Integrated first and second generation bioethanol production from sugarcane – evaluation of alternative process configurations

Dias, M.O.S.[1,2]; Junqueira, T.L.[1,2]; Jesus, C.D.F.[1]; Rossell, C.E.V.[1,2]; Maciel Filho, R.[1,2]; Bonomi, A.[1]

[1] Laboratório Nacional de Ciência e Tecnologia do Bioetanol (CTBE), Campinas, SP - Brazil

[2] Faculdade de Engenharia Química, Universidade Estadual de Campinas (UNICAMP), Campinas, SP - Brazil

The integration of second generation ethanol production process from lignocellulose with first generation ethanol production from sugarcane may improve its feasibility. In comparison with a stand-alone second generation unit, the integrated process will require a lower investment, since some operations may be shared between both plants. Besides, fermentation inhibitors generated during pretreatment will have minor effects on yields since the hydrolyzed liquor will be fermented mixed with sugarcane juice.

Since sugarcane bagasse and trash are used as fuels in conventional bioethanol production, the amount of surplus lignocellulosic material used as feedstock for bioethanol production depends on the energy consumption of the production processes. Residues from the second generation process (e.g., unreacted lignocellulosic material) may be used as fuels and increase the amount of surplus bagasse, along with improved technologies for cogeneration and for conventional bioethanol production process. For instance, pentoses fermentation to ethanol instead of biodigestion to produce biogas will lead to higher ethanol production, increasing energy consumption of the process and consequently decreasing the amount of surplus lignocellulosic material available.

In this work different configurations of the second generation ethanol production process (e.g. pretreatment with steam explosion coupled or not with delignification, pentose biodigestion or fermentation to ethanol, solids loading on hydrolysis), are evaluated through simulation using Aspen Plus. Stillage biodigestion and different cogeneration systems are evaluated as well. The results show which process alternatives may lead to higher ethanol production, pointing towards where research should be directed in order to provide important gains on ethanol production in the integrated process.