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Insight into thermally enhanced and conductive material-mediated anaerobic co-digestion of organic fraction of municipal solid waste

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Abstract

Anaerobic co-digestion (AcoD) has shown the potential to achieve higher biogas yield. However, complex organic materials in municipal solid waste (MSW) and sewage sludge obstruct their biotransformation and are a rate-limiting step of the process. AcoD of thermal and thermal-alkali pretreated organic fraction of MSW (OFMSW) and sewage sludge could improve process efficiency in terms of enhanced CH4 yield. However, high-temperature thermal pretreatment also leads to the formation of recalcitrant compounds, 5- Hydroxy Methyl Furfurals (5-HMF) and furfurals due to the Maillard reaction that occurs between soluble proteins and carbohydrates, which is intensified with increasing the temperature. The recalcitrant formation at high-temperature thermal-alkali pretreatment conditions has been mitigated using carbon-based conductive materials, granular activated carbon (GAC), and granular biochar (GBC). Adding Fe3+ ions during the high-temperature thermal-alkali pretreatment of the feedstock effectively reduces the formation of recalcitrant compounds. The application of conductive materials shows the potential to effectively control the recalcitrant formation under intensive feedstock pretreatment conditions and enhance overall AcoD process performance by creating a direct interspecies electron transfer (DIET) environment in the digester.

Keywords: Anaerobic Co-digestion; Thermal-alkali pretreatment; Direct Interspecies Electron Transfer; Organic fraction of municipal solid waste