

Recovery of Phosphorus for Recycling

Kaj Thomsen^{C, S}

*Technical University of Denmark, DTU Chemical Engineering, Kongens Lyngby, Denmark
kth@kt.dtu.dk*

Phosphorus is a limited resource that cannot be replaced. The availability of phosphorus is essential to all life on earth. Phosphorus production is expected to peak within the next 25 years. The recovery of phosphorus for recycling is therefore expected to become increasingly necessary. A large part of the phosphorus that has been used as fertilizer ends up as a waste product. By combustion of biomass and sewage sludge a fly-ash consisting of mainly very soluble, inorganic salts is produced. Usually ions of heavy metals, chlorine, fluorine, and aluminum are concentrated in the fly-ash together with phosphorus, potassium, and sulfate. Due to the contents of heavy metals, the fly-ash can't be used as fertilizer in spite of the high content of potassium, sulfate, and phosphate. The deposition of such fly-ash is no longer allowed in the European Union. By separating fly-ash into its valuable, pure salts, this waste product can be made useful. In particular, the valuable phosphorus can be recycled. In order to facilitate the development of such processes, a thermodynamic equilibrium model describing the aqueous potassium – sodium – calcium - sulfate – fluoride - chloride – phosphate system including components such as iron(III), copper, and aluminum was developed. The model is able to describe the solubility of the various solid phases appearing in this system as a function of temperature and composition. The model is the Extended UNIQUAC model, a thermodynamic model for electrolytes that previously has been applied to describe the phase behavior of multi component electrolyte solutions. Parameters in the model were re-determined on the basis of a large amount of experimental data from the open literature. The data included solubility data, activity/osmotic coefficient data, and thermal property data.