PRODUCTION OF BIO – ETHANOL AND BIO – BASED MATERIALS FROM SUGAR CANE BAGASSE

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Ethanol may be produced using sugarcane bagasse as raw material through organosolv process with dilute acid hydrolysis, thus increasing ethanol production with the same cultivated sugarcane area . In this work, simulations of bioethanol production from sugarcane juice and bagasse are carried out using software UniSim design. A typical large scale production plant is considered;1000m^3/day of ethanol is produced using sugarcane juice as raw materials. A three-step hydrolysis process (pre-hydrolysis of hemicellulose, organosolv delignification and cellulose hydrolysis) of surplus sugarcane bagasse is considered. Pinch analysis is used to determine the minimum hot utility obtained with thermal integration of the plant, in order to find out the maximum availability of bagasse that can be used in the hydrolysis process, taking in to consideration the use of 50% of generated sugarcane trash as fuel for electricity and steam production. Two different causes were analyzed for the production purification step: conventional and double-effect distillation systems. It was found that double effect distillation system allows 90% of generated bagasse to be used as raw material in the hydrolysis plant, which amounts for an increase of 26% in bioethanol production considering exclusively the formation of hexoes obtained from the cellulosic fraction.

Introduction

Sugarcane, or sugar cane, are several species of tall perennial true grasses of the genus Saccharum, tribe Andropogoneae, native to the warm temperate to tropical regions of south and south east Asia, Polynesia and Melanesia, and used for sugar production. It has stont, jointed fibrous stalks that are rich in the sugar sucrose which accumulates in the stalk internodes. The plant is two to six meters (six to twenty feet) tall. All sugarcane species interbreed and the major commercial cultivars are complex hybrids.

Sucrose, extracted and purified in specialized mill factories is used as raw materials in the food industry or is fermented to produce ethanol. Ethanol is produced on a large scale by the Brazilian sugar cane industry. Sugarcane is the world's largest crop by production quantity with 1.9 billion tonnes produced in 2016, and brazil accounting for 41% of the world total. In 2012, the food and agriculture organization (FAO) estimated it was cultivated on about 2.6 x 10^6hectares (6.4 x 101 acres), in more than 90 countries. Other than sugar, products derived from sugarcane include falernum molasses, rum, cachaca (a traditional spirit from Brazil), bagasse and ethanol.

Sugarcane is harvested by hand and mechanically. Harvesting accounts for more than half of production, and is dominant in the developing world. In hand harvesting, the field is first set on fire. There fire bums dry leavesand chases away or kills any lurking venomous snakes. Harvesters then cut the care just above ground level using cane. A skilled harvester can cut 500kg (1, 100 lb) of sugar cane per hour.

Materials and Methods

Sucrose, extracted and purified in specialized mill factories is used as raw material in the food industry or is fermented to produce ethanol. Ethanol is produced on a large scale by the Brazilian sugarcane industry cane become sugar with milling process with the fiterate evaporated under vacuum to leave 60% sugar solution. Further evaporation yields first crop of raw sugar and the raw sugar shipped to a refinery, where it is recrystallized into table sugar 99.9% sucrose. The final mother liquor is known as blackstrap molasses, and the remaining plant material is bagasse. Each of the four components sugar molasses, bagasse and fiber mud has several uses an can lead to value added products.

However, the bagasse which is the dry fiber of the care juice has been extracted is used for several purposes: fuel for the boilers and kills production of paper, paper board products, and reconstituted panelboard, agricultural mulch and more as a raw material for production of chemicals. The primary use of bagasse and bagasse residue is as fuel source for the boilers in the generation of process steam in sugar plants. The new plant will also be able to produce animal feed by mixing the stillage with two other by products fish waste and sugarcane bagasse.

Ethanol and Glycerin

The proposed rum plant will not be large enough to produce many chemical products, but a molasses based fuel ethanol plant would be such a plant could be a significant new source of glycerin. Kampen, Njapau and Munene have studied the fermentation that produces both ethanol and glycerin and kampen holds patents for increased glycerine production. The glycerine can be recovered by using membrane fitteration and liquid chromatography. If the osmotic pressure in the fermentation vessel is increased, the cells undergo plasmolysis and survive by raising their osmotic pressure. The cells raise their pressure by making polyolsclriefly glycerin.

Result and Discussion

Table 1st Nutrient Information from Esha Research Units

Units	(26.56kal)111.13KJ	27.51/g	26.98g	0.27g
Nutrients	Energy	Carbohydrates	Sugars	Protein

Table 2

Minerals	Calcium	Iron	Potassium	Sodium
Percentage	11.23mg	0.37mg	41.96mg	17.01mg
Quantity DV+	1%	3%	1%	1%

Units; mg=micrograms. Mg=milligrams; IU=International units. Percentages are roughly approximated using US recommendations for adults.

Source: USDA Nutrient Database.

Bio-Gas Production

Recent cogeneration technology plants are being designed to produce 200 to over 300KWh of electricity per tonne of bagasse. As sugarcane is a seasonal crop, Shortlyafter harvest, the supply of bagasse would peak, requiring power generation plants to tragically manage the storage of bagasse. A greener alter native to burning bagasse for the production of electricity is to convert bagasse to biogas. Technologies are beings developed to use emymes to transform bagasse into advanced biofuel and biogas.

Sugarcane crop is able to efficiently fix solar energy, yielding some 55 tonnes of dry matter per hectare of land annually. After harvest, the crop produce sugar juice and bagasse, the fibrous dry matter. This dry matter is biomass with potential as fuel for energy production. Bagasse can also be used in tilling, transportation etc. Thus, the solar energy-to-ethanol convention efficiency is 0.13%.

The sugarcane delivered to the processing plant is called burned and cropped (b and c), and represents 77% of the mass of the raw cane. Each ton of b and c yields 740kg of juice(135kg of sucrose and 605kg of water) and 260kg moist bagasse(130kg of dry bagasse). Since the lower heating value of sucrose is 16.5MJ/kg, and of the bagasse is 19.2MJ/kg, the total value of a ton of b and c is 4.7GJ of which 2.2GJ came from sucrose and 2.5GJ from the bagasse. Per hectare per year, the biomass produced corresponds to 0.27TJ. This is equivalent to 0.86W per square meter. Assuming an average insolation of 225W per square meter, the photosynthetic efficiency of sugar cane is 0.38%.

The 135kg of sucrose found in 1 ton of b and c are transformed in to 70liters of ethanol with a combustion energy of 1.7 GJ. The practical sucrose-ethanol conversion efficiency is therefore, 76%(compare with the theoretical 97%). One hectare of sugar cane yields 4000liters of ethanol per year(without any additional energy input, because the bagasse produced exceeds the amount needed to distill the final product). This, however, does not include the energy used in tilling transportation and so no. Thus, The solar energy-to-ethanol conversion efficiency is 0.13%

Conclusion

Sugarcane bagasse is a potentially abundant source of energy for large producers of sugarcane, such as Brazil, India and China hence, with use of latest technologies, bagasse produced annually in Brazil has the potential of meeting 20% of Brazil's energy consumption by 2020.

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