Chemical and Physical Forms of Platinum in Three-Way (TWC) and Diesel Oxidation Catalysts (DOC)

In order to better clarify the speciation of platinum within Vehicle Exhaust Catalysts (VEC), IPA sponsored a programme of work at the University of Wisconsin (USA) to determine the concentrations and chemical and physical forms of platinum in extracts of eight VEC, covering both new and aged, gasoline (Three-Way Catalysts) and diesel (Light Duty and Heavy Duty Oxidation Catalysts), catalysts.

Various environmentally or physiologically relevant fluids were used to extract platinum from the VEC, including high purity water, dilute acid (0.07M HCl), two synthetic surrogate lung fluids, and a synthetic surrogate gastric (stomach) fluid. The extracts were analysed using ion-exchange and chromatography techniques, with focus given to the identification and quantification of anionic platinum as this encompasses platinum species likely to be of higher toxicological importance. Anionic tetrachloroplatinate and anionic hexachloroplatinate, which are known to be capable of causing respiratory sensitisation (allergy), were also specifically measured.

The amount of the platinum present within the VEC that could be extracted using the five extractant fluids was very small – less than 1%. The highest extractions (0.5-0.8%) were achieved using the dilute acid, while only approximately 0.01% was extracted using High Purity Water. Between 0.05% and 0.2% of the platinum present was extracted using the artificial lung fluids.

The speciation analysis showed that, of the total amount of platinum that could be extracted from the aged VEC using the various fluids, typically only 0.05-0.5% was tetrachloroplatinate and hexachloroplatinate. Extractable tetrachloroplatinate and hexachloroplatinate therefore amounted to only about 0.00005-0.0005% of the total platinum in the aged VEC, or about 5-15 ng/g of catalyst.

The total amount of extractable anionic platinum, which represents an upper boundary limit on extractable anionic chloroplatinate levels, was <0.02-0.1% of total platinum in aged catalysts.