Chemistry and mineralogy of waste incineration fly ashes from Poland

P. R. KOWALSKI[1*] AND M. MICHALIK[1]

[1]Institute of Geological Sciences, Jagiellonian University, Oleandry 2a, 30-063 Krakow
(*correspondence: p.kowalski@uj.edu.pl)

Usage of wastes thermal treatment technologies caused production of bottom and fly ashes as incineration residues. In the next few years in Poland contribution of these materials in waste stream will rise significantly therefore a detailed mineralogical and chemical characterization is crucial to assess potential environmental impact and to find out the possibilites of their utilization.

Both in bottom and fly ashes accumulation of non-combustible fraction of thermally treated wastes took place. It is represented by amorphous and mineral phases together with metallic fragments and other heat-resistant components.

In fly ashes, where more volatile elements can concentrate as a result of processes which occur in furnace, contribution of potentially toxic elements should be defined. Fly ashes are widely used as raw material therefore these analysis linked with mineralogical studies allows to estimate it usefulness in this area.

Fly ashes from thermal treatment of municipal and industrial (also hazardous and medical) wastes were studied. Due to Polish legislation the first fly ash is treated as non-dangerous and the second as material containing hazardous elements. Samples were studied using chemical (ICP-MS, ICP-AES, LECO) and mineralogical methods (SEM-EDS, XRD+Rietveld).

Fly ashes from municipal wastes were composed mostly of SiO_2 (47 wt%), CaO (25 wt%) and Fe_2O_3 (9 wt%). Crystalline phase (~75 wt%) outweighted the amorphous glass (~25 wt%). From mealic and toxic elements Ti (~1 wt%), Zn (2800-7000 ppm), Pb (700 ppm) and in smaller concentrations (~350 ppm) Cu and Cr were detected.

Fly ashes from industial wastes shoud be considered as APC residues where domination of soluble phase were present (~50 wt% of NaCl). In their composition high content of Na_2O (31 wt%), CaO (12 wt%) and S (7 wt%) were present and high LOI values (~48 wt%) were measured. In insoluble fraction of fly ashes amorphous glass (51 wt%) and sulphate minerals (34 wt%) were main components.

Beside metallic and toxic elements Zn (0.5 to >1 wt%), Cu (2200 ppm) were these with the highest content but also relatively high concentrations of Pb (600 ppm) and As (~650 ppm) was notable.