RETASTE Conference Abstracts
Vol. 3 RETASTE-ANA-347-Oral
Athens, Greece, 27-29 September, 2023

rethink food resources, losses, and waste 2023 retaste

Digestion Enhancement of Recalcitrant Food Organics using a Low Temperature Thermo-alkaline Hydrolysis Process

[1]Basem Haroun, [2]Ajay Singh, [2]Michael Beswick and [1]George Nakhla

[1]*Western University*
[2]*Lystek International Corp*

Abstract

Lystek thermo-alkaline hydrolysis process is a well-known commercial low temperature hydrolysis technology, which significantly increases the solubility of organics, enhances anaerobic digestion processes, and facilitates the application of dewatered biosolids as a concentrated liquid fertilizer. The technology has been deployed at wastewater treatment plants in Canada, USA, and the United Arab Emirates, primarily for production of Class A liquid biosolid based fertilizers and enhancement of biosolids anaerobic digestion (Elbeshbishy et al., 2014; Singh et al., 2016). The objective of this project was to assess its impact on the non-biodegradable food wastes fractions, which are typically in the range of 15%-25% of organics (Nguyen et al., 2017; Zhou et al., 2022). Anaerobic digestion of food waste (FW) was investigated in a 9-L continuous stirred tank reactor (CSTR) for 103 days (7 phases including a recovery phase) under mesophilic conditions, at organic loading rates (OLRs) ranging from 3.2 to 9.2 g COD/L/d, and SRTs ranging from 14.2d to 20.6d. FW was collected from the Waste Resource Innovation Center, in Guelph, Ontario, Canada. After collection, the FW was immediately grinded and diluted to a range of 2.8% - 9.4% solids content, homogenized using a blender (Cuisinart SBC-1000 4-Speeds Blender Cook Soup Maker) and stored at 4◦C. Biogas production, and FW biodegradability were evaluated. The results indicated that the methane production rate and methane yields ranged from 8 L/d to 20.3 L/d, and 0.4 L CH4/ gVS added to 0.64 L CH4/ gVS added, respectively, with increasing OLR. The biodegradability of FW fluctuated between 53.2% and 85%. During and at the end of phase 7 (days 81-103), digestate samples were collected and kept in a cold room (4˚C) for further investigation. Two Biochemical Methane Potential Tests (BMPs) were conducted at 37˚C±1 and pH 7±1, using anaerobic digester sludge (ADS) as inoculum. BMP1 was conducted with the digestate collected from the CSTR during phase 7 between day 81 and day 103 when the FW biodegradability in the CSTR was 73%, and BMP2 with the digestate solids collected at the end when the FW biodegradability was 77%. In BMP1, Lystek process (pH 9.5, 75˚C, 12 min shearing) was applied to the digestate before inoculation and the BMP test was conducted with untreated and Lystek treated digestate. In BMP2, the digestate was centrifuged first and Lystek process was then applied to the

solid fraction. In this case BMP2 was conducted to both untreated and Lystek-treated digestate solids. The results showed that Lystek improved post digestion of FW by 35.5% in BMP1 (0.131 L CH4/ g COD Lystek-treated digestate added vs 0.097 L CH4/ g COD of untreated digestate added), and 22% in BMP2 (0.116 L CH4/ g COD Lystek-treated digestate solids added vs 0.095 L CH4/ g COD of untreated digestate solid added). These results provide strong evidence that Lystek not only enhances the solubility of organic matter, but also improves the biodegradability of recalcitrant FW organics. This opens the door for the treatment of other refractory agricultural wastes such as animal manures

Keywords: Food waste, nonbiodegradable organics, anaerobic digestion, Lystek thermo-alkaline technology

References

Elbeshbishy E. et al. (2014) Impact of alkaline hydrolyzed biosolids (Lystek) addition on the anaerobic digestibility of TWAS in lab and full-scale anaerobic digesters. Waste Manage. 34: 2090-2097.

Nguyen, D. D., et al. (2017). Dry semi-continuous anaerobic digestion of food waste in the mesophilic and thermophilic modes: New aspects of sustainable management and energy recovery in South Korea. Energy Conversion and Management, 135, 445-452.

Singh, A. et al. (2016) An Innovative chemical thermal hydrolysis process with multiple beneficial applications in bio-resource recovery. Proceedings of the Water Environment Federation. WEF Residual and Biosolids Conference 2016.

Zhou, H., et al. (2022). Effects of organic loading rates on high-solids anaerobic digestion of food waste in horizontal flow reactor: Methane production, stability and mechanism. Chemosphere, 293, 133650.

Acknowledgments: The authors would like to thank Lystek International Crop for partially funding this research project