International Journal of Engineering & Scientific Research
Vol.6 Issue 11, November 2018,
ISSN: 2347-6532 Impact Factor: 6.660
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com Double-
Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at:
Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

NEEM OIL AS A SOURCE OF FUEL ENERGY

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Article Received: 15th October, 2018 Article Revised: 25th October, 2018 Article Accepted: 30th October, 2018

Abstract

As we all know that the petroleum resources are limited and are non-renewable in nature, we must start to think about the alternatives as we are likely to run out of the petroleum resources in few decades, Bio-fuel is renewable energy fuel that can be used directly in any existing, the research emphasis the feasibility of using Neem oil as a substitute of Diesel and Kerosene, Physical properties like kinematic viscosity, carbon residue, flash point, fire point and Absorption has been determined. The results obtained shows that the Viscosity of Neem oil is $8.94mm^2/s$ while that of Diesel and Kerosene are $3.65mm^2/s$ and $3.75mm^2/s$ respectively. The Flash point is 30^0C and the Carbon Residue is 0.09gm representing approximately 9% of total Neem fuel, Neem fuel is very good for consumption.

Keywords: feasibility, Neem oil, renewable & non- renewable, petroleum resources.

1 Introduction

Neem Oil is a vegetable oil gotten from the fruits, leaves or seeds of Neem tree. The tree is a member of the Mahogany family, with generic name Azadirachtin Indica, it is an evergreen tree which is endemic to the Indian subcontinent and has been introduced to many other areas in the tropics(Ahmed, 2008). It has also been found to thrive in the semi tropics, arid and semi arid climates in some countries including Nigeria where it is known as Dogon-yaro, meaning "Tall Boy"(Ayoola et.al, 2014).

Neem oil is generally light to dark brown in colour. It has a bitter taste and an offensive odour similar to the combined odours of garlic and peanut(Kattimani et.al, 2015). It comprises mainly of triglycerides (esters formed from a molecule of glycerol and three molecules of fatty acids), and is very rich in Azadirachtin- the key component acting as insect repellent, Anti-Feedant, anti-fungal and anti-viral, among others, it is perhaps the most important commercial product of Neem for organic farming and medicines. Also, it is being increasingly used in manufacturing a large number of skin products: body soaps, body lotions, and beauty care facial packs in combination with other natural ingredients (International Journal of Environmental Research and Public Health).

Research reveals three ways in which Neem oil may be extracted from its seeds and they are: mechanical pressing, supercritical fluid extraction and solvent extraction. Mechanical pressing involved crushing of Neem seed to extract oil. Though oil obtained by cold pressing preserves the key components of the oil (particularly Azadirachtin), but reports however show that such oil has low yield and poor market value (quality) as the oil is turbid and has high water and metal contents. Supercritical fluid extraction process utilizes carbon dioxide at critical temperatures and pressures to extract the active ingredients of the Neem leaves or seeds. It produces high quality oil but it is very expensive to operate and involves the release of CO_2 to the atmosphere(Liauw et al., 2008).

The use of solvent extraction for the extraction of Neem oil is generally the preferred choice. This is due to very high oil yield and less turbid oil obtained than that from mechanical pressing, also due to the relatively low operating cost compared to

supercritical extraction (International Journal of Environmental Research and Public Health, 2008).

2 Materials and Method

Having obtained the leaves, the leaves were stored in such a manner that allowed passage of air for further drying and prevention of the fungi growth.

Oil Extraction was done to ensure high extraction efficiency as leaf coats contain little or no oil. To achieve this, leaf pulps were soaked in warm water to soften the outer leaf coat and the leaf coats and fruit were then peeled off by hand.

25g of sample was accurately weighed and placed in a 500ml flask, 250ml of n-hexane solution was added swirling the flask and carefully warming the mixture with an electric heating mantle until the sample was completely dissolved. 5ml of saturated alcohol solution was added and the contents swirled for exactly 1 minute.

35ml of distilled water was then added and the contents shaken vigorously to liberate iodine from the chloroform layer. The resulting mixture was titrated was titrated until the blue-gray colour disappeared in the oil.

The entire procedure was repeated for the remaining.

Leaf cleaning this was done to remove foreign materials such as sticks, stems, bad leaf, sand and dirt, to ensure that the oil produced is not contaminated and of high quality.

Drying was done to remove the moisture content of the leaves so as to ensure high extraction efficiency. The drying of the leaves was done using electric dryer operated at a temperature of 45^0C for about 4hours.

$$H = IVt \quad \text{_____} \quad (1)$$

Where as

H: Is the amount of heat in joule

I: Is the amount of current in Ampere

V: Is the voltage in volt

t: Is the time taken in seconds

Grinding was done to obtain a very large surface area for extraction to be completed using mortar and pestle.

Heating this was the final stage of the leaves preparation steps. It involves heating the ground leaves just before extraction to remove moisture content completely. This was done for 10mins at a temperature of 50^0C using Oven.

This process is subjected to joule's law of heating.

$$Q = I^2Rt \quad \text{(2)}$$

Where as

Q: Is the amount of heat in joule

I: Is the electrical current flowing in Ampere

R: Is the amount of resistance in Ohm

t: Is the time taken in seconds

Extraction Procedure

After the completion of the leaf preparation steps, extraction of oil from grinded Neem leaf was done. Extraction experiments involved the use of: soxhlet extractor (coupled with heating mantle) and extraction solvents (at different combinations), varied extraction time and varied temperature.

Experiments were carried out to achieve the set objectives of the determination of the maximum oil yield obtainable with: soxhlet n-hexane, mixtures.

From the second law of thermodynamic

$$\Delta Q = T\Delta S \quad \text{(3)}$$

Where as

ΔQ: Is the amount of heat absorb by the system

T: Is the temperature of the system

ΔS: Is the entropy of the system

Distillation of oil-solvent mixture will be carried out at 100^0C for one hour to obtain pure Neem oil using Burette tight on a Retort stand.

Soxhlet Extractor is a form of continuous solid-liquid extraction where desired compound is extracted from solid material (containing unwanted products) using a solvent.

Electric Drier is the laboratory Oven for sample drying, sterilizing, evaporating and dehydrating.

Grinder is for particle size reduction to grind or homogenize wet, dry elastic and fibrous material.

Viscometer is an instrument used to measure the viscosity of fluid. For viscosities which vary with flow conditions.

Flash point machine provides a simple, convenient index for the flammability of diverse material.

3 Result and Discussion

This research provides the different experimental set-up and procedures both for measuring fuel properties.

Comparison of Percentage Oil Yield by percentage

Sample Run	**Neem Leaf**
1st	40.1
2nd	33.2
3rd	38.1
Mean	**37.133**

$$\%\, Yield = \frac{Weight\ of\ ectracted}{weight\ of\ sample} \times 100 \quad (4)$$

$$\%\, Yield = 1.63$$

Determination of Fuel Properties

This is an experimental set-up and procedures of measuring relevant fuel properties - viscosity, Absorption, carbon residue, pour point, percentage yield Fire and flash point. Individual set-up for each parameter are outlined below:

Viscosities of fuels were measured using viscometer. Time of falling of 20 ml sample under controlled conditions through a standard oil tube was measured. This time was recorded using stop watch. The Corresponding kinematic viscosity was obtained from viscometer reading and the value was checked by computing the same as for others over a wide range of stop watch. Measured values of kinematic viscosities are presented on table below using ASTM standard.

Viscosity of Neem oil is higher than all other samples which is $8.94mm^2/se$ higher than Diesel $3.65mm^2/sec$ and kerosene$3.75mm^2/sec$. High viscosity of Neem oil attributed to molecular composition and structure, greater carbon chain length and reduced number of double bonds, high viscosity leads to pour atomization of fuel spray which results in larger droplet size. This in turn leads to poor mixing of fuel and air, finally leads to incomplete combustion that results in loss of power and efficiency.

Viscosity Analysis of Neem Oil:

$$Kinematic\ Viscosity = efflux\ time\ \times Viscometer\ Constant \quad \text{(5)}$$

Where viscometer constant

$$Where\ Viscometer\ constant = 0.005mm^2/s$$

$$Room\ Temperature = 32℃$$

S/N	Temperature (^{0}C)	Efflux Time (s)	Kinematic viscosity(mm^2/s)	Weight of Oil(gm)	Concentration (mol/dm^3)
1	32	1788	8.94	26	1.60
2	25	1750	8.75	20	1.44
3	22	1730	8.65	19.85	1.20

Kinetic Viscosity of Diesel:

$$Kinematic\ Viscosity = efflux\ time\ \times Viscometer\ Constant \quad \text{(6)}$$

Where viscometer constant

$$Where\ Viscometer\ constant = 0.005mm^2/s$$

$$Room\ Temperature = 28℃$$

S/ N	Temperature (^{0}C)	Efflux Time (s)	Kinematic viscosity(mm^2/s)	Weight of Diesel (gm)
1	28	730	3.65	26.10
2	32	400	2.00	15.20
3	35	250	1.25	13.8

Kinetic Viscosity of Kerosene:

$Kinematic\ Viscosity = efflux\ time\ \times Viscometer\ Constant$ _____ (7)

Where viscometer constant

$Where\ Viscometer\ constant = 0.005mm^2/s$

$Room\ Temperature = 28℃$

S/ N	Temperature (^{0}C)	Efflux Time (s)	Kinematic viscosity(mm^2/s)	Weight of Kerosene(gm)
1	28	750	3.75	21.30
2	32	630	3.15	18.61
3	35	157	0.78	15.62

4. Conclusion

The kinematic viscosity, carbon residue, flash point and fire point has been determined. The results obtained shows that the Viscosity of Neem oil is $8.94mm^2/s$ while that of Diesel and Kerosene are $3.65mm^2/s$ and $3.75mm^2/s$ respectively. The Flash point is 30^{0}C and the Carbon Residue is 0.09gm representing approximately 9% of total Neem fuel, Neem fuel is very good for consumption.

5. Acknowledgement

I am forever grateful to Almighty Allah the originator of knowledge, who made my challenges within the period of this research a stepping-stone. I am overwhelmingly grateful to my Supervisor Prof. E.O Ajala, My profound gratitude goes to Dr. Stellar, Mr. Mike, Shaiyi of Sheda Science and Technology Complex Abuja and Muhammad M. Usman of Kaduna Refinery and Petrochemical Company Kaduna State, who's not only believed in my capability to achieve this mighty task but went extra miles to bring the best out of my knowledge. I am forever grateful. I also wish to appreciate all my colleagues.

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