PAH in size segregated aerosol: seasonal and inter-site variability

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Content of toxic polycyclic aromatic hydrocarbons (PAH) adsorbed on the surface of particle matter varies according to different environmental conditions and anthropogenic emissions (Saarnio *et al.*, 2008; Zhou *et al.*, 2008). The aim of the study was to compare PAH concentrations in aerosol samples of three size fractions collected in winter and summer at four localities in the Czech Republic.

24 hours samples of three size fractions, coarse (1 - 10μm), fine (0.5 – 1μm) and accumulation mode (0.17 – 0.5μm) were collected on the polyurethane foam (PUF) substrates using by high volume cascade impactor BGI-900. Sampling head was usually positioned on the roof of the mobile station at height of 4 meters or on the roof of university building in Prague at height of 25 meters above street level. The sampling campaigns went at four localities differing by extent of air pollution. They were: 1.Village, proximity to open cast lignite mine and coal power stations, 2. Highway, 3. Prague center – urban background, 4. Background. Samples were collected for 10 days at each locality in winter and summer 2009.

Organic matter from PUF substrates was extracted by dichloromethane and extracts analyzed for 13 types of PAH using by liquid chromatography in the ALS Czech Republic, s.r.o. laboratories.

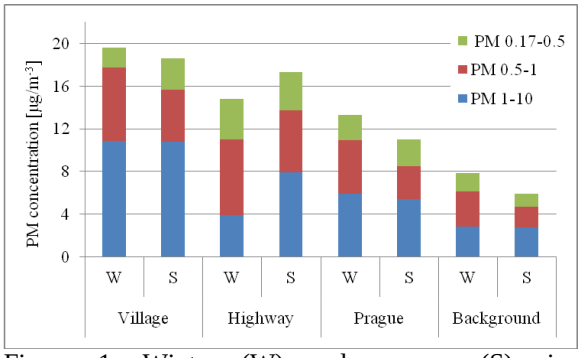

Figure 1: Winter (W) and summer (S) size distribution of PM_{10} mass from four localities.

Average total aerosol mass concentration were the lowest, as expected, at background (W 7.8 $\mu g/m^{-3}$, S 5.9 $\mu g/m^{-3}$) and the highest in the Village in polluted region (W 19.6 $\mu g/m^{-3}$, S 18.7 $\mu g/m^{-3}$). Fine particles (aerodynamic diameter < 1 μm) dominate PM_{10} mass near highway and at background locality, whereas coarse particles was major component of PM_{10} mass at the village (Figure 1). Summer PM_{10} concentrations were lower than winter ones, but there were not observed any extreme seasonal differences of aerosol mass size distributions.

Contrary to PM_{10} mass, total PAH concentrations exhibited strong seasonality when winter PAH concentrations were near two orders of magnitude higher then summer ones. While the highest PAH concentration was 21 ng/μg of PM in winter, it was only 0.5 ng/μg PM in summer.

Size distributions of total PAH of winter PM_{10} (Figure 2), indicate that PAH molecules prefer to bind onto fine and accumulation mode particles. The highest relative abundance of PAH in PM was determined in $PM_{0.5\text{-}0.17}$ at all the localities. Exceptional high value was measured at the Village, where PAH mass contributes to mass of the fraction by 1.6 %, which is more 200 times more compared to values determined at the background.

Major part of total PAH mass was composed of phenantrene (22-32%), fluoranthene (19-31%), pyrene (10-19%) and anthracene in winter (11-15%). There was a slight variability in individual PAH abundances among the different sizes, e.g. PAH mass in $PM_{10\text{-}1}$ contained 2% of benzo(a)pyrene in the summer and 7% in $PM_{1\text{-}0.5}$ in the winter.

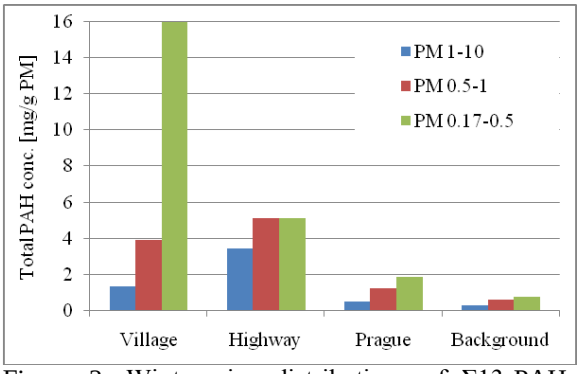

Figure 2: Winter size distributions of Σ13-PAHs mass concentration in aerosol from four localities.

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Saarnio, K. *et al.*, (2008). *Atmospheric Environment, 42, 9087 - 9097.*

Zhou, J. *et al.*, (2008). *Environmental Engineering Science*, 25, 207 - 220.