K-STRUVITE PRECIPITATION AT DIFFERENT PH AND TEMPERATURES FOR POTASSIUM AND PHOSPHORUS RECOVERY

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The recovery of nutrients from swine wastewater and their recycling as fertilizers is a challenging opportunity to the reduce the demand from mineral fertilizers. The intensification of swine farming in confined feeding operations has led to increased generation of wastewater rich in nutrients such as phosphorus (P) and potassium (K). P and K from mineral resources are widely used, mainly as chemical fertilizers, but these resources are exhaustible. Therefore, it is interesting to recover P and K to avoid environmental problems and also to add value to the effluents. The production of K-struvite, a mineral compound containing P, K and magnesium (Mg) seems to be a promising alternative within the circular economy concept. Therefore, the objective of this work was to evaluate the recovery of K and P from swine wastewater through chemical precipitation of K-struvite.

For this purpose, the effluent from nitrogen removal module from SISTRATES® (a Portuguese acronym for swine effluent treatment system) was used. After the effluent chemical characterization, laboratory tests were carried out to evaluate the production of K-struvite and P and K recovery efficiency. To optimize the best K-struvite precipitation condition, a 22 factorial design with central point was applied to understand how the pH and temperature influence the K-struvite formation process. The experiments were performed in random order to avoid systematic errors at batch and using 1 L of effluent for each test. A stirring time and speed of 10 min and 200 rpm, respectively, were used and the pH was adjusted by adding NaOH 4M. After the reaction time under stirring, the samples were transferred to Imhoff cones and left for 24 h for complete reaction and seetling. Then, the supernatant and precipitate fraction were separately collected and analyzed for P and K.

It was possible to observe a P removal efficiency higher than 90% in most of the tests, and a K K removal between 5% and 27%. To evaluate the production of K-struvite, the molar ratios of K:P:Mg contained in the precipitates were observed in relation to the molar ratios in the effluent used for the study. In this way, the best condition observed was at pH 10, with no significant difference between the different temperature ranges. At pH 10 and 20ºC, the molar ratios in the sludge were 2.3:1:0.6. At pH 11, the molar ratios were 1.5:1.0:1.5, showing that in addition to the precipitation of K-struvite (1.0:1.0:1.0), other compounds possibly precipitated, as magnesium hydroxide.

The initial pH of the effluent was 6.77, after the addition of NaOH it was possible to verify that at higher pH, the volume of sludge inscreaded, corroborating with greater removals of K, P and Ca of the effluent, regardless of temperature. However, for K-struvite precipitation, the best pH range was between 10 and 11. In the other values tested, it was possible to observe the precipitation of other compounds, as mentioned. Thus, the production of K-Struvite is a promising alternative for the recovery of K and P from swine wastewater.