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A Review on Biodiesel Production

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ABSTRACT

Millions of people in India have been lifted out of poverty as a result of economic growth, and society has modernised. economic aspiration has not been accomplished without expense. Energy security has been impacted by India's increased reliance on energy imports. Air quality is impacted by pollution from industry, transportation, and conventional cook stoves, which is also raising greenhouse gas emissions and accelerating climate change. India began producing biofuels about a decade ago in order to lessen its reliance on imported oil and so enhance energy security, and it is currently one of the leading producers of Jatropha oil. In 2001, the government launched a 5% ethanol blending (E5) pilot programme, and in 2003, it established the National Mission on Biodiesel, with the goal of reaching 20% biodiesel blends by 2011-2012. (Government of India, 2002, 2003). India's biofuel initiatives, like those of many other countries throughout the world, have suffered difficulties, owing mostly to supply constraints and global worries about food security. In 2009, India's National Regulatory on Biofuels set a non-mandatory aim of a 20% mix for both biodiesel and ethanol by 2017, as well as a broad plan for the biofuels programme and policy measures to support it. The purpose of the article is to examine how biofuels may be used in India to offset the country's reliance on fossil fuels and cut greenhouse gas emissions. It will be discussed how biofuels have been used recently and historically in relation to recent changes in government policy. A whole lifecycle evaluation will be utilised to analyse sample materials (crops, wastes, and residues) that can be used for biofuels. Case studies showcasing biofuel utilization's failures and achievements will be provided as examples of the difficulties and possibilities for use of biofuels in India, as well as recommendations for their potential future use.

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I. INTRODUCTION

With 1.27 billion inhabitants, India is on track to surpass China as the world's most populous country [1]. The economy has been expanding at a rate of about 8% annually in recent years [2], and energy consumption has been rising at a rate of 8.5% annually [3]. India's energy needs are largely satisfied by fossil fuels. In 2012, the proportions of coal, oil, gas, nuclear, hydro, biomass/waste, and other renewable energy sources in the total primary energy demand were, respectively, 45%, 23%, 6%, 1%, 1%, 24%, and below 0.5%, as shown in Fig. 1. India has extremely little fossil fuel reserves and must import gas, coal, and oil, with oil import dependency being particularly severe.

About 75% of India's oil consumption was met by imports in 2012; by 2035, this percentage is expected to increase to 92% [4]. The transport sector consumes over 50% of the total oil consumption, followed by agriculture (18%) and industry (11%). The commercial energy consumption of India has been expanding quickly in recent years, keeping up with the country's economic expansion, which has been relatively rapid. In order to lower its energy import costs, improve energy security, and cut greenhouse gas (GHG) emissions, India must reduce its reliance on oil. Therefore, it is crucial to encourage the use of biofuels in India.

1.1. Biofuel Policy

1.1.1. History of Biofuel in India

India began its biofuel programme more than a decade ago and has since implemented many regulatory initiatives to boost biofuels. In 2002, India introduced its "Ethanol Blending Programme," mandating a 5% ethanol (E5) mix with fuel in nine states and four union territories beginning in January 2003 [5]. In July 2002, India's Planning Commission established a Committee on Biofuel Development. The Committee's report, issued in 2003, advised that India gradually move toward greater objectives for biofuel blending, including expanding the ethanol blending scheme.

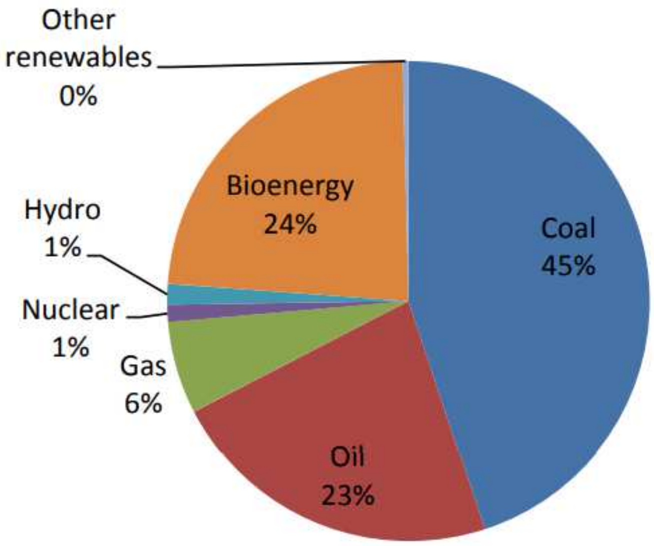

Figure 1 Primary Energy Demands of India in 2016

However, because to a lack of bioethanol supply, the 5% blending demand for ethanol could not be satisfied; in October 2004, the mandate was revised to "require E5 blends only when enough ethanol supplies were available" [7]. The 5% blending mandate was increased in 2006 to encompass 20 states and 8 union territories; however, this objective was not attained due to a lack of bioethanol supply. The Union Cabinet established a 5% blending objective for the country in September 2008. Although the 5% aim could not be met, the government established a 10% blending target in October 2008.

The 2003 Planning Commission report advocated the establishment of a National Mission on Biodiesel based on non-edible oil and recognised Jatropha curcas as the best tree-borne oilseed for biodiesel production [8]. One of the Mission's goals was to progressively increase the blending objective to 20% by 2012. The Planning Commission calculated that 11.2 million hectares of land would be needed for Jatropha planting in order to meet the 20% objective by 2012, and identified 13.4 million hectares of land that may be used for cultivation. The Ministry of Petroleum and Natural Gas issued a biodiesel purchasing policy in October 2005, requiring Oil Marketing Companies to source biodiesel in the nation for blending with diesel beginning in January 2006.

The Government of India approved India's National Biofuel Policy in December 2009 in order to strengthen the country's faltering ethanol and biodiesel blending programs.

1.1.2. National Biofuel Policy

The policy's goal is to assure the easy supply of biofuels to satisfy demand, and it has suggested an indicative target of 20% biofuel blending, both for biodiesel and bioethanol, by 2017. The biodiesel blending objective was planned to be optional, but the bioethanol aim was supposed to be required.

The following are notable aspects of the biofuel policy:

1. Biofuels will be based only on non-food feedstocks grown in degraded or wastelands unsuitable for agriculture, avoiding a potential conflict between fuel and food security.
2. A Minimum Support Price will stimulate the cultivation / planting of non-edible oil seeds for the production of biodiesel.
3. Plantations that supply feedstock for biodiesel and bio-ethanol will be supported by a Minimum Support Price for the non-edible oil seeds used to create bio-diesel. In addition, relevant financial and fiscal measures will be considered from time to time to boost the country's biofuel development.
4. Research, development, and demonstration will be supported in many elements of biofuel feedstock production and processing, including the creation of second generation biofuels.

The Policy Paper also includes interventions and enabling systems for plantings, processing, distribution, and marketing, finance, financial and fiscal incentives, and R&D.

However, the biofuel business is now in a deplorable stage of development. The 5% blending aim for ethanol has proven elusive till now. Biodiesel blending in the nation remains minimal; only around 500,000 hectares of Jatropha have been planted so far, and biodiesel output in the country is low [9].

1.2. Biofuel Resources

Bio-fuel is most usually characterised as a renewable energy source derived from biological materials or biomass, such as sugar cane, corn, or vegetable oils.

Bio-strategic fuel's objective is to augment or perhaps replace fossil fuels. However, the policies emphasise the utilisation of non-food biomass for biofuels. India offers a multitude of species that may be produced from traditional oil seeds, woody materials, agricultural waste, and municipal trash. In fact, India has approximately 300 oil-seed producing tree species [10].

India is rich in biomass, and the bulk of the Indian people has traditionally used biofuels inefficiently, resulting in a couple of severe societal concerns, mainly the health implications of air pollution. Appropriate technology for making biofuels available to the public, as well as their successful use, would have a substantial influence on India's socioeconomic situation. Technologies for producing biofuels include the following:

1. Energy plantation
2. Accumulation and/or reclamation of wastes
3. Conversion of biomass to bio-fuels
   A. Using mechanical process
   i. Extraction (Eg. bio-diesel)
   ii. Compression (Eg. Pelletization)

   B. Using chemical process
   i. Liquefaction (Eg. Conversion of cellulosic biomass to oil)
   ii. pressurized water reactor in a hydrothermal medium
   a) hydrolysis
   b) fractionation
   c) gasification and
   d) reaction

   C. Using bacteria (Eg. Bio gasification through biomethanisation)
   D. Using algae for Conversion of micro-algal biomass to biofuels
   i. Oil extraction from microalgae
   ii. Microalgae wastewater treatment
   a) Hydrothermal gasification
   b) super-critical water as reaction medium
   c) ultrasonic treatment

Bio-fuels utilization technologies include the following:

1. Direct burning, combustion or gasification for heating or power generation or both (cogeneration)
   a) Co-firing along with fossil fuel(s)
   b) Fluidized bed
   c) Transported bed
   d) Circulating fluid bed
   e) Ablative (vortex and rotating blade)
   f) Rotating cone
   g) Vacuum
2. Bio-gas for cooking or fuel cells for power generation or co-generation
3. Transport fuels

II. LITERATURE REVIEW

The rising need for fuel, rising energy carrier prices, and limited resources have created a severe challenge for science and technology [1]. Due to its widespread use in heavy-duty transport vehicles, rail transit networks, agricultural machinery, and construction equipment, diesel fuel is recognised as a crucial fuel in many nations [2, 3]. Diesel fuel, on the other hand, is a major polluter due to the presence of various hydrocarbons, sulphur, and crude oil residues [2].

Best wealthy nations have now shifted toward mass production and commercialization of bio-energy as the most sustainable way to address the aforementioned concerns [1]. Among the many kinds of bio-energy, biodiesel has received a lot of attention as the ultimate solution for partially or totally replacing petro-diesel and thereby lowering combustion emissions [3, 4]. Biodiesel is made by Trans-esterifying renewable and typically domestic sources like vegetable oil (fresh or waste) or animal fats with an alcohol (methanol or ethanol) in the presence of a catalyst. The use of biodiesel has been shown to reduce engine emissions such as particulate matter (PM), CO, and SO_x.

This Chapter will examine the potential for biofuels to offset the use of fossil fuels while reducing greenhouse gas emissions.

Obed M. Ali [4] has considered that the Depleting non-renewable energy source sources joined by constantly developing vitality requests lead to expanded enthusiasm for elective vitality sources. Mixed biodiesel fuel has been endorsed as a business fuel at a low mixing proportion. Be that as it may, issues identified with fuel properties are diligent at high mixing proportions. Thus, in this examination, the achievability of biodiesel created from palm oil was researched. Portrayal of mixed fuel properties with expanding palm biodiesel proportion is led to assess motor execution test outcomes. The passing of mixed fuel properties was utilized to show the most extreme mixing proportion reasonable for use in unmodified diesel motors as per the mixed fuel standard ASTM D7467. The property test outcomes uncovered that mixed fuel properties satisfy mixed fuel guideline necessities at up to 30% palm oil biodiesel. Moreover, mixing is productive for decrease of the pour point from 14 for unblended biodiesel to not exactly at a 30% biodiesel mixing ratio. However, the vitality substance decreases by about 1.42% for each 10% augmentation of biodiesel. Motor test outcomes showed that there was no measurably huge contrast for motor brake warm productivity among tried mixed energizes contrasted with mineral diesel, and the least motor cyclic variety was accomplished with mixed fuel B30.

Sateesh Yalavarthi et al.[12] has examined the option of oxygenated mixes to diesel, supply extra oxygen which results in all the more consuming of the fuel and along these lines diminishing emanations. In the present investigation, two oxygenated mixes, for example, Ethoxy ethanol and Ethylene glycol are considered on a 3.7KW, water cooled, and Kirloskar motor. The chose oxygenated mixes are mixed with diesel fuel in extents of 5% and 10% by volume and the test study is directed to assess the exhibition and emanations of the diesel motor. The information acquired is contrasted and the traditional diesel fuel and the outcomes uncover that Brake Thermal Efficiency (BTE) diminished with increment in the mix rate.

E. Mensah et al.[6] has considered that the motor execution utilizing biodiesel from waste palm piece oil (WPKO) and blended waste vegetable oils (WVOs), which were contrasted and diesel fuel. A four stroke single chamber air cooled diesel motor was utilized. The motor execution was controlled by estimating brake control, brake explicit fuel utilization, warm productivity and fumes temperature. The properties of the biodiesel mixes were additionally decided in the lab. Among the properties decided, sulphur substance and cetane record demonstrated some huge contrasts in qualities between the biodiesel mixes and diesel fuel. The outcomes demonstrated that BM10 (90% diesel + 10% blended WVO biodiesel) and BM5 (95% diesel + 5% blended WVO biodiesel) mixes demonstrated the least sulphur substance of 113.6 ppm and 1290 ppm individually contrasted with 1348 ppm for diesel fuel. For cetane list, both biodiesel mixes of WPKO and blended WVOs gave higher qualities than diesel fuel. As far as motor execution, BPK10 (90% diesel+10% waste palm part oil) and BPK20 (80% diesel+20% waste palm portion oil) showed higher brake control, higher warm proficiency yet lower fumes temperatures at all motor stacking conditions. Brake explicit fuel utilization was lower much of the time for BPK10 and BPK20 mixes than the remainder of different mixes. Thusly, it very well may be presumed that 10% and 20% mixes of waste palm piece oils (BPK10 and BPK20) can be utilized as an elective fuel in diesel motor with no huge adjustment of the motor and that the consistency of BPK20 was like that of diesel fuel.

M. Habibullahet al.[13] has studiedthat Biodiesel is an inexhaustible and practical elective non-renewable energy source that is gotten from vegetable oils and creature fats. This examination researches the generation, portrayal, and impact of biodiesel mixes from two unmistakable feedstocks, in particular, palm and coconut (PB30 and CB30), on motors. To total the upsides of high start nature of palm and high oxygen substance of coconut, joined mix of this two biodiesels (PB15CB15) is inspected to assess its impact on motor execution and emanation attributes. Biodiesels are delivered utilizing the soluble base catalyzed trans esterification process. Different physic substance properties are estimated and contrasted and the ASTM D6751 standard. A 10 kW, level, single-chamber, four-stroke, and direct-infusion diesel motor is utilized under a full load and changing velocity conditions. Biodiesel mixes produce a low brake torque and high brake-explicit fuel utilization (BSFC). Nonetheless, all emanations, aside from NOx, are altogether decreased. PB15CB15 improves brake torque and power yield while decreasing BSFC and NOx discharges when contrasted and CB30. In the interim, contrasted and PB30, PB15CB15 lessens CO and HC emanations while improving brake thermal proficiency. The trial investigation uncovers that the joined mix of palm and coconut oil indicates better execution and outflow over individual coconut and palm biodiesel mixes

KhiraiyaKrunal B. et al.[8] has contemplated that India has extraordinary potential for creation of biodiesel from non-eatable oil seeds. From around 100 assortments of oil seeds, just 10-12 assortments have been tapped up until now. The yearly assessed potential is around 20 million tons for every annum. Wild harvests developed in the west land likewise structure a wellspring of biodiesel creation in India and as per the Economic Survey of Government of India, out of the developed land zone, around 175 million hectares are delegated waste and corrupted land. In this manner, given an interest based market, India can without much of a stretch tap its potential and produce biodiesel in a huge scale.

Stewart et al.[14] has considered that the vegetable oils incorporate soyabean oil, cottonseed oil, sunflower oil, rapeseed oil, palm oil, linseed oil, jatropha oil, neem oil and mahua oil. There are in excess of 350 oil bearing harvests recognized whose cetane number and calorific worth are practically identical with those of diesel energizes and are perfect with material vehicle fuel framework. Vegetable oil is of exceptional intrigue since it has appeared to fundamentally diminish particulate discharge in respect to oil diesel. Late examinations demonstrates that cetane number, sweet-smelling substance and type, sulfur content, thickness are significant factor for outflow control.

Donghui Lu et al. [10] This paper is to learn about the various kinds of folios utilized for pelletization for various sorts of biomass various covers, for example, bentonite, rough glycerol, wood buildup and lignosulfonate were tried and see the advantages of utilizing these covers in pellets for the capacity and transportation. Pellets of wheat straw with bentonite, wood buildup, and lignosulfonate were gotten and the properties, for example, explicit vitality utilization, compound sythesis, rigidity, slag content, calorific worth and dimensional soundness of the pellets were resolved.

Results demonstrated that the particular vitality utilization for wheat straw palletisation fundamentally diminished with the expansion of lignosulfonate, bentonite, wood build-up, and pre-treated wood build-up with rough glycerol. With the expansion of folios the elasticity of wheat straw pellets was improved with qualities going from 1.13 to 1.63 MPa. The expansion of both pre-treated and non-pre-treated wood build-up fundamentally diminished the fiery debris substance of wheat straw pellets.

C.S. Rani et al. [11] this paper learn about the water bubbling test for the different biomass pellets. The notable Water Boiling Test (WBT) is an unpleasant re-enactment of the cooking procedure that encourages stove planners to see how vitality is moved from the fuel to the cooking pot. It tends to be performed on a large portion of the stoves all through the world. It is straightforward test which aides in institutionalization and replicable trial of various that are made for various cooking applications.

The Water Boiling Test (WBT) comprises of three stages that quickly pursue one another.

1. In the principal test, the chilly start high-control test, in this the stove is at room temperature and a determined measure of fuel to heat up a given measure of water in a standard pot. This bubbled water at that point supplanted with new chilly water for further testing.
2. The second test, the hot-start high-control test, this test is following the main test while stove is as yet hot. Once more, a similar measure of fuel is consume to bubble same measure of water. This test discovers contrasts in execution of a stove under these two conditions.
3. The third stage is soon after the second one in this we decides the measure of fuel required to stew a given measure of water at just beneath bubbling for 55 minutes. This progression mimics the long cooking of vegetables' a significant part of the world. The yields of above test are:

- ➢ time to bubble
- ➢ burning rate
- ➢ Explicit fuel utilization and warm effectiveness

This section incorporates all the exhibition parameter, chart and their trademark with one another and talk of it. In this test surrounding temperature is measure and after that in the interim of 1 min take a perusing of bubbling water temp by utilizing thermocouple and it is increment with time straight. Rice husk take normal 13.20 min to bubble of 1kg of water and wooden pellets take normal 6.56 min to bubble 2 kg of water.

Jaya Shankar et al. [12] The point of this examination is to discover the impact of pellet kick the bucket distance across on the strength and thickness of the pellets produced using high dampness herbaceous (for example wheat straw, vitality sorghum and corn Stover) and woody biomass. The pellets are made utilizing two distinctive bite the dust breadths for example 8 mm and 10 mm for a high dampness content (33%) biomass. Anyway palletisation speeds and introductory temperature kept steady for a wide range of test. The outcome demonstrates that 8 mm breadth kick the bucket brings about high dampness misfortune when contrasted with the 10 mm measurement pass on for woody biomass. Additionally 10 mm distance across bites the dust bring about higher thickness pellets aside from corn Stover yet the toughness of all the example decline with the expansion in the pass on breadth.

Reberto Gsrcia et al. [13] The reason for investigation of this paper is to discover the impacts of various strong lignin rich added substances like Grape Pomace (GP), cocoa shell, miscanthus, olive stone and olive pomace. Pine sawdust (PIN) and its terrified partner (PINT) were utilized for testing because of their broad effectively accessibility. The outcome acquired from the analysis demonstrates that on blending lignin-rich added substance such GP increment the coupling limit of the biomass when contrasted with crude PIN and PINT. However, because of higher sulphur content in GP its amount is restricted to 10 to 20 wt%. Additionally a limited quantity of GP is a reasonable added substance to upgrade the HHV particularly for unnerved example.

Wei yang et al. [14] this paper is to contemplate the impacts of various covers and minerals on emanation of particulate issue (PM) on burning of biomass pellets. This investigation is finished utilizing a fixed bed combustor alongside Dekati low weight impactor and use cotton stalk pellets with various covers and minerals. The outcome demonstrates that including the Diatomite fastener lessens the discharge of PM, though utilization of Ca (OH) 2 advances the arrangement of PM. Additionally Calcium lignosulfonate and CMC likewise increment PM development at different degree.

Jindaporn Jamradloedluk et al. [15] this paper is to contemplate the impacts of folio type and blending proportion on the diverse biomass pellets. The pellets are produced using (for example natural product shell, eucalyptus, and papaya and so on.) and utilizing various covers (for example cashew nut, shell fluid, dammar and so forth.). The outcome demonstrates that the blending proportion has no criticalness consequences for the thickness and mechanical properties of the pellets created. Though the pellets framed utilizing cashew nutshell fluid gives better mechanical properties (for example yield quality, most extreme pressure, greatest power and so on.) and the pellets arranged utilizing dammar as a folio demonstrates the higher warm productivity.

III. CONCLUSIONS

This article has shown that, despite legislation, resources, and technology, the demand for biofuels still outweighs their contribution to the existing fuel mix. The development of biofuels in India faces a variety of difficulties (and other parts of the world). The following market obstacles serve as a concise summary of the primary market restraints unique to biofuels:

- Economic hindrances: The cost of producing biofuels is still high, and positive externalities are not costed.
- Technical difficulties: Some biofuels' conservation methods are still in their infancy, and the fuel quality is not yet consistent (e.g. for synthetic biofuels.)
- Trade obstacles: Some biofuels still don't have quality standards in place.
- Barriers related to infrastructure: Depending on the kind of biofuel, new or modified infrastructures are required. Particularly the use of biomethane and biohydrogen.
- Moral obstacles: Food supplies may be in competition with biomass feedstock sources.
- Knowledge gaps: Politicians and members of the general public both lack information on biofuels.
- Political impediments: Government subsidies for kerosene continue to encourage its inefficient and occasionally unlawful use, even though the target population might have benefited just as much or more from the use of biofuels if political will and policy had been in place.
- Conflict of interest: Disagreement between first- and second-generation "promoters" The general development of biofuels may be hampered by biofuels.

In conclusion, future palm-biodiesel advances will probably concentrate on striking a balance between commercial demands and societal and consumer views. Currently, efforts are being made to find additional green biodiesel sources. Because they are less expensive, more readily available, abundant, environmentally friendly, and have no impact on food security, this study suggests using mill effluent and by-products from the palm oil industry as possible biodiesel source materials. There aren't many technologies that have been developed that still have room for improvement. New research possibilities to enhance product quality and address other issues, including environmental issues, will be made possible by a number of major challenges. For the foreseeable future, a thorough investigation is still necessary.

The best currently available raw materials, palm oil has the highest content of the widely regarded palmitic and oleic acids.

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