



# International Journal of Modern Chemistry and Applied Science

International Journal of Modern Chemistry and Applied Science 2016, 3(2),398-401

## Ethanol: A Future Fuel for Light Motor Vehicles

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**Abstract:** The present article describes the importance of ethanol as a next generation vehicle's fuel in India. 5- 10% of ethanol blended petrol (gasoline) is being used as fuel in all over the world. Ethanol has received the most of the countries' attention, usage of ethanol as fuel increased in the world due to its environmental friendly nature and reduces the global dependence on fossil fuels. A blend of around 30% ethanol containing gasoline is available in all gas stations for light motor vehicles in Brazil. The Indian government launched the ethanol blending scheme in 2001, aiming to mix 5 % of ethanol with petrol. India is always behind in the race of using renewable fuels. But India never achieved their target. Recently, The Ministry of New & Renewable Energy has proposed a target of 20% blending of biofuels by 2017. It's clear that India does not have capable of producing ethanol even for 10% blending of ethanol to petrol. Now, here we proposed that what steps are to be taken for achieving the target.

**Keywords:** bio ethanol, renewable fuel, flexible fuel vehicle, cellulosic ethanol

### 1. Introduction

Ethanol or ethyl alcohol is a renewable chemical, domestically produced from plant material such as corn, sugarcane, or grasses. The process of ethanol synthesis named fermentation (scheme 1). The chemical formula of ethanol is C<sub>2</sub>H<sub>5</sub>OH. It is a colorless liquid flammable with a pleasant smell. Ethanol is used as an antiseptic solution, solvent, fuel, in thermometers. Ethanol is main component in alcoholic beverages, have been using from centuries. Addition to these uses, Ethanol is known as biofuel which made from biomass materials. Ethanol is usually blended with Petrol (Gasoline) and used as fuel in transportation sector. In the present article describes the importance of ethanol as a next generation vehicle fuel in India.



Scheme 1: Fermentation process of starch or sugar

### 2.1 Ethanol as Fuel

5-10% of ethanol blending with petrol is used as fuel for light motor vehicles. E5, E10 and E15 are ethanol blended petrol available in global market, the number after the "E" indicates the percentage of ethanol added to petrol by volume [1]. All gasoline vehicles in the U.S. today can accept ethanol blended gasoline (called as 'gasohol') up to 10 %. All automakers approve blends up to E10 in their gasoline vehicles, no engine modification required. Flexible Fuel Vehicles (FFVs) are specially designed vehicles that can operate on alcohol, gasoline or any combination of the two. FFVs are cars and trucks available in the market that

can use any level of ethanol up to 85%. They're built with special fuel system components designed to be compatible with higher ethanol concentrations, however ethanol content in fuel should be recommended by the automaker. A fuel made up of 85 to 100 % ethanol depending on country specifications, can be used in specially designed engines.

### 2.2 Advantages and Disadvantages of Using Ethanol as Fuel

Usage of ethanol blending petrol reduces global dependence on fossil fuels, saves foreign exchange. Ethanol adds extra oxygen to petrol which helps in reducing of air pollution and harmful emissions (carbon monoxide, unburnt hydrocarbons) in tailpipe exhaust [2]. Bioethanol is carbon neutral fuel, it means that the carbon dioxide released when ethanol is used in vehicles and bioethanol production process is the same amount as the one the crops previously absorbed during photosynthesis (Figure 1). An Argonne National Laboratory's study on greenhouse gas (GHG) emissions considering entire fuel life cycles, It was found that instead of using petrol, using corn based ethanol cuts life cycle GHG emissions by 19-48% and 90 % on average for ethanol produced from sugar cane, depending on the source of energy used during ethanol production [3]. Ethanol is a high-octane fuel that helps prevent engine knocking and generates more power in higher compression engines. Even 10% of ethanol blended with low-octane petrol is to attain the standard 87 octane requirement. That's better than any other liquid biofuel produced today at

commercial scale. Moreover, ethanol reduces usage of expensive high-octane additives (fuel additives).

Calorific value of ethanol is 33-36% lesser than petrol. It means that burning 1 liter of ethanol gives around 34% less energy than burning the same

amount of petrol. Pay more for more fuel to do the same work. So the use of bioethanol in public transportation will lead to increasing the price of the service.

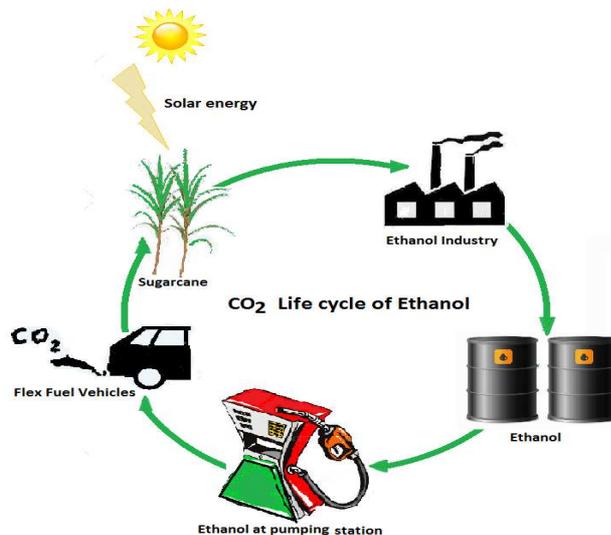


Figure 1: CO<sub>2</sub> Life Cycle of Ethanol

Pure ethanol is also difficult to vaporize which can make starting a car in cold weather difficult and that is why most fuels retain at least a small amount of petrol such as E85 cars with 85% ethanol and 15% petrol. The octane number of bioethanol is at around 105, this substance can be burned in the engines with much higher compression ratio. The engines made for working on the new energy cannot be used for their petrol or diesel variants. In turn of biodiversity, a large amount of arable land is required to grow crops. This could see some natural habitats destroyed including rainforests.

### 2.3 Brazil: A Leader in Ethanol Production and Usage

Brazil has achieved greater energy security, a lot of attention has been focused by the country on developing a competitive sugarcane industry and making ethanol, a key component for fuel mix. Now, Brazil is one of the world's largest sugarcane ethanol producers and a pioneer in using ethanol as a motor fuel. Brazilian ethanol production achieved 27.5 billion liters (7.3 billion gallons) in 2013-14. Most of ethanol is absorbed by the domestic market where it is sold as either pure ethanol or blended with petrol as fuel. A blend of 18 to 27 % ethanol containing gasoline is available in gas stations for vehicles in Brazil. Brazil stands as role model in the world for other countries, who seeking to expand use of ethanol and other bio renewable fuels. The country first initiated using ethanol blended petrol in vehicles as early as the 1920s, and increased using blended petrol as vehicles fuel after the oil shock of the 1970 s. However, with the introduction of FFVs in to the market in 2003, Bioethanol's popularity

really took off that run on either gasoline or pure ethanol. As a result, the consumers have a choice at the pumping stations when they fuel their cars, the most are choosing sugarcane ethanol for its price and environmental benefits. A remarkable accomplishment is achieved in less than a decade, more than 90 % of new cars sold today in Brazil are FFVs due to consumer demand, and the FFVs now are about half of the country's total using light vehicles. Since 2003, the combination of sugarcane ethanol and flex fuel vehicles has reduced Brazil's emissions of carbon dioxide by more than 300 million tons. That's equal to planting and maintaining 2.1 billion trees for 20 years. That's great achievement by the country for the environmental aspects.

### 2.4 Energy Balance

The total amount of energy spent for the processing and making fuels compared to the energy released by burning of fuel is known as the energy balance. Dr. Michael Wang developed The Greenhouse gases, Regulated Emissions and Energy use in Transportation (GREET) model for the U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE). From GREET's calculations, the fossil energy input per unit of ethanol is lower, only 0.78 million British thermal units (Btu) of fossil energy consumed for each 1 million Btu of ethanol delivered whereas 1.23 million Btu of fossil energy consumed for each 1 million Btu of gasoline delivered ( Figure 2)<sup>[4]</sup>. The studies showed that the energy balance for sugarcane ethanol produced in Brazil is more favorable, Sugarcane ethanol has an energy balance

ratio of 9.3 units of energy created for every unit of energy spent to produce it.

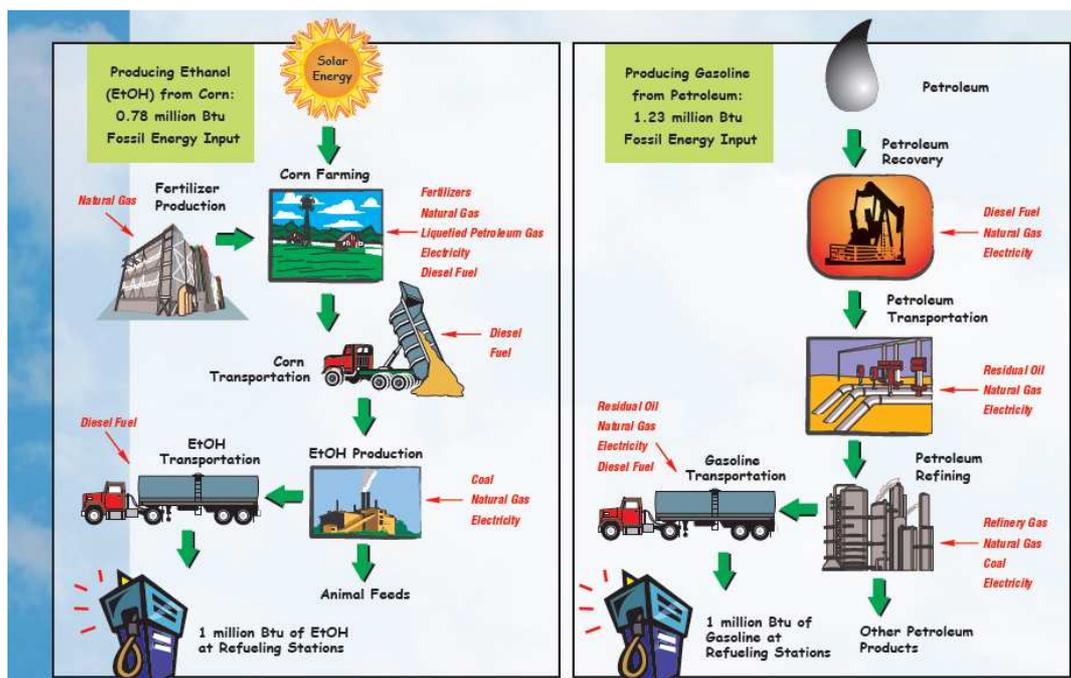


Figure 2: A comparison of energy balance sheet of ethanol and petrol  
Source: <http://www1.eere.energy.gov/>

## 2.5 Food Vs Fuel

The availability of petroleum reserves are limited, the researcher's attention is focused on the conversion of food or feedstock to fuels and chemicals. The world's population continues to grow drastically, consumes more energy for need to be fed in improved life style. Now, the question raises 'Food versus Fuel'. The available cultivating land and resources are very limited, how should they be used and what are the priorities? It is a big dilemma, if cultivate more biofuel crops, we reduce greenhouse gas emissions but it is difficult having the lands to grow food. If cultivate more food in the fields, there is less land available for environmentally beneficial biofuels.

## 2.6 What's Next?

Ethanol produced from feedstocks today is made from the sucrose or starch found in sugarcane or corn respectively. This current process produce only less than one-third of the energy feedstocks can offer. The other two-thirds remains locked in leftover as waste. The scientists have discovered new techniques to produce ethanol known as *cellulosic ethanol* from leftover plant material. This *cellulosic ethanol* is known as second generation ethanol (2G ethanol). This complex process involves hydrolysis and gasification technologies to break down lignocellulose. The procedure uses abundant and diverse raw materials like bagasse and other agricultural waste. The cellulosic ethanol production is currently more expensive than traditional sugarcane ethanol, its production requires

a greater amount of processing. The Scientists and engineers are working for improving commercial-scale manufacturing of cellulosic ethanol. With the improved technology, the production prices will come down, and cellulosic ethanol might double the volume of fuel coming from the same amount of land planted with sugarcane. Moreover, cellulosic ethanol shows a more positive energy balance than sugarcane ethanol. There are currently commercial plants producing cellulosic ethanol in Brazil and USA. The GranBio, the DuPont and the Raizen groups are the producing 2G ethanol in commercial plants. Now, India is an attractive destination for 2G ethanol production. Collaboration between Novozymes with PRAJ, optimized the enzymatic hydrolysis processes in the production of 2G ethanol using the enzymes.

## 2.7 Where We Are?

The Ministry of New & Renewable Energy has proposed an indicative target of 20% blending of biofuels, both for bio-diesel and bio-ethanol, by 2017. The government tries to promote the cleaner burning fuel to check pollution and helping to sugar mills. India has doubled its target of blending ethanol with gasoline to 10 %. The A B Vajpayee led NDA government in 2002 launched the ethanol blending scheme. It was aimed at 5 % mixing with petrol in nine states and four UTs. But the UP government discontinued it in 2004 due to lower sugarcane production. The scheme was relaunched in 2007. But, India is close to achieve 5% blending of ethanol with petrol, after 14 years of rollout of the

policy. It's clear that India does not have capable of producing ethanol for 10% blending of ethanol to petrol.

### **2.7 The Government's Role**

There is a demand for ethanol for blending with petrol but there are technological and financial challenges which need to be overcome. Various departments of government, state governments, academic and research institutions to work together to find a solution to these challenges. The government should encourage the sugar mills for arranging and scaling up facilities to produce ethanol from sugarcane. The money saved from reducing oil imports will be spent instead on subsidies for sugar mills, developing in new technologies, creating jobs in rural sector and food price inflation. The encouragement is required for fast track projects on production of second generation ethanol production from lignocelluloses which uses agricultural wastes and residues.

### **2.8 Rural Development**

The usage of ethanol blended petrol will help in value addition to the farmer's produce and also reduce foreign exchange expenditure to the nation. The benefits of blended petrol would be in the form of employment generation in rural areas, entrepreneurship promotion and environment protection. Sugar mills will be asked to increase

ethanol production, the demand for 2016 is 230 crore liters of ethanol to meet 10% blending with petrol. This demand improves the economy of sugar mills and the farmers as well. The government is very serious this time, the investments flow will increase in rural area. The government has extended soft loans of up to 40 % to encourage sugar mills to set up ethanol plants. Finally, the rural economy will be improved. Indian Oil Corporation Limited is setting up an integrated cellulosic ethanol production facility in partnership with sugar mills. This will also provide some additional income to cane farmers. Cellulosic ethanol can also be produced from other agricultural waste. Apart from that additional jobs creation is also anticipated through setting-up of these types of projects. Hence, the proposed steps taken by Govt. could significantly contribute to socio-economic development of rural India.

### **References:**

1. <http://www.fueleconomy.gov/>
2. Agarwal, A.K. *Progress in energy and combustion Science*, 164-176, 207, 2016.
3. Farrell, A. E., Plevin, R. J., Turner, B. T. , Jones, A. D., Hare, M., Kammen, D. M., *Science* , 506-508, 311, 2006.
4. <http://www1.eere.energy.gov/>