

Determination of Cr(VI), selected heavy metals, and elemental carbon in PM10 from a roadside sampling site in Vienna City

Harald Hagendorfer¹, Sebastian Koeppel² and Andrea Hanus-Ilmar²

¹Karl-Franzens-University Graz, Institute of Chemistry - Analytical Chemistry,
Universitaetsplatz 1, A - 8010 Graz

²Umweltbundesamt Austria, Spittelauer Laende 5, A – 1090 Vienna

Pollution from motor vehicles, in particular exhaust fumes and the wearing of disc brake pads, clutches, and tires, seems to be responsible for increased levels of heavy metals in particulate matter near roadside locations. Earlier studies have shown that, besides Sb and Fe, elevated levels of Cr also occur in particulate matter sampled near roadsides. In most cases, only total chromium, and not Cr(VI) levels are determined, which consequently provides only limited information about the toxicity and mobility.

The aim of the presented work was to assess the levels of selected heavy metals (Ba, Cd, Co, Cr, Cr(VI), Cu, Fe, Mn, Mo, Ni, Pb, and Sb) with the emphasis on Cr(VI). Furthermore, the origin of heavy metals was evaluated by calculating correlations with a marker for combustion engines, namely elemental carbon.

For this purpose a sampling strategy with specially prepared quartzfilters and appropriate storage conditions, combined with a straight forward and reliable sample preparation technique for the extraction of Cr(VI) in PM10 samples was developed. For the determination of Cr(VI), a chromatographic system with an anion-exchange column (Hamilton PRP-X100) was coupled to an ICPMS. Analysis time was less than 6 minutes and a LOD in the region of 50 pg/Nm³ was achieved. Quality control involved spiking the extraction solutions and the use of appropriate reference materials (BCR 545, welding dust loaded on filter).

For total element analysis, the filter samples were digested with aqua regia via a microwave-assisted acid digestion. Elemental carbon was measured coulometrically after a Toluol/Isopropanol extraction step.

In addition to Sb, the elements Mn, Fe, Cu Mo and Ba showed a good correlation with the elemental carbon value. For the elements Pb, Cd, Co, Ni, as well as total Cr and Cr(VI), correlation with the elemental carbon was not observed. Values of all monitored heavy metals were in the µg/Nm³ region. Cr(VI) concentration did not exceed values of 1 µg/Nm³.