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Experimental Study on The Use of Neem Oil as Lubricant in IC Engine

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Abstract - *Bio-lubricant based on vegetable oil is emerging as an alternative lubricant in the recent times. In this paper, experimental studies of vegetable oil-based bio-lubricants as alternative lubricants for automobile applications are discussed. The bio-lubricant derived from blending Neem oil with the conventional oil in proportion of 10%, 15%, and 20% is used for testing the properties like density, flash and fire point and wear properties. The effect of this lubricant on emissions was also determined.*

Key Words: Bio-lubricants, Engine, Blending, Transesterification, Neem oil.

1. INTRODUCTION

Lubricants are utilized every day for automotive, farming, industrial, aviation, and marine applications. Mineral based lubricants are released into the environment during use, spills, and disposal. The mineral based lubricants are not completely biodegradable and have high toxic content and cause significant damage to the environment like water sources and burning lubricants for disposal produces airborne pollutants and waste containing heavy metal.

The growing environmental concerns have initiated interest in the use of certain percentage of renewable-oils in passenger vehicles. Lubricants are of two types namely, petroleum based lubricants and bio-based lubricants. Most of the oils which have been used to meet lubricating needs originated from petroleum. [7]

1.1 Functions of Lubricating oil

The following are the important function of the lubricating oil in engine:

a. **Lubrication:** The main function of the lubricating system is to facilitate the free movement of the sliding parts and reduce the engine friction and wear.

b. **Cooling:** To maintain low temperature of the surfaces by taking away the heat.

c. **Sealing:** The lubricating oil must form a good seal between piston rings and cylinder walls.

1.2 Properties of Lubricants

Following are the desired properties of lubricants [11]:

a. **Viscosity** is resistance to the flow, which is directly related to the film formation that protects the metal surfaces.

b. **Pour Point** of a liquid is the lowest temperature at which it will pour or flow under prescribed conditions.

c. **Cloud Point** is the temperature where the mixture starts to separate in to two phases, thus becoming cloudy.

e. **Flash Point** of a flammable liquid is the lowest temperature at which it can form an ignitable mixture with oxygen.

f. **Fire Point** of a fuel is the temperature at which it will continue to burn after ignition for at least 5 seconds.

g. **Oxidation Stability** is an ability to show resistance towards oxide forming tendency which increases at increased temperatures.

h. **Neutralization Number** is an indication of the amount of acid/base content for neutralization.

1.3 Bio-based lubricants

Bio lubricants are being manufactured for minimizing the environmental impacts that are caused using mineral based lubricants. The oil extracted from different edible and non edible seeds are used in the production of the lubricant. The use of bio lubricant from vegetable oil can also reduce the cost of the lubricants.
There are two ways to use vegetable oil as a bio-Lubricant, either by directly blending vegetable oil with commercial lubricant or converting the vegetable oil into methyl ester to be used as lubricating oil for internal combustion engines [13].
The sources of lubricant used in this study are Neem oil. Neem oil is a vegetable oil pressed from the fruits and seeds (fig. 1) of the neem, an evergreen tree which is easily available in India. Neem oil is either reddish brown or greenish brown.

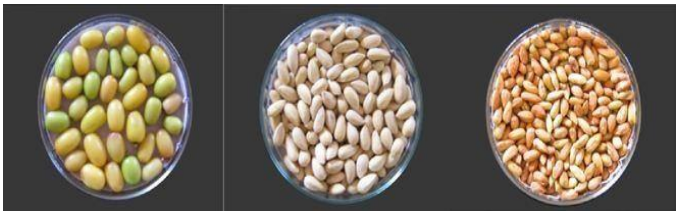

Fig.1 Neem oil Seed, kernels and dry kernel for oil extraction.

2. General Objective

This study presents a comparison of the properties of the lubricant derived from blending different percentages of neem oil with mineral oil and its effect on the engine emissions.

The main objective of the project is:

1. Finding the alternative source to produce lubricants.
2. To blend the different proportions of non-edible oil with the engine oil.
3. Studying the various properties of the bio-lubricant prepared.
4. Investigation and comparison of the properties of the bio-lubricants and unblended engine oil.
5. Testing the effect of these lubricants on the IC engine performance and emissions.

3. Methodology

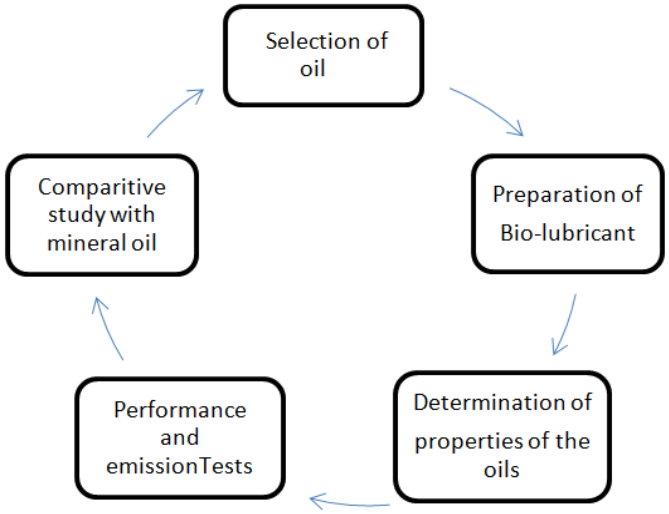

Fig .2 Flow chart representing the methodology adopted.

Neem oil was selected for blending with mineral oil to form the bio-lubricant. Samples were prepared by blending 10%, 15% and 20% neem oil with the SAE 20W-50 oil. Tests were conducted to determine density, flash point, fire point and dynamic viscosity.

3.1 Preparation of Bio-lubricant Samples

Vegetable oil can be chemically modified by different processes.

This modified vegetable oil was used as lubricating oil and as base oil in formulating bio based lubricant.

The chemical modification is carried out in two-steps:

1. Esterification: This process is used to reduce the free fatty acid content in the oil in by mixing it with the alcohol in the presence of acid catalyst.
2. Transesterification: Transesterification reaction is the transformation of an ester, a triglyceride (vegetable oil) into another ester in the presence of acid or base as a catalyst. In the production of biodiesel, the products are mixtures of fatty esters (biodiesel) and glycerol. [14]

The formation of esters by transesterification of vegetable oil requires oil, 15% of methanol & 5% of sodium hydroxide as catalyst on mass basis. For the equilibrium of the reaction 50°C temperature was kept. From 1litre of neem oil 850ml of neem oil methyl ester was obtained.

Fig. 3 Magnetic Stirrer Heater

The lubricant SAE 20W-50 was used as a base lubricant and comparison purpose. The blended samples were prepared by mixing of 10%, 15% and 20% neem oil esters with SAE 20W-50. The samples were mixed with the base lubricant using agitation apparatus for 45 minutes for homogenization. The amount of each sample prepared was around 1.5 Liters.
Name given to the neem oil blends is N10, N15 and N20 for 10%, 15% and 20% respectively.

Fig. 4 Agitation apparatus used for the blending of oils

3.2 Properties of bio-lubricant

Following are the experimental results for the properties of the neem oil and SAE 20W-50 oil and the bio-lubricant samples.

Properties	Neem Oil	SAE 20W-50 oil
Density (kg/m^3)	0.88	0.888
Flash point (^{0}C)	284	215
Fire Point (^{0}C)	295	232
Dynamic Viscosity (x10^{-4}) (Ns/m^2)	0.842	1.39

Table 1. Properties comparing neem oil and mineral oil

Properties	Mineral Oil	Neem oil Blends		
		N10	N15	N20
Flash Point	215	220	224	234
Fire Point	232	237	241	249
Kinematic viscosity (m^2/s)	1.579	1.322	1.276	1.092
Dynamic Viscosity (Ns/m^2)	1.39	1.1633	1.1229	0.96

Table 2. Properties of the Blended oils with mineral oils

3.3 Wear test

The main aim of this test is to determine wear and co-efficient of friction of a standard specimen using pin-on-disk wear testing machine.

Fig. 5 Pin on Wear testing machine

The brief procedure of the experiment is as follows:
Fix the specimen (aluminium pin) in the pin holder . Fill the disc bowl with oil.
Note down the track radius. Apply a load of 1Kg in the Pan. Switch on the power of the control unit and set the timer to 5 minutes. Start the wear testing machine and set RPM to 400. Note down the change in length of the aluminium pin for each sample.

4. Results and Discussion.

Figure 6, 7(a), 7(b) shows the comparison of the properties of neem oil with the properties of mineral oil. It can be seen from the figure that the densities of the all these oils are almost equal. Fig 8 shows the comparison of dynamic viscosity for the oils.

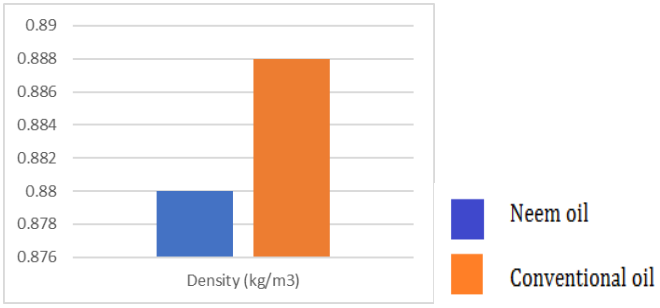

Fig. 6. Density comparison of the neem oils with mineral oil.

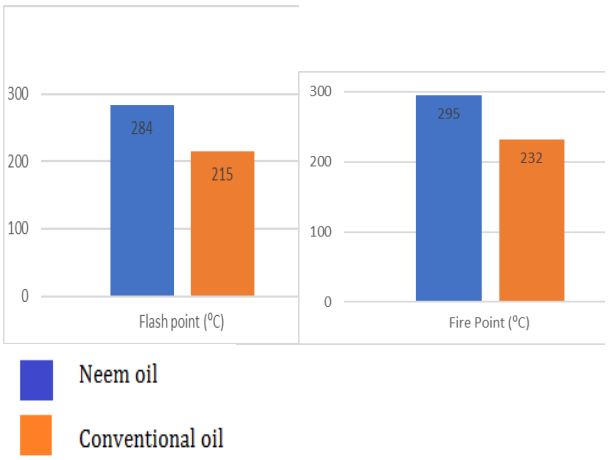

Fig. 7 (a) and (b). Flash and fire point of neem and mineral oil.

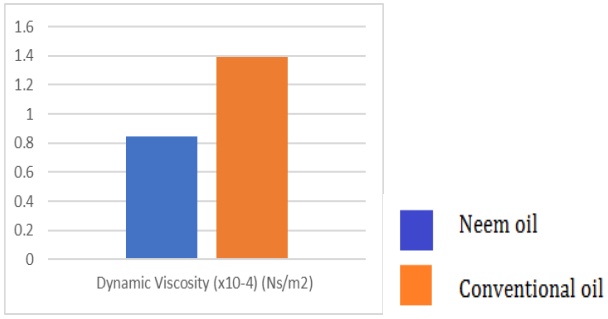

Fig. 8 Dynamic or Absolute viscosity of the oils.

Acid percentage in the neem was found to be 4.67%.

The properties were tested for the different blends of neem oil with mineral oil and following are the results obtained.

a) Flash and fire point

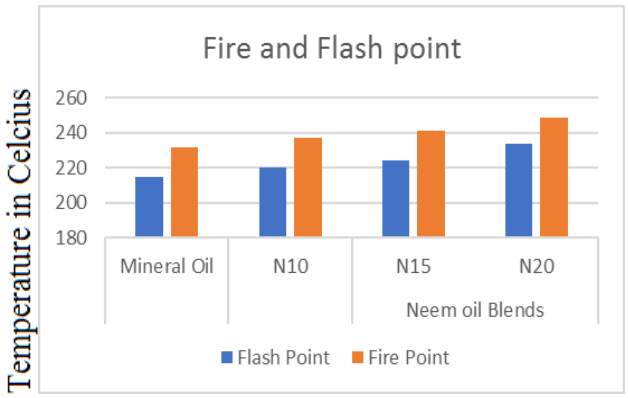

Fig. 9 Flash and Fire point of different blends of neem oil

b) Viscosity

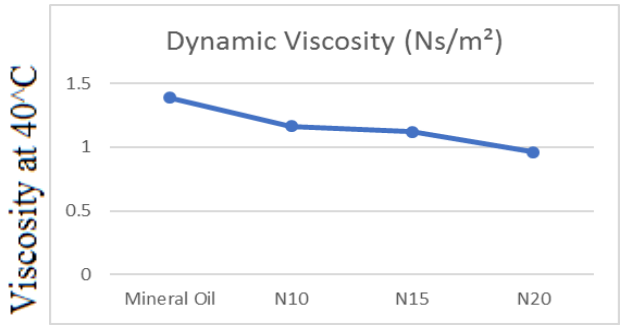

Fig. 10 Dynamic viscosity of different blends of oils ($x10^{-4}$ Ns/m^2).

c) Wear Rate

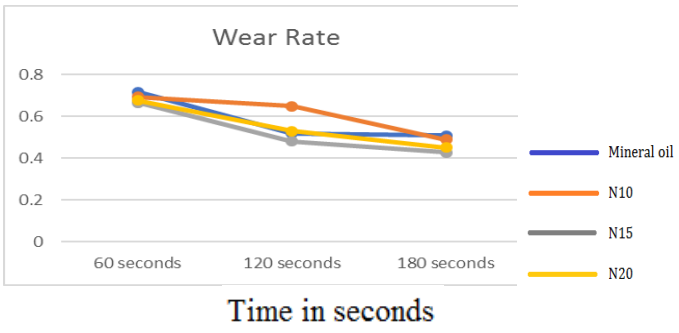

Fig. 11 Comparison of wear rate for different samples

4.1 Effect of lubricant prepared on engine performance and emission

The samples prepared along with the mineral oil was tested on the engine for any change in the performance i.e., power output and emission characteristics and were compared. The specification of the engine used for the test is given below,

Fig.12 Engine with Rope brake Dynamometer

Brand	Piaggo Ape
Engine Type	Single cylinder diesel engine
Displacement	395
Max. Torque	22.2 Nm @ 2000 rpm
Max. Power	8.04 bhp @ 3400 rpm
Cooling Type	Air-cooled

Table 3. Specification of the engine

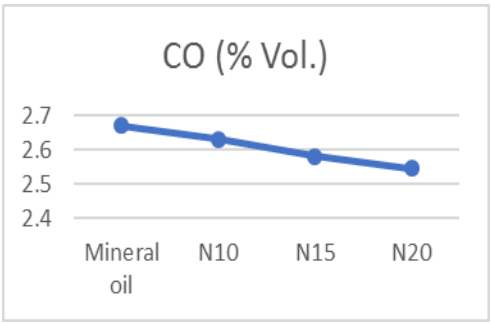

Fig. 13 Comparison of CO emissions in % using different Samples

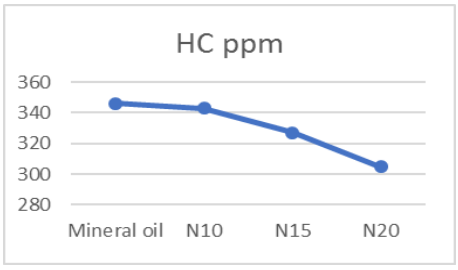

Fig. 14 Comparison of HC emissions in ppm using different Samples

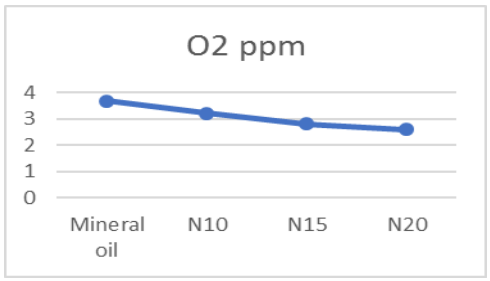

Fig. 15 Comparison of O_2 emissions in ppm using different samples.

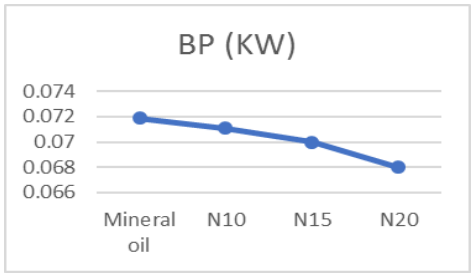

Fig. 16 Comparison between BP (KW) obtained for all the samples

5. CONCLUSIONS

Based on the observation and results obtained it is clear that the blended lubricant oil of has a slide edge over the conventional mineral oil depending upon the comparison of the properties and various other aspects. Since their viscosity is little less compared to the conventional mineral oil, but also the blended oils showed good anti-wear properties than the mineral oil. All the samples were tested in engine for any change in the performance and mainly the emission respectively.

Of all the samples prepared N15 lubricants shows better characteristic compared to the conventional mineral oil. While selecting a lubricant one must look mainly towards the viscosity and other physical properties, but also the look into the impacts caused by these on the environment.

REFERENCES

[1]. Jumat Salimon, Nadia Salih and Emad Yousif, Bio-lubricants: raw materials, chemical modification and environmental benefits, January 22, 2010.

[2]. Prerna Singh Chauhan, Dr. V K Chhibber, Non-Edible Oil as a Source of Bio-Lubricant for Industrial Applications: A Review, International Journal of Engineering Science and Innovative Technology (IJESIT), Volume 2, Issue 1, January 2013

[3]. Amit Suhane, A. Rehman, H.K.Khaira, Potential of Non-Edible Vegetable Oils as an Alternative Lubricants in Automotive Applications, International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 5, September- October 2012

[4]. Jasenka Petran, Ljiljana Pedišić, Mirko Orlović, Štefica Podolski, Vesna Bradač, Biolubricants from natural waste oils and fats, 18.9.2008.

[5]. Anjana Srivastava1 and Preeti Sahai, Vegetable oils as lube base stocks: A review, African Journal of Biotechnology Vol. 12(9), ISSN 1684–531, 27 February 2013.

[6]. Ebtisam K. Heikal, M.S. Elmelawy, Salah A. Khalil, N.M. Elbasuny, Manufacturing of environment friendly bio lubricants from vegetable oils, Egyptian Petroleum Research Institute, Received 3 November 2015; revised 1 March 2016.

[7]. Jagadeesh Kumar Mannekote, Satish Vasu Kailas, Experimental Investigation of Coconut and Palm Oils as Lubricants in Four-Stroke Engine, Research gate, January 2011.

[8]. Biniyam T. Amdebrhan, Lidya Damtew, Desta Tesfay, Hanan Endris, Gebremedhn Tekeste, Production of Bio lubricant from Castor (Ricinus) Oil.

[9]. Deepak Tanwar, Ajayta, Dilip Sharma, Y. P. Mathur, Production and Characterization of Neem Oil Methyl Ester, International Journal of Engineering Research & Technology, ISSN: 2278-0181, Vol. 2 Issue 5, May – 2013.

[10]. Ajay Gahadwal & Sanjay Yadav, Production of Neem Oil Methyl Ester by Using Two-Step Esterification Process, International Journal of Research (IJR) Vol-1, Issue-10 November 2014, ISSN 2348-6848.

[11]. H.M. Mobarak, E. Niza Mohamad, H.H. Masjuki, M.A. Kalam, K.A.H. Al Mahmud,M. Habibullah, A.M. Ashraful, The prospects of bio lubricants as alternatives in automotive Applications, 27 January 2014.

[12]. Tirth M. Panchal, Ankit Patel, D.D. Chauhan, Merlin Thomas, Jigar V. Patel, Experimental Investigation of coconut

and palm oils as Lubricants in Four-stroke engine, January 2011.

[13]. H. H. Masjuki, M. A. Kalam, M. F. Nurul, M. H. Jayed, A. M. Liaquat, M. Varman, Environmentally Friendly Bio-Iubricant Lubricity Testing, 2011 IEEE First Conference on Clean Energy and Technology CET.

[14]. Shruthi H. Heroor and S.D. Rahul Bharad, Production of Bio-fuel from Crude Neem Oil and its Performance, International Journal of Environmental Engineering and Management, ISSN 2231-1319, Volume 4, Number 5 (2013)