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Study and Synthesis of Bio-fuel from Jatropha Vegetable Oil

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***Abstract:** This work has been carried out to produce biodiesel and inspect how the production from Jatropha seeds oil, methanol and using a catalyst as Potassium iodide Aluminium oxide (KI Al_2O_3). This Methodology dried jatropha seeds ware used. This seed oil is extracted from the jatropha seed by applying the Soxhlet extraction method with methanol as the organic solvent and screw-type mechanical expeller. In the oil free fatty acid content of jatropha seeds oil was 0. 800.i.e.is ≤ 2. After using the transesterification process and the ratio of methanol: oil ratio was 12:1, 0.5 g of catalyst and temperature of the reaction was 60 °C for 4 hours of reaction time with stirring at 600 rpm. The cloud point was 7°C. The pour point was 2°C, density was 0.38 g/cm^3 and flash point was 155 °C.*

***Keyword:** Biodiesel, jatropha seeds oil, Transesterification, Solvent extraction, Mechanical expeller, KI Al_2O_3.*

I. INTRODUCTION

India's efforts to generate biofuels are mostly focused on growing and processing the seeds of the 40% oil-rich Jatropha plant. This is due to historical, functional, economic, environmental, moral, and political factors. Since jatropha vegetable oil is used directly after extraction—that is, without being refine in like diesel generators and engines, it has been utilized for many years in India to meet in the biodiesel fuel needs isolated rural and forest communities. Since jatropha is growing in dry like mechanical instrument non-agricultural lands with the right management, it is the potential to bring economic advantages to the local community by enabling farmers of village use non-farmland for earning generation. Additionally, India gains from increasing Jatropha oil production in terms of its economy.

Jatropha is a genus of flowering plants in the spurge-family Euphorbiaceae. The colloquial name "physic nut" comes from the Greek words *iatros* which means physician and trophe which means "nutrition." The term nettles purge is another one.

The local vehicle industry performing well, India's overall biodiesel demand is anticipated to increase to 36 crores tons in 2011 to 2012. The market is still developing and needs time to catch up to competitors on a worldwide scale, according to Frost & Sullivan's Strategic Analysis of the industry of biofuel.

Pure biodiesel made from renewable biological sources such animal fats, soybean oil, pam, and edible and non-edible oil from jatropha seeds. Glycol esters with a variable chain length and saturation level make up most vegetable oils. It is evident that veggies have a sizable amount of oxygen in their molecules. One of India's most important non-edible resources is jatropha vegetable oil.

Jatropha seed oil is utilized in the production of soap, lubricants, varnish, pesticides, and pharmaceuticals. It makes an excellent feedstock for making biodiesel. Fences and shelters against erosion, wind, and animals are made from jatropha bushes. Oil is extracted from decorticated seeds to produce jatropha oil cake (oil kernel meal). It can be applied as fertilizer or as a raw material for biogas generation. Jatropha kernel meal is a product that is high in protein, however Only non-toxic Jatropha cruces genotypes, non-toxic Jatropha platyphylla species, or detoxified Jatropha curcas genotypes' kernel meals can be used safely as feed resources. After the non-dehulled seed is extracted, jatropha seed meal is produced.

Since jatropha oil may be used directly in diesel generators and engines after extraction (i.e., without refining), it has been utilized for many years in India to meet the diesel fuel needs of isolated rural and forest communities.

Jatropha seeds is a low-cost biodiesel feedstock that has more oil than other species and strong fuel characteristics. It is a feedstock made from inedible oilseeds. Thus, it won't have an effect on food costs or the argument between food and fuel.

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Biodiesel is a substitute fuel for diesel engines that was generated of methyl esters of various fatty acids and generated by chemically altering both edible and non-edible vegetable oils.

It is common knowledge that biodiesel is regarded as a sustainable alternative fuel and can be used in place of diesel fuel with a petroleum base. Because biodiesel is a renewable, biodegradable, non-toxic, and Sulphur-free alternative to diesel fuel, it reduces greenhouse gas emissions. In terms of energy security and environmental preservation, both vegetable and animal feedstocks offer promising renewable alternatives to traditional diesel fuels with significant potential for CO_2 reduction from the complete production for Biodiesel. More than 95% of the feedstock for biodiesel is made up of vegetable oil, specifically seed including soybean, rapeseed, peanut, and sunflower. Controversy can arise if culinary oils are used to produce biodiesel. Because they are less expensive than Suitable oils, they provide the best potential as a feedstock for biodiesel generation. Because of their hardiness, ease of propagation, ability to adapt to a variety of ago-atmosphere conditions, high oil content, low seed cost, and ability to serve as a commercially viable alternative to vegetable edible oils, non-edible oil-seed crops from, the synthesis of biodiesel or fatty acid methyl esters may benefit from the use of jatropha seed.

II. METHODOLOGY

A. Materials

Jatropha seeds which I used in this process had been purchased online store. In this process the material used for biodiesel production such as solvents are 95% n- Hexane, 98% Methanol, NaOH, Potassium iodide Aluminium oxide 99.9% (KI Al_2O_3) is base. which was used as catalyst.

B. Apparatus

In this process, the apparatus which were used apparatus such as Hot oven used for seed drying and moisture removal. Mechanical expeller used for oil extraction as well as Soxhlet extraction apparatus used for oil extraction. We used volumetric flask and magnetic stirrer used.

III. EXPERIMENTAL PROCEDURE

A. Seed Preparation

Jatropha seeds have been dried in sun for 2 days and after seeds were dried in the Hot air oven at temperature 70°C for minimizing the moisture containing in the seeds. Dry seed has been used for oil extraction.

B. Oil Extraction

For oil extraction, which were used Techniques such as Soxhlet extraction, ultrasonication, mechanical expeller could be used to extract oil. Here, two types of methods, I was used for oil extraction Soxhlet extraction and Mechanical expeller.

1) Mechanical Expeller

The screw-type mechanical expeller has been used to extract oil from jatropha seeds. Here I used 100gm seeds. The first machine starts then after the machine has heated up for ten minutes, and seeds are then inserted into the hopper machine. Equipment crushes the seeds, then collects the oil. The extracted had to remove because there is contain impurities. The extracted oil yield was 34.9ml.

Fig-1 Mechanical expeller

Fig-2 oil extracted from jatropha seeds

2) Soxhlet Extraction

The dry seed was first ground into powder. Using n-hexane as solvent in a Soxhlet extraction process near about 200ml. first, place 35 g of seed powder in a paper thimble, then place it in the middle of a Soxhlet, add n-hexane, and then begin the process. The temperature was 60°C for 2 hours.

Fig-3 Soxhlet extraction process

Fig-4 jatropha seeds oil

Table -1 Jatropha seeds oil Extracted by different Time and Weight

TIME	TEMPERATURE	WIGHT OF SAMPLE	OIL EXTRACTED
90 min	60°C	25gm	7ml
120 min	60°C	30gm	10ml
150 Min	60°C	40gm	15ml

C. Free Fatty Acid (FFA) determination

10ml of the jatropha seed oil was taken in conical flask with capacity of 250ml and take another conical flask and weigh out 50 ml of methanol. Now add a few amounts of the indicator of the phenolphthalein solution, and then add 0.1 N sodium hydroxide to the methanol to neutralize it. Add the neutralized methanol to the flask containing the sample now and shake to combine the mixture. Heat and boil the solution until a sample is dissolved in the methanol completely. Take 0.1N sodium hydroxide in a burette and record the initial burette reading. Start titration after adding a few drops of phenolphthalein indicator. Stop the titration when the solution color is changed into light pink. Note the final burette reading.

Calculation: $= \frac{40.001*0.1*2}{10}$

$= 0.800$ that is < 2

D. Acid Value Determination

The acid value of oil extracted from the jatropha seeds was determined using the given in equation:

Acid value = FFA*1.99

= 0.800*1.99

= 1.592 mg KOH/g

E. Biodiesel Production

In this process, the procedure of transforming extracted oil into biodiesel is known as transesterification. This process was carried out using some chemicals such as methanol, Jatropha seed oil, KI Al_2O_3 as catalyst. According to the following procedure, biodiesel was produced using the following parameters ratio of methanol: oil ratio was 12:1, and 0.5 gm of Kl -AL_2O_3 catalyst was used as a catalyst. The temperature of the reaction was 60°C and the reaction was stirred continuously for 4 hours at a speed of 600 rpm.

Taken 30 ml of seed oil was added to a 250 ml conical flask, which was then heated to 60 °C. After that, another conical flask in 14 ml of methanol was added, along with 0.500 g of catalyst, and the mixture was stirred with a magnetic stirrer once more until the solution was completely dissolved. After Kl -AL_2O_3 dissolved in methanol. The solution was then added to the first conical flask. The response time was 4 hours at 600 rpm and the temperature was 60°C.

Fig-5 Biodiesel and glycerin

The oil mixture's whole esters were transformed into methyl esters and glycerin throughout this process.

After the transesterification process is finished, the mixture is allowed to settle naturally in used a separating funnel at least 24 hours. Glycerin and the methyl ester of jatropha oil were the byproducts of the transesterification process. Glycerin makes up the bottom layer, and biodiesel makes up the top layer, which biodiesel was collected.

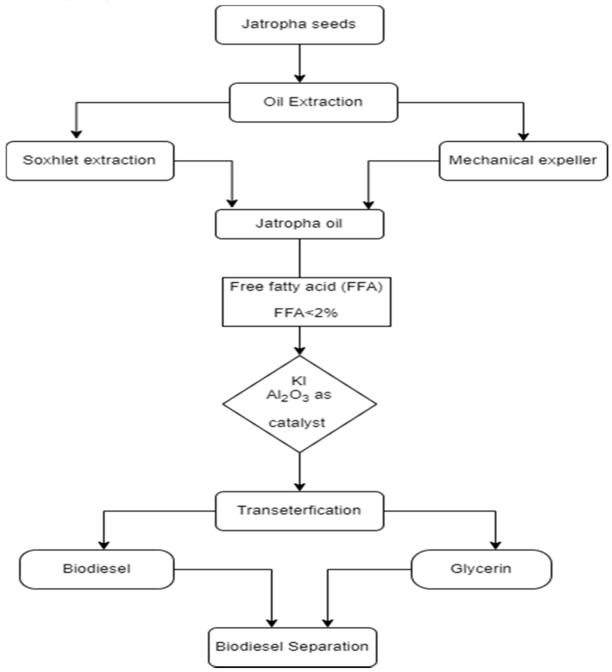

Fig-6 flow chart of biodiesel production process from jatropha seeds.

IV. ANALYSIS OF THE BIODIESEL

After the transesterification procedure was completed, the biodiesel that was created was analyzed to determine its physicochemical parameters, which are listed below.

A. Cloud Point

A wooden clamp containing a thermometer was placed around a cylindrical tube that had been filled with biodiesel to a specific level. The sample was placed in an ice bath and allowed to cool below zero degrees Celsius until it took on a whitish or cloudy look. The biodiesel's cloud point was identified as the temperature at which its white or cloudy looking hue appeared. The cloud point was obtained at 7°C.

B. Pour Point

A wooden clamp with a thermometer was affixed to a cylindrical test tube that had been filled with the generated biodiesel to a certain level. The sample was then placed in an ice bath to chill down below 0 ° C. After that, it was taken out, tilted on the clamp, and the setup was periodically checked. Its pour point was determined to be the lowest temperature at which the product was observed to flow. The pour point was 2°C.

C. Density

The biodiesel was measured out and poured into a conical flask until it had a 15ml volume. Additionally weighed were the biodiesel and glitz. The density of the biodiesel was calculated using the weight of the substance and the mass per unit. The density was 0.38 $g/cm^{3.}$

D. Flash Point

In this process, the apparatus was used for determination called Pensky Martens. Which was carried out in this work by taking 150ml biodiesel in the oil cup and heated at a slow temperature on hot plate. The flash was recorded as the temperature at which the test flame's application ignited the vapor above the biodiesel sample. The flash point was 155°C.

V. RESULT AND DISCUSSION

Table -2 Biodiesel properties

PROPERTIES	UNIT	BIODIESEL
ACID VALE	mgKOH/g	1.592
POUR POINT	°C	2
CLOUD POINT	°C	7
DENSITY	g/cm^3	0.38
FLASH POINT	°C	155
FREE FATTY ACID	mgKOH/g	0.800

The yield of biodiesel produced from the extracted jatropha oil with a reaction temperature of 60°C was achieved using the acquired optimum values, which were reaction time of 4 hours, catalyst load of 0.5g, derived methanol to oil molar ratio of 12:1, and. After being created under ideal conditions, the biodiesel was examined to determine its physical chemical characteristics. The findings of the examination are shown in Table 2.

When analyzing the extracted jatropha oil, 1.592 mgKOH/g of free fatty acid value were found, it is <2, which is capable for Transesterification process, indicating that the jatropha oil had been converted into biodiesel, as shown by the data in Table 2. When comparing jatropha seed oil to diesel, higher density equals more fuel mass per unit volume. Low temperature fuel performance is measured using the cloud and pour point criteria. Biodiesel has a very low cloud point of 7°C, which allows it to function well even in cold weather. Under cold weather circumstances, the greater cloud point might negatively impact engine performance and emission. The pour point is 2°C. In general, greater pour points frequently restrict their use as diesel engine fuels in cold weather. Jatropha seed oils lose their ability to flow when the surrounding temperature is below the oil's pour point, and wax can clog filters and fuel supply line The more fuel there is, the more energy it would produce Since the created liquid had a density of 0.38 g/cm3, a cloud point of 7 °C, and a pour point of 2 °C. The flash point was 155°C. It was clear from a comparison of its other parameters with those of the biodiesel that was produced.

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REFERENCES

[1] E. Kabir , D. Hussain , A. Haque & K.-H. Kim (2009) Prospects for Biodiesel Production from Jatropha Curcas: A Case Study of Bangladesh Agricultural University Farm, International Journal of Green Energy, 6:4, 381-391, http://dx.doi.org/10.1080/15435070903107064

[2] Daniela A. Torres-Rodríguez, Issis C. Romero-Ibarra, Biodiesel production from soybean and Jatropha oils using cesium impregnated sodium zirconate as a heterogeneous base catalyst, j. renene.2016.02.06.

[3] Andrea V. Yate, Alvaro Orjuela, aulo C. Narváez, A systematic evaluation of the mechanical extraction of Jatropha curcas L. oil for biofuels production, 10.1016/j.fbp.2020.04.001 0960-3085.

[4] I. Amalia Kartika, M. Yani, D. Ariono, Biodiesel production from jatropha seeds: Solvent extraction and in situ transesterification in a

[5] single step, Department of Agroindustrial Technolog, fuel http://dx.doi.org/10.1016/j.fuel.2013.01.021.

[6] Anik Prodhan, Md. Ikramul Hasan, Shah Mohammad Asaduzzaman Sujan, Mosharof Hossain, Md. Abdul Quaiyyum & Mohammad Ismail, Production and characterization of biodiesel from Jatropha (Jatropha curcas) seed oil available in Bangladesh, Department of Applied Chemistry and Chemical Engineering, https://doi.org/10.1080/15567036.2020.1851819

[7] A. Prabhu, M. Venkata Ramanan & J. Jayaprabakar, Production, properties and engine characteristics of Jatropha biodiesel - A review, Department of Mechanical Engineering, https://doi.org/10.1080/01430750.2018.1557548.

[8] Araceli Martíneza,c , Gabriela E. Mijangosa , Issis C. Romero-Ibarraa,c,⁎ , Raúl Hernández-Altamiranob,c , Violeta Y. Mena-Cervantes, In-situ transesterification of Jatropha curcas L. seeds using homogeneous and heterogeneous basic catalysts, https://doi.org/10.1016/j.fuel.2018.07.082.

[9] Digambar Singha, Dilip Sharmaa , S.L. Sonia , Chandrapal Singh Indab , Sumit Sharmaa , Pushpendra Kumar Sharmaa , Amit Jhalani, A comprehensive review of physicochemical properties, production process, performance and emissions characteristics of 2nd generation biodiesel feedstock: Jatropha curcas, echanical Engineering Department, https://doi.org/10.1016/j.fuel.2020.119110.

[10] Maftuchaha, Agus Zainudinb, Aris Winayaa, Yuyun Rahmadesi, Biodiesel generated from Jatropha (Jatropha curcas Linn.) seeds selected based on various genotypes crossbred. Department of Agrotechnology,Faculty of Agriculture and Animal Science, EnergyReports,https://doi.org/10.1016/j.egyr.2020.11.160.

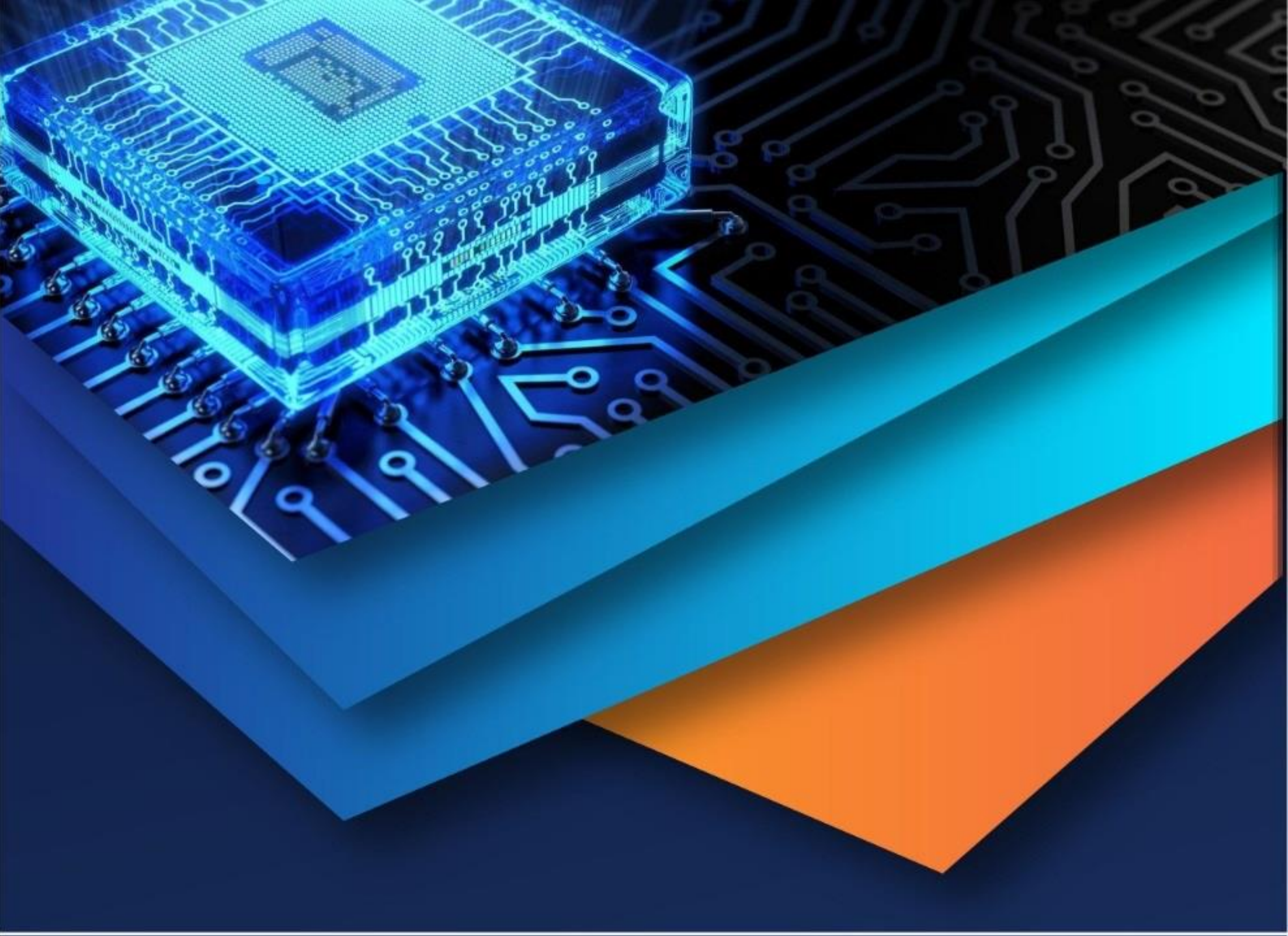
[11] S.Antony Raja, D.S.Robinson smart, and C.Lindon Robert Le, Biodiesel production from jatropha oil and its characterization, School of Mechanical Sciences.

[12] athia Oshaik, rofessor Babiker Karama Abdalla, Sheimaa Idris, Mohammed Abuuznien, Production of Jatropha Biodiesel in Laboratory Scale, https://doi.10.5455/jeas.2021050105

[13] Y W Mirzayanti , N P Asri , L Marlinda , M A l Muttaqii, Transesterification of jatropha curcas oil for biodiesel production Over NiO catalyst, Department of Chemical Engineering, Faculty of IndustrialTechnology,https://doi:10.1088/1742-6596/1833/1/012041.

[14] Department of Biotechnology, Shree M. & N., oil extraction was used by method solvent extraction, science department, using solvent as petroleum ether, hexane, isoprponel, Doi.10.5897/AJB11.776

[15] M.A. BELEWU, F.A. ADEKOLA , G.B. ADEBAYO ,transesterification reactor of jatropha seed oil for biodiesel ,and using ethanol and KOH ,temperature 65 °C of the reaction, Department of Animal Production, Department of Animal Production, http://ajol.info/index.php/ijbcs



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