

Exergetic and Life Cycle Assessment Analyses of Integrated Biowaste Gasification-Combustion System: A Study Case

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Abstract : Due to the negative impact of fossil fuels, renewable energies are promising sources to limit global temperature rise and damage to the environment. Also, the development of technology is focused on obtaining energetic products from renewable sources. In this study, a thermodynamic model including Exergy balance and a subsequent Life Cycle Assessment (LCA) were carried out for four subsystems of the integrated gasification-combustion of pinewood. Results of exergy analysis and LCA showed the process feasibility in terms of exergy efficiency and global energy efficiency of the life cycle (GEELC). Moreover, the energy return on investment (EROI) index was calculated. The global exergy efficiency resulted in 67 %. For pretreatment, reaction, cleaning, and electric generation subsystems, the results were 85, 59, 87, and 29 %, respectively. Results of LCA indicated that the emissions from the electric generation caused the most damage to the atmosphere, water, and soil. GEELC resulted in 31.09 % for the global process. This result suggested the environmental feasibility of an integrated gasification-combustion system. EROI resulted in 3.15, which determinates the sustainability of the process.

Keywords : exergy analysis, life cycle assessment (LCA), renewability, sustainability

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