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Manufacturing of Ethanol from Maize

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Abstract: *India is a developing economy, and an energy-hungry state. With its ever increasing demand for fuel, India is the fourth largest consumer of crude oil in the world and imports 70% of its total demand. Also, to reduce the carbon footprint, the search is on for eco- friendly and renewable sources of energy. In India, one such unconventional fuel is ethanol produced from sugarcane molasses and blended with gasoline for use as biofuel. The present paper propose an entrepreneurial project to produce ethanol from maize, with an objective to develop a clean & green source of energy and to give a boost to the agricultural economy. Maize is the third most important crop in India, with approximate 85% of areal coverage. Ethanol produced from maize has advantages over sugarcane, as the fibrous byproduct makes an excellent animal feedstock and can be further processed for the production of corn starch and syrup, to maximize the profit. The present paper suggests an entrepreneurial opportunity for commercial production of ethanol from maize directly purchased from farmers.*

Keywords: Maize, Ethanol, Dry-grinding, Fermentation

I. INTRODUCTION

In every industry, Unit operations are carried out for certain processing. Here main operations are distillation. The process is driven by thermal energy. Fermentation plays a vital role in this whole project. Fermentation leads to degradation of sugar and gets it converted to ethanol. Due to boiling point difference between ethanol and water, it gets separated. The ethanol generated can be utilized as fuel for generators. Blending of ethanol with gasoline to reduce cost and use of it as fossil fuel cost reducer is also possible. Due to over consumption of fuel and rise of price of fuels this is essential method. Many at times the farmers use electricity for the works in farm. But due to electricity cutoff, the work in farm is stopped and hence delay in work is result. New technologies that may further increase cost savings include coproduce development, such as recovery of high-value food supplements, and cellulosic conversion. High oil prices may spur the risk-taking needed to develop cellulose-to-ethanol production.

1.1 Advantages of Bioethanol

1. Exhaust gases of ethanol are much cleaner, it burns more cleanly.
2. Renewable energy resource
3. It reduces greenhouse gases.
4. Bioethanol is biodegradable and less toxic than fossils fuels.
5. Variety of sources of raw material.
6. Opens up untapped agriculture sector.
7. Minimizes dependence on fossil fuels.
8. Helps reduce global warming.

1.2 Disadvantages or Limitations of Bioethanol

1. Requires a large piece of land.
2. The distillation process is not good for the environment.
3. Ethanol generated from process is not edible.
4. Spike in food prices.

II. LITERATURE REVIEW

This part contains theoretical analysis and information about Cellulose, Ethanol and Generated Ethanol. To satisfy the desire to make life better for man through science and technology and having in view the potentials ethanol has in this regard, there have been some concerted efforts directed at perfecting the fermentation techniques and feedstock used.

Previous life cycle assessments for agro-bioenergy production rarely considered some agronomic factors with local and regional impacts. While many studies have found the environmental and socio-economic impacts of producing bioenergy on arable land not good enough to be considered sustainable, others consider it still as one of the most effective direct emission reduction and fossil fuel replacement measures. Developments such as dry fractionation technology, now commercially viable, may alter the structure of the industry by giving the cheaper dry-grind method an edge over wet milling. Dry milling requires smaller plants, and local farmer cooperatives could flourish as a result. Though improvements in processing and technology are important, however, the fluctuating price of inputs such as corn, the cost of energy alternatives, and environmental developments play larger roles in the fortunes of the industry.

III. MATERIAL AND METHADOLOGY

Ethanol C2H5OH

Chemical formula C2H5OH
Appearance: Clear colorless liquid
Physical state: Liquid
Molecular weight: 46.07 g/mol
Specific gravity: 0.787 gm/lit
Solubility in water: soluble
Boiling Point: 78.37 0C
Vapor Pressure: 5.95kPa

Common Properties of Raw Material to be Fermented

Properties should be known to the performer before he/she performs fermentation process on the desired materials but here Corn, Indian Gooseberry and Sugarcane (juice).

The common properties of raw materials to be fermented are:-

1. It is odourless.
2. It is insoluble in water and most organic solvents.
3. It is hydrophilic.
4. It is biodegradable.
5. It can be broken down chemically into its glucose units by treating.

Ethanol Production Processes

New Technologies are under experiment at various international research centers so as to provide more and better products to enhance the economics of the fuel ethanol. Further research in bio- fuel metrics is needed and the major thrust areas are: Production of hybrids with higher starch content, Conversion of corn kernel fiber fraction to ethanol and identification and development of new and higher value coproduces.

Ethanol can be produced from maize by the two major commercial processes;

1. Dry grinding processing and
2. Wet milling process

The dry grinding process is used for the production of ethanol only, whereas the wet milling is used for the production of corn oil and corn starch also. The yield of ethanol is greater in the drygrinding process as compared to the wet milling process.

Dry-Grind Ethanol Process

1. Milling : In this process, the grains are screened to remove any debris. The kernels are separated from the cob and ground to produce corn flour.
2. Cooking and Liquefaction: The corn flour is mixed with water and enzyme α-amylase. The process involving the cooking of this slurry is called liquefaction. The jet-cookers inject steam into flour slurry to cook at a temperature above 100°C.This process breaks the starch present in the endosperm. The cooked mash is then cooled at 80-90°C and additional α-amylase is added.
3. Saccharification: The slurry after liquefaction is called corn mash. During saccharification, the mash is cooled to approximately 30°C and glucoamylase is added to breakdown starch into fermentable sugars.
4. Fermentation: Yeast is added after the mash is transferred to the fermenter. Saccharomyces cerevisiae is a commonly used species. The fermentation process is completed in about 48-50 hours.
5. Distillatioon: The boiling point of ethanol is lower than water, so it can be separated by distillation. The beer is pumped into a multi-column distillation system and ethanol at 92-95% purity is obtained. The residual solids with water remaining after distillation is called stillage.
6. Dehydration: The ethanol produced from distillation contains 5% water. It is passed through the molecular sieves, where the desiccants absorb water to produce the anhydrous ethanol.
7. Denaturing and Storage: To make the ethanol inconsumable, it is denatured with 2-5% petrol. Thereafter, it is sent to the tanks for storage.

Co-Product Processing

The residue from this process, called „ ‟ whole-stillage‟ ‟ contains non fermentable starch, fiber, oil, and protein component of the grain and water. It is pumped out from the bottom of the columns into the centrifuges. During the ethanol production process, two valuable co-products are created: carbon dioxide and distillers grains. Asyeastfermentthe sugar, they release large amounts of carbon dioxide gas. This CO2 canbereleased in to the atmosphere, but it‟ s generally captured and sold to food processing industriesas discussed earlier. The stillage from the bottom of the distillation tanks contains solids from the grain and added yeast as well as liquid from the water added during the whole process. This is a valuable feed ingredient and can fed as such but it is usually sent to centrifuges for separation into thin stillage (a liquid with 5– 10% solids) and wet distillers grain.

Some of the thin stillage (15-30%) is routed back to the cook/slurry tanks as makeup water, reducing the amount of fresh water required by the cook process. The rest is concentrated further into syrup containing 25– 50% solids. After drying (evaporation), the thick syrup, which is high in protein and fat content, is then mixed back to cook/slurry tanks as makeup water, reducing the amount of fresh water required by the cook process. The rest is concentrated further into syrup containing 25– 50% solids. To reduce this burden WDGS is often dried to 10-13% moisture to give rise to Dried DistillersGrainSoluble (DDGS).This facilitates the removal of moisture and extends its shelf life. This dried distillers grain (DDG) is commonly used as a highprotein ingredient in cattle, swine, poultry, and fish diets.

IV. CONCLUSION

This research work is based upon experiments. After conducting trials, we canconcludethatnomatterthat sugarcane yields 100% pure product but ethanol from corn stem juice also yields 99.76%pureproduct.Aspercost analysis, the ethanol generated from sugarcanecostsmorethanethanol generated from corn stem. The cost analysis is one of the ways to conclude that ethanol from corn stem is effective andlessexpensive.AsofIndian Gooseberry, the Brix of the material was so low that equipments in the lab could not measure the brix. Talking about the Ethanol content in Indian Gooseberry trials, Lab analysis gives report that it has no ethanol (neither any alcohol) content in it.

. It may be obtained from agriculture west in future. But at this stage it was not possible to obtain ethanol from agriculture west due to very low brix value. It may have been due to very less sugar content in agriculture west Baker‟ s Yeast would have broken down the starch into sugar but could not break down enough to generate alcohol. So, we conclude that ethanol cannot be generated from agriculture west juice at such small scale and may need external treatment for breaking down the sugar in agriculture west material juice.

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