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Metals accumulations during thermal processing of sewage sludge - characterization of bottom ash and air pollution control (APC) residues

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Due to increasing mass of sewage sludge, problems in its management have appeared. Over years sewage sludge was landfilled, however due to EU directives concerning environmental issues this option is no longer possible. This type of material is considered hazardous due to highly concentrated metals and harmful elements, toxic organic substances and biological components (e.g. parasites, microbes). Currently in Europe, incineration is considered to be the most reasonable method for sewage sludge treatment. As a result of sludge incineration significant amount of energy is recovered due to high calorific value of sewage sludge but bottom ash and APC residues are being produced.

In this study we show the preliminary results of chemical and mineral analyses of both bottom ash and APC residues produced in fluidized bed boiler in sewage sludge incineration plant in Poland, with a special emphasis on metals which, as a part of incombustible fraction can accumulate in the residual materials after thermal processing.

The bottom ash was a SiO_2-P_2O_5-Fe_2O_3-CaO-Al_2O_3 dominated material. Main mineral phases identified in X-ray diffraction patterns were: quartz, feldspar, hematite, and phosphates (apatite and scholzite). The bottom ash was characterized by high content of Zn - 4472 mg kg^{-1}, Cu - 665.5 mg kg^{-1}, Pb - 138 mg kg^{-1}, Ni - 119.5 mg kg^{-1}, and interestingly high content of Au - 0.858 mg kg^{-1}

The APC residues composition was dominated by soluble phases which represent more than 90% of the material. The XRD patterns indicated thenardite, halite, anhydrite, calcite and apatite as main mineral phases.

The removal of soluble phases by dissolution in deionised water caused a significant mass reduction (ca. 3% of material remained on the filters). Calcite, apatite and quartz were main identified phases. The content of metals in insoluble material is relatively high: Zn - 6326 mg kg^{-1}, Pb - 514.3 mg kg^{-1}, Cu - 476.6 mg kg^{-1}, Ni - 43.3 mg kg^{-1}. The content of Cd, As, Se and Hg was noted also what can be a reason of potential environmental concerns.

A significant reduction of sludge volume after incineration causes concentration of numerous elements in both types of residues. The removal of soluble fraction from APC residues caused almost a 30-fold additional concentration of elements what makes this material interesting in terms of metals recovery.

A detailed identification of metals occurrences and their distribution within mineral phases will be of a great importance in determination of possibilities of their recovery.

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