

A Study on Importance of Ethanol as a By Product from Sugarcane Industry

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Abstract:-

The sugarcane industries are currently in a state of decline. One of the products that revitalises the sugarcane business is ethanol. The sugarcane industry has been beneficial to industrial growth. The production of renewable energy sources is a business in India. One of the by-products of sugarcane production is ethanol. A crucial by-product of the sugarcane business is ethanol. In recent years, ethanol's significance as a fuel substitute for conventional fuels has grown. The sugarcane industry produces ethanol as a by-product. It is a strategy to use less conventional fuel and contributes to keeping the natural system in balance. Because of the government's increased attention on ethanol production, ethanol production has increased over the past few years. In this paper, we discuss the production method of ethanol as well as its significance, limitations, and possibilities for the future.

Keywords: Ethanol, sugarcane

Introduction:

India's strategy is intended to support the government's ambitious announcement to switch from conventional or fossil fuels, which are limited, non-renewable, and polluting and must be used properly, to renewable energy sources, which are indigenous, eco-friendly, and undeniable. Renewable energy resource production is a business in India. The Indian government has developed a plan to minimise oil imports while increasing domestic production through the use of bio-fuels and renewable energy sources. India's strategy aims to achieve the government's ambitious announcement to switch from conventional or fossil fuels to renewable energy sources. While fossil fuels are limited, non-renewable, and polluting, they must be used properly, whereas renewable energy sources are indigenous, eco-friendly, and undeniable. India participates in the creation of renewable energy sources. The Indian government has developed a plan to increase local oil production and decrease imports by using bio-fuels and renewable energy sources. In order to minimise its reliance on oil and pollution, In addition, the government is concentrating on the manufacture of bio-fuels to reduce reliance on oil and pollution. [1]

Objectives:

To know the importance of ethanol as a by-product or bio-fuel from the Sugarcane Industry.

Review of the literature:

One of the main biofuels is ethanol, which is created either naturally when yeasts ferment sugars or through petrochemical processes like ethylene hydration. It can be used in medical applicant as a disinfectant and antiseptic. It serves as an alternative fuel source, a chemical solvent, and a precursor for the creation of organic compounds. A volatile, flammable, colourless liquid, ethanol is also known as ethyl alcohol, pure alcohol, grain alcohol, or drinking alcohol. A class of chemical substances known as ethanol includes molecules with a hydroxyl group (OH-). The chemical formula for ethanol is CH₃CH₂OH.

Following are the types of Feedstock for the Production of Ethanol

- Sugarbeet,
- Sugarcane, Molasses, and Beet
- Starchy Foods
- Wheat, Corn, and Barley
- Lignocellulose Materials

- Straw, Bagasse, and Wood [2]

Policies for biofuels, Implementation and the Current Situation:

The Ethanol Blended Petrol (EBP) programme was introduced by the Indian government in 2003 with the goal of promoting environmentally friendly fuels (by increasing the use of ethanol) and lowering energy imports. In general, the programme was created with a number of goals in mind. It sought to decrease carbon emissions while simultaneously saving foreign currency and decreasing reliance on imports by expanding the use of biofuels. More particular, the EBP programme creates a steady market for ethanol, which adds liquidity to the sugar industry. As a result, it helped to reduce accumulated areas and allowed cane producers to receive payments on schedule. The first phase of the ethanol blended petrol (EBP) programme, which required the blending of 5% ethanol in gasoline in nine months, saw the commercial manufacturing and distribution of ethanol blended gasoline begin in January 2003. In August 2005, the government completed an agreement between sugar industry and petroleum companies to enable the purchase of ethanol and the ethanol programme was restarted in a limited number of designated states and union territories. With a strong resurgence in sugarcane/sugar production in 2006-07, the GOI announced the second phase of the EBP programme in September 2006 that mandated 5% blending of ethanol with petrol (gasoline) subject to commercial viability in 20 states and 8 union territories. The GOI had initially planned to launch the third stage of the EBP from October 1, 2008 wherein (i) the ethanol blend ratio was to be raised from 5% to 10% and (ii) 5% blending was to be made mandatory across the country in all the states. The erstwhile National Policy on Biofuels (2009) permitted the procurement of non-food feedstock like molasses, celluloses and lignocelluloses. However, due to the short supply of sugarcane and sugar molasses in 2008-09 and forecast of short supplies in 2009 -10, the government has deferred the proposed implementation of the third phase of the EBP. Since 2013, the GOI has mandated a 5% blending of ethanol in petrol for fuel use in the country. Nevertheless, until 2017-18 ethanol for EBP programme came from molasses, allowing utilisation of a by-product of the sugar industry. The present output of molasses allows for the production of approximately 3 billion litres of alcohol/ethanol, which is targeted at 10% blending. Thus, India has had different phases of ethanol blending policies and programs since 2003, the ending of ethanol with petrol was started after ten years of biofuel policy formulation. With the available fuel ethanol production, ethanol blending was achieved only 0.67% in 2012-13 and 4.22% in 2017-18. [3]

Government initiatives during present year for ethanol production:

Ethanol Blending Programme:

Also produced are Dry Distillers Grains With Soluble (DDGS), which have the potential to bring in more money. A 100 kl per day 1G facility is expected to require between 170 and 200 crores in capital investment and around 20 acres of land.

CBG Plant: Agricultural waste, municipal solid waste (MSW), cow dung, and other materials can be used to produce compressed biogas (CBG) or bio-CNG. CNG is easily replaceable by CBG. Another source of income is the bio-manure created in the Plant. Depending on the feedstock and the required amount of land (about 15 acres), the anticipated capital expenditure for a 15 tonne per day CBG facility is in the range of Rs. 60 to 100 crores. The Government has been fixing remunerative prices of ethanol produced from different Feed-stocks for the supply of ethanol to OMCs for every Ethanol Supply Year Amended the Industries (Development & Regulation) Act, 1951 to ensure free movement Of ethanol in the country. Reduced Goods & Service Tax (GST) on ethanol meant for Ethanol Blended with Petrol (EBP) Programme from 18% to 5%. FCI Rice & maize also allowed as feedstock. Interest subvention scheme extended to grain-based distilleries Standard Operating Procedures (SOPs) issued by banks for faster loan sanctioning Environmental Clearance procedures simplified by the Ministry of Environment, Forest & Climate Change. Enhancement of storage capacities to store ethanol started by Oil Marketing Companies. Notification for 20% blending from April 2023 issued Use of automotive fuel E12 (12% ethanol with 88% petrol) & E15 notified. Notification for direct sale of E100 by OMCs issued E20 material compatible vehicles being launched from April 2023 and E20 engine Compatible vehicles being launched from April 2025 Flexi-fuel

engine & components (capable of running up to E85 fuel) included under Production Linked Incentive (PLI) scheme. Cabinet approved amendments to National Policy on Biofuels to make India energy independent by 2047. The amendments are intended to allow more feedstock for the production of biofuels, advance the ethanol blending target of 20 percent blending of ethanol in petrol and promote the production of biofuels in the country. A "Roadmap for Ethanol Blending in India 2020-25" was released by the Prime Minister in June 2021 which laid out a detailed pathway for achieving 20% ethanol blending. Due to the coordinated efforts of the Public Sector Oil Marketing Companies (OMCs) the target of 10% blending under the programme has been achieved much ahead of the targeted timelines of November 2022 wherein the Public Sector OMCs have attained an average 10% ethanol blending in petrol across the country. [4]

Government initiatives for ethanol production in future:-

The Future Landscape of Opportunities

By 2025, at 20% blending level, ethanol demand will increase to 1016 Crore litres. Therefore, the worth of the ethanol industry will jump by over 500% from around ₹9,000 crore to over ₹50,000 crore. Ethanol Industry is expected to grow by 500%. Ethanol distillation capacity to double to 1,500 crore litres annually

- Financial assistance scheme introduced by DFPD during 2018-2022 to increase ethanol production capacity.
- Long term off take agreement signed to establish 431 crore litres per Annum of dedicated ethanol capacity.
- Estimated 165 LMT of surplus grain to be utilized annually from 2025 To produce ethanol which would result in estimated 42,000 crore Payment to farmers.
- Launch of new vehicles compatible to run on E20 fuel from 2023 and Flex fuel vehicles from 2024. This will attract new investment and create employment opportunities. [5]

A Model for an Integrated Bio-Refinery

According to the concept of an integrated bio-refinery model or bio-park, the following facilities will be incorporated:

1. Second Generation or 2G ethanol plant:

This type of plant can turn agricultural wastes like rice straw, wheat straw, and energy crops into ethanol. Given that India produces over 160 MMT of surplus agricultural residues each year, 2G ethanol facilities present a large market opportunity. A 100 kl per day facility can use 2 lakh tonnes of agricultural waste annually to produce about 3 crore litres of ethanol.

2. Grain-based First Generation or 1G Ethanol Plant:

This type of plant can turn the starch found in grains like rice, corn, and others into ethanol. Certain by-products, such as dried CO₂ Also produced are Dry Distillers Grains With Soluble (DDGS), which have the potential to bring in more money. A 100 kl per day 1G facility is expected to require between 170 and 200 crores in capital investment and around 20 acres of land.

3. CBG Plant:

Agricultural waste, municipal solid waste (MSW), cow dung, and other materials can be used to produce compressed biogas (CBG) or bio-CNG. CNG is easily replaceable by CBG. Another source of income is the bio-manure created in the Plant. Depending on the feedstock and the required amount of land (about 15 acres), the anticipated capital expenditure for a 15 tonne per day CBG facility is in the range of Rs. 60 to 100 crores. depending on the feedstock and the land requirement of Approx. 15 acres.

4. **Production of Chemicals:** Production of bio-chemicals in the Bio-refinery will improve its economics significantly. Some Technologies for production of bio-chemicals are ready for Commercialization while many are still in the development stage. [5]

Ethanol distilleries in terms of numbers and ethanol distillation capacity in (crore litres/annum)

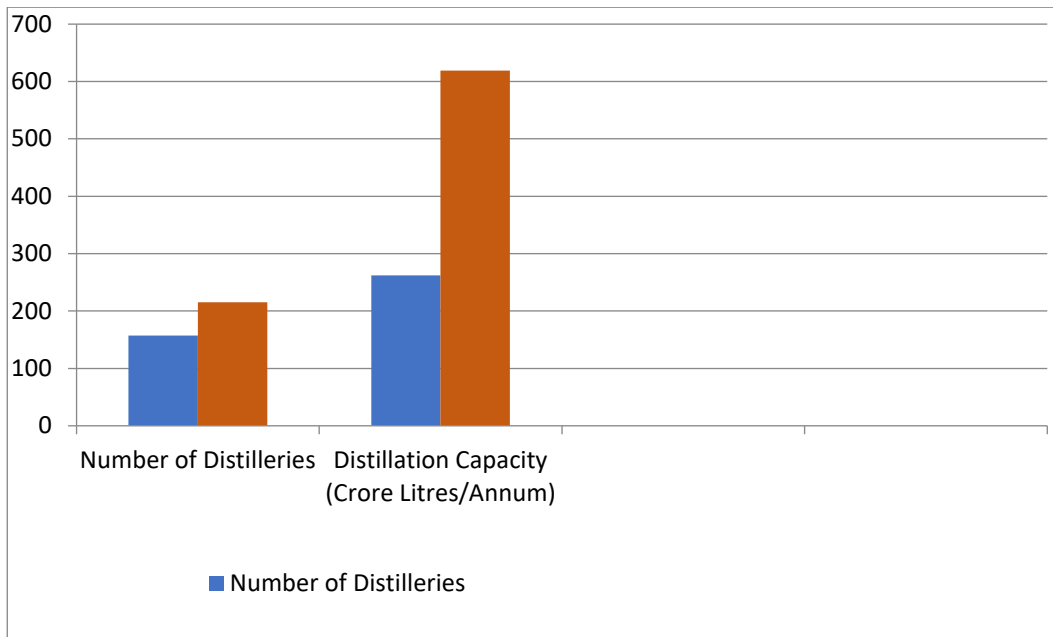


Figure1: Ethanol distilleries in terms of numbers and ethanol distillation capacity
 [Source: https://mopng.gov.in/files/uploads/BPCL_Ethanol_Booklet_2023.pdf]

Percentage of Contribution From Different Sources For Production of Ethanol

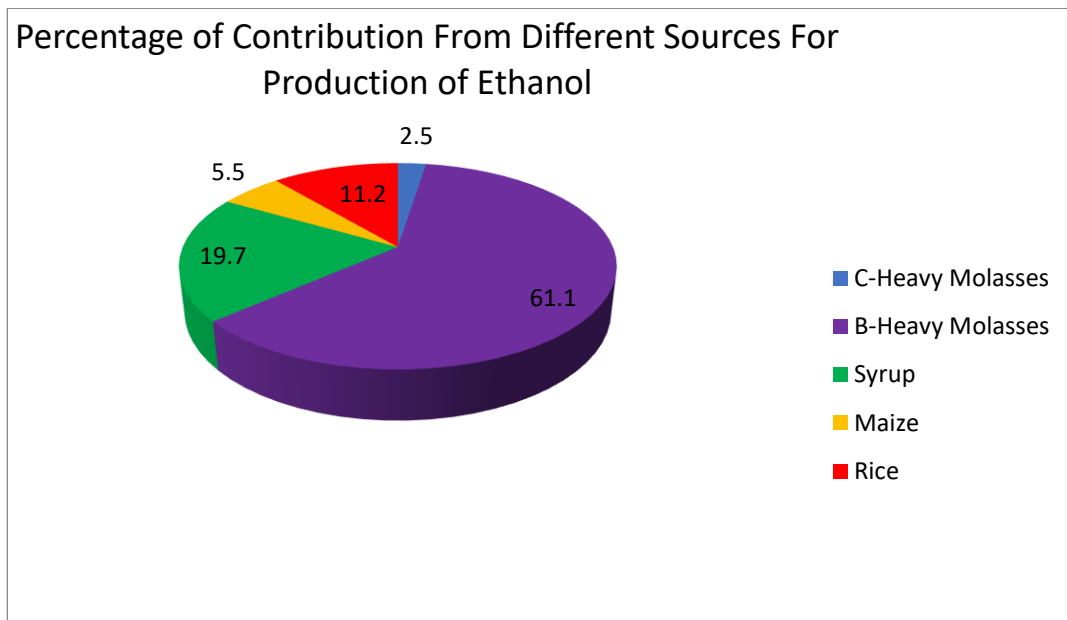


Figure2: Percentage of Contribution From Different Sources For Production of Ethanol
 [Source: https://mopng.gov.in/files/uploads/BPCL_Ethanol_Booklet_2023.pdf]

Landmark achievements in ethanol production

•In ethanol production 8 times increase in ethanol blending from 38 crore in 2013-14 to 300 crore in 2021- 22.

•Ethanol distillation capacity almost doubled.

•Number of distilleries increased by 40% percent in 5 years.

•Help contain lower prices as compared to petrol.

•Long term investment investments ethanol production for ethanol production in coming years [6][7]

Steps in ethanol production:-

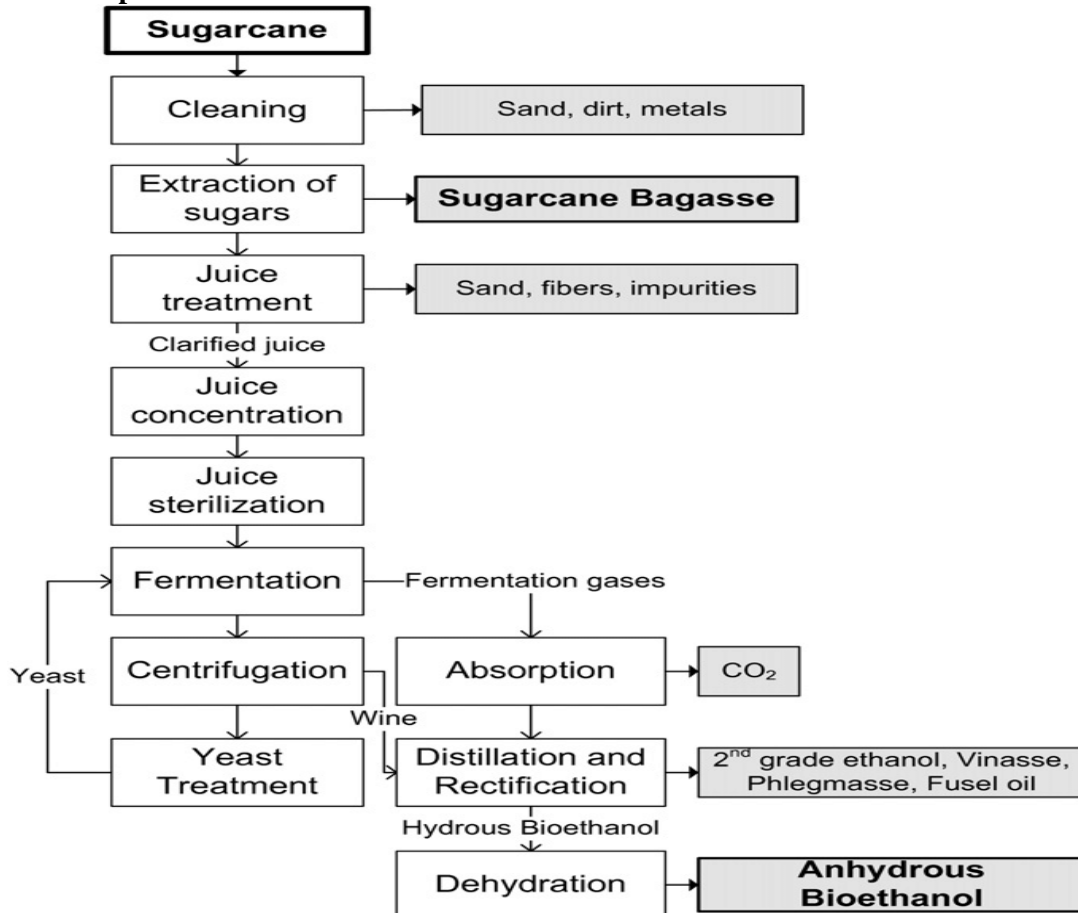


Figure3: Steps in Ethanol Production

[Source: G.H.Jenkins, Sugarcane Technology, First Edition, University of Queensland, Elsevier Publishing Company, 1966]

Step1: Sugarcane Collection

This is the first step in which sugarcane is collected from farmers.

Step2: Extraction of Juice

Juice extraction is done with the help of large machines.

Step3: Juice Concentration

The clarified juice contains about 15% wet solids so it must be concentrated before fermentation in order to produce adequate ethanol content that allows reduction of energy consumed during purification steps.

Step4: Sterilization

In sterilization operation the juice which contains 22% wet sucrose is sterilized and cooled till fermentation temperature.

Step5: Fermentation

In this process sterilized juice is added to the fermenters along with the yeast stream. The fermented sucrose is inverted to glucose and fructose, which are consumed by the yeast producing ethanol CO_2 and other products such as higher alcohols organic acids, glycerol and yeast. Fermentation was carried out at 28 degree Celsius in order to obtain wine with higher ethanol content.

Step6: Distillation

In the distillation process ethanol rich streams containing around 40% wet ethanol are obtained. In the rectification column hydrous ethanol and residues are obtained. Hydrous ethanol in the vapour phase is produced on top of another column.

Step7: Dehydration

In this process some percentage of water is present in ethanol which is dehydrated and anhydrous ethanol is obtained. [2][8]

Importance of ethanol production:-

- 1) **Use as a chemical feedstock:** In the chemical industry, ethanol is an intermediate in many chemical Processes because of its great reactivity. It is thus a very important chemical feedstock.
- 2) **Solvent use:** Ethanol is widely used in industry as a solvent for dyes, oils, waxes, explosives, cosmetics, etc.
- 3) **General utility:** Alcohol is used as a disinfectant in hospitals, for cleaning and lighting in the home and in the laboratory second only to water as a solvent.
- 4) **Fuel:** Ethanol is mixed with petrol and used in automobiles.
- 5) **Helps in reducing pollution:** Ethanol is a substitute for petrol and it can reduce dependency on conventional fossil fuels.
- 6) **Helps sugarcane industries to transfer from sugar to ethanol production:**
Ethanol helps sugarcane industries to transfer from sugar production to ethanol production which is more profitable.
- 7) **Ethanol industry provides job opportunities to people:**
As this industry is related to agriculture and people it will provide job opportunities as the ethanol industry expands.
- 8) **Increase in prices of food grain crops:**
Farmers can see an increase in demand for food grain which helps to stabilize prices.

[1][9][10]

Conclusion:

Ethanol is a fuel alternative with a wide range of applications. For the sugarcane and traditional fuel sectors, ethanol works well. In this research paper, we learn about the ethanol production process, including its features, drawbacks, and potential applications. Laws governing ethanol policy should be correctly defined and ethanol prices should be more appropriately set. The government has started a number of reforms to increase ethanol use in the nation. The use of ethanol as a blend stock with other primary vehicle fuels, such as gasoline, has been encouraged by the government with the National Biofuels Policy.

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