OP 4.7

Flow-injection system for ultra trace analysis of mercury species by AFS

Kerstin Leopold, Lena Harwardt, Anja Zierhut and Michael Schuster

Technische Universität München, Lichtenbergstrasse 4

85747 Garching, Germany, Kerstin.Leopold@lrz.tum.de

The high mobility and toxicity of mercury, which is set free by natural and anthropogenic processes and distributed therefore ubiquitously, requires analytical monitoring of all environmental compartments. Here, especially the hydrosphere plays an important role, since mercury is enriched from water in fish and sea fruits up to 10^6 times (1). In the European water framework guideline (2) mercury is classified as one of the 33 most precarious pollutants, and thus its monitoring is strictly demanded.

Since bio transformation leads to organic mercury species with extremely higher toxicity than that of inorganic mercury, speciation analysis became more and more important in this context. Most speciation methods are based on chromatographic separation techniques coupled to varying detection methods providing differentiation of all kinds of mercury species (3). In water however only a few mercury species are solved, i.e. elementary mercury, complexes from inorganic and monomethyl mercury and dimethyl mercury (4). Therefore, it seems meaningful to develop simpler methods for affordable and reliable monitoring of certain mercury species in the hydrosphere.

The new developed flow injection system provides the successive determination of total mercury, organic Hg species, elemental mercury and inorganic mercury species in aqueous samples. Total mercury is determined without addition of reagents by separation and enrichment on an active precious metal surface in aqueous solution and can be set free as Hg^0 vapour for AFS measurements by thermal desorption. The separation of solved inorganic mercury is based on the selective reduction of Hg^{II} to Hg^0_{aq} and the selective amalgamation of Hg^0_{aq} on a smooth gold surface. This amalgamation process is carried out in aqueous solution and provides also the separation of elemental Hg from the aqueous sample. The selectivity of the gold trap was investigated in detail.

The enrichment of the organic Hg species remaining in solution takes place similar to the total mercury determination after enrichment on an active precious metal surface. The optimization of the collectors was the most important point of the new development. All individual steps of separation and enrichment are integrated into a fully automated FI system and coupled to AFS for detection. Detection limits of about 200 pg Hg l^{-1} are reached for all species when using a sample injection volume of 15 - 30 ml for a three-fold measurement.

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(2) Europäische Wasserrahmenrichtlinie 2000/60/EG (WRRL).
(3) A.V. Hirner, Anal. Bioanal. Chem., 385 (2006) 555–567.
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