Exploring Conditions for Struvite Precipitation with Sustainable Goals in Wastewater Management

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Municipal and farmland effluent and CAFO produced wastes contain high phosphate and ammonium levels, which must be brought to EPA mandated standards. Current treatments are relatively expensive and remove ammonium and phosphates separately. Production of struvite, crystals consisting of magnesium, ammonium and phosphate (MAP) in 1:1:1 ratio, is a potential effective, low-cost method to recover ammonium and phosphate together. This process has implication for environmental management and sustainability since struvite is an excellent slow-release, eco-friendly fertilizer, which allows for the recycling of MAP. This project aims to optimize conditions for recovery through struvite precipitation. Towards this goal, solutions of ammonium acetate, magnesium chloride and potassium phosphate were mixed at varying concentrations over ranging pH (7-9.5). Crystal morphology was observed. Ammonium and phosphate recovery was measured using reagent-based tests and test strips, respectively. The ratio of the three ions was varied and compared with solutions compounded in 1:1:1 ratio. Possibility of K-Struvite formation was tested by comparing usage of potassium phosphate with sodium phosphate. Effect of eggshell and sodium carbonate was later explored. Crystal formation increases with increasing initial pH. Precipitation was accompanied by drop in pH of supernatant and reduction of AP concentrations. Recovery increases with higher ratios of phosphate, addition of phosphate as a base and addition of eggshell. The K-Struvite hypothesis was supported. My results significantly show that neutralization of pH drop is vital to maximum recovery. Eggshell proves to be a promising, novel approach to neutralization as it is a cheap, abundant waste and effectively increases struvite production.

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