SPATIAL AND SEASONAL VARIABILITY OF MERCURY CONCENTRATIONS IN AEROSOLS FROM MALOPOLSKA REGION, SOUTH POLAND

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INTRODUCTION

The ubiquity of mercury in the environment became one of the most frequently discussed topics in the environmental science. Its presence is strictly linked to the energy production and coal combustion processes as well as incineration of other fossil fuels, mining and smelting [1]. Atmospheric Hg have three main forms: gaseous elemental mercury (GEM), gaseous oxidized mercury (HgII) compounds (GOM), and mercury associated with particulate matter (denoted also as total particulate mercury – TPM or $Hg_{(P)}$ [2, 3]. Bad ambient air quality in the South Poland (Malopolska Voivodeship) is continuously a matter of concern of local authorities and researchers, but most of all it poses a problem for the inhabitants of Poland's second largest and most PM10 polluted city – Krakow [4]. This study is a part of larger measurement campaign, aiming to describe the chemical composition of aerosols in Krakow agglomeration. The concentrations of mercury in atmospheric aerosols in Krakow agglomeration were not a matter of research so far. This study is a continuation of at the results described by Styszko et al. [3].

EXPERIMENTS

The concentrations of total particulate mercury (TPM) have been measured during heating and non-heating seasons of 2013 in South Poland (Malopolska). All samples were collected on quartz fibre filters (Pallflex, Pall Life Sciences) with a diameter of 47 mm. An automatic Hg analyser, MA-3000 (NIC, Japan) with autosampler was applied for determination of the particle-bound mercury in the collected samples. Measurements were conducted with calibration curve linear (r^2 = 0.9984) in the range 0.045-1.000 ng. Limit of detection was determined as 0.015 ng, while limit of quantification 0.045 ng. PM10 and PM2.5 were collected at three locations representing the urban (Krakow), industrial/residential (Skawina) and rural/residential (Bialka) environment.

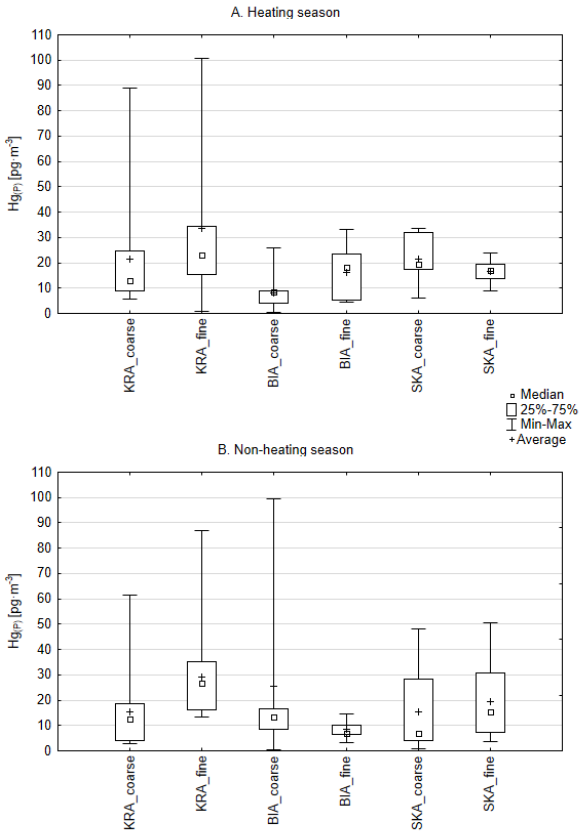

Fig.1. Hg(P) concentration in PM10 and PM2.5 [pg·m^{-3}] during the whole study period.

RESULTS AND DISCUSSION

The results referring the particulate mercury concentration in three regions of the Malopolska Voivodeship are the continuation of works presented before [5]. The presented study aims at the comparison of the total particulate mercury concentration variations at three chosen measuring stations in Malopolska region, Poland. The data obtained in Krakow, Skawina and Bialka were used to estimate the coarse and fine particulate mercury concentrations, showed that up to 71% of the mercury present in PM10 was present in the PM2.5 fraction. The measured mass concentrations of PM10 and PM2.5 fractions in heating season were in the range of 30 to 128 $\mu g \cdot m^{-3}$ and 9 to 75 $\mu g \cdot m^{-3}$, respectively. In the non-heating season those concentrations were in the range of 6 to 40 $\mu g \cdot m^{-3}$ and 0.3 to 36 $\mu g \cdot m^{-3}$. The average concentration of mercury (Hg_{coarse}) in coarse fraction (PM2.5-10) during the heating season ranged from 8.0±7.1 $pg \cdot m^{-3}$ to 21.3±21.7 $pg \cdot m^{-3}$. In the non-heating season, the average Hg_{coarse} ranged from 15.2±16.4 $pg \cdot m^{-3}$ to 25.6±31.8 $pg \cdot m^{-3}$. The average concentration of mercury Hg_{fine} in fine fraction (PM2.5) were between 16.3±10.4 $pg \cdot m^{-3}$ and 33.4±31.8 $pg \cdot m^{-3}$ in the heating season and between 8.5±3.7 $pg \cdot m^{-3}$ and 28.6±16.7 $pg \cdot m^{-3}$ in the non-heating season. Occurrence of mercury in particulate matter is mainly caused by the local sources (like emission from coal-fired power plants), long-range transportation of fine particles and processes of particles transformation: like absorption, coagulation and agglomeration favoured additionally by mild weather conditions, higher relative humidity of air and low wind velocities.

CONCLUSION

TPM was present in the samples from the rural area (Bialka) in concentrations only slightly lower than those observed in the city (Krakow, Skawina) during the heating and non-heating seasons. The higher concentrations of TPM in Skawina and Krakow are believed to be caused both by local emission sources like coal-heated power plants and by a long-range transport of fine particles. This is confirmed by pHg values and particulate mercury deposition rates. The relation between origination of fine mercury from power plants and long-range transport needs to be still identified. This creates the justification for further research on the particulate mercury fate. Recognition of the mercury speciation is extremely important for identification of the mercury emission sources. Hence, in the following part of the study authors will focus on the mercury partitioning between solid and gas phase.

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