Indoor dust granulometry in aspect of magnetic properties of anthropogenic pollution.

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Abstract: In recent years an indoor air quality is attractive field of study due to the fact that people spend the more time in indoor environments. The concentration and size of particle matter (PM) is important as the factor affecting lung injury. Many studies demonstrated that quality of indoor air is the result of an emission from indoor sources and penetration of outdoor pollution particles to inside environment by mechanical and natural ventilation system, and by activities of people.

In our earlier paper (Górka–Kostrubiec et. al. 2014) we presented magnetic properties of about 200 household dust samples collected in flats in different parts of Warsaw, Poland. The aim of the present study was to identify differences in magnetic properties and the chemical composition of indoor dust samples depending on granulometry of particles pollution. For the study two locations were selected: the first in city center (labeled O2) and the second in suburb (labeled B-14) of Warsaw. In both locations the different sources have a significant impact on the level of outdoor pollution. Dust samples were mechanically sieved using the laboratory shaker with standard sieve set. In this manner the fractions of grains with a diameter of 0.1mm, 0.5mm, 0.25mm, 0.071mm and less than 0071mm were obtained.

Results indicate that the magnetic susceptibility depends on the granulometry of pollution. Magnetic susceptibility of finest fraction pollution (d <0.071mm) is 3.5 times and 8 times higher than the coarsest fraction (d=0.5mm) for samples B-14 and O-2, respectively. The particular fractions also differ in magnetic hysteresis parameters. For both locations, the coarsest fractions (0.5 and 0.25mm) have high values of coercivity: B_c=9mT and B_{cr}=39mT. The low values of B_c=4mT and B_{cr}=18mT were observed for particles of 0.1mm diameter. Temperature measurements of magnetic parameters SIRM(T) and k(T) revealed that each fraction contains magnetite. In both locations, the finer fractions (d=0.1mm, 0.071mm and d<0.071mm) additionally contain magnetic mineral with a Curie temperature above 700^{o}C. On the basis of direct observations of Scanning Electron Microscopy (SEM) and the Energy Dispersive X-ray Spectroscopy analysis (EDS) it was identified as pure iron.

The SEM observation of the magnetic extract of 0.5mm fraction revealed angular-shape particles with variable chemical composition. The finer fractions contained two kinds of spherules differing in the type of surface, and chemical composition. Orange-peel spherules contain a high concentration of Fe, O and C while the chemical composition of the second type spherules was more varied and includes: Fe, Mn, Al, Si, Ca, Ti, K, Mg, O and C. Chip-shaped particles were observed in the finer fraction of magnetic extract of indoor dust. The chip-shaped particles contained following elements: Fe, Mo, W, V, Cr and Fe, O, C, Al for B-14 and O-2 locations, respectively.

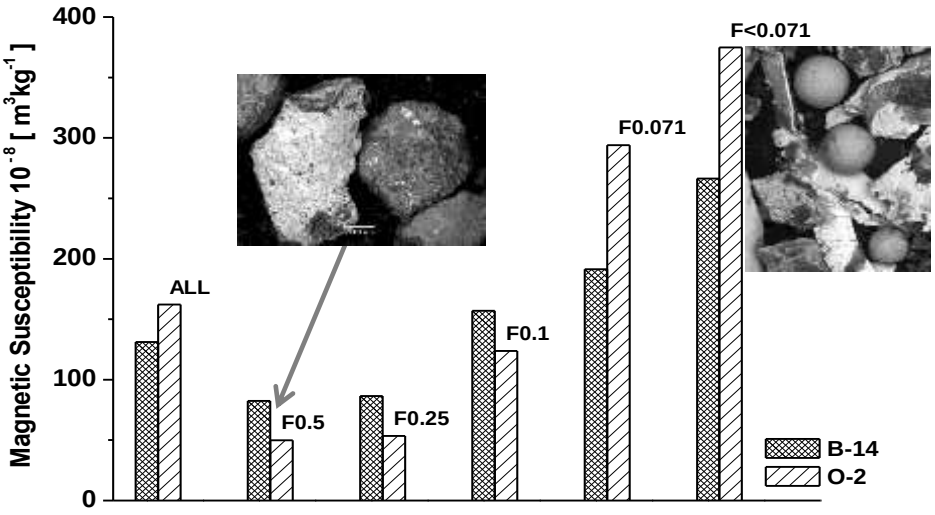

Figure 1: Dependence of magnetic susceptibility on the granulometry of indoor dust for two different locations: B-14 and O-2. Inside SEM photographs the grains for magnetic extract for coarsest and finest fractions are shown.

Keywords: indoor dust, size of particle pollution, magnetic method, magnetic susceptibility.

References :

B. Górka–Kostrubiec, M. Jeleńska and E. Król, 2014: Magnetic signature of indoor air pollution: household dust study. Acta Geophysica, (in press).