Ethanol 360 – Ethanol production beyond sugarcane harvesting season

C. Seita[1], J. Lima-Ramos[1], M. Villela[2],D. C. Gaeta[3], J. Finguerut[4], A. K. Gombert[5], J. M. Woodley[1]

[1] Department of Chemical and Biochemical Engineering, Technical University of Denmark
[2] Evonik Industries AG, Business Unit Health&Nutrition, Germany
[3] Sermatec, Brazil
[4] CTC- Centro de Tecnologia Canavieira, Brazil
[5] Universidade Estadual de Campinas, Faculdade de Engenharia de Alimentos, Brazil

Background

Brazil has more than 30 years of expertise ahead of other countries in first generation (1G) ethanol production and a privileged position in the fuel sector, being the second biggest ethanol producer in the world [2]. Indeed, sugarcane is a highly competitive feedstock for ethanol production when compared with other crops (corn, sugarbeet, etc.), since it shows the highest energy balances, yields per hectare and lower production costs [2].
However, despite of several decades of optimization that have put the Brazilian ethanol production processes in a competitive position, the availability of feedstock is still not optimized.
Since sugarcane is perishable and must be processed in a short time after harvest, the industrial processing technology is based on the maximization of the output during the harvest season alone. In the past decades, the harvest season has been enlarged by many improvements in agricultural management and development of new cane varieties. However, its duration cannot be extended further because of the rainy season, during which it is impossible to move machines in the sugarcane fields. This means that industrial operation has idle months (e.g. from December until April in the Southeast of Brazil).
The objective of this project is to evaluate the retrofit of the sugarcane processing industry, in such a way that a full-year operation becomes possible, in contrast to the current partial operation.

Ethanol 360 production process

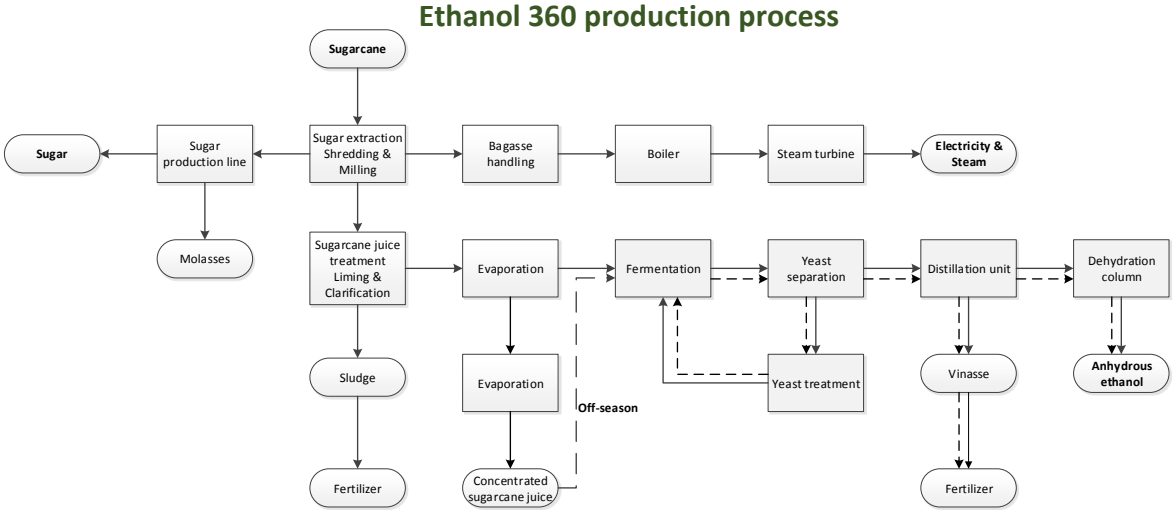

Figure 1. Process flowsheet for Ethanol 360 production using concentrated sugarcane juice (65 °Bx). Dashed lines represent the off-season production.

Process simulation

Base-case scenario	1G biorefinery running 8 months/year (sugarcane flowrate=500 ton/h)
Ethanol 360 scenario	1G biorefinery running 12 months/year with constant ethanol production throughout the year (Figure 1).

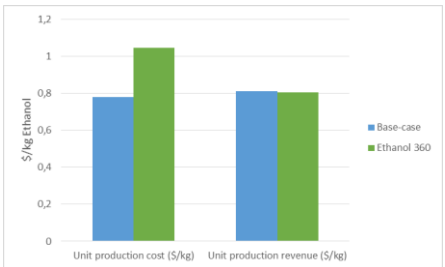

Figure 2. Unit production cost and unit production revenue for the base-case and Ethanol 360 scenarios.

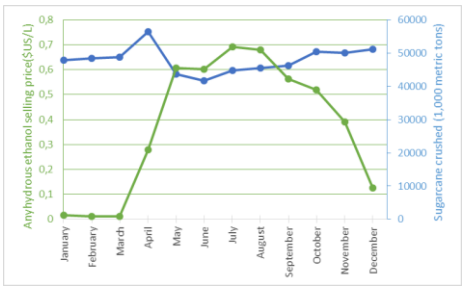

Figure 3. Distribution of sugarcane crushed and ethanol selling price across the year (Adapted from [3]).

- ✓ Ethanol 360 requires investment in extra equipment (evaporators, storage tanks, etc.) and shows a higher operation cost compared to the base-case scenario.
- ✓ Having a stable and continuous production across the year might put the producer in a competitive advantage → higher ethanol selling price.

Conclusions

- Other types of feedstock (*e.g.* molasses) for fermentation in the off-season could increase the profitability of the biorefinery;
- The additional capacity can be used for ethanol production for the chemical industry.

References

[1] F. F. Furlan, *et. al*, "Bioelectricity versus bioethanol from sugarcane bagasse: is it worth to be flexible?," *Biotechnol. Biofuels*, vol. 6, no. 1, p. 142, Oct. 2013.
[2] B. E. Della-Bianca, *et. al*, "What do we know about the yeast strains from the Brazilian fuel ethanol industry?," *Appl. Microbiol. Biotechnol.*, vol. 97, no. 3, pp. 979–91, Feb. 2013.
[3] Barros, Sergio. 2013. Sugar Annual Report. USDA Foreign Agricultural Service. GAIN Report Number: BR13001