

Speciation analysis and preconcentration of Tl in water samples using solid phase extraction by cation exchange resin and electrothermal atomic absorption spectrometry

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Thallium is a heavy, very toxic metallic element, which occurs in earth's crust in an estimated abundance from 0.1 to 0.8 mg.kg⁻¹. In the environment, it is mainly combined with other elements (primarily oxygen, sulfur, halogens, potassium and rubidium) in inorganic compounds. During the weathering processes it can be mobilized by aqueous media and accumulated in sediments and soils. The main sources of pollution nowadays come from anthropogenic emissions from refineries, coal-fired power stations, mining activities, metal smelters and the cement industry (1).

Thallium exists in natural waters as either Tl(I) (thallos) or Tl(III) (thallic) species. The oxidation state of Tl affects its complexation and subsequent bioavailability and toxicity in the environment. Thallium content in surface waters is within the range 1-82 ng l⁻¹. Due to this low contents of Tl in water samples, it is necessary to combine the laboratory separation, preconcentration and determination techniques for the purpose of Tl speciation analysis (1).

The scope of the presented work was to use an solid phase extraction (SPE) for the separation and preconcentration of Tl species in water samples followed by the determination using electrothermal atomic absorption spectrometry (ET AAS). In this method, Tl(III) was stabilized by formation of a Tl(III)-DTPA complex. Tl(I) species remained in its original form. These two species were then separated by using a cation exchange resin Amberlite IR120 and nitric acid as the eluent in a batch SPE protocol. The potential interferences of Fe (III), Al, Ca, Mg and other metals were investigated. The optimized experimental conditions for separation/preconcentration step (pH 2-3, time 15 min, temperature 60 °C) and Zeeman ET AAS determination (chemical modifier Pd + ascorbic acid, atomization temperature 2100 °C) (2) were used for the speciation analysis of thallium in filtered acid water samples from open quartzite mine in the Banská Štiavnica – Šobov region (Slovakia) where an acid mine drainage is present mainly as a product of pyrite oxidation (2). For both Tl species the preconcentration factor about 40 was achieved, LOD and LOQ were 25 and 90 ng l⁻¹, the calibration curve was linear from 75 ng l⁻¹ to 25 µg l⁻¹, the precision expressed by a RSD ranged from 3 to 19 %. The accuracy of analytical results was checked by the analyte addition technique and by analysis of water CRM samples.

References

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