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Distribution of minor metallic elements within waste incineration bottom ashes defined by WDX/EDX spectrometry

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Since incineration of waste is used as one of the most common treatment method in waste management, worldwide production of waste incineration residues is growing. By using thermal treatment process, the amount of waste is reduced with their simultaneous detoxification while solid residues such as bottom and fly ashes and air pollution control residues are produced. They are concentrates of waste inflammable fraction composed of newly formed phases, materials barely affected by high temperature and metallic components. Great number of elements are still entrapped in incineration residues and excluded from their natural cycles, until new methods of their management or recycling will be developed. Most of elements mass is concentrated in bottom ashes (BA), which are of potentially highest interest from the point of view of their recovery. This study was focused on BA metallic components, especially these dispersed and present in minor amounts.

BA from the Polish incinerators of industrial and hazardous (IH) and municipal waste (MW) were investigated using ICP-OES, ICP-MS and LECO methods. BA components were studied in details using SEM microscope (Hitachi S-4700) coupled with EDS analyzer and electron microprobe (JEOL JXA-8230) equipped with 5 WDX detectors (19 elements measured).

BA were enriched in Si, Ca, Fe, Al, Na and composed of amorphous ($\geq$ 50 wt%, mostly as silicate glass) and crystalline phase (rich in silicates, aluminosilicates, oxides of non- and metallic elements and sulphates). The average content of metallic elements (Al, Fe, Mg, Ti, Mn, Cr, Ni, Mo, Cu, Pb, Zn, Sn) was 9.5-11.5 wt% in MS and 13-19 wt% in IH BA (from $\frac{1}{2}$ to $\frac{2}{3}$ of this amount were Al and Fe). They were mostly concentrated in the form of metallic fragments: mainly as metallic inclusions and separated metallic grains. These occurrences were dominated by Fe, Al-rich fragments and rarely occurred any others (Cu, Zn, Ni and very few Pb, Ti, Cr, Sn-rich). Most of the minor metallic elements in the BA were admixtures in heterogeneous alloys and other non-metallic phases, where few elements prevailed those present in low amounts (from tenth parts to few of wt%). WDX mappings indicated that: Al, Fe and Cu were concentrated mostly in discrete grains and large inclusions; Mn was present as component of alloys; Ti occurred in marginal zones of metallic Fe-rich fragments; Cr and Zn concentrated in the form of micro-inclusions; Sn, Ni and Pb were dispersed in glass.

Minor metallic elements present in the BA are most interesting from the point of view of their recovery, but they were dispersed within number of phases (often as trace components) and characterized by multiplicity of forms of their occurrences what make the process of their recovery difficult.

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