International Journal of Engineering & Technology, 7 (4.39) (2018) 468-470

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

A review on Role of Biofuel in India- Potential & Technology

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Abstract

India is the 3rd energy consumer in the world, while China is the first & USA is the 2nd energy consumer. By 2021, India expected to become 3rd automobile market in the world. India is the world fastest growing developing economy in the world. Automobile industries have a multiplier effect on the country economy, health & climate change. Indian automobile sector is growing with the average of 11%. For continue economic development & minimum health hazard, the use of Biofuel for India is essential. The major sources of Biofuel in India are Jatropha, corn, vegetable oil & food grains etc. Indian government set 5% necessary blending for crude oil in the initial stage than 10% blending after that 20% blending with NBM. India became the 4th largest Biofuel producer country in the world.
The aim of this review of Biofuel and its potential on carbon emission & its effect on health & climate change is to discuss. From this review, it is found that carbon emission can be reduced by Biofuel. It can be used as an alternative fuel. Government policy on Biofuel with suggestions in future use will be presented.

Keywords: *Biofuel, Carbon, Energy, Emission, NBM*

1. Introduction

India's automobile sector is growing by 11% [2]. The rapid growth in automobile industry causes air pollution, health hazards & climate change [1]. India's capital has around 1% of India's population but has 8% of vehicles available in India [SAE-2002].Automotive emissions such as nitrogen oxide, particulates, carbon monoxide are responsible for air quality, health hazards & climate change [3]. Diesel engines & petrol engines are responsible for degrading the air quality. Due to the increasing demand for vehicles, about 22% of greenhouse gas emission comes globally [4].India is a 4th largest carbon-di-oxide emitter in the world. As indicated by global Energy Agency, 8.6 BM tones of CO2 will be discharged to environment from 2020 to 2035[7].If there are no alternative options for fossil fuel there may be a chance of an increase of 39% of the greenhouse by 2030 [5].
In 2017, India produces 56% energy from coal, 30% energy from fossil fuel, 6% energy from natural gases, 1.15% of energy from nuclear, 4.7% of energy from hydro-electricity & 3% energy from renewable energy sources. It is the 5.6% of global energy production. In 2017, India imports nearly 198.8 million tons of petroleum products. India becomes 2nd after China in renewable production in the world. That is why we need to develop alternative fuel which can be used as a fossil fuel for vehicles which have a minimum negative impact on health, climate change and emission.
Biofuel is considered as green renewable fuel due to the reduction in greenhouse gases. From 2001 to 2010, biodiesel's production increased by 15 times & consumption also increased by 19 times [6]. Contrasted with oil, the utilization of Biofuel for transport is still very low in every one of the nations. By a long shot the biggest generation and utilization of ethanol is in Brazil and the United States, with relatively comparable volumes, yet significantly higher than some other nation [8]. As of now, ethanol is mixed with gasoline and biodiesel is mixed with oil-based diesel for use in ordinary diesel-fuelled vehicles. Figure 1 shows the dependence of India on crude petroleum increase 1% per annum.

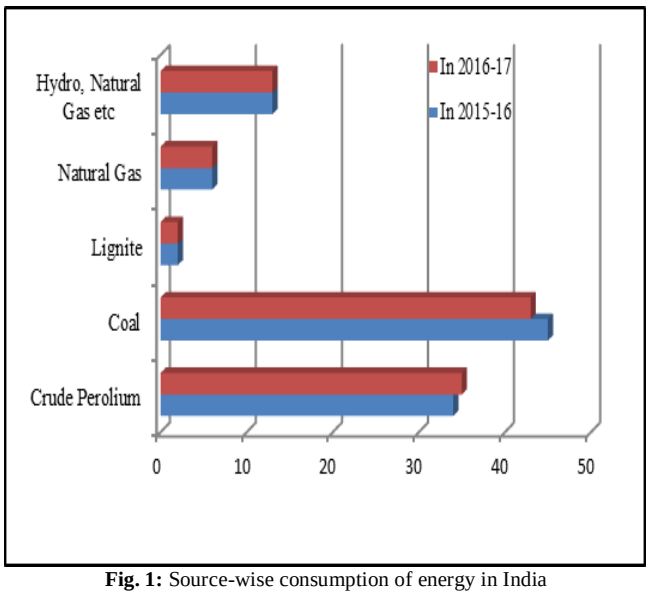

Fig. 1: Source-wise consumption of energy in India

In India, considering the market potential in diesel utilization and additionally, plantation potential on badlands and uneven regions, as indicated by the Economic Survey of Government of India, out of the developed land zone, around 175 million hectares are named squander and debased land. Along these lines, given an interest-based market, India can without much of a stretch tap its potential and create biodiesel on a substantial scale. The seed cake (Non-consumable Seeds) is decent compost. Since the Non-consumable seed oil is made locally even in the town, it diminishes the reliance on imported oil based oils sparing extensive remote trade for the better national economy. Biodiesel acquired from

non-eatable oils like Jatropha Seed Oil, Karanja Seed Oil, Rape Seed Oil, Castor Seed Oil and so forth which are low support plants should be given more unmistakable quality henceforth biodiesel has the potential to jump from the advancements for the elective fuel. Powers got from sustainable organic assets for use in diesel engines are known as biodiesel. Biodiesel is a naturally amicable fluid fuel like petrol diesel in burning properties. It is an oxygenated fuel containing 10% - 15% oxygen by weight. Additionally, it very well may be said a sans sulpher fuel [9].
Ethanol is delivered from various harvests, for example, potatoes; sugarcane, grains, corn, and sorghum and so forth while, biodiesel can be created from vegetable oils, reused squander oil, and creature fat [10]
Thus this review will investigate the potential of Biofuel to reduce carbon emission and it can be used as alternative fuel for internal combustion engines.

2. Biofuel Policy

2.1 Biofuel Development in India

India initiated its Biofuel program in excess of a decade back and propelled a few strategy measures to advance Biofuel programme at that point. In 2002, India propelled its "Ethanol Mixing Program" and ordered a 5% mixing of ethanol (E5) with patrol in 9 States and 4 Union Regions with impact from January 2003. Indian government established a Committee on Biofuel in July 2002. The report of the Committee, released in 2003, recommended India to dynamically move towards higher targets with respect to the mixing of Biofuel, including the fortifying of the ethanol mixing program [11].
The world's energy consumption rate is increasing by 6%, petroleum reserves diminish day by day. India produces only 1% of petroleum as compared to petroleum produces by the world and consumes 3.1% of total petroleum. The number of private and Government associations are engaged with the creation and dispersion Biofuel in India. The pioneers in Biofuel preparing in India are D1 Oil Plc, Reliance Industries Ltd, and Godrej Agro vet, Sagar Jatropha Oil Extractions Private Limited and so forth [13]
In any case, the 5% mixing mandate on account of ethanol couldn't be met because of the deficiency of bioethanol supply; in October 2004, the mandate was changed "requiring E5 mixes just when satisfactory ethanol supplies were accessible". In 2006, the 5% mixing order was reached out to cover 20 States and 8 Union Territories; again this objective could be met because of the lack of bioethanol supply. In September 2008, the Union Cabinet set an objective of 5% mixing the nation over. In spite of the fact that the 5% target couldn't be understood, the Government set an objective of 10% mixing in October 2008 [12].
In 2003, Planning Commission recommended propelling of a National Mission on Biodiesel to be based on non-eatable oil and distinguished Jatropha curcas as the most appropriate tree-borne oilseed for biodiesel creation [13]. One point of the Mission was to progressively raise the mixing focus to 20% continuously in 2012. The Planning Commission assessed that 11.2 million hectares of land would be required for Jatropha manor to accomplish the 20% focus by 2012 and distinguished 13.4 million hectares of arrive that could be really utilized for the ranch. In October 2005 the Ministry of Petroleum and Natural Gas reported a biodiesel buy approach, which required Oil Marketing Companies to get biodiesel in the nation for mixing with diesel with impact from January 2006.
Keeping in mind the end goal to reinforce the floundering ethanol and biodiesel mixing programs, India's National Biofuel Policy was endorsed by the Govt. of India in December 2009.

2.2 Biofuel Policy of India

Road transport sector considers 6.7% of India's Gross Domestic Product (GDP). At present, diesel alone meets an expected 72% of transportation fuel requirement taken after by oil at 23% and balance by different energies, for example, CNG, LPG and so forth for which the interest has been relentlessly rising. Temporary evaluations have shown that raw petroleum required for indigenous utilization of oil-based commodities in 2017-18 is around 210 MMT. The local unrefined petroleum generation can meet just around 17.9% of the interest, while the rest is met from imported unrefine. To address these worries, Government has set an objective to diminish the import reliance by 10 % by 2022. Greenhouse gases reduction by using of Biofuel is shown by Table 1.

Table 1: Feedstock potential: Country –wise

S.No.	Country	Feedstock
1	Argentina	Soybeans
2	Brazil	Soybeans/ cotton oil/ palm oil
3	China	Jatropha/ used cooking oil
4	France	Sunflower/ rapeseed
5	Germany	Rapeseed
6	India	Soybean/ sunflower/ peanut/ Jatropha/ karanja
7	Japan	Used cooking oil
8	Mexico	Animal fat/ waste oil

The Goal of the Policy is to empower accessibility of Biofuel in the market in this manner expanding its mixing rate. As of now the ethanol mixing rate in oil is around 2.0% and biodiesel mixing rate in diesel is under 0.1%. A characteristic focus of 20% mixing of ethanol in oil and 5% mixing of biodiesel in diesel is proposed by 2030.
The extent of the Policy envelops following classes of energies as "Biofuel" which can be utilized as a transportation fuel or in stationary applications-

2.2.1 Biodiesel

‘Biodiesel’ a methyl or ethyl ester of unsaturated fats delivered from non-eatable vegetable oils, acid oils, utilized cooking oil or creature fat and bio-oil or creature fats and it is not dangerous, biodegradable, non-combustible, inexhaustible, non-poisonous [16]. It tends to be utilized in diesel engines as an option of diesel fuel without major adjustment of the engine with the same or better execution in contrast with conventional diesel fuel. Presently, the sources of biodiesel incorporate corn oil, Molasses, Jatropha, and corn etc.

2.2.2 Bioethanol

Ethanol is a minimal effort oxygenates which contains 34% higher oxygen content by weight. 'Bioethanol': ethanol created from biomass, for example, sugar-containing materials, similar to sugar stick, Stover, sunflower and so on. Starch-containing materials, for example, corn, cassava, spoiled potatoes, green growth and so on [15]

$$\text{Glucose} + \text{Yeast} \rightarrow 2\times\text{Cabon di-oxide} + 2\times\text{Ethanol}$$

2.2.3 Advance Biofuel

'Advanced Biofuel’ Fuels which are (a) delivered from lignocelluloses feed stocks (i.e. agrarian and ranger service deposits, e.g. rice and wheat straw/corn cobs) , non-nourishment crops (i.e. grasses, green growth), or mechanical waste and deposit streams, (b) having low CO2 discharge or high GHG decrease and don't rival nourishment crops for arrive utilize. Energizes, for example, Second Generation (2G) Ethanol, Drop-in powers, green growth based 3G Biofuel, bio-CNG, bio-methanol, Di-Methyl Ether got from bio-methanol, bio hydrogen, drop in fills with MSW as the

source/feedstock material will qualify as "Cutting edge Biofuel" [15].

2.2.4 Impact of Biofuel on Automotive Industry

It is necessary to decrease our dependency from crude oil to produce the least amount of greenhouse gases, which are dangerous to human health and climate change.

Table 2: Country-wise Biofuel target

S.No	Country	Years	Target
1	Australia	2012-17	10% Ethanol & Biodiesel to 20% Ethanol & Biodiesel
2	Brazil	2013-2020	B5 to B20
3	China	2010-2020	2 million Biodiesel to 12 million Biodiesel
4	India	2017-2030	10% Biofuel to 20% Biofuel
5	USA	2013-2020	1 billion liters of cellulosic Ethanol to 25 Ethanol blend

Ekren [18] found that at full load condition, Diesel engine produces lower NOx emissions, CO and smoke by using Biodiesel as compared to Diesel fuel. He also found that performance efficiency remains at the acceptable range by using low concentration blends.

Table 3: Greenhouse gases reduction by using Biofuel

S.No.	Source	% reduction
1	Ethanol from cellulosic feedstock	70
2	Biodiesel from rapeseed, EU	50
3	Ethanol from sugar cane, Brazil	90
4	Ethanol from grain, USA	30
5	Ethanol from sugar beet, EU	45

Zhihao et al. [19] found that NOx emission reduces by using a blend, B10 & B20 when blend, B30 used, it slightly increases NOx emissions because of higher O2 content causes the higher temperature of the cylinder. Shiet et al. [20] found that particulate matter can be reduced by 30% by using ethanol-Diesel-Biodiesel blends but this blend increases NOx emissions by 5.6% to 11.4%.
Experimental results shows, there are two factors on which emissions are depended first Biofuel concentration & secondly operating conditions of the engine. CO emission is increased and NOx emission decreased by ethanol blend for all operating conditions.

2.2.5 Biofuel Potential in Indian Market

India has a potential for the creation of biodiesel. Wild harvests developed in the no man's land likewise frame a wellspring of biodiesel generation in India and as indicated by the Economic Survey of Government of India, out of the developed land territory, around 175 million hectares are named squander and degraded the land. Along these lines, given an interest-based market, India can without much of a stretch tap its potential and create biodiesel on a huge scale. Agribusiness and Non-Conventional Energy Source would all be able to assume driving jobs in this program. Industry and research establishments have additionally the imperative job for the achievement and a reasonable store network instrument with usage plan is important for the national level like somewhere else over the globe. Research associations ought to be urged to embrace Life Cycle Analysis practice in biodiesel creation.

3. Conclusion

Biofuel has a lot of potential in India region because of availability of feedstock. Many researchers claimed that by using Biodiesel which is a form of Biofuel in Diesel engine, particulate matters, carbon mono oxide and hydrocarbon reduced because of Biodiesel has high cetane number as compared to Diesel fuel however some researchers reported that the possibility of increasing NOx emission by using Biodiesel because of Biodiesel has high oxygen content which is responsible for complete combustion of fuel.
Biofuel has potential to reduced emission by 80%, hence some countries like India sets target to use B20 by 2030, USA & Brazil set goal to use B25 by 2020.
Hence, Biofuel has potential to use as Biodiesel in Diesel engines by some engine modification to obtain optimum efficiency, which helps to reduce fossil fuel consumption and reduce emission which is dangerous to health and climate change. The use of Biofuel in India can provide employment in rural areas however it may compete with food supply.

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