Integration of ethanol production from sugarcane using bagasse in the enzymatic process: a techno-economic evaluation

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In the present work the process of 1st and 2nd generation bioethanol from sugarcane as a whole was modeled, focusing on the bagasse use. The bagasse is converted by steam pretreatment followed by separate enzymatic hydrolysis and fermentation (so called SHF layout). Experimental data for all process steps at lab-scale were obtained within the CaneBioFuel EU-FP7 project in partnership with Brazilian company, research center and university. Then data was implemented in the flowsheeting program AspenPlus to simulate the whole process.

The aim of this study was to perform simulations in order to highlight the effects of different integration options on mass and energy balances as well as on operating and capital cost. The impacts of the following operating variables were analyzed suggesting unit operations modifications to lower even further the production cost: enzyme dosage, solids loading (WIS) in enzymatic hydrolysis, the addition of sugarcane trash (tops&leaves) as a substrate for 2G ethanol. Also the opportunity to improve, replace or add new stages was evaluated, e.g. biogas production from stillage streams containing high COD, evaporation modeled either as a single or multiple-effects, distillation with series/parallel configuration for strippers and rectifiers.

Results from the technical and economic evaluation will be presented for the most promising scenarios, discussing the marginal production costs from 2G ethanol in relation to plant flowsheet, energy use and overall ethanol production.

Integration of 1G and 2G ethanol production resulted in an increase in energy efficiency. The overall ethanol production increased by 56% for the best case, when both bagasse and trash were used for ethanol production, compared with the 1G ethanol production. The lowest overall ethanol production cost was 1,52 USD/gallon, when 27% of ethanol was obtained from both bagasse and trash.

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