

Relationship between c-PAHs concentration and elemental composition of urban size-segregated aerosol in winter

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Polycyclic Aromatic Hydrocarbons (PAHs) are a large group of chemical compounds. They are formed mostly by incomplete combustion and some of them are highly carcinogenic, mutagenic and teratogenic. We call them carcinogenic PAHs, c-PAHs. Elevated concentrations of particle-bound c-PAHs are frequent urban air quality problem in the Czech Republic. EU limit exceedance for Benzo[a]pyrene (B[a]P) is everyday reality during cold period of winter.

Therefore, comprehensive characterization of urban aerosol was conducted in residential district of the city of Mladá Boleslav (about 60 km north-east of Prague, Czech Rep.), in close proximity to a large industry, for 14 days in February 2013.

24h samples of four aerosol size fractions (1–10 μm , 0.5–1 μm , 0.17–0.5 μm , <0.17 μm) were sampled by high volume cascade impactor BGI 900. Size fractions were analyzed by HPLC (ISO 11338-2) for 13 PAHs including 12 of 16 US-EPA priority PAHs and 8 c-PAHs (benz[a]anthracene, benzo[a]pyrene, chrysene, benzo[k]fluoranthene, benzo[b]fluoranthene, benzo[ghi]perylene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene).

At the same time, three aerosol size fractions (1.15–10 μm , 0.34–1.15 μm , 0.15–0.34 μm) were collected by a 3 stage cascade impactor with rotating substrate, 3DRUM (Delta Group UC Davis), and the size fractions were analyzed for Na, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Br, Rb, Y, Zr, Mo, Pb in 1h resolution.

Therefore, we may analyze relationship between highly time resolved elemental composition and PAHs enrichment in size-segregated aerosol.

There was an overcast weather with temperature average -2.3 $^{\circ}\text{C}$, minimum -12.8 $^{\circ}\text{C}$ and maximum 4.8 $^{\circ}\text{C}$ and with low average wind speed of 1.21 $\text{m}\cdot\text{s}^{-1}$ during the campaign.

Campaign medians of PM_{10} and sum of c-PAHs were 20.9 $\mu\text{g}\cdot\text{m}^{-3}$ and 19.2 $\text{ng}\cdot\text{m}^{-3}$ respectively. The c-PAHs were predominantly bound to aerosol fraction of 0.5–1 μm of aerodynamic diameter (Table 1) and their concentrations were slightly higher than an average in the Czech Republic. Concerning c-PAH concentrations as per aerosol mass, c-PAHs were evenly distributed among aerosol size fractions with some enrichment in coarse and accumulation mode particles (Figure 1). Interestingly, c-PAHs enrichment in aerosol mass was high enough to exceed the EU limit for B[a]P (1 $\text{ng}\cdot\text{m}^{-3}$)

even when PM_{10} values did not went over the EU limit for PM_{10} .

Table 1: Medians of c-PAHs concentration in size-segregated aerosol ($\text{ng}\cdot\text{m}^{-3}$) in Mladá Boleslav, 14-27 February 2013

c-PAHs	1-10 μm	0.5-1 μm	0.17-0.5 μm	<0.17 μm	All fractions
B[a]A	0.61	1.34	0.51	0.16	2.69
CHRY	0.88	1.84	0.78	0.28	3.72
B[b]F	0.83	1.88	0.76	0.29	3.86
B[k]F	0.36	0.82	0.34	0.12	1.66
B[a]P	0.54	1.36	0.56	0.16	2.77
DB[ah]A	0.04	0.08	0.04	0.01	0.17
B[ghi]P	0.43	1.01	0.46	0.18	2.08
I[cd]P	0.41	0.98	0.43	0.16	2.02
Σ 8 c-PAHs	4.14	9.37	3.86	1.33	19.15

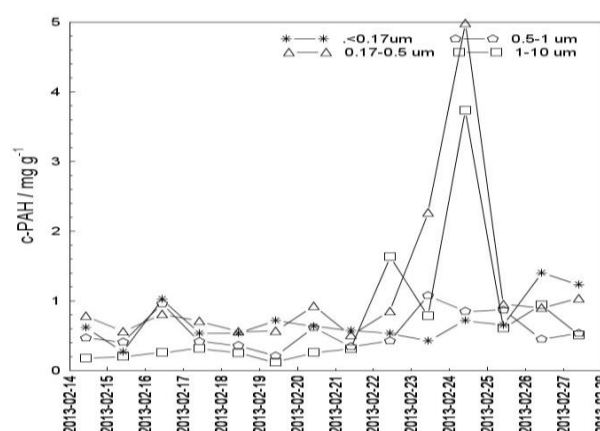


Figure 1: C-PAHs concentration per mass of size-segregated aerosol in Mladá Boleslav, February 2013

Revealing and analyzing a relationship between higher concentration of elemental composition and PAHs could help to apportion source of these poisonous substances. This study is in progress.

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