

Mercury Speciation in Contaminated Sediments Using Headspace Trap Gas Chromatography and Atomic Fluorescence Spectrometry

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Mercury is a contaminant of great concern in the environment, particularly in water where the formation of methylmercury (most toxic form) in aquatic sediments, and its subsequent bioaccumulation in aquatic organisms, presents a major pathway for human exposure to methylmercury (MeHg). The sediment of the Deûle River in northern France is highly contaminated by many metals; this is a consequence of a smelting plant which disperses great quantities of industrial wastes, dusts and metal ores.

In this work, we present preliminary data relating to the extent of sediment mercury contamination in this site. For this purpose, Mercury contamination was investigated in surface and in core sediment. These were analyzed for total mercury, methylmercury and acid volatile sulphide (AVS) to provide more detailed information about mercury toxicity. Total mercury was measured in dry sediments (without any pre-treatment) by means of an AMA 254 solid phase Hg-Analyzer using atomic absorption spectroscopy. The organic form (methylmercury) was analysed by isothermal GC-CVAFS (Gas Chromatography Cold Vapour Atomic Fluorescence Spectrometry) after MeHg extraction from sediment into dichloromethane and reextraction into the water phase by dichloromethane evaporation. A new system "TurboMatrix HS-40 Trap" (filled with Tenax sorbent) coupled with GC and CV-AFS detector (TEKRAN) was used, this method combines a headspace introduction system with trapping process that pre-concentrates analyte before injection into the GC, which offers the possibility to develop an automated method with lower detection limit. The system HS with Trap used for analysis of methylmercury in sediments was compared with the conventional HS injection.

It was shown that combination of HS with Trap offered better performances for methylmercury determination than the HS only, regarding several aspects. Trap system offer better detection limit due to possibility of pre-concentration in several cycles, so a greater part of the analyte can be introduced into GC. This method was tested on certified reference materials sediments IAEA 405, IAEA 433 and IAEA 158 and validated for the analysis of methylmercury in high contaminated sediments. Surface sediment samples from the Deûle River were analysed for total mercury and methylmercury (MeHg) with results ranging between 2.3-78 mg kg⁻¹ (dry weight) and 1.1-46 µg kg⁻¹ (dry weight) respectively. The principal sediment mercury source of contamination was identified near a former smelting plant (Metaleurop) that produced lead and zinc until 2003. This high contamination suggests that some organism toxicity near this site would be expected. Sediment cores were then sampled closeness Metaleurop location. Concentrations of total mercury show an increasing trend with depth, showing that a much greater volume of contaminated sediments is present at this location.