Struvite-K, sustainable recovery of pure phosphate from sewage sludge and biomass ash

Kaj Thomsen, kth@kt.dtu.dk
Department of Chemical and Biochemical Engineering, Technical University of Denmark

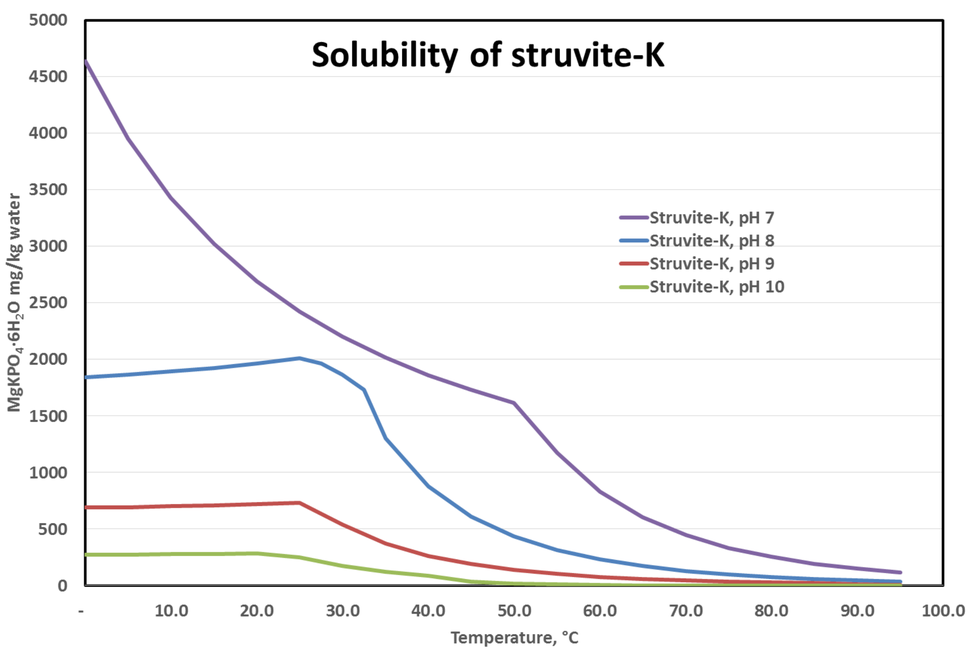
Struvite-K ($KMgPO_4 \cdot 6H_2O$) is similar to struvite but contains potassium instead of ammonium. Struvite is already produced from waste water many places. Lab experiments at DTU indicate that Struvite-K has properties similar to struvite. Struvite-K can for example be produced in a very pure form even when impurities are present. Struvite-K can probably be used as a slow release fertilizer (see figure below, left). Struvite-K is a PK-fertilizer, while struvite is a NP-fertilizer.

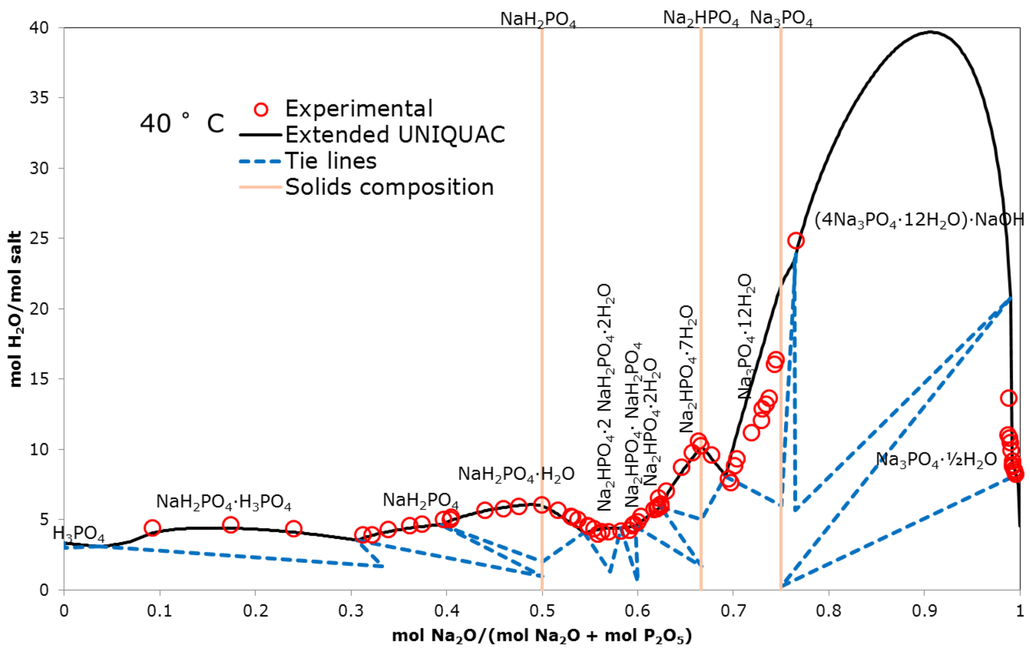
Production from sludge and bio-mass

Struvite-K can be produced from aqueous solutions under similar conditions as struvite is formed. The only difference is that potassium should be present for struvite-K production, whereas ammonium should be present for struvite production. Ash from bio-mass combustion is rich in potassium. By combining ash from combustion of waste water sludge, ash from bio-mass combustion, and a magnesium salt, struvite-K can be produced.

Potential to increase recycling of phosphorus significantly

This process has the potential to significantly increase the amount of phosphorus recycled. The production of struvite is limited to reject water from sludge while struvite-K can be produced from the sludge itself, after combustion. The potential amounts of struvite-K that can be produced are therefore much larger.





Development of thermodynamic model

Using a thermodynamic model, which is under development at DTU Chemical Engineering, the precipitation of struvite-K, struvite ($NH_4MgPO_4 \cdot 6H_2O$), hazenite ($KMgPO_4 \cdot NaMgPO_4 \cdot 14H_2O$), and similar compounds can be predicted. Many other solids can precipitate from the complex solution of different ash fractions in water (see figure above, right). In order to produce the desired product, process conditions need to be within certain limits. These process conditions, such as the adjustment of pH, the addition of magnesium salt, the mixing ratio of ash from biomass/sludge combustion can be determined based on this model.