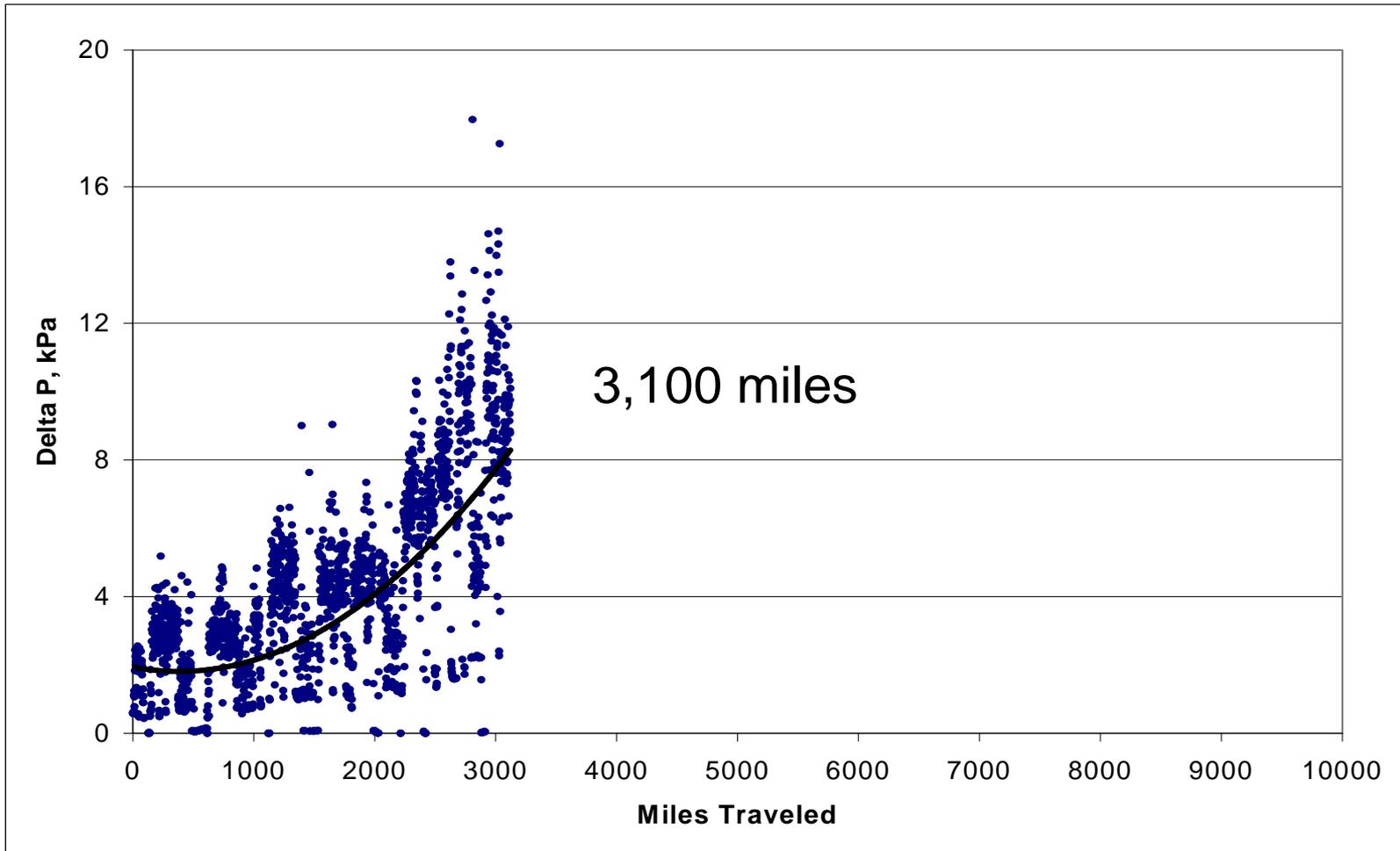


DPF Mounted Underbody

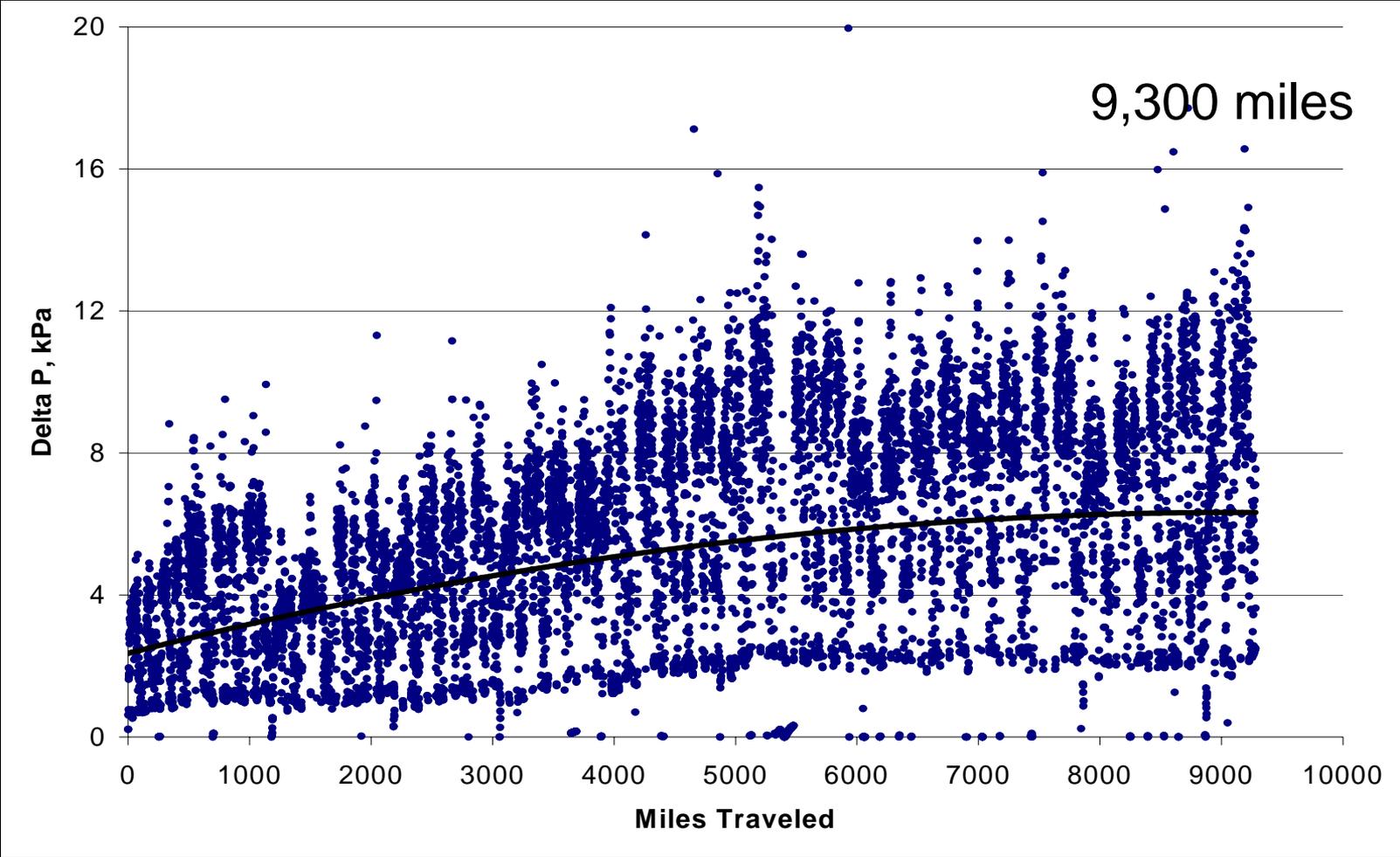
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Base Fuel - Delta Pressure vs. Mileage



MMT Fuel - Delta Pressure vs. Mileage



Update 8/22/03 Currently at 15,000+ miles with no change in slope

Diesel NOx Aftertreatment

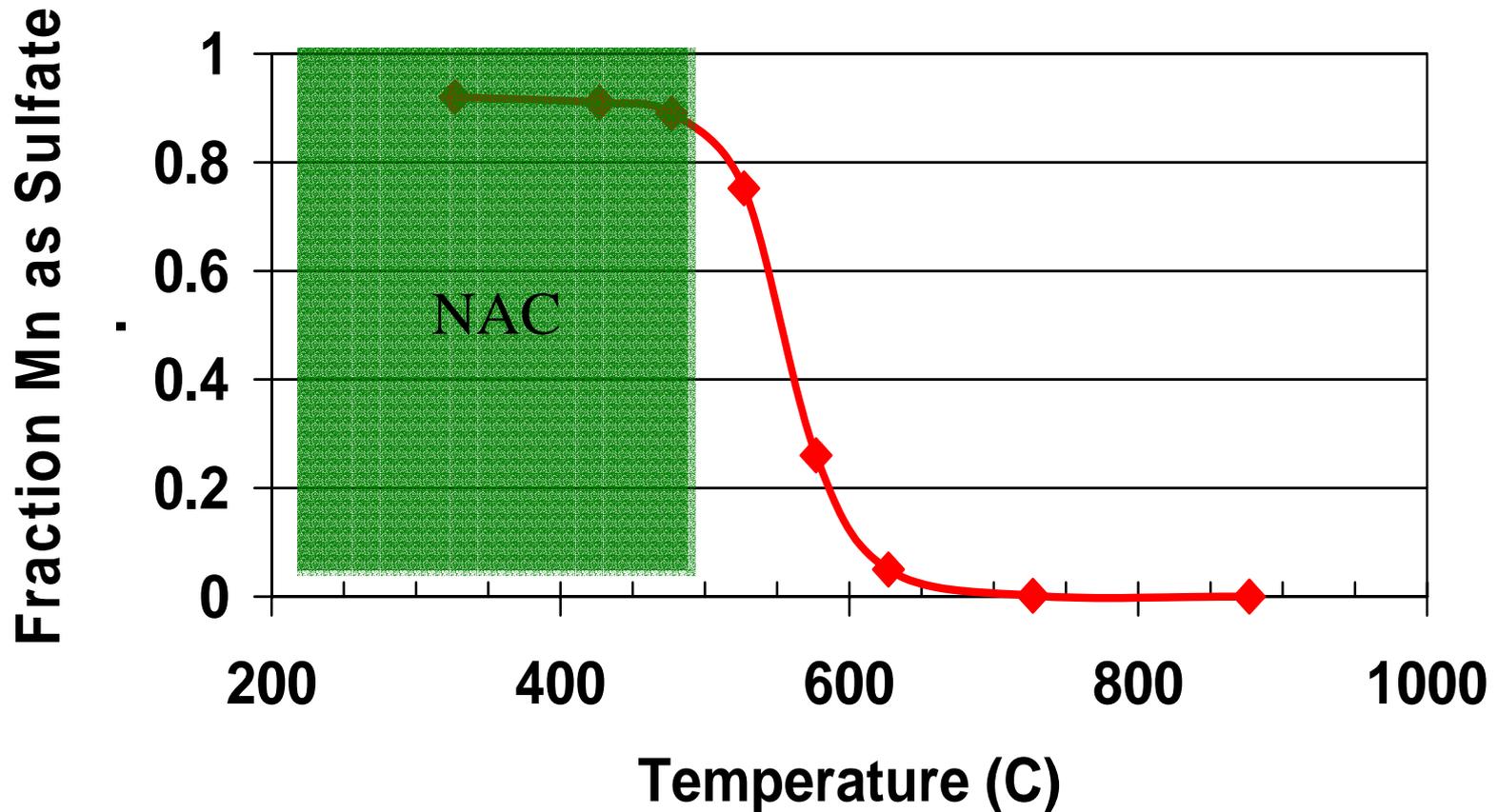
Ethyl

- Many current and proposed aftertreatment technologies are negatively affected by Phosphorous and Sulfur
- Sulfur will continue to exist in most diesel fuels at some level even after 2007
- P & S chemistry will continue to be used in crankcase lubricating oil to prevent wear and oxidation possibly at reduced levels
- One solution involves scavenging P & S with additives before interaction with aftertreatment

Mechanism For Sulfur Scavenging

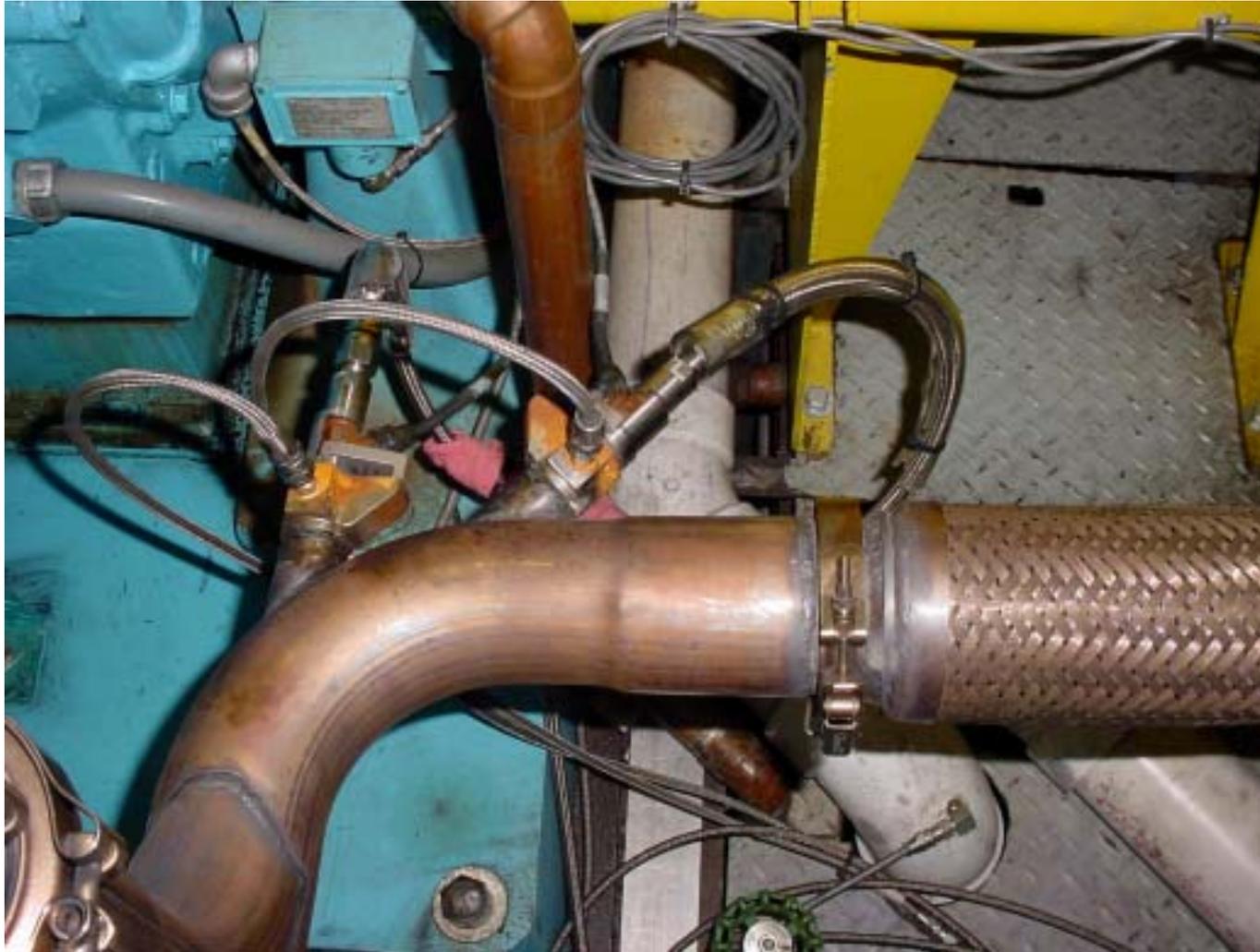
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Manganese from combustion of MMT interacts with sulfur species in the exhaust to form Mn sulfate which is stable below 500°C



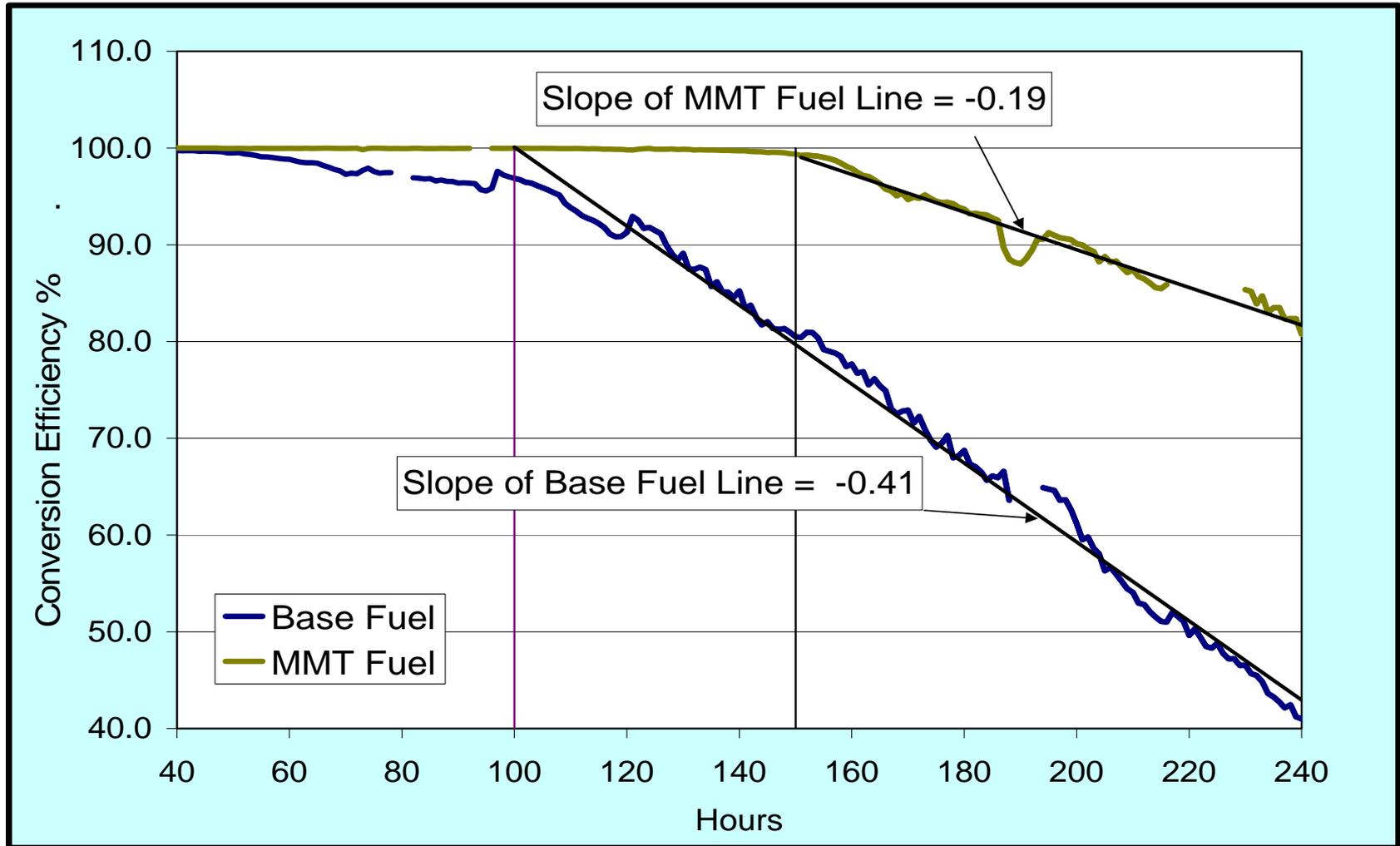
Supplemental Fuel System for NOx Regens

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NAC Conversion Efficiency vs Time

Ethyl



Fuel Borne Catalyst Summary

Ethyl

Use of MMT in Diesel Fuel Improves Aftertreatment Performance

Phosphorous and Sulfur scavenging have been demonstrated in multiple diesel engines

Aftertreatment protection from P & S helps to preserve catalyst conversion efficiency

- **Higher lifetime catalyst efficiency will allow optimization of emission control systems**

MMT – Diesel Particulate Filters

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MMT decreases the rate of soot accumulating in a DPF. There is also a significant reduction in soot oxidation temperature leading to earlier and more complete regeneration.

- **Resulting lower average exhaust back pressure improves fuel economy**
- **Can reduce the need for heat addition to regenerate DPFs resulting in reduced fuel consumption penalty**

For more details on the joint Cummins/Ethyl DPF research look for SAE 2003-01-3145 at the Fall Powertrain and Fluids Conference

Ethyl R&D continues to study fuel borne catalysts in current and advanced technology diesel engines

- Additional benefits of the fuel additive MMT in diesel have been discovered in bench tests and are being confirmed in engine tests
- **Not all fuel borne catalysts are the same!**