

Ethanol Future Fuel for India: An Introduction

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ABSTRACT

The increasing prosperity of India has led to a surge in the country's vehicle population and the need for more fuel. The transportation industry must contend with a diminishing supply of fossil fuels, fluctuating crude oil costs, and more strict environmental rules. These problems may be solved by switching to other fuels. Bio-fuels are being aggressively explored because of the reduced complexity involved in their manufacture, storage, transportation, and application in internal combustion engines compared to other options. Ethanol's higher energy density and lower environmental impact make it a promising alternative fuel. The Indian government has previously required a 10% ethanol mix in gasoline as part of a plan to cut oil imports. This study provides an introduction to ethanol as a potential replacement fuel for gasoline engines in the Indian context.

Keywords: Ethanol; alternative fuel; gasoline engine; emissions.

1. INTRODUCTION

Ethanol's potential environmental and long-term economic benefits over fossil fuel have garnered a lot of interest for its usage in internal combustion engines, either alone or in combination with other fuels. Ethanol has been used as a fuel for cars from the early days of the internal combustion engine. Nikolas A. Otto, in his early research on engines, looked at using ethanol as a fuel for automobiles in 1897. Since the 1920s, this fuel has been widely used in Brazil. Any amount of ethanol up to 100% may be added to gas (E100). Blends of anhydrous ethanol (ethanol without water) and gasoline may minimize both petroleum fuel use and emissions. Since methyl t-butyl ether is a major contributor to groundwater and soil pollution, ethanol is gradually replacing it as an oxygenate component for regular gasoline. Fuel cells and bio diesel may also be powered by ethanol.

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Alcohol fuels like ethanol are high quality and high octane, which leads to increased engine performance and lower emissions. In 1908, Henry Ford invented the Model T that could run on alcohol [1,2].

One of the primary biofuels, ethanol is created either by the fermentation of carbohydrates by yeasts or through petrochemical processes. Raw resources used in its manufacture in India include sugarcane or specific kinds of heavy molasses, sugarcane juice/sugar/sugar syrup, leftover rice from the Food Corporation of India, and maize. First-generation biofuels are those made from plants [3,4].

According to the IEEFA report, written by Charles Worringham of Australia, a sole proprietor researcher, it takes 187 hectares of maize-derived ethanol to equal the annual travel distance of an EV recharged from one hectare of solar energy, and that's after factoring in the losses from electricity transmission, battery charging, and grid storage. Experts agree that India may be putting too much emphasis on reaching the E20 objective, and that the current level of ethanol production based on surpluses or damaged foodgrains may be maintained at status quo or at E10 (10 percent ethanol-blended fuel) [5].

Flex fuel vehicles, which are designed to operate on either pure fossil fuel or fossil fuel combined with any degree of biofuels, may be used to transport ethanol. There is still a ways to go before all cars can run on E20. Vehicles manufactured in India after 2008 have rubber and plastic components that are compatible with E10 and meet the standards for fuel efficiency while using E5 (5 percent ethanol combined with petrol), but their engines are not optimized for E10. When E10 gasoline is made accessible nationwide, new cars will need to have their engines modified [6].

Additionally, it is estimated that when using E20, fuel efficiency drops by 7% for four-wheelers that were built for regular petrol but were calibrated for E10, by 4% for two-wheelers built for regular, unblended petrol but were calibrated for E10, and by 1%-2% for four-wheelers built for E10 but calibrated for E20. The government may need to provide tax breaks for E10 and E20 gasoline to make up the difference [7].

2. PRODUCTION OF ETHANOL

The fermentation of carbohydrates into ethanol has been in use for thousands of years. Even today, this method is used to produce 100% of the ethanol used in beverages and over 50% of the ethanol used in industry. The primary ingredients are just simple sugars. Ethanol is made from a variety of sugary feed stocks including sugarcane, sweet sorghum, and sugar beets. Cereals including corn, wheat, and rye all include starch that can be quickly transformed into sugar. Ethanol is often made from sugarcane molasses in India [8]. For the production of ethanol, for instance, the first generation of biofuels relied on biomass that included significant quantities of sugar or components that can be converted to sugar, such as starch. Yeast enzyme converts the carbohydrates to ethanol and

carbon dioxide. Ethanol may be fermented from a variety of plant starches, including potatoes, maize, wheat, and others. On the other hand, the starches have to be converted into sugars first. Diastase is an enzyme that is produced by germinating barley and is responsible for the conversion of starches into sugars. Therefore, the first stage in making beer from starchy plants like corn (maize) and wheat is the germination of barley, known as malting [9].

3. PROPERTIES AS FUEL

Ethanol is a colorless, odorless liquid with a distinct, pleasant scent. It has a somewhat pleasant flavor when dissolved in water, but a scorching aftertaste when concentrated. At 20 degrees Celsius, the average density of ethanol is 0.789 g/ml, and its melting point is -114.1 degrees Celsius.

Ethanol, with its 113 octane rating, is the best performance fuel available and is ideal for today's high-compression engines. Ethanol molecules include oxygen, therefore they help an engine burn fuel more thoroughly, which reduces pollution. Because it can be made from plants that use the energy of the sun, ethanol is also called a renewable fuel. The absence of sticky deposits in a fuel system is one of the many benefits of using ethanol-blended gasoline. Ethanol's antifreeze properties in gas lines make it useful throughout the winter [10].

4. INDIA'S PERSPECTIVE ON ETHANOL BLEND

In 2003, India first began using ethanol as a fuel for automobiles. In September 2002, 9 major sugar producing states and 4 union territories were notified by the Ministry of Petroleum and Natural Gas (MoPNG) that beginning in 2003, they would be required to mix 5% ethanol into their gasoline supply. The blending requirement was temporarily suspended in October 2004 due to an ethanol shortfall in 2004–05, and it was reinstated in October 2006 for a second phase that would gradually increase blending to 10%.

The Ministry of New and Renewable Energy implemented the National Policy on Biofuels in 2008 to reduce the country's carbon footprint and its reliance on imported crude oil. Starting in October 2008, a 5% bio-ethanol/gasoline mix was suggested, with a goal of 20% bio-ethanol blends by 2017. It also outlined a schedule for rolling out the program over time. OMCs are permitted to sell gasoline with up to 10% ethanol added under the government's current Ethanol Blended Petrol (EBP) Programme. As of April 1st, 2019, the whole country of India is included in the initiative to encourage the use of alternative and environmentally friendly fuels, with the exception of the Union Territories of Andaman Nicobar and Lakshadweep islands. As an added bonus, this action should help the agricultural sector and lessen the need to import energy [11].

OMCs received 173.03 crore ltrs of ethanol from sugar mills and grain-based distilleries in 2019-20, reaching the 5% blending goal. 10% ethanol in gasoline by 2022, 20% by 2030, and 5% biodiesel in diesel by 2030 are government aims. Blending ethanol with gasoline minimizes the quantity of gasoline required to

power a vehicle, reducing the demand for imports. Currently, India imports 85% of its oil. The ethanol blending plan published in June 2021 by NITI Aayog, the Centre's policy think-tank, estimates that India's net petroleum imports in 2020-21 totalled 185 million tonnes at a cost of \$551 billion. In light of the fact that most petroleum products are put to use in transportation, the E20 project has the potential to save the government Rs 30,000 crore yearly. Ethanol, in addition to being cheaper than gasoline, is also more environmentally friendly. The roadmap for E20 cites a number of factors as justification, including the fact that the target is "not only a national imperative, but also an important strategic requirement," the availability of large arable land, the increase in foodgrain and sugarcane production that has resulted in surpluses, the availability of technology to produce ethanol from plant-based sources, and the feasibility of making vehicles compliant to ethanol blended petrol (EBP) [11].

5. BENEFITS OF ETHANOL FUEL

5.1 Cost-effective

Almost every nation has the technology to make ethanol, making it the world's cheapest energy source. Because corn, sugar cane, and grain are all widely available and easy to cultivate, they can be harvested at a lower cost than fossil fuels. Most countries' economies are negatively impacted by fossil fuels, but this is particularly true for emerging nations that lack the infrastructure to search for them. Consequently, it is rational for these expanding economies to focus on ethanol fuel production as a means of decreasing their reliance on fossil fuel and, thus, saving money.

5.2 Environmentally Friendly

Ethanol has a number of advantages over other fuel sources, the most notable of which is that it does not contribute to the pollution of the environment. When used as a fuel for cars, ethanol contributes to much lower quantities of pollutants being released into the environment. Ethanol is often used with gasoline in order to speed up the process of converting it into fuel [12].

To be more specific, a ratio of 85:15 between ethanol and gasoline. The little amount of gasoline in the mixture serves just as an igniter; the majority of the work is carried out by the ethanol. Because it burns more cleanly than pure gasoline, this mixture of ethanol and gasoline reduces the amount of harmful greenhouse gases that are released into the atmosphere.

5.3 Abatement of Climate Change

The continuous release of harmful greenhouse gases into the atmosphere as a result of the burning of fossil fuels is the root cause of global warming (oil, natural gas, and coal). The results of global warming are disastrous, and they include shifts in weather patterns, an increase in sea level, and extreme heat. When

burned, ethanol fuel simply produces carbon dioxide and water as by-products of the reaction. The emission of carbon dioxide does not contribute significantly to the deterioration of the environment.

5.4 Availability

Because it is a kind of biofuel, ethanol may be obtained by nearly everyone with little effort. Energy that is obtained from plants, such as sugarcane, cereals, or maize, is referred to as biofuel. Sugarcane may flourish in any environment that is classified as tropical. Grain and maize are both common crops around the globe.

5.5 Alternative for Fossil Fuels

One of the most cost-effective ways to maintain any economy and protect it from becoming too dependent on the importation of fossil fuels like oil and gas is to develop methods for extracting fuel from maize or biomass. Adopting ethanol as a fuel source may help a nation save a significant amount of money that can be reinvested in the economy.

Because it is generated locally using crops that are grown domestically, ethanol contributes to a reduction in both reliance on imported oil and emissions of greenhouse gases. The change would be evident if we were able to run our automobiles on ethanol exclusively instead of gasoline [13].

5.6 Unlocks the Potential of the Agricultural Industry

Due of ethanol's reliance on agricultural goods, many individuals will be driven into the neglected agricultural sector, improving the nation's economy. This will assure ethanol fuel for many years. The need for more maize and grains is growing the agriculture economy. When there is a greater demand for ethanol as a fuel source, there will be a corresponding rise in the number of sugarcane, maize, and grain plantations.

It also implies there will be an increase in the number of ethanol fuel processing facilities, which will lead to an increase in employment possibilities. Ethanol may also be used in the production of alcoholic drinks, which can lead to the development of new employment prospects within the hotel sector [14]. It's a renewable resource since most of its energy comes from the sun's kinetic energy. First stage in making ethanol is photosynthesis, which is required for sugarcane development. Sugarcane becomes ethanol fuel.

6. CHALLENGING WITH ETHANOL

6.1 Vaporization Ability

It is difficult to evaporate ethanol in its purest form. Because of this, it is quite challenging to start a car when it is really cold outside. As a result, many people

who own automobiles make it a point to keep a little amount of gasoline in the tank at all times. For example, E85 cars utilize 15% petroleum and 85% ethanol.

E85, which consists of 85% ethanol and 15% gasoline, is a typical mixture that is utilized these days. The mileage that is produced by this mix is lower than that which is offered by regular gasoline or by the E10 blend, which contains 10% ethanol. However, employing the E85 mix has the advantage that the engine oil stays clean for a longer period of time, there is less strain placed on the engine, and the amount of total engine maintenance required is decreased. Because of advantages such as these, the expense of getting a reduced mileage rate may be compensated. Not to mention the general decrease of your carbon footprint, which is the one advantage of using ethanol fuel that everyone should strive for. This is the one benefit that comes from using ethanol fuel [15].

6.2 Attraction to Water

Ethanol in its purest form has a strong attraction to water and the ability to take up any trace of water that may be present in its surroundings or in the air. This fact is likewise valid for the mixtures of gasoline and ethanol that are used in the operation of motor vehicles. It is difficult to get ethanol in its purest form due to the fact that it has a strong capacity to draw water. This is because there will always be some trace of water present, no matter how careful one is. In point of fact, most producers specify ethanol that is 99.8 percent pure. This poses a greater threat to those who utilize boats than it does to conventional drivers on roads.

7. SUMMARY

Many governments have made cutting down on gasoline emissions a priority during the last decade. Many individuals and groups are exploring options to lessen their environmental effect in the hopes of lowering the world's carbon footprint. Because of this, several nations have been making more use of Ethanol as a fuel source. Even yet, those who are interested in making the transition to a new fuel source have numerous concerns regarding Ethanol. Many of them wonder what exactly this fuel is and how much of an impact it has on our daily lives and wallets. This paper presented an overview of ethanol as a future fuel for gasoline engines.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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