



Glass phase in municipal and industrial waste incineration bottom ashes

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Waste incineration bottom ash is a material with rising significance in waste streams in numerous countries. Even if some part of them is now used as raw materials the great amount is still landfilled. High temperature of thermal processes ($>1000^{\circ}\text{C}$) together with fast cooling results in high content of glass in bottom ash. Its chemical composition is influenced by various factors like composition of raw wastes and used incineration technique. Most of bottom ash grains are composed of glass with large amount of mineral phases and also metallic constituents embedded into it. Glass susceptibility for alteration processes together with the characteristics of glass-based grains can bring environmental risk in time of improper or long term storage on landfill site.

In this study bottom ashes from thermal treatment of municipal and industrial (including hazardous and medical) wastes were studied to determine glass content, its chemical composition with emphasis on metal content (especially potentially hazardous) and its relations to metallic components of grains. Samples were collected from two thermal treatment plants in Poland. Qualitative and quantitative X-ray diffraction (XRD) analyses were used for determination of mineral composition of studied samples. Rietveld method and addition of internal standard for determination of amorphous phase content were used. Scanning electron microscopy fitted with energy dispersive spectrometry (SEM-EDS) were used for detailed analysis of glass and glass associated phases. Waste incineration bottom ash is a multi-components material rich in amorphous phase. Its dominant part is represented by Si-rich glass. It is a main component of bottom ash grains but it contains minerals present in large quantities and also various forms of metallic elements. Glass within grains is often porous and cracked. In bottom ashes from thermal treatment of municipal wastes $\sim 45\text{-}55$ wt % of amorphous phase were present, mostly in form of glass with high Si content (~ 38.5 wt %). In bottom ash from thermal treatment of industrial wastes content of amorphous phases was higher and account for $70\text{-}75$ wt % of the samples. Its main form was also glass with high Si content (~ 32 wt %). Glass chemical composition in bottom ashes is influenced by presence of metallic components which result in elevated content of some metals like Fe (~ 4 wt %), Al (~ 4 wt %), Zn (~ 2.5 wt %) and Ti (~ 1.3 wt %) in municipal bottom ash and ~ 11 wt % Fe, 5.5 wt % Al, ~ 3 wt % Ti, Cu, ~ 2 wt % Cr, Zn in industrial bottom ash. Due to the fact that the glass is more susceptible for alteration processes than crystalline components it is important to estimate their content characteristics. In waste incineration bottom ashes it is especially important taking into consideration presence of metallic elements including potentially hazardous metals (Zn, Cr) which can be easily released to the environment during landfilling.