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Vinasse concentration and juice evaporation system integrated to the conventional ethanol production process from sugarcane – Heat integration and impacts in cogeneration system

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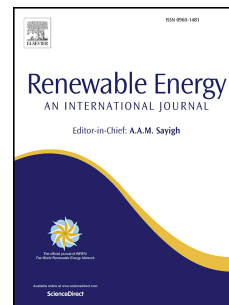
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9

10 **Abstract:**

11 In the ethanol production process one of the most polluting residues is the vinasse, which is the bottom
12 product of distillation column. Vinasse is produced in the range of 10 to 15 litres per litre of ethanol, and is
13 currently used to irrigate sugarcane fields because of the presence of macronutrients (N, P, K) in its
14 composition. However, because of the large amount produced, its disposition in sugarcane fields involves
15 high transport costs and does not allow an adequate application, thus causing damage to soil and
16 groundwater due to its high content of organic components. In this context, vinasse concentration with
17 multiple-effect evaporator systems not only allows to reduce significantly its volume through the increase of
18 its initial solids concentration, that is generally between 2 - 5%, which reduces the costs of disposal; but also
19 allows to consider alternative ways of energetic usages, for instance, its incineration or anaerobic
20 biodigestion. Thus, the aim of this study is to accomplish an energy evaluation of the heat integration of a
21 juice evaporation system and a vinasse concentration system in the conventional ethanol production process
22 by analysing three different configurations of multiple-effect evaporator systems. The energy and mass
23 balances were solved using the EES® software while heat integration, using the Pinch Method, was applied
24 in order to minimize the utility consumption. A simulation of the cogeneration system was also performed in
25 order to evaluate bagasse and electricity surplus. Two configurations for the cogeneration system were
26 studied: i) using back-pressure steam turbines and ii) using condensing-extracting steam turbines.
27 Additionally, an economic assessment was performed in order to estimate the capital and operating costs,

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