Oxidative potential of atmospheric aerosols collected at high air pollution site related to chemical composition: Krakow case study

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Measurements of the oxidative potential (OP) of airborne particulate matter may be applied for the assessment of the health-based exposure by integrating various biologically relevant properties of particles. This study aimed at the determination of oxidative activity of two size fractions of particulate (PM2.5 and PM10) using the ascorbic acid (AA) and reduced glutathione (GSH) assay.

Samples of PM were collected in Krakow, one of the most polluted cities in Poland, in the city centre. Samples were collected during wintertime, when heating sources used in residential areas have significant influence on the concentrations of particulate matter in the air. PM10 and PM2.5 concentrations varied from 8.9 to 92.5 µg·m⁻³. The decrease of antioxidants concentration due to the interactions with particulate matter, the technique of HPLC/UV-Vis was applied. Samples were analysed following after 15, 30, 60 and 90 min of interactions between antioxidants and PM. Organic and elemental carbon concentrations were determined using a thermal-optical method. The concentration of the inorganic anions and cations were analysed with isocratic Na⁺, K⁺, Mg²⁺, Ca²⁺, NH₄⁺, NO₃⁻, NO₂⁻, Cl⁻, SO₄²⁻ ion chromatography. Concentrations of elements: Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, Sr, Rb, and Pb in PM10 and PM2.5 were analysed by means of a multifunctional energy dispersive X-ray fluorescence spectrometer.

Variations of gravimetrically measured concentrations of PM10 and PM2.5 and oxidative potential (OP) expressed as depletion of AA and GSH mass (µg) over the 90 min incubation period per m³ are showed in Figure 1. OP_AA and OP_GSH measured for PM10 varied from 14.50 to 65.27 µg·m⁻³ and from 6.00 to 39.5 µg·m⁻³, respectively. For PM2.5, OP_AA and OP_GSH ranged between 2.1 and 81.7 µg·m⁻³ and between 37.0 and 132.0 µg·m⁻³. PM2.5 fraction performed the higher values of OP than PM10. OP_GSH was significantly higher for PM2.5. The significant correlation between oxidative stress and PM mass concentration was observed only for OP_AA and PM10. Furthermore, on the basis of correlation, OP_AA of PM10 was significantly correlated with organic and elemental carbon as well as the following metals: Fe, Cr, Mn, Cu, Zn, Pb, Ti, V, Rb, Sr. OP_GSH of PM10 differed in respect to their correlation with PM components, it was significantly correlated with OC, Pb and nitrite. The high correlation between OP_AA of PM2.5 and carbonaceous fraction, both OC and EC, between OP_GSH of PM2.5 and EC and Ni were only observed.

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