High Temperature Recycling of Phosphorus from Sewage Sludge Ash

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ABSTRACT

Phosphorus, as a key element in DNA molecules and in cell energy carrier ATP, is essential for life. For intensive food production, modern agriculture needs to provide it in the soil through fertilizers. Industrial manufacturing of P-containing products is mainly based on non-renewable, scarce phosphate ores, extracted in only a few places around the globe.

Alternative phosphorus sources are, however, available, and new processing techniques are developed. One of them, investigated in the *RecoPhos* project, consists in using ashes from the incineration of sewage sludge.

These ashes, containing up to 20 wt% of P_2O_5 and available in considerable volumes, can be processed at high temperature in the InduCarb furnace, an inductively heated packed carbon bed reactor. Phosphorus is recovered by reduction and vaporisation. The P-containing gas can then be treated and the phosphorus further recovered as white phosphorus or phosphoric acid.

In order to describe the chemistry and predict the potential outputs and yields, InsPyro has developed a thermodynamic model as well as the required thermodynamic phase descriptions. The thermodynamic model is based on equilibrium with assumptions on the fast removal of gases in a thin film reactor.

In this paper, we discuss the results of the model compared to pilot trials. The influence of basicity is very relevant, as well as the iron oxide content in the ash. The basicity is important for the physical properties of the slag, the phosphorus activity, as well as the reduction of silicon. The ash iron oxide content will also be of significant importance, as the phosphorus combines with reduced iron and forms a stable ferro-phosphorus alloy. Available data from pilot trials was in good agreement with the model, which could function as a framework to interpret fragmentary results from first trials.