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Study of Flex-Fuel Vehicle

Akash Pawar, Akash Jadhav, Prof. P.M. Ingole

Prof. Ram Meghe Institute Of Technology And Research, Badnera

Abstract

A flexible-fuel vehicle (FFV) or dual-fuel vehicle (also known as a flex-fuel vehicle) is an alternative fuel vehicle with an internal combustion engine that can run on more than one fuel, often gasoline combined with ethanol or methanol, and both fuels are kept in the same common tank. Fuel injection and spark timing are automatically modified according to the actual blend detected by a fuel composition sensor in modern flex-fuel engines, allowing them to burn any proportion of the final mix in the combustion chamber. Bi-fuel vehicles, in which two fuels are stored in separate tanks and the engine runs on one fuel at a time, such as compressed natural gas (CNG), liquefied petroleum gas (LPG), or hydrogen, are distinguishable from flex-fuel vehicles.

. The new technologies have given rise to a new engine idea that allows for the use of various types of fuel. The multi-fuel engines on the market have just one compression ratio, making them sensitive to optimization, as the engine must work with a variable compression ratio to achieve maximum efficiency. This process, while technically viable, is not considered feasible for a low-cost product. This paper presents a system that allows each type of fuel to achieve maximum efficiency by varying the engine intake pressure without changing the compression ratio, which is a feature that can be incorporated to a low-cost product

Introduction

I. A flexible-fuel vehicle (FFV) or dual-fuel vehicle is an alternative fuel vehicle with an internal combustion engine that can run on more than one fuel, often gasoline combined with ethanol or methanol, and both fuels are kept in the same common tank. Fuel injection and spark timing are automatically modified according to the actual blend detected by a fuel composition sensor in modern flex-fuel engines, allowing them to burn any proportion of the final mix in the combustion chamber.

II. In addition to ethanol-fueled flex-fuel vehicles, successful test programs with methanol-fueled flex-fuel vehicles, known as M85 flex-fuel vehicles, have been conducted in Europe and the United States, mostly in California.

Our country's energy demand is increasing as a result of its growing economy, population, urbanization, changing lifestyles, and increased purchasing power. Fossil fuels currently meet 98 percent of the fuel requirement in the road transportation sector, with biofuels accounting for the remaining 2%.

III. Currently, several Oil Marketing Companies (OMCs) in India sell fuel with a 10% ethanol blend (E10) wherever it is available. However, because there isn't enough ethanol, only about half of the gasoline sold is E10 blended, with the rest being unbleached gasoline (E0). In the United States, the average percentage of ethanol blending is currently 5%. (Ethanol Supply Year 2019-20). The Ministry of Petroleum wants to achieve 10% ethanol blending levels in the Ethanol Supply Year (ESY) – 2021-22, i.e. April 2022, as a result of multiple initiatives in the ethanol supply side.

IV. It establishes safety standards for pure ethanol, flex-fuel, and ethanol-gasoline blended cars in India.

Currently, gasoline cars in the country (two-wheelers and four-wheelers) are built to run on pure gasoline and can be tweaked to run on ethanol blended fuels ranging from E0 to E5 depending on the vehicle type. Rubber and plastic components are compatible with E10 in terms of material compatibility. With the proposed E20 target, however, cars must now be both material compliant and optimized for usage with E20 fuel.

Production Of Ethanol And Its Pricing

The government has used numerous pricing models based on the current macro-economic status of the sugar industry and the oil sector since the commencement of the EBP Program. Following the implementation of the Administered Pricing Mechanism for Ethanol in ESY 2014-15, ethanol procurement gained traction. The Cabinet Committee on Economic Affairs (CCEA) approves the price of ethanol made from sugarcane, whereas OMCs decide on the price of ethanol made from foodgrains. Since the 2018-2019 fiscal year, the government has implemented a differential pricing scheme in which sugar mills have been offered higher rates for producing ethanol from B-heavy molasses and sugarcane juice. Further In ESY 2019-20, even higher prices for sugar/sugarcane juice to ethanol conversion were provided. Table 5.1 shows the ex-mill price of ethanol paid to ethanol suppliers for ESY 2020-21 produced from various sugarcane and food grain varieties.

Table 5.1: Administered Price of Ethanol by Source

Raw material Source	**Ex-mill Ethanol Price (Rs./litre)**
B-Heavy	57.61
C-Heavy molasses	45.69
Sugar/Sugar Syrup	62.65
Damaged Food Grains/ Maize	51.55
Surplus Rice (FCI)	56.87

5.1 Current Fuel Ethanol Price Comparison With Other Countries

Table5.2:Ethanol price comparison

Country	**Price in USD per litre (as on 22.02.2021)***
USA	0.613
Brazil	0.606
Thailand	0.684
India	Sugarcane juice / Syrup–0.865 (INR 62.65) B-molasses- 0.795 (INR 57.61)
	C-molasses- 0.630 (INR 45.69)
	Damaged food grains- 0.712 (INR 51.55) Surplus Rice with FCI – 0.785 (INR 56.87)

The cost of raw materials such as sugarcane and foodgrains are fixed by the government to support the farming community, hence the price of ethanol produced in India is greater than that of global players.

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The following three primary variables drive ethanol production and use in the transportation industry globally:

I. Demand Enrichment: The government's requirement that a certain amount of gasoline be blended with ethanol, as well as the development of ethanol-compatible cars.

II. Supply Enrichment: Plans for producing ethanol from a variety of feedstocks, as well as encouragement to expand bio-refineries and their capacities.

III. Incentives: Increasing the usage of higher ethanol blends through pricing incentives (retail tax reduction) and tax breaks for automobiles that can run on E20 and E85. Blending ethanol with gasoline has several advantages, including a higher Research Octane Number (RON), fuel embedded oxygen, and a faster flame speed. These qualities of ethanol aid in full combustion and reduce hydrocarbon, carbon monoxide, and particulate matter emissions from vehicles. Ethanol has around two-thirds the calorific value of gasoline.

5.2 Pricing Of Ethanol From Sugar Sector

I. Sugar/Sugarcane Juice/Sugar Syrup: The pricing model is based on the Fair and Remunerative Price (FRP) of Sugar Cane, to which the ex-mill price of ethanol (Rs. 62.65/litre) is added.

II. B Heavy: The pricing model for B Heavy is based on the normative cost of sugar, which is then multiplied by the cost of capital to arrive at the ex-mill price of ethanol (Rs.57.61 per litre).

III. C Heavy: The pricing model used is based on molasses prices and sugar ex-mill prices. For ESY 2020-21, an 11.2 percent all-India average recovery rate per metric ton of sugarcane was used, and a C heavy rate of Rs. 45.69 per litre was calculated.

5.3 Impact Of Existing Ethanol Pricing

I. **Central** Government: While gasoline is subject to excise duty, ethanol is subject to GST. While the GST on ethanol would range from Rs. 2.28 to Rs. 3.13 per litre based on an ex-mill price of Rs. 45.69 to Rs. 62.65 per litre, the excise duty on fuel is Rs. 32.98 per litre. The central government loses Rs. 10,950 crore per year owing to the replacement of petrol with ethanol, based on total national ethanol blending volumes of 332 crore liters.

II. **Oil PSUs**: OMCs pass on any increase in the price of gasoline due to ethanol blending to consumers and are thus unaffected by ethanol pricing. Currently, the excise duty on the landed cost of gasoline at oil depots is higher than the GST on the landed cost of ethanol, and the savings are passed on to retail customers. However, if the price of ethanol rises above the price of gasoline in the future, consumers may have to pay more for ethanol blended fuel. In such a case, Ethanol tax breaks (GST) may be required.

III Environmental Cost Sugarcane is a water-intensive crop, hence it has a high environmental cost. One tonne of sugarcane produces 100 kg of sugar and 70 litres of ethanol on average. Each kg of sugar necessitates 1600 to 2000 gallons of water for cultivation. As a result, one litre of sugar ethanol takes approximately 2860 litres of water11. Sugarcane and paddy use 70 percent of the country's irrigation water, according to estimates12. Given the need for water conservation, it is recommended that some of the sugarcane land be converted to less water-intensive crops by giving appropriate incentives to farmers. The Task Force on Sugarcane and Sugar Industry, chaired by Professor Ramesh Chand, Member (Agriculture), NITI Aayog, has proposed strategies to reduce water use by encouraging farm diversification through various approaches.

IV. **Ethanol production from non-sugar sources**: Ethanol production from non-sugar sources, such as damaged food grains and FCI rice, accounts for a modest percentage of total ethanol production. Sugarcane net returns are substantially larger than those from food crops; for example, in Karnataka, they were around Rs. 1,13,590 per hectare in FY 2018-1913, compared to Rs. 33,877 per hectare for paddy and 22,931 per hectare for maize. Other states are in a similar situation. Sugar and its by-products, such as molasses and ethanol, are more expensive when sugarcane prices are high.

V. Environmental impact of feedstock choice: In the interests of environmental sustainability, making ethanol available across India, and widely disseminating the benefits of EBP, measures to promote production from non-sugarcane sources, such as food grains, particularly maize14, and second-generation sources, may be promoted through appropriate pricing mechanisms.

Conclusion

Ethanol is regarded as a superior fuel than gasoline and is a viable alternative that is pollution-free, indigenous, and cost-effective. The amount of ethanol purchased has increased from 28 million litres to 320 million litres.

A fuel-efficient vehicle (FFV) is a customized version of a vehicle that can run on both gasoline and doped gasoline with various levels of ethanol mixes. These are currently being effectively used in Brazil, allowing consumers to switch between fuels (gasoline and ethanol) based on price and convenience. In fact, FFVs account for the vast majority of vehicles sold in Brazil.

FFVs will have a distinct advantage in India since they will allow vehicles to use various blends of ethanol mixed gasoline available in various sections of the country. Flex fuel vehicles may not be a priority for every driver, but for those who desire the flexibility to use a range of fuels while reducing their environmental impact, purchasing a used flex fuel vehicle can be a wise and cost-effective choice.

Furthermore, the usage of ethanol in flex-fuel vehicles has the potential to enhance India's agriculture sector and create thousands of employment. Furthermore, choosing to drive this type of vehicle will significantly reduce carbon dioxide emissions. This would help India fulfill its COP26 climate summit goal of reducing greenhouse gas emissions to zero by 2070. Because ethanol readily absorbs dirt, it has the ability to corrode and destroy your engine. As a result, it's probable that no one will be interested in this project.

Future Scope

The arguments about the advantages and disadvantages of flex fuel and flex-fuel vehicles aren't going away anytime soon. However, there appears to be a trend toward adopting ethanol as a cost-effective and environmentally benign fuel source. More ethanol refineries are

springing up, and even if you're not ready to switch to a flex-fuel vehicle just yet, it's something to keep in mind. Because technology is continually evolving, it's impossible to forecast what flex-fuel vehicles and advancements may emerge in the next years.

According to Nitin Gadkari, India's union minister for road transport and highways, automakers would begin producing automobiles with flex-fuel engines within six months. He also stated that the administration is working on a strategy to transition public transportation to 100% renewable energy.

Flex-fuel, also known as flexible fuel, is an alternative fuel that blends gasoline with methanol or ethanol. Ethanol is made from rice, corn, and sugarcane juice bioethanol. In comparison to gasoline or diesel, ethanol is considered a greener and cleaner fuel. In comparison to pure gasoline, ethanol-blend gasoline is substantially cleaner and emits fewer toxins into the environment.

In order to reduce automobile emissions, India plans to increase its ethanol blending target over the next few years. Brazil and the United States are currently the two largest users of ethanol-blend gasoline. With its ambitious agenda, India might be the next great competitor in this market. In December 2021, the Indian government issued a recommendation to automakers encouraging them to use flexible-fuel engines in their automobiles.

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