DPF + SCR RETROFITS AND THEIR IMPACT ON DIESEL EMISSIONS

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(ACES +) PRINCIPAL STUDY FOCUS IS 2010-type TECHNOLOGY: SCR+DPF

SCR retrofits >>> 75+ % reduction in NO\textsubscript{X}
DPF retrofits >>> 90+ % reduction in PM
Key Observations for this Presentation:

| Metal emissions                          | – Strong dependence on driving cycle (i.e., exhaust temperature) and retrofit type  
|                                          | – Possible release of SCR catalyst washcoat ($V_2O_5 / TiO_2$)          |

| Ultrafine particle emissions             | – Temperature drives formation for well-broken-in catalytic devices  
|                                          | – Sulfate dominates chemical composition of ultrafine particles          |

| Toxicity                                | – Significant reduction of overall toxicity by retrofits  
|                                          | – Potency (toxicity/distance) correlates with decreasing sulfate nanoparticle number emissions |
Increase in some metal emissions from retrofits

Cruise @ 50mph

Fe-zeolite?

SCR washcoat release?

PGE release?
Water soluble metals could be **biologically active and promote** formation of **reactive oxygen species (ROS)**

**Fe-Zeolite-SCR > Vanadium-SCR**

![Graph showing water-soluble fractions of different elements](image)

- Trends generally consistent: **alkali metals > alkaline earth metals > divalent transition metals > hydrolysable higher oxidation state transition metals**
Retrofits can induce formation of sulfate nanoparticles

Exhaust **temperature** promotes substantial formation of nanoparticles for well-broken-in **catalytic** devices
Ions and Carbon:
Sulfate and Nitrate dominate composition of particle emissions from retrofits

Cruise at 50mph

UDDS

- EC
- OC
- Potassium
- Ammonium
- Sodium
- Sulfate
- Nitrate
Oxidative Stress Potential of Total PM Per Distance Driven

Significant reduction of overall toxicity by retrofit
Higher nanoparticle emissions from retrofits correlate to lower toxic potency per distance.

Toxicity (DTT bioassay) as a function of nanoparticle number emissions.

INCREASING PARTICLE NUMBER EMISSIONS
SELECT REFERENCES

18th CRC 2008 On-road Workshop


2008 CRC Mobile Source Air Toxics Workshop

Hu, S., Herner, J., Robertson, W., Chang, M.-C. O., Huai, T., Collins, J, and Ayala, A. “Emissions from HD Diesel Retrofits for PM and NOx Control.”

Publications


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