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Multi-objective optimization of an industrial ethanol distillation system using direct and indirect heating

SILVA, R. O. ^{a*}, TORRES, C. M. ^b, ROCHA, L. B. ^a, LIMA, O. C. M. ^a, COUTU, A. ^b, BRUNET, R. ^b, JIMÉNEZ, L. ^b, JORGE, L. M. ^a

a. Universidade Estadual de Maringá, Maringá

b. Universitat Rovira i Virgili, Tarragona

**Corresponding author, orgeda@hotmail.com*

Abstract

In this work, the performance of an ethanol from sugarcane autonomous distillery simulated on AspenHysys is evaluated using an automated tool programmed on Matlab to assess the environmental and economic impacts associated. We compare the current plant operation (direct heating), located in the South of Brazil, with the use of indirect heating, analyzing vinasse discharge using trucks, as well as the effect of its application in the soil. Results show that the replacement of direct steam injection by reboiler decreases approximately 15% of the vinasse quantity, consequently, decreasing the associated problems generated. Moreover, as the modifications do not change flegma and ethanol flowrates, the revamping might be done without further operational changes. The environmental evaluation presents positive results, showing that the distillery may decrease the eighteen environmental impacts categories assessed. From an economic perspective, the plant could also have higher net profits with the use of reboiler than direct steam injection to heat the distillation column. Finally, the new improved system is treated as a multi-objective optimization problem and it is solved by using the weighted sum method for the Pareto frontier technique to find the best compromise, to be as interesting economically as ecologically.

Keywords: *Simulation, Sugarcane vinasse, Economic evaluation, Environmental assessment, Multi-objective optimization.*