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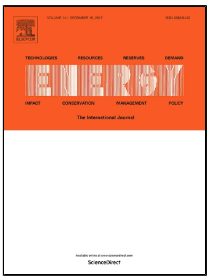

Exergetic diagnosis and performance analysis of a typical sugar mill based on Aspen Plus® simulation of the process

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ABSTRACT

The sugar industry is the second largest agro-industry in the world, with more than 80 % of sugar produced from sugarcane. Sugar mills are energy-intensive and historically not designed to be energy efficient, even though they may be energy self-sufficient. This study presents a comprehensive exergy analysis of cane sugar production processes to identify inefficient components for improvement. The exergy analysis was based on rigorous mass and energy balances calculated from an Aspen Plus® simulation of a typical 250 ton per hour sugar mill, along with an appropriate exergy methodology. The exergy analysis of the cogeneration system, which has been found to be the principal sugar mill exergy destruction unit, is conducted separately and will be presented in a subsequent paper. The overall sugar mill irreversibility and functional exergy efficiency were 217.3 MJ per ton of cane crushed and 9.7 %, respectively. The evaporation unit generated the highest irreversibility of 100 MJ/ton of cane, while crystallization unit had the lowest functional exergy efficiency of 9.6 % and the highest potential for improvement of 47.0 MJ/ton of cane. The exergetic performance of the mill may be improved by adopting a single stage crystallization with an integrated biorefinery.

Keywords: Sugarcane mill, Exergy analysis, Functional exergy efficiency, Exergetic improvement potential, Grassmann diagram, Aspen Plus®.