Sustainable Valorisation of Biogenic Municipal Solid Waste to Biobased Products

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Abstract

Minimizing the dependency on fossil-based resources and reducing the generation of solid wastes represent the main challenges for the modern society. Biogenic municipal solid waste (BMSW) a potential feedstock to harness the energy and biobased products. Currently, open dumping is the common practice of BMSW disposal followed by biomethanation and incineration. In the present study, re-engineering of anaerobic fermentation process for the high rate production of biobased products (reducing sugars, short chain carboxylic acids and biohydrogen) using biogenic municipal solid waste as a feedstock. Initially, to convert the polysaccharides into monomers novel bio-electro hydrolysis (BEH) system is designed as a pretreatment unit to carry the hydrolysis of BMSW with simultaneous bioelectricity generation. Resulting sugar rich effluents were used as a substrate in acidogenic fermentation process (stage-I) to produce short chain carboxylic acids (SCCA) along with biohydrogen (H_2) as co-product. Further, the resulting effluent from stage-I rich in SCCA was used as feedstock for polyhydroxy alkanoates (PHA) production (stage-II), which was carried out in two steps viz., PHA culture enrichment followed by PHA production. Bacteria capable of accumulating PHA were enriched in a sequencing batch reactor operated at two different cycle lengths (CL-24h; CL-12h). Higher PHA production as well as SCCA removal was achieved in CL-12 operation followed by CL-24. The results enumerate the advantages of integrated multistage process for the production of biobased products by simultaneously addressing the solid waste remediation in the framework of biorefinery.

Keywords: Municipal Solid Waste, Bioplastic, Biohydrogen, Short-Chain carboxylic acids