STRUVITE PRECIPITATION FROM Mg-RICH AQUEOUS SOLUTION: MACRO- TO NANOSCALE EXPERIMENTS

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ABSTRACT

High phosphorus and ammonia accumulation in anthropogenic waste streams results into environmental problems such as eutrophication. A promising solution towards phosphorus and ammonia recovery is considered the low-soluble struvite (magnesium ammonium phosphate or MAP, $MgNH_4PO_4 \cdot 6H_2O$) precipitation. Struvite could be used as slow-release fertilizer in agriculture production Due to the lack of Mg^{2+} in wastewater effluents supplements of Mg^{2+} is necessary for the simultaneous recovery of total ammonia-nitrogen, TAN and PO4–P by struvite precipitation. Among different Mg sources proposed [1, 2] Mg-rich seawater [3] and MgO [4] may considered as low cost Mg-rich sources.

The aim of this study was the investigation struvite precipitation from supersaturated solutions using different magnesium sources. Macro- to nanoscale experiments were performed in artificial seawater and calcined magnesia saturated solutions, supersaturated with respect to struvite. The stability domain and the kinetics of both spontaneous and seeded growth of struvite in supersaturated solutions were measured at constant solution supersaturation with respect to struvite. Solution supersaturation was maintained by the addition of titrant solutions according to the stoichiometry of the precipitating salt. The magnesium source in the titrant solutions was the same to the respective source used for the preparation of the supersaturated solutions. Artificial seawater solution and saturated magnesia solutions were both promising alternatives for phosphorus recovery from ammonia and phosphorous solutions through struvite precipitation. Nanoscale observations of the crystal growth of synthetic struvite crystals were performed under Atomic Force Microscope, AFM. Struvite crystals were prepared using diffusion-crystallization of aqueous solutions of magnesium chloride or magnesium acetate and ammonium hydrogen phosphate at different pH values. In situ AFM experiments of struvite heterogeneous nucleation and crystal growth were performed using freshly cleaved brucite, $Mg(OH)_2$ and struvite crystal surfaces prepared in the lab, exposed in supersaturated solutions at flow conditions.

REFERENCES

[1] Kofina A.K., Koutsoukos P.G. (2005). Cryst. Growth Des., 5: 489–496

[2] Mpountas I., Papadakis E., Koutsoukos P. (2017). J. Chem. Technol. Biotechnol., 92: 2075–2082.

[3] Lahav O., Telzhensky M., Zewuhn A., Gendel Y., Gerth J., Calmano W. (2013). Sep. Purif. Technol., 108: 103–110.

[4] Huang H., Guo G., Zhang P., Zhang D., Liu J., Tang S. (2017). J. Taiwan Inst. Chem. Eng., 70: 209–218.