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Fly ash (FA) is one of the main solid residues from municipal solid waste incineration (MSWI). FA is a fine powder that consists of particles entrained by flue gases from the incineration chamber. FA has an aluminosilicate matrix with bound trace elements and is generally classified as hazardous waste due to the high content of soluble salts, potentially toxic elements, and trace organic pollutants. The production of FA typically accounts for 10–30 kg/t of incinerated waste. In the Czech Republic, about 20 thousand tons of FA are produced every year. Due to the upcoming landfill ban, the construction of new MSWI plants can be expected in the near future and, together with them, the increase in FA production.

FA contains valuable metals (especially, zinc, copper, and lead) in significant concentrations; therefore, it can be a suitable secondary source of the materials. Because of the gradual decrease in easily accessible natural resources and the growing shortage of metals, it is desirable to find effective and economically feasible methods for metals recovery from FA.

The recovery of metals from FA is possible using the FLUWA technology, which is a hydrometallurgical process based on acid extraction of FA using process water from the flue gas treatment system, which contains on average 5% of HCl and different amounts of other acid compounds and volatile metals condensed from the flue gases (for example Hg). The extract is treated in a multi-step process including neutralization, precipitation, coagulation, and sedimentation. Extracted metals are precipitated into the metal-rich filter cake, which can be potentially used as a raw material in smelters.

The technology was primarily developed for the removal of hazardous properties of FA, therefore, in TERMIZO Liberec, since it was built in 1990, FLUWA has never been properly monitored and described from the point of view of possible recovery of valuable components. Because the extraction step is crucial for metals recovery, long-term monitoring of physical and chemical properties of liquid and solid technological streams was conducted. Then short- and long-term variability of composition and properties of the streams was analyzed and the behavior of 26 elements in the reaction system was investigated as well. Based on the results, material flow analysis (MFA) and resource recovery potential of the main valuable metals (Zn, Cu, and Pb) were assessed.

The results of the analysis of current technology show that there is high variability in composition and properties of both of the inputs, the FA and the process water used as an extraction agent. For example, the raw FA may contain 29.5–47.6 g/kg of Zn, 3.25–7.76 g/kg of Pb, and 1.06–2.71 g/kg of Cu present in different chemical species; the process water may contain 39,700–111,000 mg/l of chlorides, 1,390–50,200 mg/l of sulfates and up to 500 mg/l of fluorides in different ratios. Moreover, extraction conditions also vary: the pH of extraction is 2–5 and the liquid-to-solid ratio is 3–10. The variability of extraction conditions and chemical composition of inputs cause a variability in extraction efficiency (for example, the extraction yield for copper varies from 0%, caused by cementation, to 60%). For efficient recovery of metals from FA, it is necessary to optimize the extraction step.

For this reason, different options of optimization and stabilization of the extraction conditions were tested in the laboratory and then verified in real-scale operation. The presentation will summarize the results of the experiments. The MFA of the main valuable metals after FLUWA optimization will also be shown.