Characterization of Particulate Matter in Different Archives

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CHARACTERISATION OF PARTICULATE MATTER IN DIFFERENT ARCHIVES

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INTRODUCTION

Indoor air pollution in cultural heritage buildings such as museums, libraries and archives can be harmful for materials stored there. Adverse effects of most of gaseous pollutants are well described (Thomson, 1965), but less is known about airborne particles. Particles cover a wide range of sizes and have a variable composition. These characteristics determine their transport to the surfaces and also possible negative effects (Nazaroff and Cass, 1989).

EXPERIMENTAL SETUP

The measurements were carried out in four archives in the Czech Republic, representing different outdoor environments: (1) Zlatá Koruna (rural), (2) Třeboň (small town), (3) Teplice (industrial area), and (4) Prague (large city with traffic). The measurements were performed during four intensive campaigns in different seasons of the year at every location. Indoor PM1 and PM10 fractions were sampled in parallel on Teflon and Quartz filters and analysed gravimetrically, by ion chromatography, particle-induced X-ray emission spectrometry and thermal–optical transmission method, giving mass, ionic, elemental and organic and elemental carbon concentration. In order to evaluate indoor and outdoor mass, ionic and elemental size distribution particulate matter (PM) was sampled by two Berner type Low Pressure Impactors (10 size fractions, size range 0.025 – 10 μm). For reconstituting indoor PM, nine aerosol components were considered (Maenhaut et al., 2002).

RESULTS AND CONCLUSIONS

The indoor/outdoor concentration ratio was for all PM compounds lower than 1 for every location. It indicates that particles detected inside have their source outside the archive. In all cases the submicron fraction dominated. The average percentage attributions to the indoor fine and coarse PM for the six major aerosol types are for every archive given in Table 1. The dominating component of the both fine and coarse PM was organic matter. In the fine fraction the next most abundant components were EC and sulphate and in the coarse fraction crustal matter and sulphate. The included components explained 83.7(±12.3)% and 98.7(±28.9)% of the gravimetric indoor PM in the fine and coarse size fractions, respectively.

Table 1: Average percentage attribution and associated standard deviation of aerosol mass to six major aerosol components for the PM1 and PM1-10 fractions measured in the indoor environment of archives.

Fine (PM1)

	Třeboň	Zlatá Koruna	Teplice	Prague
Organic matter	49(±18.4)%	53.2(±8.8)%	42.2(±15.5)%	59.5(±17)%
EC	11(±4.3)%	8.5(±2.5)%	11.5(±7)%	19.1(±16.5)%
Sulphate	11.2(±8.1)%	8.2(±4.1)%	14.2(±10.8)%	6.3(±4.7)%
Nitrate	1.3(±1.4)%	0.6(±0.4)%	0.4(±0.4)%	0.4(±2.1)%
Ammonium	4.9(±3.2)%	3.4(±1.5)%	5.2(±3.9)%	3.3(±1.8)%
Crustal matter	3.2(±4.3)%	2.4(±1.2)%	1.8(±1.7)%	7.5(±5.7)%
Total	80.6(±12.1)%	76.3(±6.9)%	75.3(±6.4)%	96.1(±9.2)%

Coarse (PM1-10)

	Třeboň	Zlatá Koruna	Teplice	Prague
Organic matter	45.3(±28.9)%	51(±29)%	50(±23.6)%	56.1(±33.7)%
EC	4(±2.9)%	1.7(±2.1)%	1.7(±1.7)%	1.8(±2.2)%
Sulphate	9.1(±8.1)%	8.9(±8.3)%	4.6(±3.7)%	12.4(±12.1)%
Nitrate	3.3(±2.7)%	6(±8)%	1.1(±1.2)%	7.9(±16)%
Ammonium	2.5(±3.2)%	2.8(±2.8)%	1(±1.2)%	4.4(±5.2)%
Crustal matter	34.8(±17.2)%	41.9(±35.9)%	15.1(±12.1)%	10.8(±13.1)%
Total	99(±21.5)%	112.3(±43.2)%	73.5(±18.9)%	93.4(±29.3)%

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REFERENCES

Maenhaut, W., Schwarz, J., Cafmeyer, J., Chi, X., Aerosol chemical mass closure during the EUROTRAC-2 AEROSOL Intercomparison 2000, *NIM B: Beam Interactions with Materials and Atoms.*, 184(1-4), 233-237, (2002).

Nazaroff, W.W., Cass, G.R., Mass-transport aspects of pollutant removal at indoor surfaces, *Environ. Int.*, 15(1-6), 567–584, (1989).

Thomson, G., Air pollution-a review for conservation chemists. *Studies in Conservation*, 10, 147-167, (1965).

Brunekreef B., Holgate S. T., Air pollution and health, *Lancet*, 360, 1233-1242, (2002).