

Comparative Study on Hydrothermal Carbonization as Pre- and Post-treatment of Anaerobic Digestion of Dairy Sludge: Focus on Energy Recovery, Resources Transformation and Hydrochar Utilization

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Abstract : Hydrothermal carbonization (HTC) is a thermochemical reaction that utilizes saturated water and vapor pressure to convert waste biomass to C-rich products. This work evaluated the effect of HTC as a pre- and post-treatment technique to anaerobic digestion (AD) of dairy sludge, as information in this field is still in its infancy, with many research and methodological gaps. HTC effect was evaluated based on energy recovery, nutrients transformation, and sludge biodegradability. The first treatment approach was executed by applying hydrothermal carbonization (HTC) under a range of temperatures, prior to mesophilic anaerobic digestion (AD) of dairy sludge. Results suggested an optimal pretreatment temperature at 210 °C for 30 min. HTC pretreatment increased methane yield and chemical oxygen demand removal. The theoretical model based on Boyle's equation had a very close match with the experimental results. On the other hand, applying HTC subsequent to AD increased total energy production, as additional energy yield was obtained by the solid fuel (hydrochar) beside the produced biogas. Furthermore, hydrothermal carbonization of AD digestate generated liquid products (HTC digestate) with improved chemical characteristics suggesting their use as liquid fertilizers.

Keywords : hydrothermal carbonization, anaerobic digestion, energy balance, sludge biodegradability, biogas

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