

Introduction

- problematic situation with atmosphere in Ostrava
- daylight overdraft of PM₁₀ immersion limit
- risk potential of airborne aerosol particles

The atmosphere of the Ostrava region has been rightfully considered unsatisfactory in the long term. Combination of the geographical, climatic and meteorological conditions and the accumulation of industrial plants, small local heating sources and transportation, results in the basis to regularly repetitive situations – inversion accompanied with considerable increase of PM₁₀ (and PM_{2.5}) concentration. The number of days during which the immersion limit of PM₁₀ daily concentration can be exceeded is 35 days/year. The real situation is about 6 times worse. The immersion limit of PM_{2.5} and PM₁ has not been introduced yet and the value of 0.8 of PM₁₀ and PM_{2.5} concentration ratio of Ostrava airborne aerosol shows relatively higher apportionment of finer fractions in Ostrava atmosphere, compared to other Czech or European towns. Moreover there are not available systematic data of ultrafine aerosol fractions in the Ostrava urban atmosphere so far. In this work we present two campaigns results of a nanoparticles monitoring conducted under different meteorological conditions at four locations in Ostrava

- Ostrava - Poruba, which is considered to be a suburb with a relatively low pollution level
- Ostrava - Přívoz, close to the city centre and the coking plant
- Ostrava - Mariánské hory and Ostrava - Bartovice considered be the most polluted locality in the region, often mentioned as the most polluted village of the central Europe.

Experimental method

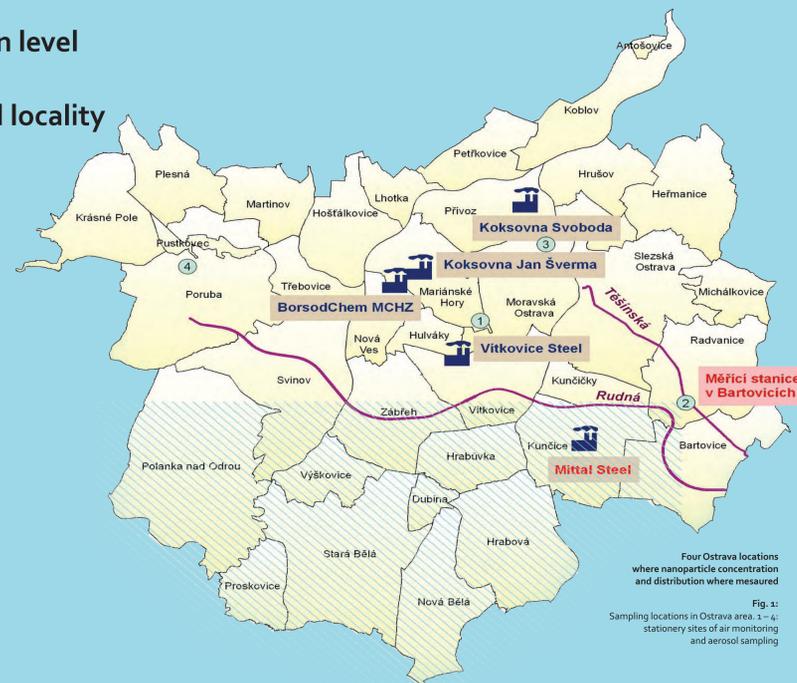
- shape and surface observation by SEM, TEM
- determination of chemical compositions by ICP-MS
- particular nanoparticles concentration measured by FMPS 3091 spectrometer

The objective is to examine the particle number and size distribution in submicron size range with respect to nanosized particles. Examining the physicochemical properties like shape and surface observation by SEM, TEM and chemical compositions by ICP-MS of samples obtained from various localities and various seasonings might help pollutant source identification in residential localities. The nanoparticles concentration in the Ostrava urban atmosphere was measured in the range 5 to 100 nm by FMPS 3091 spectrometer. Four stationary sampling locations were used for preliminary data on nanoparticle number and distribution obtaining. Samples of airborne particles of 0.25 to 20 µm were collected on the carbon layer treated glass slides, particles of 0.002 to 0.25 µm nylon and stainless steel nets using the NanoID Wrass system and a grids using thermal precipitator.

Results

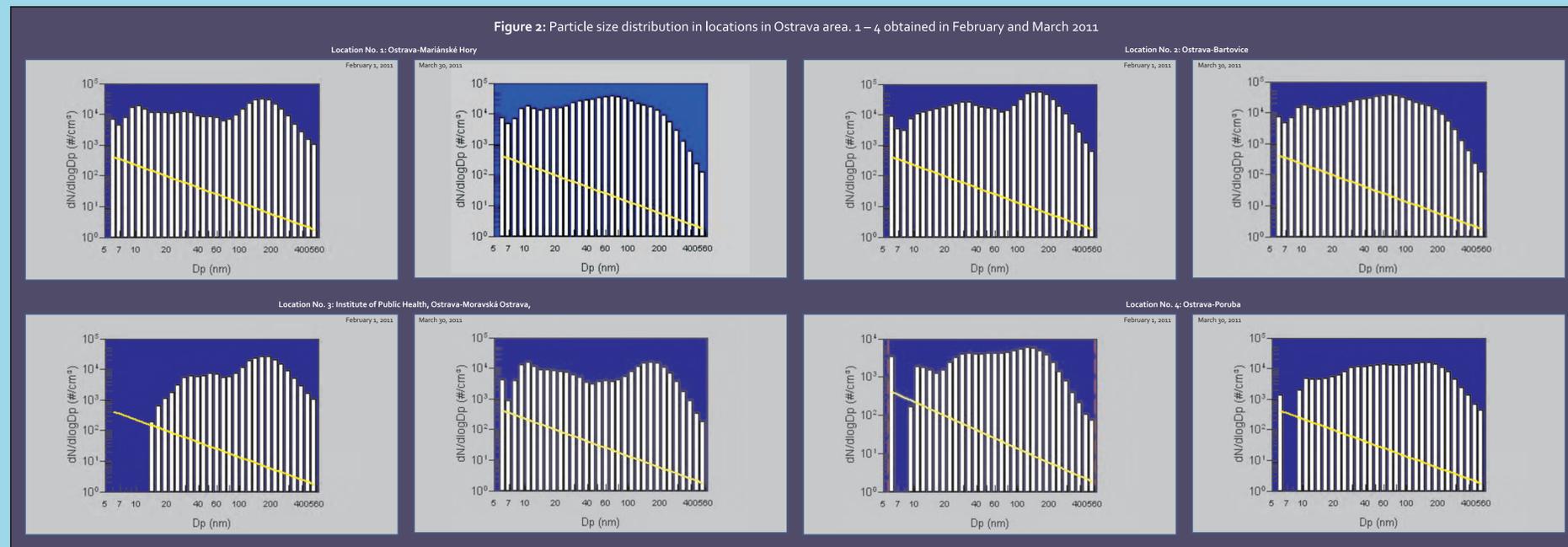
- remarkable variations in localities
- predominance of spherical or globular particles
- larger particles are composed mostly from iron oxides

The total particle number and particle size distribution show remarkable variations in all localities, primarily characterised by size distributions modality, given by place but also by different date. The peaks in number concentrations were observed at different diameters in all localities. With the respect to the same place in different sampling time, the diameter of peak value changes significantly. For example, in Zelená Street, Ostrava – Mariánské Hory the diameter of peaks were 10 and 200 nm on February 1, while at March 30, 2011 they were 10 and 100 nm. This fact can result partly from higher temperature in March and if the wind direction and speed is similar in both days and local heating (coal and wood combustion) still active, the significant increase in smaller particles is attributed to transportation.



Four Ostrava locations where nanoparticle concentration and distribution were measured
 Fig. 1: Sampling locations in Ostrava area. 1 – 4: stationary sites of air monitoring and aerosol sampling

Figure 2: Particle size distribution in locations in Ostrava area. 1 – 4 obtained in February and March 2011



The observations results of samples collected by NanoID WRAS or Thermal precipitator show predominance of spherical or globular particles (Fig. 3 and Fig. 4). The particles in range of 200 – 500 nm are composed mostly from iron oxides with a small amount of accompanying elements like chromium, zinc, copper, calcium and aluminium. EDAX analysis of ultrafine particles is interfered by matrix elements and on spectrum is always one dominant peak from iron, copper or aluminium, so it is not easy to take exact information of chemical composition of particles less than 100nm (Fig. 4).

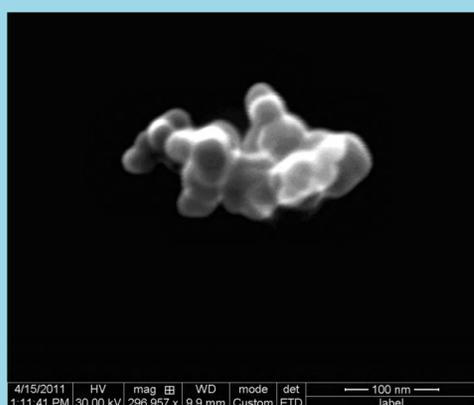


Fig. 3: SEM picture of agglomerate of nanoparticles collected in the locality of Ostrava - Bartovice by sampler Nano ID

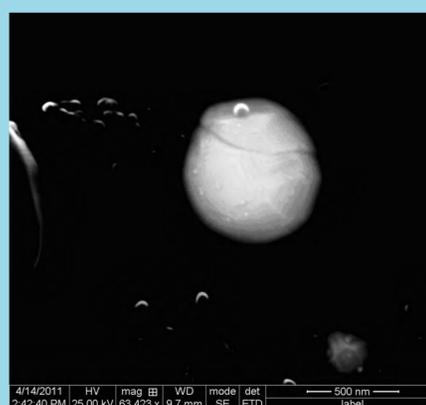
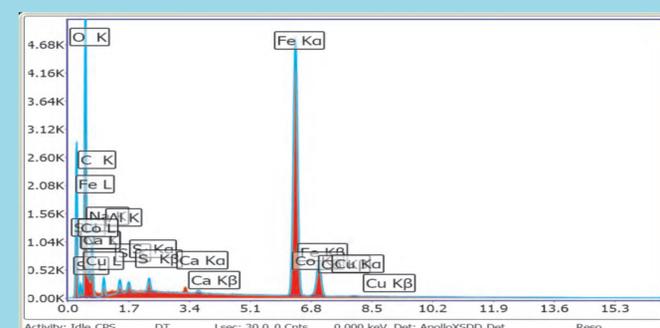


Fig. 4: SEM picture of fine particle of iron oxide with its EDAX spectrum collected by Nano ID sampler, stage 7 (250 – 500nm) in the locality of Ostrava - Bartovice.



Discussion and conclusion

The total particle number and particle size distribution shows remarkable variations in all localities, primarily characterised by size distributions modality. Given the fact there is much greater danger of ultrafine fractions of airborne dust, it will be paid more attention to this issue in the future. The nearest monitoring campaign will continue in the particle number and size distribution measurement, but also shall be focused on the sampling of aerosol samples in range of approx. 1 nm – 20 µm by various sampling equipment for further physicochemical properties like shape and surface observation by SEM, TEM and chemical compositions of samples obtained from various localities and various seasonings.