Traffic-generated changes in the chemical composition of 13 fractions of PM in an urban area of Upper Silesia, Poland.

W. Rogula-Kozłowska

Institute of Environmental Engineering, Polish Academy of Sciences, 34 M. Skłodowska Curie St., 41-819 Zabrze, Poland

Keywords: chemical mass closure, traffic, size-resolved chemical composition.

email: wioletta@ipis.zabrze.pl

Within urbanized areas, the growth of road traffic intensity is correlated with the growth of the ambient concentrations of particulate matter (PM) and its components. The aim of the study was to determine the influence of road traffic on chemical composition of 13 fractions of PM in a typical urban area of Upper Silesia.

PM was sampled simultaneously at two sites in Katowice (Upper Silesia, Poland). One of the measuring points, located in the city centre, represented so-called urban background (UB). The second point (HW), located near the A4 motorway, was directly exposed to the traffic emission. PM was sampled in summer 2012 using two thirteen-stage DEKATI cascade impactors. The samples were analyzed for carbon (organic and elemental), water soluble ions (Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_3^-, SO_4^{2-}) and concentrations of 24 elements by using, respectively, a Sunset Laboratory carbon analyzer, a Herisau Metrohm AG ion chromatograph, and a PANalitycal EPSILON 5 X-ray fluorescence spectrometer.

To perform the mass closure calculations for each dust fraction in the measuring period the PM chemical components were categorized into seven classes (Tab. 1) according to Rogula-Kozłowska et al. (2012; 2013).

Table 1. Chemical mass closure for 13 dust fractions at HW and UB in Katowice.

	EC	OM	SIA	NaCl	CM	TE	UM
HW	**%**						
>10	5.5	28.6	7.2	5.6	18.3	3.7	31.2
6.8-10	6.7	31	8.6	9.7	18	3.8	22.2
4.4-6.8	12.1	48.8	9.3	5.5	23.6	4.1	-3.4
2.5-4.4	9.8	36.1	8.5	3.3	20.2	2.8	19.4
1.6-2.5	6.9	37.5	13.9	3.3	7.2	9.7	21.5
1-1.6	3.3	53.4	21	2.8	2.4	4	13
0.65-1	2.4	51.9	22.5	2.5	0.8	1.8	18
0.4-0.65	2.6	43.4	21.3	2.4	1	1.4	27.9
0.26-0.4	3.4	37.8	17.6	2.5	1.4	1.3	36
0.17-0.26	8.3	33.5	15	2.9	1.3	1.6	37.5
0.108-0.17	13.7	32	10.9	3.3	2	2.5	35.6
0.06-0.108	10.2	24.2	8.9	3	2.1	3.2	48.5
0.03-0.06	10.6	38.3	13.4	4.8	4.1	7	21.9
UB	**%**						
>10	5.1	32.2	12.3	7	19.9	4.9	18.5
6.8-10	8.1	43.1	13.5	5.6	16.7	6.1	6.9
4.4-6.8	8.5	41.5	12.2	5	21.5	4.5	6.8
2.5-4.4	5.7	33.9	11.2	4.3	17.6	3	24.3
1.6-2.5	3.4	37	16.9	3.6	6.6	6	26.5
1-1.6	2	52.9	19.1	2.7	2	3.7	17.6
0.65-1	1.6	52.4	23.6	2.5	0.8	1.8	17.2
0.4-0.65	1.7	42.9	21	2.4	1	1.3	29.7
0.26-0.4	1.3	38.8	17.6	2.4	1.7	1.2	37
0.17-0.26	2.1	30.8	15.6	2.6	2	1.7	45.2
0.108-0.17	2.6	34.2	14.6	4.7	3.7	3.9	36.3
0.06-0.108	3.2	34.9	18.1	6.9	8.4	7.3	21.2
0.03-0.06	3.1	39.6	19.8	9.7	12.1	11.6	4.1

EC-elemental carbon, OM – organic matter, SIA – secondary inorganic aerosol, CM – crustal matter, TE – trace elements, UM – unidentified matter

The concentrations of PM_1, $PM_{2.5}$, PM_{10} and of total PM did not differ significantly between the measuring points. The concentrations of the particles with the aerodynamic diameters smaller than 1 µm differed more explicitly.

The effect of traffic at HW showed as the high concentrations of elemental carbon (EC, significantly higher than at UB, Fig. 1). $PM_{0.108\text{-}0.17}$- and $PM_{0.06\text{-}0.108}$-bound EC had the ambient concentrations 8 times greater at HW than at UB and the mass contributions to PM--6 times. In Katowice, because of municipal emission and poor quality of the vehicle fleet, also the coarse fraction of dust was enriched in EC. Such a phenomenon is unusual if compared with other European regions.

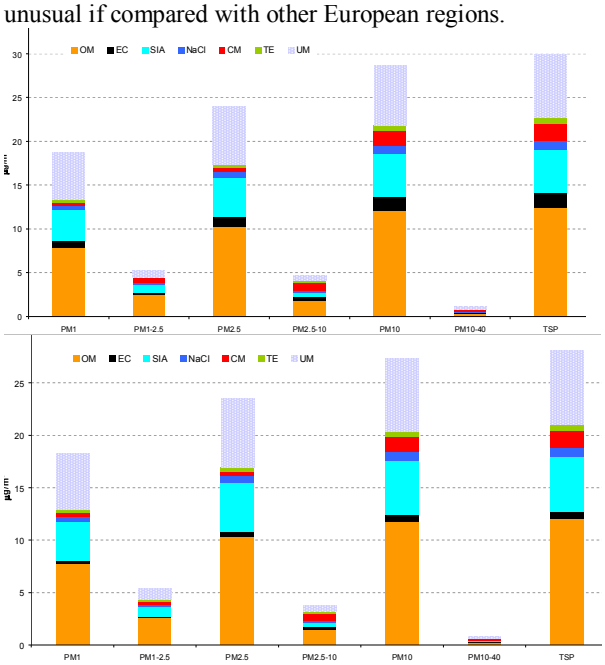

Figure 1. Concentrations of PM components in selected dust fractions at HW (top diagram) and UB (bottom diagram).

The work was supported by the grant No. N N523 564038 from the Polish Ministry of Science and Higher Education.

Rogula-Kozłowska W., Klejnowski K., Rogula-Kopiec P., Mathews B., Szopa S. (2012) *Bull. Environ. Contam. Toxicol.*, 88, 722–729.

Rogula-Kozłowska W., Klejnowski K. (2013) *Bull. Environ. Contam. Toxicol.*, 90, 103-109.