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ORIGINAL PAPER

Methane Production and Struvite Recovery from Disintegrated Biosludge at Different Microwave Powers

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Abstract This study examined the impact of microwave (MW) irradiation on the disintegration of waste biological sludge (WBS) and CH_4 production during anaerobic digestion (AD), alongside the recovery of NH_4–N and PO_4–P via struvite precipitation in AD tailings. MW treatment was conducted under controlled conditions (120 °C and 2 °C/min) at the power levels of 900 W and 1,800 W. The soluble chemical oxygen demand (sCOD) increased by factors of 465 and 432 at 900 W and 1,800 W, respectively, while sugar and protein concentrations rose by factors of 840–110 and 1.93–2.15 compared to the untreated WBS. However, MW irradiation was less effective for releasing NH_4–N and PO_4–P. The disintegration of WBS improved CH_4 production in the biochemical methane potential (BMP) test by 26% and 35% at 900 W and 1,800 W, respectively, relative to the control. Despite these enhancements, the process was deemed uneconomical due to the high energy demand of MW irradiation compared to the energy gained from the increased CH_4 yield. Additionally, the sludge dewatering properties, measured as sludge filter resistance (SFR), deteriorated significantly, increasing from 2.87×10^{14} for the untreated WBS to 6.50×10^{14} and 6.70×10^{14} at 900 W and 1,800 W, respectively. Kinetic modeling of the BMP tests revealed that the Transference Function provided the best fit to the experimental data. In the struvite precipitation, the optimal recovery of NH_4–N and PO_4–P (96%) was achieved at a molar ratio of 1.25/1/1 for Mg/N/P.