

Exergy analysis of a lignocellulosic-based biorefinery annexed to a sugarcane mill

Mohsen Mandegari¹, Somayeh Farzad, Johann F Görgens, Mortaza Aghbashlo², Meisam Tabatabaei^{3,4} and Ali Dadak²

¹Stellenbosch University, South Africa

²University of Tehran, Iran

³Biofuel Research Team, Iran

⁴Agricultural Biotechnology Research Institute of Iran, Iran

This study was aimed at exergetically analyzing a lignocellulosic biorefinery annexed to a sugar mill for simultaneous lactic acid and electricity production using sugarcane bagasse and brown leaves as feedstock. The main goal was to reveal the reasons and sources of thermodynamic inefficiencies associated with the biorefinery under investigation. After presenting the exergy balance equations for all the subunits of the biorefinery, their exergetic performance parameters were computed and consequently, exergetic performance parameters were measured for the whole system. The exergetic values of the net electricity and steam were found to be 20.66MW and 50.41MW, respectively, while the chemical exergy content of the produced lactic acid was determined at 112.84MW. The overall exergy destruction of the system stood at 207.69MW. The contribution of the steam generation, as the main subunit wasting exergy, to the overall exergy destruction of the system was found to be 63.31%. Furthermore, lactic acid production subunit stood in the next rank in terms of exergy destruction, contributing 16.30% of the overall exergy destruction of the biorefinery. The universal and functional exergetic efficiencies of the system were determined as 52.71% and 44.73%, respectively, while the normalized exergy destruction was calculated as 1.13.

mandegari@sun.ac.za