Combustion Products of the MMT Fuel Additive

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ABSTRACT

The multifunctional fuel additive methylcyclopentadienyl manganese tricarbonyl (MMT) is used in gasoline to increase fuel octane rating. It is also added to fuels used in diesel engines and other combustion systems to increase carbon burn out and reduce particulate and smoke emissions. The nature of the MMT combustion products has been investigated extensively. The fate of the manganese compounds in the exhaust and the emission rates of manganese have been determined. Size classification data evaluating the dispersion of manganese throughout the particulate size range will be reported. The consumption of MMT in combustion systems results in the formation of primarily divalent manganese compounds. These combustion products have been characterized using X-ray photoabsorption spectroscopy (XAS) and X-ray photoemission spectroscopy (XPS). To evaluate the potential impact of widespread use of the additive in combustion systems, personal exposures to $PM_{2.5}$ manganese in urban areas where all gasoline contained manganese have been determined.

The manganese was emitted from the gasoline and diesel engines using MMT containing fuel primarily as a phosphate and/or sulfate with some of the oxide present. These emissions were found to have little if any effect on environmental levels of manganese and personal exposures to manganese. In metropolitan Toronto, where MMT was present in all gasoline at levels to the maximum limit of 18 mg Mn/liter, the 50^{th} and 95^{th} percentile annual personal exposures to $PM_{2.5}$ were 0.008 μg Mn/m^3 and 0.0215 μg Mn/m^3 respectively, which are well below the established safe levels. This indicates that the wide spread use of MMT in fuel had little practical impact on Mn exposures. Data on personal exposures to manganese in other geographic areas will be discussed. This work provides information to aid evaluation of MMT contributions to ambient Mn exposure and to assist in the design of health testing on MMT combustion products.