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Slags and ashes from municipal waste incineration in Poland – mineralogical and chemical composition

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In the next few years there will be a large change in the waste management system in Poland. Its primary aim will be reduction of the amount of landfilled waste by enhancing level of recycling, waste segregation, composting of biomass and incineration. The biggest investment during this transformation is construction of nine incinerators with assumed slags production around 200 thousand tons per year. Slag production is accompanied by fly ash generating. This ash can be a valuable raw material as fly ash from the power industry. Waste management system transformation will cause big increase in slag production in comparison to the present amount and will require taking necessary steps to ensure environmental safety. For this purpose, studies of slags and fly ashes in terms of environmental risk and potential impact on human health are significant.
The object of the study are fly ashes and slags produced in the biggest municipal waste incineration power plant in Poland. Two series of samples obtained in municipal waste incineration process were studied in order to characterize mineralogical and chemical composition and to determine the concentrations of heavy metals and their possible negative environmental impact. Characteristics of these materials will be the basis for determining their value in application, for example in building industry.
Mineralogical characteristic of slags was based on X-ray diffraction. Characteristic of structures and forms of occurrence of mineral phases was based on the optical microscopy and SEM imaging coupled with EDS analysis. Chemical analysis were performed using ICP-MS/ICP-AES methods. They allowed to follow variability between studied samples and gave basic information about metals.
Metals in samples of slag and ashes are present as component of mineral phases and in the form of metallic inclusions in glass or minerals. Potentially hazardous concentrations for environment are observed for copper (330-4900ppm), zinc (1500-8100ppm) and lead (50-2400ppm).
All samples are rich in amorphous phase. Municipal slags are rich in Si, Ca and Al, whereas Fe and Na are minor component. Fly ashes from incineration of waste are similar to Ca-type ashes from power industry. They are rich in Ca and Si and they contain minor amount of Al, K and Na.
The main mineral components of municipal slags are quartz, gehlenite, calcite and lime. They are present in all samples. Smaller quantities of apatite, wollastonite, feldspar, anhydrite and magnetite were also detected. In addition to main components, two groups of associated minerals can be identified. The first group is represented by wollastonite and apatite, whereas in the second group magnetite and feldspar or anhydrite were detected. Moreover, if feldspar is present in the sample there is no anhydrite. Also the presence of magnetite is correlated with the absence of wollastonite and apatite.
In all fly ash samples quartz, calcite, anhydrite, lime and halite or sylvite are present. Minor components are periclase, portlandite and syngenite, wollastonite and meionite. Here we can observe also some dependence. When halite and syngenite are present in sample there is no wollastonite and when gelenite is present, portlandite is absent.