

BBEST Conference 2011 – Tutorials

Tutorial 3 – Advanced Biofuels I – Ethanol Production

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A. Program

1. Current technology of ethanol production from sugarcane and other feedstock
2. Bioelectricity production with sugarcane bagasse
3. Innovations and technological breakthroughs in conventional technology

B. Abstract

Nowadays, the routes commercially implemented abroad for ethanol production from biomass use basically two types of raw material: sucrose-rich feedstock (sugarcane and sugar beet) or starch-rich feedstock (corn, wheat and cassava). These feedstock are used to produce fermentable solutions, which should be fermented with yeasts and successively distilled to obtain ethanol. These routes are very different in terms of efficiency and requirements, with ethanol production from sugarcane presenting the most favorable indicators of agro-industrial productivity and lower natural resources demand per unit of energy produced. In fact, in accordance to EPA evaluation, the ethanol from sugarcane already accomplishes the requisites of to be considered an advanced biofuel.

This speech will start with a brief discussion of the main feedstock used for ethanol, presenting their basic characteristics and selection criteria, followed by a more detailed analysis of the agricultural and industrial stages of production of sugarcane and corn ethanol, addressing relevant issues such as mass and energy balances (under Life Cycle Analysis concept), input requirements (such as fertilizers, agrochemicals, lime) and yields in each case as well as current and prospective productivity indicators. Concluding this part of tutorial, a discussion on environmental aspects will be introduced, stressing the importance of co-products recycling, as largely done with vinasse and filter cake, and presenting an evaluation of GHG emission considering the full life cycle of ethanol produced in this agro-industry, taking into account the Brazilian context.

Due its composition (sucrose, ligneous-cellulosic fiber and water), sugarcane processing allows the simultaneous production of liquid biofuel and sugarcane bagasse, which is largely used in cogeneration schemes to supply all needs of thermal and electrical energy in sugar mills and generate relevant surpluses of bioelectricity to the grid. Regarding this aspect, a basic cogeneration scheme for a typical sugar mill will be presented, using simple back-pressure steam turbines, as the departure point to introduce improvements and presenting a path of possible development of power production in the framework of sugarcane agro-industry, which can increase significantly the amount of electricity produced. The technologies to be implemented can involve, considering conventional steam cycles, high pressure boilers and extraction-condensing steam turbines, and in more advanced schemes, bagasse and straw gasification systems associated to gas turbines.

In the final topic of this tutorial, a summary of new trends in processes and technologies of interest of ethanol production from sugarcane will be presented, including systems already put in place and alternatives in evaluation, involving improvements in sugarcane agriculture (direct cultivation, precision agriculture, controlled salivation irrigation, breeding sugarcane varieties using bioengineering, energy sugarcane, among other), feedstock processing (process control, by-products utilization, sucrose losses reduction, among other) and raw material, product and co-product logistics. Although the current technology adopted for ethanol production from sugarcane is already efficient enough, there are still interesting opportunities for improvements with relevant gains in productivity, cost reduction and environmental benefits in this conventional route.

Concluding, it is worth to mention that these technologies, required for sustainable production of sugarcane and its conversion in a drop-in biofuel, are basically open-access and freely available. Indeed, sugarcane agro-industry is already rather known and its technology is widely utilized in many tropical countries where ethanol as fuel is still a dream but can be a desirable reality in short term.

C. References

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