Effect of Nixing Intensity, Mode, and Direction on Biomethane Production in Batch Thermophilic Anaerobic Digestion of Tomato Waste

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Abstract

Anaerobic digestion (AD) is a promising method for the sustainable management of organic waste, especially tomato waste, which is abundant in agricultural and food processing industries. This study examines the effects of mixing intensity, direction, and pattern on methane production in batch AD reactors. Five reactors were tested under different mixing conditions, including high, moderate, and no mixing. The findings indicate that high-intensity mixing initially enhances hydrolysis and acidogenesis, resulting in increased methane generation during the initial phases. However, excessive turbulence caused volatile fatty acid (VFA) to build up (around 8000 mg/L as $CaCO_3$), which lowered the pH (about 4) and stopped methanogenesis. On the other hand, reactors with moderate and no mixing produced higher long-term methane yields. The No-Mixing reactor had the greatest total production (around 350 mL), which was up to 1.5 times higher than the others. The direction of mixing (clockwise vs. counterclockwise) had little effect, while continuous mixing resulted in more stable methane production compared to alternating patterns. These results highlight the importance of using phase-specific mixing strategies to optimize the efficiency of the AD process.