# Summary

Sources of technogenic magnetic particles are mainly anthropogenic dusts deposited on the ground. They cause soil magnetic anomalies around urban and industrial centers. The presence of magnetic particles in soils can be detected using an easy method of soil magnetometry consisting in magnetic susceptibility measurements of soils in the field and laboratory. Many researches have revealed that ferrimagnetic minerals are often accompanied by heavy metals.

Studies of soils in the vicinity of different industrial works, especially ironworks, non-ferrous, power and cement plants showed increase in magnetic susceptibility in these areas. Data is lacking on the influence of the coke industry on soil magnetic susceptibility. The coke industry is considered as the weakest recognised source of magnetic particles.

This research work presents first results of magnetic susceptibility of dusts and soils currently being under the influence of imissions from cokeries (recent study was performed around liquidated cokery "Concordia" in Zabrze). There are some published data of heavy metal or polycyclic aromatic hydrocarbon (PAHs) contents, but only around single plants.

Soils around chosen cokeries (in the west-east transect) located in Zdzieszowice, Radlin, Dębieńsko, Zabrze, Bytom, Dąbrowa Górnicza and Kraków were investigated. In the field, magnetic susceptibility κ along 4–5 transects each c.a. 2 km in length using MS2D Bartington meter was measured. From selected sites 30 cm soil cores were taken (with the help of Humax sampler), as well as representative soil samples for further chemical and mineralogical analyses. In addition, dust samples from different productive divisions of the coke plants were collected.

In the laboratory, volume magnetic susceptibility of dust and soil samples (in 2 frequencies using MS2B Bartington meter in order to obtain values of mass magnetic susceptibility) and along every soil cores was measured with the use of MS2C Bartington meter. AAS method for the determination of heavy metal contents in dust and soil samples (after previous 2M $HNO_3$ and *aqua regia* extractions) and gas chromatography with mass detection for determination of PAH contents were used. Dust and soil samples after magnetic separation were subjected to mineralogical analyses.

Soils around investigated coke plants (except Zdzieszowice Cokery) are characterized by heightened values of magnetic susceptibility, which decrease

with increasing distance from the emitter, reaching value of $50 \times 10^{-5}$ SI about 1–2 km from coke plants. Magnetic susceptibility of soils depends mainly on the distance from an emission source, the wind direction and emission rate. There was observed a much higher level of soil contamination with ferro-, ferrimagnetics and heavy metals in the vicinity of a cokery and metallurgical work.

The coke industry is one of the greatest sources of pollutants contributing to increase in heavy metal and PAH contents. The content of benzo(a)pyrene, which is highly carcinogenic, exceeds threshold value in all samples, and a sum of 9 PAHs – in almost all samples.

The content of heavy metals of technogenic origin (especially Zn, Pb and Cd) is very high and also exceeds the limits. In the case of "Jadwiga", "Carbo-Koks" and "Przyjaźń" cokeries the contents of Zn, Pb and Cd are even several times higher than threshold values specified in the Regulation of Environmental Minister [29].

Strong positive relationships between magnetic susceptibility and contents of PAHs and heavy metals confirmed the technogenic origin of pollutants in investigated soils.

The results of mineralogical analyses of dust and soil samples after magnetic separation revealed a high heterogeneity of magnetic particles in respect of constitution, shape, size and surface pattern. Magnetite, maghemite and hematite were the dominant magnetic minerals and they are accompanied by nonmagnetic phases of clayey minerals, feldspars, dolomite and quartz. Additionally, the presence of pyrrhotite, wustite and metallic iron was stated in dust samples.