Determination of Platinum Group Elements on Particles Emitted from Automobile Catalysts

Michael Paraskevas, Chrisostomos Selimis and Maria Ochsenkuehn – Petropoulou

National Technical University of Athens, School of Chemical Engineering, Laboratory of Inorganic and Analytical Chemistry, Iroon Polytechniou 9, 15773, Athens, Greece

Catalysts for automotive traction implemented in all new cars registered in the EU since 1993 contain Pt, Pd and Rh (platinum-group elements, PGEs) for conversion of the pollutants CO, CxHy and NOx into the more innocuous gases CO2, H2O and N2. However, a part of these elements leave the catalyst surface during the lifetime of a catalyst and are transferred into the environment. Although a great progress has been made in creating super ultra low level emission vehicles, there has been an observation of higher concentrations of Pt, Pd and Rh in environmental samples [1].

This research consists in analyzing the quantity of PGEs (Pt, Pd and Rh) spread in the environment through particles emitted from gasoline cars. The sampling is done by the use of a filter holder with a PM10 quartz filter directly attached to the exhaust pipe of gasoline cars, during the 91441 extra urban drive cycle (EUDC). The filters are digested with aqua regia in a small autoclave bomb at about 120 °C in order to dissolve the metals collected on the filter. After filtration of the filter residues the solution is evaporated to dryness in order to dispose of the aqua regia. The final residue is dissolved in HCl (0.5-2M) that contains the PGEs plus other metals emitted from the car catalysts which are mainly Al, Mg, Ce, Zr, La, Ni, Fe, Ag, alkaline-earth oxides etc. [2]. All measurements were carried out by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS).

It was found that the PGEs emitted are in the ng range and these preliminary results show some trends depending on the age of the catalyst, the type, the size of the engine and the thermal state of the exhaust system. A further investigation is in progress for the preconcentration-separation of the PGEs by means of selective ion exchangers. This will help to enrich them and overcome the interferences from the other main metals mentioned above emitted from the catalysts, facilitating the determination by other analytical techniques such as Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES) or Cathodic Striping Voltammetry (CSV).

Acknowledgements:
The authors would like to thank the Department of Exhaust Gases Control of the Hellenic Ministry of Transport & Communications for their cooperation.

References