

## **Innovative Process to Convert Sugar Cane Bagasse into Ethanol, Biogas and Natural Fertiliser**

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Sugar cane bagasse has been utilised at the sugar mill as a solid fuel in Steam-Rankine cycle systems or in new process called Integrated Gasification Combined Cycle (IGCC) [1]. Despite their relative simple operations, the first process presents low energy conversion efficiencies [1] and the latter the feedstock must be sized and dried before gasification [2]. In addition, emissions from burning biomass have been an important concern by specialists [3].

Considering these above statements we have proposed and tested a cleanest environmental technology where bagasse is mixed with vinasses and converted into biogas through anaerobic digestion. Biodigestion of crude stillage has presented several problems and bagasse has been very helpful increasing its solid content and consequently the biogas yield.

Intending to aggregate value to the whole process and to increase CH<sub>4</sub>/CO<sub>2</sub> ratio, we are developing a thermochemical pre-treatment to be applied to the lignocellulosic biomass prior to its digestion. From literature data, approximately 80% of the total hemicellulose can be removed easily from whole biomass by steam explosion process [4] and the resultant pentoses and hexoses might generate approximately 60 gallons of ethanol per ton of dried biomass. In addition to steam generation for ethanol recovery, the energy of the biogas produced (72-74% of CH<sub>4</sub>), from the resultant cellulose-lignin solid fraction plus vinasses, is enough to power most electrical energy needs of the whole sugar production process. Part of the liquid waste might be recycled to the process and most produced sludge can be discharged back to the crop as a neutral and safe fertiliser, with very fast absorption and without bad smell characteristic of crude vinasses.

The proposed approach, conceived for a sustainable production, looks more appropriate than conventional biomass burning systems because it satisfies the requirements for air quality, recomposes soil by natural fertiliser and generates two sources of green fuels: biogas and ethanol. Different types of solid residues like municipal solid waste (MSW) might be used as well in this process shortening composting time with additional liquid fuel production.

### **References**

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