

ORIGINAL PAPER

Mercury characterisation in urban particulate matter

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A five-step sequential extraction procedure was proposed in order to assess the distribution of mercury (Hg) forms in urban particulate matter (PM): exchangeable, HCl-soluble, organic-bound, elemental and other slightly soluble Hg species, mercury(II) sulphide (HgS), and residual Hg. This process was applied to the analysis of urban dust samples collected at locations in Prague (Czech Republic) with high traffic density. In addition to sequential extractions, thermal desorption analysis was performed. The differences in Hg concentrations between untreated and thermally treated samples were indicated as the thermally releasable amount of Hg. For the study of PM-adsorbing capacity, Hg vapours were passed through the samples as long as the enrichment of materials was observed. The retained elemental Hg was readily released by thermal desorption. All Hg analyses were based on the highly sensitive pyrolysis technique of atomic absorption spectrometry using the mercury analyser AMA-254.

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Introduction

The atmosphere is the dominant medium for Hg transport in the environment. When Hg is released into the atmosphere, it is subjected to various physical, chemical, and photochemical processes and interactions (Lin & Pehkonen, 1999). An important characteristic distinguishing Hg from other elements in the atmosphere is its ability to be re-emitted into the atmosphere from both terrestrial and aquatic surfaces (Downs et al., 1998; Pacyna et al., 1995; Schroeder & Munthe, 1998; Xiu et al., 2009). The Hg is emitted into the environment by human activity (fuel combustion, waste incineration, ore processing, production of chemicals) and from natural sources (weathering of rocks, degassing of soils, emissions from forests, lakes and oceans, volcanic activity) (Pacyna et al., 2001; Park et al., 2008; Schroeder & Munthe, 1998).

Atmospheric Hg exists primarily in three forms. The predominant form in ambient air is gaseous elemental mercury Hg(0) (GEM). GEM constitutes over

95 % of all gaseous Hg (Xiu et al., 2005, 2009). In the atmosphere, Hg(0) may be oxidised by ozone, alkyl peroxides, radicals, peroxides, and halogens into Hg(II) compounds, commonly including HgCl₂, Hg(OH)₂, and HgBr₂. Oxidised Hg compounds are known as reactive gaseous mercury (RGM), usually defined as the gas phase Hg compounds that can be collected with potassium chloride sorbent (Xiu et al., 2009). The Hg associated with particulate matter (PM) is known as particulate-phase mercury (Hg(p)). This Hg(p) is not the major form of Hg emitted directly into the atmosphere, but it is often formed through the adsorption or partition of gaseous Hg or its compounds on the particle surface (Xiu et al., 2005). It has been shown that the background concentration of Hg(p) varies from 0.3 % to 0.9 %, but it can represent up to 40 % of total gaseous Hg in industrialised regions (Lin & Pehkonen, 1999).

Some fly ash may capture Hg that would otherwise be emitted into the atmosphere (López-Antón et al., 2009). A great deal of attention has been given to the

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