ELECTRO-PRECIPITATION OF K-STRUVITE IN BIOLOGICAL WASTEWATER TREATMENT EFFLUENT

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The decline of terrestrial resources, rising ore costs, and increasing pollution demand wastewater recycling in the circular economy context. Swine wastewater is characterized by the presence of nitrogen (N), phosphorus (P), and potassium (K), of which P and K can be recovered as K-struvite crystals. Combining two or more processes is necessary for high nutrient removal and recovery efficiency. Among these technologies, the electrochemical process is considered promising due to its high removal efficiency of K and P in solid form. This study evaluated the current density (DC) and hydraulic detention time (HDT) in a continuous-flow electro-precipitation reactor using magnesium electrodes. The wastewater used for K-struvite production was collected from the outlet of the N module, where the nitrification/denitrification process of the SISTRATES® system, designed for swine waste treatment, is implemented on a farm located in Videira, Santa Catarina, Brazil (27°02'38.8?S 51°05'35.7?W). The electrochemical system consisted of a continuous-flow electrochemical reactor made of acrylic. The experiments were conducted continuously at room temperature (23°C), in an open reactor with a useful volume of 1.8 L. The magnesium electrodes had an area of 4,000 mm2 and dimensions of 130 mm in height x 70 mm in width, made of AZ91 alloy (donated by RIMA Industrial). The evaluated DC of 0.1 and 0.3 A was controlled using a power supply connected to a direct current (DC) electric source (DC Power Supply FA-3005 Intrutherm). The two electrodes (1 cathode and 1 anode) were vertically installed with a constant distance of 2 cm between them during electro-precipitation. A peristaltic pump (Masterflex L/S) was used to provide flow rates of 15 and 30 mL.min-1 to the electrochemical reactor, generating HDTs of 120 min and 60 min, respectively. Samples were collected at 0, 1, 2, 3, 4, 5, and 6 hours. The analytical determinations performed included potassium (mg.L-1), magnesium (mg.L-1), total phosphorus (mg.L-1), calcium (mg.L-1), and pH. The effect of current density and HDT on the recovery of nutrients by electrochemical precipitation was investigated. Under the conditions of DC of 0.1 A and HDT of 60 and 120 min, and DC of 0.3 A and HDT of 60 and 120 min, it was observed that the pH values increased throughout the process under all conditions, with minimum values of pH 7.42 and maximum values of pH 10.2. When comparing the phosphorus (36%), potassium (10%), and calcium (13%) removal values, there is a correlation between the increase in pH and the enhancement of the removal of these parameters, with the condition that showed the best removal having the highest DC (0.3 A) and the longest HDT (120 min). The magnesium concentration increased in all experiments, with values ranging from 79 to 217 mg.L-1. Overall, our results show that electrochemical crystallization is promising for the recovery of K-struvite fertilizers.