Electrochemical precipitation potential for recovering phosphorus

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Phosphorus is irreplaceable in nature. Predictions indicate a yearly increase of 1.5 % in phosphorus demand [1]. The effluent from anaerobic digesters contains nutrients such as concentrated phosphorus and ammonia nitrogen, facilitating convenient nutrient recycling [2]. Previous research has indicated that extracting struvite from such wastewater is favourable, as it presents a reusable resource - struvite, a slow-release fertilizer [3]. In this study, a synthetic sample reflecting the anaerobic digestion supernatant of a wastewater treatment plant was created to represent actual content of nitrogen (737 mg/l) and phosphorus (121 mg/l). Subsequently, electrochemically induced struvite precipitation was conducted utilizing magnesium electrodes. This method introduces a new way of sourcing magnesium, decreasing dependence on chemical additives for struvite formation. Four experiments were conducted at pH levels of 7.5, 8, 9, and 10, investigating the impact of pH on nitrogen and phosphorus release. The experiments were carried out in a borosilicate beaker with a total volume of 600 ml and an effective volume of 500 ml (Figure 1). A current of 25A/m^2 was applied, and each experiment lasted for 4 hours. The results obtained reveal complete removal of phosphorus (P) across all tested pH levels. However, nitrogen (N) content decreases progressively with higher pH values; for instance, at pH 10, 55 % less nitrogen was detected compared to the initial level (Figure 2). Similar observations were published in Kim *et al.* [4]. Analysis of magnesium (Mg) in the water post-treatment indicated excessive extraction, with concentrations of approximately 500 mg/l detected after all treatments. Given these findings, the next phase of this research will involve investigating the impact of time and current strength to identify the optimal conditions for extracting nitrogen and phosphorus in the form of struvite. Additionally, to confirm the composition of the resulting precipitate, X-ray diffraction (XRD), scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS), and Fourier-transform infrared spectroscopy (FTIR) analyses will be conducted.

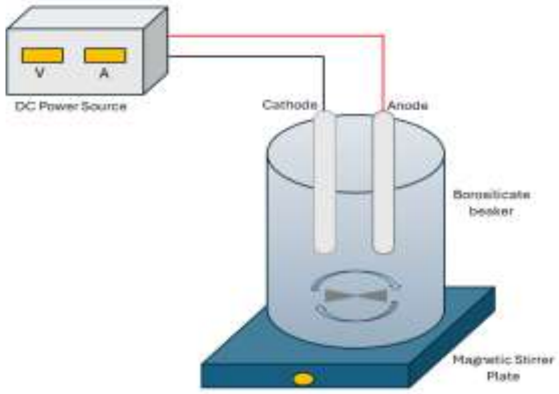

Figure 1. Schematic of the batch reactor

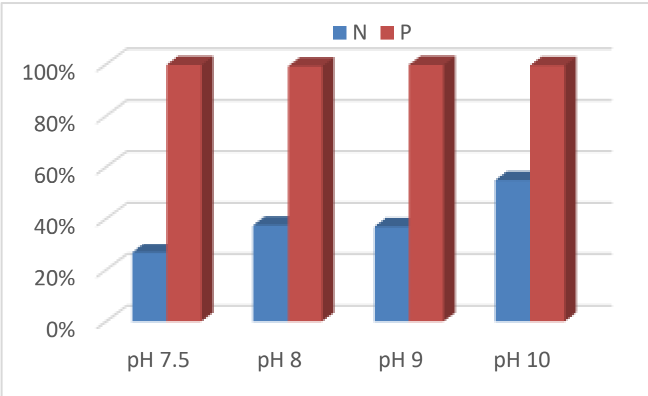

Figure 2. Efficient removal of N and P after treatment

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