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Phosphorous Recovery from Tomato Waste Digestate

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Abstract

The current sustainability wave is pushing the market towards making more products from renewable and sustainable sources. Each year the agriculture industry has high amounts of waste production during post-harvesting period especially for annual crops. Tomato plants are one of these annual crops in Europe which produces approximately 3 million metric tons waste per annum (Løvdal et al., 2019). Anaerobic digestion (AD) for producing energy is an alternate method of managing and valorising these materials. Apart from Biogas, another by product of the AD process is a nutrient-rich digestate. For e.g.; the solid fraction (SF) from digestate produced after mechanical separation contains high levels of phosphorus (P), which can be recovered by acid leaching followed by re-precipitation. Tomato plants are rich in phosphorous and so is the resulting digestate at the end of anaerobic digestion. This study aims to recover phosphorous from tomato waste digestate. The efficiency of four inorganic acids (sulphuric acid (H2SO4), hydrochloric acid (HCl), nitric acid (HNO3), phosphoric acid (H3PO4)) and one organic acid, citric acid ($C_6H_8O_7$) in extracting P from the solid fraction of digestate to soluble P (PO4-) was investigated. The SF was mixed in L:S of 2:1, 3:1 and 4:1 at varied concentrations (0.1-1M) on a lab scale to obtain a wide pH range. It is observed that lower the pH, higher is the phosphorous recovery, but a pH range of 3-6 is chosen as optimum pH for further treatment of supernatant. The acidic supernatants produced by this study will be used to re-precipitate the dissolved K and P as potassium struvite using bases, and the effect of recovered phosphorus as a potential fertilizer will be studied later. Hence, this study will compare various strategies with different acids, such as cheap inorganic acids, strong acids with mineral nutritional values, and organic acids, to determine which is the most techno-economically and environmentally interesting so that a well-founded choice can be made to recover two of the three macronutrients.

Keywords: phosphorous recovery, acid leaching, nutrient recovery, tomato plant, digestate processing

References

Løvdal, T., Van Droogenbroeck, B., Eroglu, E. C., Kaniszewski, S., Agati, G., Verheul, M., & Skipnes, D. (2019). Valorization of tomato surplus and waste fractions: A case study using Norway, Belgium, Poland, and Turkey as examples. Foods, 8(7). https://doi.org/10.3390/foods8070229