Jatropha Oil Extraction
(An Alternative Source of Energy)

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Abstract— *Biofuels are replacement to petro-diesel. These fuels are renewable because the can be continuously cultivated. Since jatroph seeds were identified as one of the best sources of oil for biodiesel production. This will also provide cheaper, more environment-friendly alternatives to diesel fossil fuels which will directly affect the imports and hence the economy. The Physico-chmical properties of the bio diesel produced were evaluated and compared with that of fossil diesel. The Physico-chemical properties assessed include, specific gravity, density, flash point, kinematic viscosity (40□°C), sulfated ash, carbon residues, and iodine value. The results reveled significant difference between the Physico-chemical properties of biodiesel from that of fossil diesel.*
Keywords:-Biodiesel, biofuels, flash point, fossil fuel, jatropha, Kinematic viscocity, specific gravity.

I. INTRODUCTION

Jatropha oil is one of the promising sources of bio fuel in future. This oil which is extracted from Jatropha seeds can be directly used or mixed with petrol-diesel. This will relate to savings on imported petroleum oil. As potential source for bio diesel , the jathopha plant can produce an oil content of 30-58%, depending on the quality of the soil where it is planted. Its seeds yield an annual equivalent of 0.75 to 2 tonnes of bio diesel per hecter.Bio-fuel is non-polluting, locally available, Accessible, sustainable, and

reliable fuel obtained from renewable sources . The fraction of biomass that have been used and are still enjoying renewed attention as feedstock for production of liquid bio fuels are from agricultural source like; lipids, simple sugars and polysaccharides sources. The benefits of the Jatropha as biodiesel includes the reduction of greenhouse gas emission, as well as the country’s oil imports. Local production of Jatropha is also practical because as a non-food crop, it will not compete with food supply demands. It can also grow on marginal fertile land, leaving prime agriculture lots for food crops while at the same time restoring the marginal and degraded land’s fertility. All of these benefits can be possibly be achieved by the presence of this locally fabricated high efficiency Jatropha oil extractor.

Biodiesel to vegetable oil or animal fat-based diesel fuel consisting of alkyl (methyl, propyl, or ethyl) esters obtained by chemical reaction of lipids (vegetable oil, animal fat) esters obtained by chemical reaction of lipids (vegetable oil, animal fat) within alcohol. Biodiesel is a clean burning alternative fuel to fossil diesel. It is produced from domestical growing renewable resources. Chemically, most biodiesel consists of alkyl ester s instead of the alkanes and aromatic hydrocarbons of petroleum derived diesel. Petroleum diesel , also called petro-diesel or fossil diesel is produced from fractional distillation of crude oil between 2000C (3920F) and 3500C (6620F) at atmospheric pressure resulting in the mixture of carbon chains that typically contain between 8 and 21 carbon atoms per molecule . However, recent research findings have indicated that biodiesel has combustion properties similar to petro-diesel, including combustion energy and cetane ratings.

Jatropha is a genus of approximately 175 juicy type plants, shrubs and trees (some are deciduous, like Jatropha curcas) from the family Euphorbiaceae.

The percentage of removable oil is affected by pressing technology. These hand operated extractors has a capacity of about 4 kg seeds an hour and has an average of 60% extraction of the recoverable oil. Jatropha oil extractor equipment is powered by a fraction HP induction motor and electric heating elements. It has a capacity of four times that of the hand operated extractors or about 16 kilograms of seeds per hour and approximately 80% extraction of the recoverable oil per cell. The number of cells depends on the desired capacity of the facility. Say, for 1 ton seed capacity per day, the oil extraction facility will need 8 cells. Per cell consists of 32 Kg seed and 4Kg of seeds produce 1liter of oil.

The hardy Jatropha is resistant to drought and pests, and produces seeds containing 27 – 40 % oil. The cake of Jatropha seeds after oil extraction could be considered for energy production. The plant is considered as the best source of bio-fuel production among the various plants based fuel resources. It has been reported that this underutilized bio-fuel plant will help in meeting the challenges of global bio-fuel demand (37 billion gallons) by 2016.

Hence this study aimed at quantify the percentage oil yield and biodiesel output of the oil of *Jatropha Curcas* seed grown and compare its physico-chemical properties with that of fossil diesel obtained in the locality.

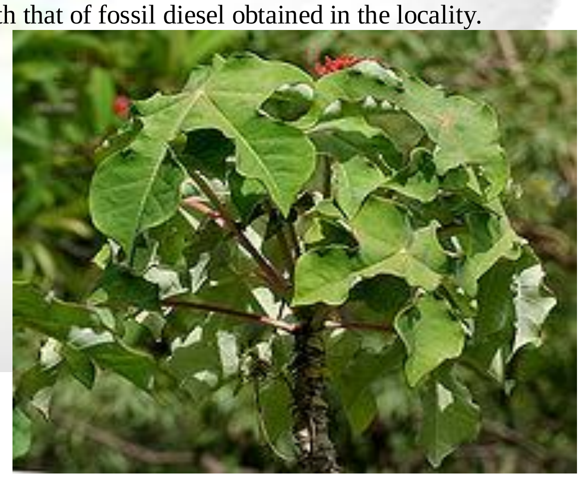

Fig.1: Jatropha plant

II. PREPARATION OF JATROPHA OIL INTO BIODIESEL FUEL

450 ml of the oil was pour into the reactor and heated to 450C to improve the oil’s mixability with the alcohol. .This catalyst concentration level was achieved by dissolving 4.1g of potassium hydroxide (KOH) in 100 ml of the alcohol and

the mixture was stirred for twenty minutes to form potassium alkoxide. The resulting solution was added to the oil in the reactor and the entire content was brought to a temperature of 55°C and then held at this temperature for an hour. The reactions product mixtures were allowed to separate into phases by standing for eight hours in a separating funnel so as to separate glycerol from the biodiesel. 5 ml of acetic acid was added to the biodiesel followed by washing with water to and was allowed to stand for eight hours in a separating funnel. The denser soapy mixture was carefully drained from the bottom of the separating funnel leaving behind the biodiesel. The biodiesel obtained was dried in an oven at 100°C for 1 hr and the volume determined.

III. Advantages And Disadvantages

Biofuel is the most promising source of energy for future fuel needs. Biodiesel can be developed from growing plants which naturally contains oil namely Jatropha, palm oil, Soybean and algae. Bioethanol can be extracted from sugar crops like sugarcane, sugar beet, maize, corn etc by yeast formentation.Wood products can be converted into Biofuels. The obtained Biofuels from these products contain both advantages and disadvantages

A. *Advantages of Biofuels:*

1) *Ecological benefits:* The main expectation of using the biofuel is to be carbon netural, less of CO and Sulfur, as it is made from natiral resources, and it is renewable and pure fuels so it is good for autombile. It reduces the greenhouse considerably compared to other fossil fuels

2) *Renewability and Degradable:* The biofuels are made from crops which are reewable and it is biodegradable and safer to handle and less hazardous than fossil fuels.

B. *Disadvantages of Biofuels:*

1) *Availability:* The biofuels are not available in surplus so the diesel engines which are modified for biodiesel usage may face problems. The most automibles are not equipped for using biofuels in engines. Some biodiesel cannot resist frost; it gets frozen in the colder areas. It also increases the risk of microbial growth in the engine. Only few petrol stations offer this biofuels and it is impossible to transport the biofuels using pipelines.

2) *Carbon emission:* Biofuels are reduces the JATROPHA GREENHOUSE GASES emission compared to other fossil fuels. Resently the European scientist reported that the burning of biodiesel espically corn and rapeseed procduce more nitrous oxide.

Table.1: presents the result of the physicochemical properties of the biodiesel produced by transesterification of oil extracted from Jatropha curcas and fossil diesel. [2]

S/N	Parameters	Biodiesel	Fossil diesel
1	Specific gravity	0.875	0.841
2	Density	0.876g/cm^3	0.832g/cm^3
3	Flash point	170°C	70°C
4	Kinematics viscosity (40°C)	4.8cts	3.6cts
5	Sulfated ash	0.06%	0.2%
6	Carbon residue	0.2%	0.7%
7	Iodine value	7.64	3.05

Table.1: Physico-chemical parameters of Bio-diesel and Fossil fuel

From the result, it could be observed that the specific gravity of Biodiesel 0.875 was in agreement with 0.88 obtained, and 0.88 in other report, however, the specific gravity of biodiesel is higher compared to that of fossil diesel (0.841). The density obtained for the biodiesel (0.876 g/cm3) was in agreement with the specified value reported which range from 0.860 to 0.90 for biodiesel, and also in agreement with 0.868 as reported (2010). While a value of 0.832 g/cm3 obtained for the density of diesel fuel is lower than the specified standard of 0.920 - 0.845 g/cm3.The flash point of Biodiesel 170 °C is in agreement with specified standard, and also similar to ASTM and EN specification of biodiesel but lower compared to 200 °C reported. For diesel fuel, the flash point gotten is also in the agreement with the standard specified. Flash point helps to monitor the safe handling and storage of fuel The higher the flash point the safer the fuel and vice -versa. The flash point of Biodiesel 170° C is in agreement with specified standard and also similar to ASTM and EN specification of biodiesel but lower compared to 200° C reported. For diesel fuel, the flash point gotten is also in the agreement with the standard specified. Flash point helps to monitor the safe handling and storage of fuel. The higher the flash point the safer the fuel and vice versa. The flash point of Biodiesel is higher than that of fossil diesel; therefore it could be said that Biodiesel is safer to handle than fossil diesel. The kinematic viscosity of Biodiesel 4.8 cts is in agreement with the manufacturer standard given and also falls within the ASTM and EN limit of biodiesel. But lower compared to 9.60 cts reported. The kinematic viscosity of fossil diesel 3.6 cts is in agreement with that specified. The viscosity of biodiesel is higher compared to that of fossil diesel the implication is that biodiesel will have lubricating effect in engines which will be an added advantage to the users, since it will reduce wear and tear in the engine. The value of sulfated Ash obtained for biodiesel 0.06 is slightly higher compared to the standard specified 0.02% max.

However the value is lower than that obtained for diesel fuel 0.2%. The Ash content is a measure of the amount of metal contained in the fuel. From the result in table 4, it shows that fossil diesel contains more metal compound than the biodiesel. During the Burning of the fuels, Biodiesel burnt with very low smoke compared to that of fossil diesel which burnt with heavy smoke. This implies that biodiesel emissions from exhaust of vehicles will help reduce the pollution introduced to the atmosphere compared to that of fossil diesel. The carbon residue of the biodiesel 0.2% was higher compared to 0.050max documented. This could be due to the contaminant which might have entered the sample during the heating to evaporate the oil. The carbon residue of the diesel fuel from table 4 is higher compared to Biodiesel. This implies that diesel fuels will form a higher deposits compared to that of biodiesel in engines.

The reason why jatropha was chosen as the fuel-source crop over other plants is because of its several advantages:

- It can survive under adverse conditions;
- It is cannot be consumed by animals;
- It is a vigorous, drought and pest resistant plant and when planted as a fence protects the interplantations.

Thus, jatropha is a unique among renewable energy sources in terms of the potential benefits that can be expected to result from its widespread use. Its cultivation is technologically simple and requires comparatively low capital investment.

The large-scale cultivation of jatropha should target the 1 million hectares of unfertile land that requires treatment before food production is possible on them again.

Once the trees establish themselves and fertilize the soil, their shade can be used for intercropping shade-loving commercial crops that will provide additional income for the farmers. The oil, which is the main product derived from the Jatropha, also has lots of application aside from making it into biodiesel. It can be used to producesoap, used in pharmaceuticals, and fuel cooking stoves, ovens, and driers.

The jatropha oil may not be feasible as a biodiesel feed stock as of the moment, but it may be a profitable renewable source of alternative to petro-fuel in the near future when fossil-fuel deposits are too low and its price are rocketing sky-high

IV. Seeds And Flowers OF JATROPHA Plants

Undesirable to the farmers, they can extract their own jatropha oil using the extractor and sell it to soap producer or pharmaceuticals or simply make their own biodiesel (assuming they have enough knowledge to do so) for their own consumption.

Four products may then be obtained from Jatropha oil: soap; pharmaceuticals; fuel oil for firing stoves, ovens, and driers; and biodiesel. The efforts and capital outlay of these farmers planting jatropha one or two years ago will not be wasted because of the existence of CHMSC's high efficiency jatropha oil extractor equipment.

Fig.2:jatroph seed

Fig.3:jatropha flowers

V. Materials And Methods

[1]The materials used in fabricating the machine may be sourced out locally and it can be done in any machine shop in areas interested to adopt the project. The operation is so easy that anybody could operate it without spending too much time studying it (user-friendly).

VI. Methodology

[1]The first test included extracting oil from dried jatropha seeds with hull using the conventional hand operated expeller machine. The results showed that about four kilos of dried seeds can be processed in one hour. After several trials, the average oil extracted from the dried seeds was noted to be one liter. The second test conducted was oil extraction using the jatropha oil extractor equipment made by CHMSC. First, the dried seeds were passed into the de-huller to remove its outer covering. Then, particle size of the de-hulled seeds will be reduced using the crusher. After this, the crushed seeds were fed to the oil expeller for extraction. It was observed that the process can be done simultaneously after the seeds had reached the oil extraction stage. After several trials it was noted that an average of sixteen kilograms of dried seeds can be processed in an hour and about four liters of jatropha oil was extracted during the process.

Fig, 4: below illustrates the prototype of the Jatropha Oil Extractor Equipment and its Process Flow:

VII. Data Gathered

Test on extraction of oil from seeds of Jatropha

Type of Extraction	Trial Number	Weight of seeds Processe-d in 1hour	Volume of oil Extractio-n in 1hour
Conventional Hand Operated	1	3.95 kg	0.90L
	2	3.75kg	0.95L
	3	4.15kg	1.10L
AVERAGE		3.95kg	0.98L
CHMSC Extractor	1	15.00kg	4.10L
	2	16.20kg	4.26L
	3	16.90kg	3.90L
AVERAGE		16.03kg	4.08L

VIII. Physical and chemical properties OF PETRO-DIESEL AND Jatropha OIL [3], [4]

Properties	Petro-diesel	Jatropha oil
Density(gm/cc),30°C	0.836-0.850	0.93292
Kinematic viscosity(cSt), 30°C	4-8	52.76
Cetane No.	40-55	38.00
Flash point, °C	45-60	210.00
Calorific value,MJ/Kg	42-46	38.20
Saponification value	-	198.00
Iodine No.	-	94.00

IX. Results Obtained

The percentage oil yield of Jatropha curcas seed and biodiesel gotten from the oil are 39.7 and 80.2 respectively. The oil yield was in agreement with 30-40% of earlier reports but lower than 60-80% the petroleum ether is used in this work. The use of n-hexane may give a higher yield. The biodiesel yield of the oil is also low compared to that which was specified in a literature. This was reported to be 98% when a base catalyzed mechanism is used. This could be due to the formation of soap which was so prominent during the conversion process.

X. Conclusion

Generally, this project intends to answer the need of both the government and private sectors involved in jatropha propagation for biodiesel oil feedstock and other products from the extracted oil of the jatropha seeds. [1]

a. Specifically it shall;

b. Efficiently extract oil from jatropha seeds;

c. Operate jatropha oil extraction using less power input;

d. Provide simplified and easy oil extraction operation;

e. Offer a reliable and low maintenance oil extraction equipment; and

f. Make the oil extraction equipment readily available in the Market.

References

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[2] K. Pramanik, "Properties and use of jatropha curcas oil and diesel fuel blends in compression ignition engine,"

[3] Science, vol. 28, pp. 239-248, 2003. "Analysis results of pure Jatropha curcas," Petroleum product analysis laboratory-VILASS 292 - Hanoi -Vietnam, p. 26/05/10KN, 2010.

[4] "Analysis results of Jatropha oil," Resesrch Centre for Sustainable Energy - Rostock, German, vol. Labor - Nr, 2010