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Review Paper on Sugarcane Bioethanol as an Anticipating Biofuel for IC Engines

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***Abstract*— Biofuels are various fuels which are in some way derived from biomass. Biofuels are gaining increased public and scientific attention, driven by factors such as oil price spikes, the need for increased energy security and concern over greenhouse gas emissions from fossil fuels. Biofuels have become particularly appealing to developing countries because of their potential to stimulate economic development in rural areas and eradicate poverty through the creation of employment opportunities and increased income in the agricultural sector.**

It was found that the ethanol generated from sugarcane and crop residue gives additional income to the farmer and helps the environment & safe disposal of farm stubble. Hence, ethanol is a promising biofuel can be blended with petrol to operate the sprayers and leads to reduce environmental pollution.

Key words: Biofuel, Sugarcane ethanol, Sprayers

I. INTRODUCTION

The fossil fuel is the most efficient and useful in all sectors of modern day living. Fuel is playing a major role in developing countries, particularly in transport, industrial sector, Agriculture and consumer farm. India is one of the fastest growing economies in the world and will continue to enjoy the demographic dividend for few decades. Energy is a critical input toward raising the standard of living of citizens. The energy strategy of country charts the way forward to meet the Government's recent ambitious announcements in the energy domain such as electrification of all census villages by 2019, 24X7 electricity, 175GW of renewable energy capacity by 2022 and reduction in energy emission intensity by 33% - 35% by 2030.Fossil fuels will continue to occupy a significant share in the energy basket. However, conventional or fossil fuel resources are limited, nonrenewable sources are to be extracted. The crude oil price has been fluctuating in the world market. Such fluctuations are straining various economies the world over, particularly those of developing countries. Road transport sector accounts for 6.7% of India's Gross Domestic Product (GDP). Currently, diesel alone meets an estimated 72% of transportation fuel demand followed by petrol at 23% and balance by other fuels such as CNG, LPG for which the demand has been steadily raising. Provision estimates have indicated that crude oil required for indigenous consumption of petroleum products in Financial Year 2017-2018 is about 210 MMT. It was found that the ethanol generated from sugarcane and crop residue gives additional income to the farmer and helps the environment & safe disposal of farm stubble. Hence, ethanol is a promising biofuel can be blended with petrol to operate the sprayers and leads to reduce environmental pollution.

In India, Bioethanol can be produced from multiple sources like sugar containing materials, starch containing materials, cellulose and lignocelluloses material including petrochemical route. However, this policy of Ethanol Blended Petrol (EBP) Programme allows bioethanol to be procured from non-food feed stock such as molasses, cellulose and lignocelluloses material including petrochemical route. Currently, ethanol for EBP programme is coming from molasses route as a by- product of sugar industry. At the present levels of cane and sugar production (about 350MMT and 26-28 MMT per annum respectively), the maximum quantity of molasses available is about 13MMT, which is sufficient to produce about 300 crore liters of alcohol/ethanol. One MMT of sugar sacrificed can produce 60 crore litres of ethanol. Ethanol will also be allowed to be produced directly from sugarcane juice to increase blending percentage. The Goal of the National Biofuel Policy – 2018 is to enable the availability of biofuels in the market, thereby increasing its blending percentage. Currently, the ethanol blending percentage in petrol is 2%, an indicative target of 20% blending of ethanol in petrol is proposed by 2030.

II. LITERATURE SURVEY

A.F Kheiralla et al. have reported on ethanol-gasoline blends that engine performance and emission characteristics found little difference in power performance, specific fuel consumption, and thermal efficiency between engines fueled with gasoline or gasoline blend of 15% ethanol (E15). The gasoline fuel replacement is regulated by the amount of ethanol in the blend. However, problems arise, due to the presence of water in the blend because commercially available ethanol is seldom found in an anhydrous state. The commonly available ethanol grades contain between 10% and 20% water. Typical local distillation converts fermented sugar molasses to 190-proof or industrial ethanol, containing 5% water, and removing the remaining water requires special measures at added cost. Thus, there would be an economic incentive if the spark ignition engine could be run on industrial ethanol instead of anhydrous ethanol.

Vladan Micic and Milovan Jotanovic have addressed that most promising biofuels are bioethanol. Ethanol has many favorable properties. For example, the octane number of ethanol is higher than the octane amount of conventional petrol. The octane number influences the anti knocking property of the fuel. A high octane number stands for an anti-

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knocking fuel. Knocking describes uncontrolled combustion that puts heavy mechanical and thermal loads on the engine.

Dr. Shrishail Kakkeri et al. have reported that, All alcohols can absorb water. The condensation of water in the fuel system is absorbed and does not have the opportunity to collect and freeze. Since ethanol blends contain at least 10 percent ethanol, they can absorb water and eliminate the need for adding a gas-line antifreeze in winter.

III. METHODOLOGY

Biofuel is the environment friendly and renewable source of alternative fuel which is mainly produced from animal fats (tallow, lard, white or yellow grease, poultry fats, or fish oils); recycled greases (used cooking and frying oils); and most commonly, plant oils (from soybeans, corn, rapeseed, sunflowers, and cottonseeds, etc.) To use this biofuel in diesel engine, there is no need for an engine modification as well. Generally, the term biofuel is used to represent all the liquid and gaseous transportation fuels derived predominantly from biomass. Biofuels conversion system is one of the important steps in the whole biofuel production chain. Factors such as high yields and low energy consumption are important to consider in promoting the future competitiveness of biofuels to fossil fuels in the market.

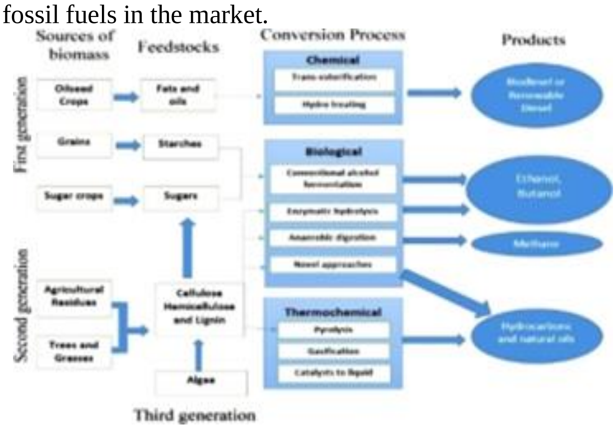

Fig 3.1 Different Levels of Biofuel

Biofuels can be derived from any biological carbon into biofuel via different production pathways to produce source, but photosynthetic plants are the most biodiesel, ethanol, butanol, methane, or other fuels; all are commonly used feedstock. Biofuels are categorized as ongoing research. Technologies to produce first-generation biofuel and advanced biofuel (second-first-generation fuels are mature but some feedstocks are generation, third-generation, etc.). Currently, biodiesel and bioethanol are the two most promising biofuel being projected to replace conventional fossil fuels in transportation.

Ethanol is a high octane; water-free alcohol produced from the fermentation of sugar or converted starch. It is used as a blending ingredient in gasoline or as a raw material to produce high-octane fuel-ether additives. Ethanol is made from grains (mainly corn) or other renewable agricultural or forestry products such as wood, brewery waste, potatoes, cheese whey, paper waste, beets, or vegetable waste.

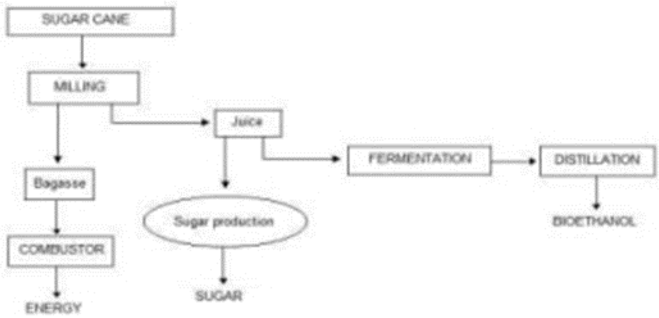

Fig 3.2 Schematic representation of Bioethanol Production

This gives an account of the advantages of ethanol blending in conventional petrol like other substitute such as ethanol. Ethanol's vapour pressure is lower than that of petrol, resulting in lower evaporative emissions, while its flammability is also much lower than that of petrol, reducing the risk of vehicles catching fire. In addition, there is no gum formation associated with ethanol, and anti-oxidants and detergent additives are not required.

Other advantages of ethanol are that it improves the octane number, has a higher volumetric efficiency leading to increased power and has advantages of wider flammability limits and higher flame velocity. Although the calorific value of ethanol is lower than that of petrol, it is still preferred because of its higher efficiency due to its higher oxygen content. This is also the reason for its use as a 100 per cent fuel in Brazil.

The main mechanical differences between ethanol and petrol vehicles lie in engine calibration and the fuel management system. The success in using ethanol as a fuel in Brazil, the US and EU offer a large experience that can be usefully tapped by countries such as India to develop their own infrastructure for EBP.

The Indian Government is adopting a multi – pronged approach to promote and encourage use of biofuels by blending ethanol in petrol through Ethanol Blended Petrol EBP Programme using ethanol derived from multiple feedstock.

This study experimentally determines fuel properties of biofuel blend as a fuel for Internal Combustion engine. Fuel properties of tested biofuel blends are determined in accordance with American Standard for Testing Materials (ASTM) procedures for petroleum products.

The density of each tested blends is measured by hydrometer method (ASTM D287 Standard). The kinematic viscosity was measured in Redwood viscometer in accordance with ASTM standards. Flash and fire points were measured by Pensky-Martin apparatus (ASTM D93A). Cloud and Pour point was measured by Petrotest (ASTM D97 Standard). The heat of combustion was measured in bomb calorimeter according to PARR 1266 standards, The calorific value of the sample was determined by equating the heat generated to heat transfer to calorimeter.

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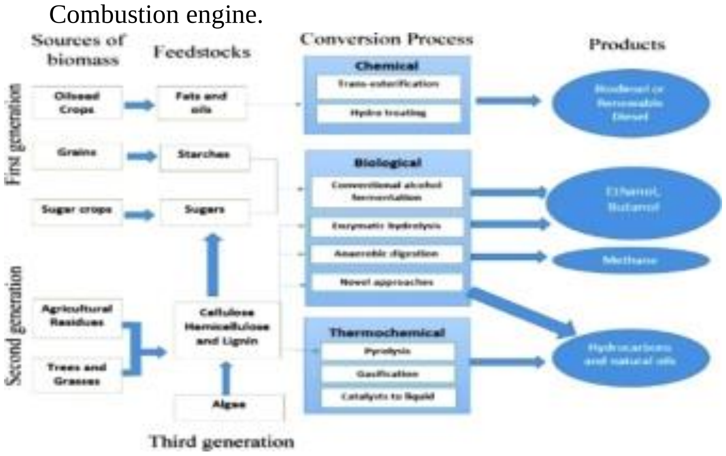
Density:
The density is measured using a meter that meets the requirements of ASTM D 4052, Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter, is recommended. A meter with a computer interface is preferred but not required.

Flash point (ASTM D93A):
The flash point temperature is the minimum temperature at which the fuel will ignite (flash) on the application of an ignition source under specified conditions. Flash point varies inversely with the fuel's volatility. Flash point minimum temperatures are required for proper safety and handling of biofuel blend as a fuel. Fire point is defined as the lowest temperature to which oil should be heated to give sufficient vapors to form an inflammable mixture with air to burn for at least five or more seconds, when a pilot flame is introduced near it.

Cloud Point & Pour Point:
Cloud point is the temperature at which solidification of heavier components of a fuel resulting cloud crystals within the body of the fuel first appear. The temperature at which further cooling of fuel, results in increased size and number of wax crystals and eventual coalescence of the fuel to form a rigid structure is termed pour point. Cloud and Pour point temperatures are of importance in knowing the behavior of fuels in cold weather.

Kinematic Viscosity:
The resistance to flow exhibited by fuel blends, as expressed in various units of viscosity, is a major factor of consequence in establishing their suitability for mass transfer and metering requirements of engine operation. Kinematic Viscosity affects injector lubrication and fuel atomization. Biofuel blends have improved lubricity: however, their higher viscosity levels tend to form larger droplets on injection that can cause poor combustion and increased exhaust smoke. In this study there is a need to investigate physico – chemical properties available biofuel blending with fossil fuels in different ratios and compare these values with respect to pure fossil fuels to decide whether the blend is suitable for Internal Combustion engine.



The important performance parameters of I C Engines are described as follows.

Brake power:
In an engine, indicated power is the power produced in the cylinder and the brake power is the useful power at the output shaft. Brake power is always less than indicative, due to losses by mechanical friction and parasitic loads (oil pump, air conditioner compressor, etc.). The engine brake power increased slightly at all engine speeds when the ethanol content in the blended fuel was increased. The reason for this was the increase of indicated mean effective pressure for higher ethanol content blends.

Torque output:
This is the turning-effort about the crankshaft's axis of rotation and is equal to the product of the force acting along the connecting-rod and the perpendicular distance between this force and the center of rotation of the crankshaft. Engine torque was found to be higher when ethanol petrol blend fuel was used in a Internal Combustion engine.

Brake thermal efficiency:
Brake thermal efficiency (BTE) is defined as brake power of a heat engine as a function of the thermal input from the fuel. It is used to evaluate how well an engine converts the heat from fuel to mechanical energy.

Volumetric efficiency:
The volumetric efficiency in the internal combustion engine design refers to the efficiency with which the engine can move the charge into and out of the cylinders. More specifically, the volumetric efficiency is a ratio (or percentage) of the quantity of air that is trapped by the cylinder during induction over the swept volume of the cylinder under static conditions. The volumetric efficiency can be improved in numerous ways; most effectively this can be achieved by com-pressing the induction charge (forced induction) or by aggressive cam phasing in naturally aspirated engines.

Brake-specific fuel consumption:
Brake-specific fuel consumption (BSFC) is a measure of the fuel efficiency of any prime mover that burns fuel and produces rotational or shaft power. It is typically used for comparing the efficiency of internal combustion engines with shaft output. It is the rate of fuel consumption divided by the power produced. It may also be thought of as power-specific fuel consumption for this reason. Brake-specific fuel consumption allows the fuel efficiency of different engines to be directly compared. Calorific value and the density of the blend are the major properties of the brake-specific fuel consumption of a fuel blend.

Sl no.	Physico – Chemical Properties of Ethanol	
	Characteristics	**Ethanol**
1	Molecular weight	46.07
2	Specific Gravity	0.794
3	Density	790
4	Boiling Temp	78^0C
5	Freezing Point	-114^0C
6	Ignition Temp	423^0C
7	Flash point	-35^0C

Table 3.1 Physico-Chemical Properties of Ethanol

IV. CONCLUSION

The first benefit of the production of the Bioethanol will directly impact the society because it is economical & ecofriendly. We observed that the use of alternative fuels with better octane rating would improve efficiency and emissions. It was reported that better blending capability and anti-knock characteristics of alcohols make it a viable alternative fuel for Internal Combustion Engine. In the literature survey, we observe that performance tests were conducted for different engine specifications such as 2 stroke petrol engine, 4 stroke diesel engine, VCR petrol engine, variable speed internal combustion engine, but the performance parameters depend on engine specification, quality of blends and working condition. Hence there is a need of research work is to be performed for optimization of bioethanol as an alternate fuels. After Brazil, India is the only country whose sugarcane production is high. India is agro based approximately half of the population is directly engaged with the sector. Then, this will increase the job opportunity for them and not only those who directly associated with agriculture but also for the chemical engineers, accountants, helpers, legal advisors in simple word one medicine for different pains. Most importantly the farmers of the country will enjoy more benefit and will lead to balanced growth of the nation, which is the major issue of the economy Nowadays.

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