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Experimental Investigation of Crude Palm Oil as Engine Oil In 4s Si Engine

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Abstract*: Crude palm oil (CPO) is one of the vegetable oil cheaply available in the Andhra Pradesh region in India. It is mainly used as a vegetable oil in cooking purposes. It has potential to use as engine oil in IC engines. In this paper, we investigated crude palm as engine oil in 4 Stroke motorbike instead of commercially available engine oil in the market and the results shows that the thermal properties are nearly same that of engine oil and it can be used as engine oil in automobiles.
Keywords*: Crude palm oil, Engine oil, Thermal conductivity, Kinematic Viscosity, Flash & fire point, Pour & cloud point.

I. INTRODUCTION

Vegetable oils as lubricants provide a new renewable source of environmentally friendly and economically better compared to commercially available lubricants in the market. Some of the naturally available organic lubricants having better and same thermal properties of commercial chemically refined lubricants. There are some Eco friendly mineral oils in which they cannot harm to pollution and can be used in different applications.

At the point of emissions, biodegradable mineral lubricants are expected to behave much better from conventional lubricants, with respect to soluble organic fraction emissions. Polycyclic aromatic hydrocarbons are absent in vegetable oils, which benefits to human health. Vegetable, mineral oils are also less in potential pollutants like NOx and Sox (sulfuroxides and Nitrogen oxides).

The main advantages of using vegetable oil as engine oil in IC engines, it is non toxicity, natural resource renewability, biodegradability, economical cost, good thermo physical properties, and so forth.

II. LITERATURE REVIEW

Cheenkachorn and Fungtammasan [1] investigated the use of palm oil is economically low cost and it can be used as engine oil in motorcycle engines. They studied about the tribological properties of palm oil and they concluded that palm oil can be used as engine oil, but there is no significant change in the engine and its performance.Masjuki et al. [2] carried out a comparative study of wear properties, lubricant degradation, and exhaust emissions with palm oil compared to commercial lubricating oil. They concluded with their study, that palm oil having better wear and better performance in terms of friction. However, palm oil as lubricant is more effective in terms of decreasing in pollutant levels.

T.S.Yusuf et al. [3] carried out an experiment that palm oil as fuel additive with diesel in different compositions (25%, 50& & 75%). They directly used this composition of palm oil and diesel in CI engine instead of diesel with varying speed conditions (1000 rpm to 3000 rpm). They concluded that the palm oil-diesel exhibit high torque and power output at engine speeds greater than 2000 rpm, while the brake specific fuel consumption was found to be higher than the diesel at the same engine speeds. Palm oil enhanced the BSFC at higher engine speeds (<2000 rpm). The palm oil-diesel blends exhibited lower NOx emission and higher CO emission compared to the ordinary diesel.

Schramm [4] carried out measurement of emission on a chassis dynamometer to compare the emissions of CO, THC, CO_2, lubricant-SOF and PM from diesel engine, engine performance and fuel consumption also carried out. They performed an operation on engine based on conventional crude oil-base fuels and alternative fuels. Lubricant samples were taken after running the engine upto 7500 km and were analysis was done in order to study biodegradability of the used lubricating oil and engine wear.

Sari et al. [5] studied the viscosity of crude palm oil at room temperature after preheating upto 100^0C. Results shows that the viscosity of crude palm oil is gradually decreases that provides smooth flow and to avoid fuel filter clogging and it could not affect the injection system of engine upto 100^0C. They also concluded that by using crude palm oil produces lower NOx and CO compared with those from emissions of diesel combustions.

K.S.V. Krishna ruddy [6] et al. has done experimental investigation on CI engine by using palm oil (25% and 50%) blendes with commercial engine oil SAE 20W 40 and evaluated performance and emission characteristics of diesel engine at different load conditions.

Boehm an et al. [7] have carried out the experiment on single cylinder engine with and without thermal barrier coated components, with petroleum based lubricants and a mineral oil lubricant for comparison. Four ball testers is used to test the data of wear characteristics of vegetable mineral oil and petroleum lubricants. The results shows the better and similar wear characteristics of vegetable oil compared to commercial petroleum lubricants.H.H Masjuki et al. [8] have demonstrated that crude palm oil can be converted into methyl esters and can be used as additive in small diesel engine. The Results obtained from his study show that the output power and brake specific fuel (BSF) consumption of the diesel engine, lubricated with commercially available SAE 40 oil blended with Palm oil diesel, is compared with pure SAE 40 oil. The results show the wear analysis of blends of palm oil diesel and SAE 40 oil increase the anti-wear characteristics of the engine when compared to SAE 40 engine oil.

The main objective of this work is to use crude palm oil which is abundantly used as vegetable oil in India and done experiments to find out thermo physical like thermal conductivity, kinematic viscosity, flash point and fire point properties and four stroke engine performance characteristics.

III. EXPERIMENTATION

The following experiments are conducted using KD2 pro thermal property analyser, Cleveland open cup apparatus, Redwood viscometer II and cloud & Pour point apparatus.

A. Thermal conductivity

KD2 pro thermal property analyser is an instrument made from Decagon company, USA is used to find the thermal property of Palm oil and is compared with commercial available engine oil 20W 40. It consists of handled microcontroller and sensor needles to find the rate of heat transfer takes place per unit time. The sensor needle is used to find the thermal conductivity from 0.2–2 W/mK with an accuracy of ±5%. The thermal conductivity has been tested at various temperature conditions by using addition experimental setup as shown in figure 3.1.

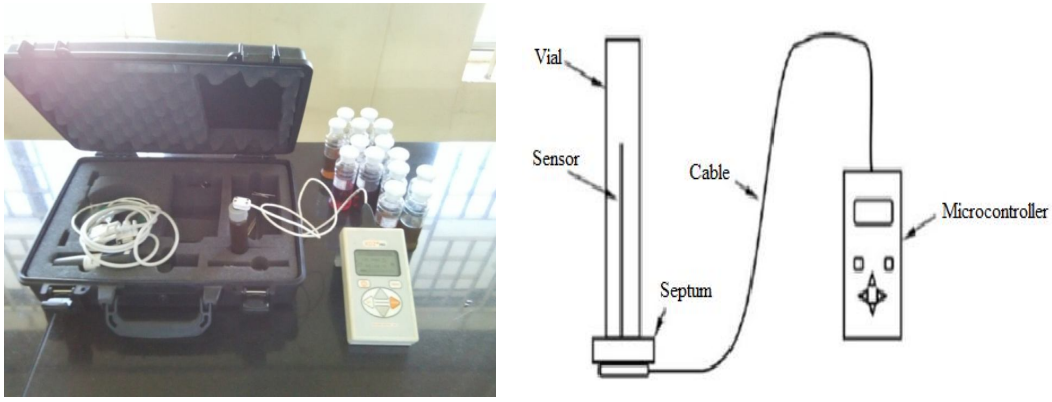

Fig 3.1: Snapshot and schematic reprentation of KD2 pro thermal propert analyzer

B. Kinematic Viscosity

The rate of oil resistance against flowing is called viscosity, which is one of the most important factors of lubricant to resist the rate of flow. The Kinematic viscosity of Crude palm oil (CPO) and commercial engine oil 20W 40 is experimentally studied by using Redwood viscometer I at different temperature conditions. The experiment is carried out using standard experimental procedure in engineering laboratory as shown in figure 3.2.

Fig 3.2: Redwood viscometer 1

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C. Flash & fire point

Flash point is auto ignition temperature at which a particular organic compound gives off sufficient vapour to ignite in air. For fire point detection, the sample continues to be heated until permanent flame is detected which is known as Fire point. Flash and Fire Point on petroleum products, gas oils, fuel oils, lubricants are measured by using Cleveland open cup apparatus shown in Figure 3.3. Both the flash & fire point of Crude palm oil and commercial 20W 40 engine oil are carried out on Cleveland open cup apparatus. The experiment is carried out as per standard procedure in engineering laboratory.

Fig 3.3: Cleveland open cup apparatus

D. Pour point & cloud point

Pour point is a property of fluid temperature at which it becomes semi solid and loses its characteristics of liquid. In crude oil a high pour point is generally associated with high paraffin content, typically found in crude deriving from a larger proportion of plant material. Whereas cloud point refers to the temperature below which wax in lubricant appear in cloudy form. The wax which present in solidified form thickens the oil and clogs fuel filters & injectors in engine equipment. These properties are tested on cloud and pour point apparatus by standard laboratory test method (Double test) as shown in figure 3.4.

Fig 3.4: cloud and pour point apparatus

IV. RESULTS AND DISCUSSIONS

A. Thermal conductivity

The results shows for the comparison of commercial 20W 40 engine oil and crude palm oil, with the increase in temperature there is a decrease in thermal conductivity. The same is happening for the engine oil as well as crude palm oil and the results are as shown in table 4.1. The results show that the thermal conductivity value of palm oil is higher than 20W 40 engine oil.

TABLE 4.1
THERMAL CONDUCTIVITY COMPARISON FOR CPO & ENGINE OIL

S.No	Temperature (^{0}C)	Thermal conductivity (W/mK)	
		Crude Palm oil (CPO)	20W 40 Engine oil
1	25	0.1721	0.1384
2	30	0.1717	0.1380
3	35	0.1712	0.1375
4	40	0.1708	0.1373
5	45	0.1704	0.1371
6	50	0.1699	0.1365
7	55	0.1695	0.1360
8	60	0.1691	0.1355
9	65	0.1687	0.1345
10	70	0.1683	0.1325
11	75	0.1679	0.1320
12	80	0.1675	0.1315
13	85	0.1671	0.1310
14	90	0.1668	0.1309
15	95	0.1664	0.1305
16	100	0.1660	0.1300

B. Kinematic viscosity

The kinematic viscosity of crude palm oil and commercial engine oil decreasing with the decrease in temperature at initial condition. The viscosity of palm oil is higher than that of engine oil as shown in figure 4.1. The rate of resistance to fluid flow is higher to palm oil than engine oil. After running four stroke IC bike engine for 500Km the viscosity graph of CPO is shown in figure 4.2

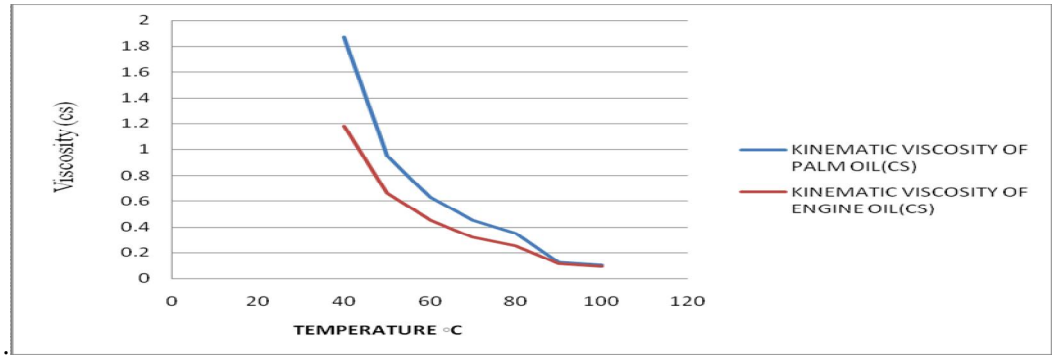

Fig 4.1: Viscosity of 20W 40 Engine Oil & Crude Palm Oil

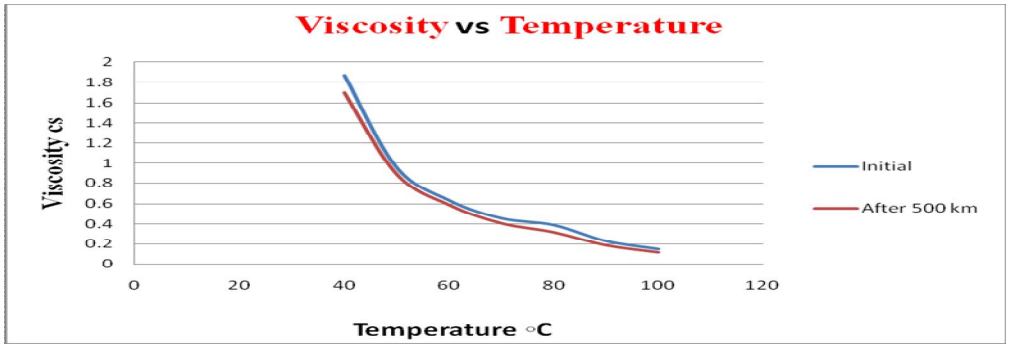

Fig 4.2: Viscosity of Crude Palm Oil after 500km

C. Flash point and fire point

The results show that flash point and fire point values of CPO is higher than that of 20W 40 engine oil. The commercial 20W 40 engine oil very volatile and has a fairly low flashpoint as well as fire point than crude palm oil. The obtained results of flash and fire point shown in table 4.2 and in figure 4.3.

TABLE 4.2
FLASH & FIRE POINT OF CPO & 20W 40 ENGINE OIL

Type of oil	Fire Point (^{0}C)	Flash Point (^{0}C)
20W 40 Engine oil	230	226
Crude Palm oil	257	252

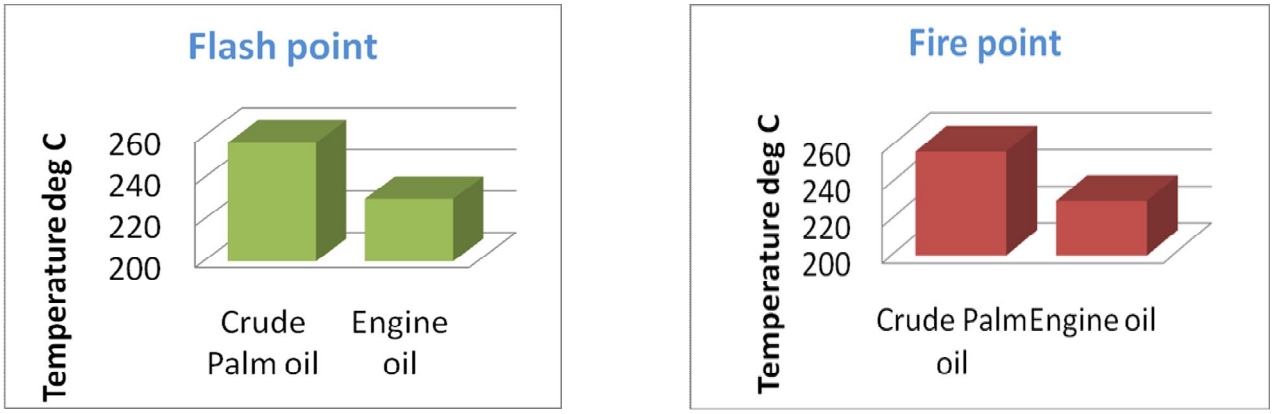

Fig 4.2: Flash point & fire point of CPO & 20W 40 engine oil.

D. Pour point & cloud point

The pour point and cloud point results show that 20W 40 engine oil having less cloud point temperatures compared to crude palm oil. The cloud point results of CPO show 30% better than that of 20W 40 engine oil as shown in table 4.3 and figure 4.3.

TABLE 4.3
POUR & CLOUD POINT OF CPO & 20W 40 ENGINE OIL

Type of oil	Pour point (^{0}C)	Cloud point (^{0}C)
20W 40 Engine oil	-21	7
Crude Palm oil	-25	10

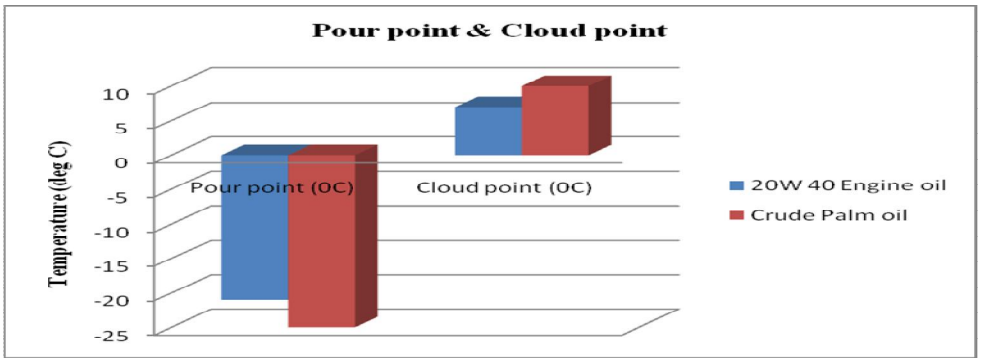

Fig 4.2: Flash point & fire point of CPO & 20W 40 engine oil.

V. CONCLUSIONS

By the above experimental results we can say that it is alternative lubricant oil for four stroke SI-Engines (up to 130CC engines). We can minimize soil pollution and environmental pollution by using crude palm oil instead of engine oil. As the crude palm oil is

available at 4.5 times lesser price and exhibiting better properties of viscosity, flash point, fire point, pour point and cloud point, this would be a better alternative to the existing engine oil. .

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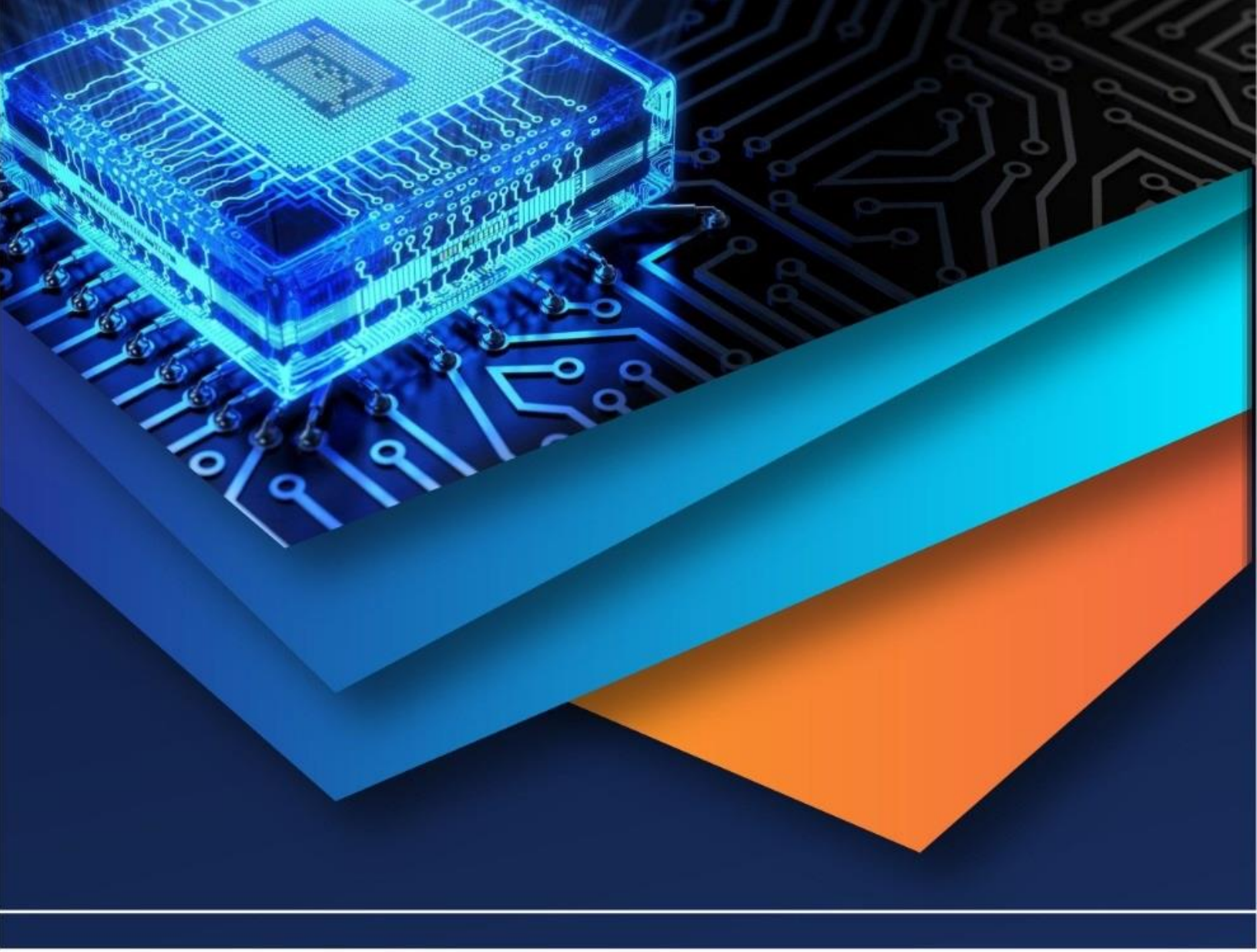

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