Stabilization of As-species in water using different SPE materials

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Arsenic in groundwater has become a serious problem particularly in India and Bangladesh [1]. However, groundwater of former industrial areas can also contain remarkable amounts of arsenic, especially in Eastern Germany. As the exposure of the general population to arsenic occurs mainly through arsenic in drinking water and food, a reliable method to detect and eliminate arsenic from water is required. The water analysed in this work contains higher amounts of sulphur, iron and miscellaneous organic compounds beside the different investigated arsenic species, arsenous acid (As (III)), arsenic acid (As (V)), monomethylarsenic acid (MMA) and dimethylarsenic acid (DMA). This matrix poses a challenge for the stabilisation of the arsenic species.

As the common additives like EDTA [2] and phosphoric acid [3] could not prevent the species from conversion several materials for solid phase extraction (SPE) were tested for their ability to adsorb the different arsenic species. The behaviour of As(III), As(V), MMA, DMA and Arsenobetaine (AsB) towards different ion exchange materials were investigated. AsB can not be found in the water samples but as it is a main component in fish and mussels [4] it was also included in the investigations. A strong anion exchanger was used to adsorb As(V), MMA and DMA and to stabilise the arsenic species which are mainly present in anionic form. The possibility of selective elution according to the pKa of the different acidic species was investigated. The As concentration in particular fractions was determined by ICP-MS and HPLC ICP-MS.

In acidic solution, AsB could be adsorb on a strong cation exchanger and eluted with 0.1 M NaOH. As AsB is an arsenoorganic acid with a pKa of 2.2 and has a permanent positive charge on arsenic, the compound can be transferred to a cation by acids and adsorb on a cation exchanger. For elution the compound is transferred to a zwitterion by a base.

The influence of different matrices on SPE was investigated. Model waters were created that contained high amounts of either sulphur or iron or both sulphur and iron. Also the influence of different salinity of the water was investigated to check if the method can also be used for marine samples. For the determination of arsenic species in fish it is important to know the influence of the fat matrix on the adsorption capability of the ion exchanger. So various amounts of fish oil were added to the solutions of the arsenic compounds and their influence on SPE determined.

At last real fish and water samples were investigated and the results of SPE and HPLC separations were compared.

[1]   A.G. Gault, et al., Anal. Bioanal. Chem., 2 (2005) 347-353.
[2]   P.A. Gallagher, J. Environ. Monit., 3 (2001) 371-376.
[3]   B. Daus, et al., Talanta, 58 (2002) 57-65.
[4]   S. Rattanachongkiat, et al., J. Environ. Monit., 6 (2004) 254-261.