

ORIGINAL PAPER

Determination of mercury species using thermal desorption analysis in AAS

Pavel Coufalík, Ondřej Zvěřina, Josef Komárek*

Department of Chemistry, Faculty of Science, Masaryk University, Kotlářská 2, Brno 611 37, Czech Republic

Received 1 May 2013; Revised 18 June 2013; Accepted 19 June 2013

Analytical aspects of the determination of inorganic mercury (Hg) species by thermal desorption followed by atomic absorption spectrometry (AAS) detection were investigated in this work. Characteristic Hg release curves of the following species were observed: Hg^0 , HgCl_2 , HgO , HgSO_4 , HgS , and the Hg bound to humic acids. Particular attention was dedicated to the thermal stability and change of bond of Hg^0 in the following matrices: sand, kaolinite, granite, peat, power plant ash, and soil. The bond of elemental Hg in environmental materials was described on basis of this experiment. Contaminated soil samples from two locations in the Czech Republic were investigated by thermal desorption analysis. Afterwards, the contents of volatile and plant-available Hg in the studied samples were determined. The determination of Hg^0 using the thermal method was related to the results of liquid sequential extraction. The development of Hg speciation and the stability of Hg were assessed on basis of the data obtained. Thus, the analytical procedure used is a suitable tool for the study of inorganic Hg species in contaminated soils.

© 2013 Institute of Chemistry, Slovak Academy of Sciences

Keywords: mercury, speciation, soil, thermal desorption, extraction

Introduction

The amount of Hg circulating in ecosystems represents a serious problem nowadays. Contamination of anthropogenic origin substantially increases the quantity of Hg which is transported between atmosphere and surface, as well as the total amount of this metal and its compounds deposited in oceans, sediments and soils. Toxicity of mobile Hg forms is a distinct biospherical threat, especially in case of organometallic species formed via biological processes from inorganic Hg forms. The process of speciation change is dependent on both environmental conditions and properties of the original form.

The study of Hg speciation in soil and similar materials constitutes a form of trace analysis, which is essential for the risk assessment of contaminated environmental samples. Natural Hg species almost never occur freely scattered in the material (with the exception of cinnabar crystals), but are chemically or

physically bound to the surface of particles. Thus, the binding interactions of analytes in the matrix and their stability should be the main objects of study. Besides sequential extractions (Issaro et al., 2009), thermal desorption analysis from the solid phase has been promoted (Biester & Nehrke, 1997; Bollen & Biester, 2011). This method provides information about the binding intensity of species in the matrix and about the contents of certain Hg forms such as Hg^0 and HgS . Determination of these species by means of thermal desorption analysis may be even more successful (Biester & Scholz, 1996) than that by liquid extractions. Nevertheless, thermal desorption analysis is not used by many authors and its interpretation is still a question of debate.

In this work, the primary subject is thermal desorption analysis and its application in the speciation analysis of inorganic Hg forms. The method is based on the low thermal stability of Hg compounds, where the studied samples are heated in a stream of inert

*Corresponding author, e-mail: komarek@chemi.muni.cz