**Introduction**

US EPA and California Air Resources Board (CARB) promulgated new stringent emission standards for heavy-duty diesel engines, which limits the PM and NOx emissions to 0.01g/bhp-hr (as of 2007) and 0.2 g/bhp-hr (as of 2010), respectively. In order to achieve these ultra low PM and NOx emissions, a preferred approach is to combine diesel particle filters (DPF) and selective catalytic reduction (SCR) technologies. Biomass-based soluble and particulate bound metals can do harm to human health. Metal based catalysts have been used in the after-treatment devices to reduce the emissions. Recent studies suggest elevated ambient levels of platinum group elements (PGE) since introduction of these-way catalytic converters for gasoline vehicles. There is a parallel concern metals will be released from the after-treatment devices from heavy-duty (ID) vehicles. In the current work we present a comprehensive profile of metals emissions from several vehicles and after-treatment devices evaluated at the California Air Resources Board’s Heavy-duty Diesel Emissions Test Laboratory located in Los Angeles, CA.

**Experimental**

Four heavy-duty vehicles in various configurations include various types of diesel particle filters (DPF) and catalytic and non-catalytic, particle and after-treatment devices evaluated at the California Air Resources Board’s Heavy-duty Diesel Emissions Test Laboratory located in Los Angeles, CA. (DPX at UDDS cycle) to 0.09 \( \mu g \) km \(^{-1} \) at cruise and UDDS cycle, respectively. The overall emission rates of total trace elements from retrofit vehicles (excluding CCRT and Horizon) varied from 0.01 to 0.03 mg km \(^{-1} \) (DPX at UDDS cycle) to 0.09 to 0.06 mg km \(^{-1} \) (CRT or CCRT cycle). Trace elements as a percentage of PM for the retrofits are comparable to the baseline vehicle (less than 1%), which could be due to the similar trend of reductions of PM and trace elements. The retrofits significantly reduce the emissions of the overall total trace elements (43% and 95% for cruise and UDDS, respectively) when compared to the baseline.

**Summary**

All the DPFs significantly reduced emissions of total trace elements (+85%). Catalyst metals were soon released from the after-treatment devices at low levels. For example, the vanadium-based DPF-SCR vehicle during cruise operation exhibited higher emission rates of vanadium (182 \( \times \) 2.03 kg km \(^{-1} \)) and titanium (301 \( \times \) 3.3 kg km \(^{-1} \)), suggesting the possible release of SCR washcoat. For the catalyst under high temperature conditions. During cruise cycle, vehicles with catalyzed after-treatment emitted higher levels of platinum (\( \geq 1 \) \( \times \) 0.6 mg km \(^{-1} \) to \( \leq 1 \) \( \times \) 3.5 kg km \(^{-1} \)) when compared to the baseline (3 \( \times \) 5.1 kg km \(^{-1} \)). For the DPF-SCR systems, Fe-zosil-based system showed a higher water-soluble fraction of the emissions of most metals than vanadium based system.

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**Reference**


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