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Jhuma Sadhukhan, Kok Siew Ng, Elias Martinez-Hernandez

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Novel integrated mechanical biological chemical treatment (MBCT) systems for the production of levulinic acid from fraction of municipal solid waste: A comprehensive techno-economic analysis

Jhuma Sadhukhan[*1], Kok Siew Ng[1] and Elias Martinez-Hernandez[2]

[1]Centre for Environmental Strategy, University of Surrey, GU2 7XH, UK

[2]Department of Engineering Science, University of Oxford, Oxford, OX1 3PJ, UK

Abstract:

This paper, for the first time, reports integrated conceptual MBCT/biorefinery systems for unlocking the value of organics in municipal solid waste (MSW) through the production of levulinic acid (LA by 5wt%) that increases the economic margin by 110-150%. After mechanical separation recovering recyclables, metals (iron, aluminium, copper) and refuse derived fuel (RDF), lignocelluloses from remaining MSW are extracted by supercritical-water for chemical valorisation, comprising hydrolysis in 2wt% dilute H_2SO_4 catalyst producing LA, furfural, formic acid (FA), via C_5/C_6 sugar extraction, in plug flow (210−230°C, 25bar, 12s) and continuous stirred tank (195−215°C, 14bar, 20mins) reactors; char separation and LA extraction/purification by methyl isobutyl ketone solvent; acid/solvent and by-product recovery. The by-product and pulping effluents are anaerobically digested into biogas and fertiliser. Produced biogas(6.4MWh/t), RDF(5.4MWh/t), char(4.5MWh/t) are combusted, heat recovered into steam generation in boiler (efficiency:80%); on-site heat/steam demand is met; balance of steam is expanded into electricity in steam turbines (efficiency:35%).

* Author/s to whom correspondence should be addressed: E-mail: jhumasadhukhan@gmail.com; Phone: +44 (0)1483 686642.