
ISSN: 2319-345X
IJMRBS
International Journal of
Management Research and
Business Strategy
www.ijmrbs.org
E-mail
editor@ijmrbs.org
editor.ijmrbs@gmail.com

International Journal of Management Research and Business Strategy

ISSN 2319-345X www.ijmrbs.com

Vol. 9, Issuse. 1, January 2021

Evaluation of Tribological Properties of Karanja Base Oil Using Additives for IC- Engine Application

Miss. Neha R. Wagh M. S. Mhaske

Abstract: Vegetable oils, as opposed to mineral-based lubricants, are renewable and biodegradable. However, their technical features are not ideal. Kanja oil (lubricant) is being utilised in this study to investigate environmental pollution, toxin levels, and cost. Karanja oil's anti-wear and anti-friction qualities may be improved with the addition of HBN, Tio2 and zinc-dialkyl-dithiophosphate (ZDDP). As a result, scientists have been working to create and test ecologically friendly lubricants based on Karanja oil as an alternative base oil. When it comes to its usage as lubricant base oils, karanja oil generally has great features including high viscosity index, high lubricity, high flash point, low evaporative loss, high bio-degradability, and low toxicity. This oil's tribological qualities were compared to certain others. An international standard approach for assessing lubricating oil's tribological characteristics is given.

Keywords: A biodegradable, ZDDP-free, four-ball Karanja Oil.

INTRODUCTION

When pieces of a machine come into touch with one another, friction is created that limits the movement of the machine. friction is the name given to this resistance. It wears out a number of the components in the system. A lubricant is a substance used to lessen the friction (or resistance) between them. lubricants are used to minimise friction between two surfaces. Lubrication refers to the practise of decreasing the amount of resistance that exists between two moving or sliding objects.. It is possible to divide lubricants into three types based on their physical state: liquid, semi-solid, and solid.Improved anti-friction and chemical qualities of base oils result in increased lubricant performance and longer equipment life via the use of additives. Depending on the kind of lubricant (engine oil, gear oil, hydraulic oil, cutting oil, etc.), various additive combinations and volumes might be used.Adding nanoparticle additions including HBN, ZDDP, and TiO2 nanoparticles to karanja oil will be studied in this research. Anti-wear additives such as HBN, ZDDP, and TiO2 minimise friction and wear while also enhancing viscosity and the viscosity index (VI). Improve the cost-effective karanja oil's tribological qualities, such as viscosity, viscosity index, friction, and load-carrying capacity.

P.G. Student, Department of mechanical engineering, Pravara Rural Engineering College, Loni, Maharashtra, India

Associate Professor, Department of mechanical engineering, Pravara Rural Engineering College, Loni, Maharashtra, India

mhaskems2000@yahoo.co.in

Kanja oil (lubricant) is being utilised in this study to investigate environmental pollution, toxin levels, and cost. The seeds of the Karanja (PongamiaPinnatta) tree are used to obtain Karanja oil, an inedible oil. As a result,scientists have been working to create and test ecologically friendly lubricants based on Karanja oil as an alternative base oil. Like lubricant base oils, Karanja oil's exceptional features as a high-viscosity index, high-lubricity oil, high flash point, low evaporative loss, high biodegradability, and low toxicity make it an ideal choice.

RELATED WORK

1. Using hexagonal boron nitride nanoparticles as an addition in the extreme oil pressure characteristics of the engine, Hakimi Chua Abdullahet.al [2016] observed that nano-oil has the capacity to slow down the attack point on the surface of Contact, where you can acquire greater EP. Comparing SAE 15W-40 diesel engine oil to nano-lubrication oil, more wearable surfaces of lubricated ball bearings have been shown to have more adhesive wear. The findings of experimental research have shown that hBN may be used as lubricant additives to increase the loading capacity of lubricating oil. (3)

2.As additions to mineral base multigrade engine oil, Vijay Kumar [2016] studies the tribological behaviour of titanium dioxide nanoparticles (TiO2). Nanoparticle concentration and load were varied in the lubricating oil throughout the testing. In the course of conducting friction and wear tests,

3.carried out by use of a disc pin. Using TiO2 nanoparticles in engine oil significantly lowers friction and wear frequency, which in turn enhances the lubrication of the oil. According to UV spectrophotometer study of TiO2 nanoparticle dispersion in engine oil, the nanoparticles have high stability and solubility in the oil, increasing the fluid's lubricating characteristics. (6)

4.Zinc-dialkyl-dithiophosphate (ZDDP) has been shown to increase Karanja oil's anti-wear and anti-friction qualities when used as an additive. Adding ZDDP to Karanja oil improved its anti-wear and anti-friction qualities, according to the research. Karanja oil and additive oil (Karanja oil + 2.0 Wt. percent ZDDP) were compared to SAE20W40 mineral oil in terms of tribology, physical qualities, and chemical composition. Tests on the tribological characteristics of these oils were carried out in accordance with ASTM D4172 B. In comparison to the commonly used mineral oil SAE20W40, percent ZDDP displays lower values for the Coefficient of friction and the Wear scar diameter. Furthermore, the chemical and physical qualities of this oil were tested using an international standard process that found it to be superior than SAE20W40, a mineral-based oil that is often used. [7]

PROBLEM STATEMENT

A. Conventional lubricants for diverse mechanical systems are made up of a variety of conventional additives.

Additives are used to make sure that there is enough lubrication and resistance to wear in the lubricant. But there are several drawbacks to using traditional additives. Their lubricating and anti-wear qualities are compromised since they cannot keep their original characteristics.

Consequently, the additives should be improved to enhance the lubricant's operating range.

D. As a result, the goal of this research is to determine if HBN, ZDDP, and TiO2 nanoparticles in karanja oil are suitable and feasible as a substitute for SAE 20W40 oil in IC engine lubrication.

OBJECTIVE

Improve anti-wear properties and assess scar diameter A.

B. To enhance the anti-friction properties of Karanja oil and additives and to compute the coefficient of friction.

At 400 and 1000 degrees Celsius, kinematic viscosity, flash point, and pour point may all be measured.

D. To determine the optimal ratio of additives to base oil percent.

SCOPE

We may test karanja oil's severe pressure and anti-wear capabilities by adding additional additives like oxides, graphite and so on. A.

B. karanja oil may potentially be utilised as a fuel for vehicles by improving its qualities with additions.

There is a common practise in rural India of using C. Karanja oil for everything from lighting lights and cooking to curing skin ailments.

METHODOLOGY

- **Property comparison of Karanja oil with Mineral oil**

Properties	**Mineral Oil (SAE 20W40)**	**Karanja Oil**
Density @ 15^{0}C kg/l	0.882	0.924
Kinematic Viscosity @ 40 dc	121 cSt	43.42 cSt
Kinematic Viscosity @ 100 dc	14.2 cSt	8.32 cSt
Viscosity Index	118	172
Flash Point in °C	230	251
fire point in °C	260	260
Pour Point in °C	-6	1
Cloud point in °C:	-3	4

Table 1: Property comparison of Standard oil with base oil
• The Reason for Oil's Selection
KARANJA OIL was utilised as the starting point for this inquiry.
Focused on environmental pollution, toxicity, and the financial burden it imposes.
alternative base oil for ecologically friendly lubricant: (c) utilising Karanja oil
D) The qualities of Karanja oil as a whole are outstanding.
Viscosity index (e):
f) High levels of lubrication.
(g) A high flash point.

Reduced evaporative loss is an important consideration.
I Biodegradability is quite high.
(j) Low toxicity when used as lubricant base oils.
• Nanotechnicals.

Product Name	Titanium Oxide Dispersion (TiO2)	BoronNitride Nanoparticles	Zinc Dialkyl-dithio-phosphate(ZDDP)
Size	3-6 nm	80nm	10nm
Purity	99.9%	99.8 %	99 %
Colour	White	White	White
Molecular Formula	TiO2	HBN	ZDDP
Density	4.23 g/cm3	2.29 g/cm³	1060-1150 Kg/m3

EXPERIMENTAL APPARATUS AND METHOD

A. Equipment

According to the ASTM D4172B standard, four ball tester machines were employed in this study. Lubricating oil

friction and wear may be easily tested using this equipment. Three balls are placed in a cup below a fourth ball, which is attached to a spinning shaft via a chuck, in a four ball tester machine. The weight of the load lever is applied to the balls, resulting in a 40 kg load. For measuring the frictional torque on the three lower balls, an arm calibrated to the friction recording device's spring may be used. A link on a drum transmits the spring extension necessary to withstand the frictional force once every 60 seconds.

Fig.1: Four ball tester machine

B. Ball Materials

The tested balls material was carbon chromium steel, 12.7 mm in diameter with a surface roughness of 0.1 µm. The chemical composition of ball material was obtained by energy dispersion X-ray spectrometer as shown in table 1

Element	C	Si	Cr	Mn	Fe
wt. %	10.20	0.45	1.46	0.42	87.21

Table 2: Chemical Composition of ball material

C. Lubricant sample

Sampl e no.	Base Oil	Additives	% of Additives in Base Oil by weight(gm).
1	KARANJA	TiO_2 + HBN + ZDDP	0.50%
2	KARANJA	TiO_2 + HBN + ZDDP	1%
3	KARANJA	TiO_2 + HBN + ZDDP	1.50%
4	KARANJA	TiO_2 + ZDDP	0.50%
5	KARANJA	TiO_2 + ZDDP	1%
6	KARANJA	TiO_2+ ZDDP	1.50%

7	KARANJA	HBN + ZDDP	0.50%
8	KARANJA	HBN + ZDDP	1%
9	KARANJA	HBN + ZDDP	1.5 %

Table 3: Sample preparation

D. Test method

It is necessary to set up three balls in cups with clamping rings before commencing the experiment. The locknut is then used to hold everything in place. When the top balls chuck is full, the fourth ball is added. Between the thrust bearing and the cup, mounting discs are inserted. Afterwards, the required loads are applied to the load lever and tested there.

Ease of Movement

The coefficient of friction is computed by multiplying the mean friction torque and spring constant. It may be described in terms of the lower balls' frictional torque as follows:

Where, μ = Coefficient of friction, T= Frictional torque in kg/mm, W= Applied load in kg, r = Distance from the center of the contact surfaces on the lower balls to the axis of rotation, which is 3.67 mm.

E. Wear Test

The test run was carried out at load 40 kg and 1200 rpm with test duration 60 minutes. The wear scar diameter (WSD) is measured and analyzed by DUCOM software with installed image acquisition system.

Fig. 2 Image Acquisition System

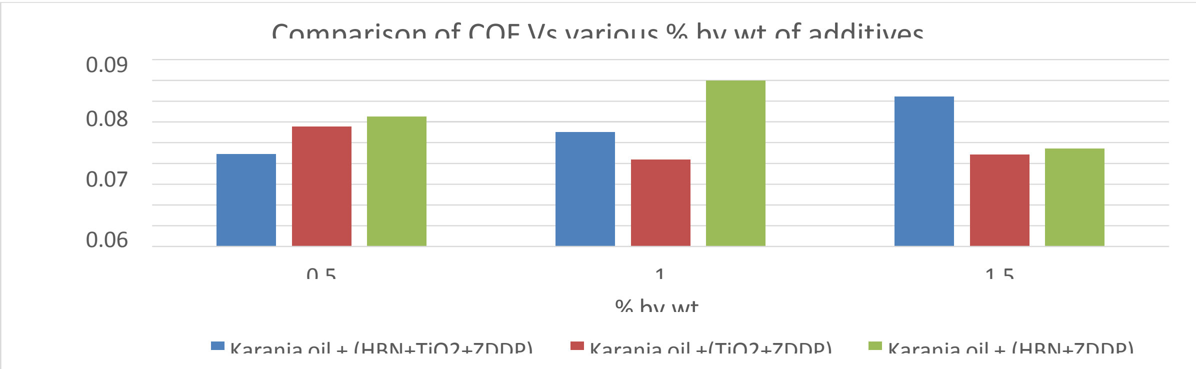
F. Kinetic Viscosity Analysis

Use of the redwood viscometer is done following the ASTM D4172 technique for lubricating oil at 400 and 1000 degrees Celsius. The viscometer is calibrated using a standard sample oil before measuring the viscosity of the lubricating oil. The oil is heated to the proper temperature and then allowed to flow through the calibrated area to be analysed. the apparatus constant is multiplied by the flow time (in secs) in order to get oil viscosity in cSt

Sample No.	Oil name	Coefficient of friction (COF)	Wear scar diameter (WSD) in micrometre
1	Karanja oil + 0.5% (TiO_2 + HBN + ZDDP)	0.044	192
2	Karanja oil + 1% (TiO_2 + HBN + ZDDP)	0.055	193.67

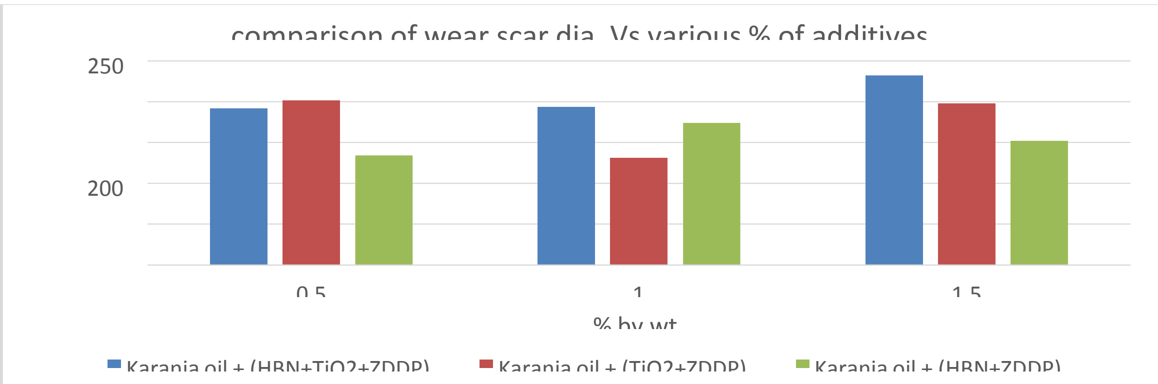
3	Karanja oil + 1.5% (TiO2 + HBN + ZDDP)	0.072	232.33
4	Karanja oil + 0.5% (TiO2 + ZDDP)	0.0578	201.33
5	Karanja oil + 1% (TiO2 + ZDDP)	0.0418	131.33
6	Karanja oil + 1.5% (TiO2 + ZDDP)	0.0443	198
7	Karanja oil + 0.5% (HBN + ZDDP)	0.0627	134.33
8	Karanja oil + 1% (HBN+ ZDDP)	0.0798	174
9	Karanja oil + 1.5%(HBN+ ZDDP)	0.0470	152

Table 4: Coefficient of friction and wear scar diameter of karanja oil with various % of additives.



Graph 1: The relation between coefficient of friction and various % of additives in karanja oil

As shown in Graph 1 karanja oil with various % of additives are being plotted on X – axis and coefficient of friction on Y- axis. This shows that karanja oil with 1% (TiO2 + ZDDP) has comparatively better coefficient of friction (μ= 0.0418) than the other samples.



Graph 2: The relation between wear scar diameter and various % of additives in karanja oil.

As shown in Graph 2 karanja oil with various % of additives are being plotted on X – axis and minimum wear scar diameter of steel ball is on Y- axis. This shows that karanja oil with 1.5% (TiO2 + ZDDP) has comparatively better wear scar diameter (WSD=131.33 micrometer) than the other samples

Oil name	**SAE 20W40**	**Karanja oil+1%(TiO2+ZDDP)**

Wear scar dia.(µm)	171.33	131.33
Coefficient of friction	0.09452	0.04177
Time required to collect oil at 40°c (sec.)	280	202
Kinematic Viscosity	68.928	49.572
Time required to collect oil at 100°c(sec.)	66	58
Kinematic Viscosity	14.545	12.036
F[illegible]	[illegible]	[illegible]
F[illegible]	[illegible]	[illegible]

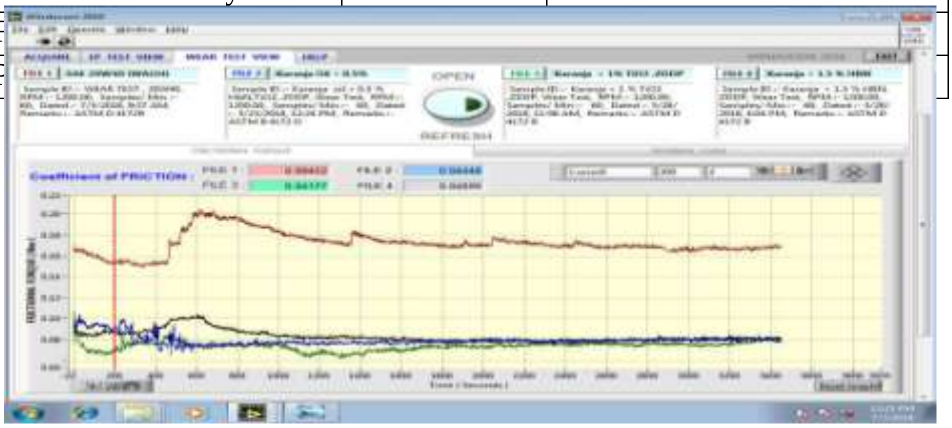


Table 5: comparison of base oil, SAE 20W40,and Karanja oil + 1% (TiO2+ZDDP)

Graph 15: Comparison of COF graph between best samples SAE 20W40, Karanja oil + 0.5% (HBN TiO2+ ZDDP), Karanja oil + 1% (TiO2+ ZDDP) and Karanja oil + 1.5% (HBN + ZDDP).

CONCLUSION

TiO2, HBN, and ZDDP nanoparticle Oxides may greatly lower the coefficient of friction and wear scar diameter in lubricating oils by conducting a tri-bological inquiry.

Karanja oil with 1% (TiO2 + ZDDP) wear scar diameter (WSD=131.33 micrometre) is superior to commercial SAE 20W40 oil in tribological tests.

TiO2 + ZDDP-infused Karanja oil has a superior friction coefficient (=0.04177), greater kinematic viscosity, and lower pour point temperature than standard Karanja oil. The tribological characteristics of oil may be easily and accurately assessed using the four ball and viscometer tests.

ACKNOWLEDGMENT

It is with great joy and happiness that I deliver the review article on "Evaluation of Tribological Properties of Karanja Base Oil Using Additives for IC-Engine Application". Prof. M. S. Mhaske's invaluable advice, discussion, and ongoing support were vital in my success in completing this project.

REFERENCE

[1] For example, [1] Tirth M. Panchal and Ankit Patel, "A systematic review on biolubricants from vegetable oil-based resources," Department of Industrial Chemistry, Institute of Science and Technology for Advanced Studies and Research (VallabhVidhyanagar, Gujarat 388120, India), 2017.

[2] "A study of the tribological behaviour of TiO2 nano-additive water-based Lubricants", School of Mechanical, Materials and Mechatronic Engineering, University of Wollongong, Wollongong, NSW 2522, Australia, HuiWua, JingweiZhaoa (2017)

[3] Ilman Hakimi Abdollah Noreffendy Tamaldin Hilmi, the Chua of Abdullah Mohd Fadzli Amiruddin Industrial Lubrication and Tribology, Vol. 68, Issue 4, Pg. 441–445 (2016), "Effect of hexagonal boron nitride

nanoparticles as an additive on severe pressure characteristics of engine oil,"
[4] "Titanium oxide nanoparticles as additives in engine oil" by Meena Laad and Vijay Kumar S. Jatti, (2016), Applied Science Department, Symbiosis Institute of Technology (SIT), Symbiosis International University (SIU), Lavale,Mulshi, Pune 412 115, Maharashtra State, India.
[5] The lubricant contains titanium dioxide nanoparticles as an additive, according to Filip Ilie and Cristina Covaliu (2016).
[6] "Titanium oxide nano-particles as anti-wear and friction-reducing additives in lubricating oil" by Vijay Kumar S. Jatti, Mechanical Engineering Department, Symbiosis Institute of Technology (SIT), Symbiosis International University (SIU), Lavale, Pune, Maharashtra State in India, 2015. [6]
[7] Mahipal D., and Jayadas N H 2014, "Analysis of lubricating qualities of ZDDP additive on Karanja oil (Pongamiapinnatta) as a green lubricant," International Journal of Engineering Research ISSN:2319-6890) (online),2347-5013 (print) Volume No.3, Issue No.8, pages 494-496. p. Cochin University of Science and Technology's School of Engineering, Kochi (Kochi, Kerala, India)
[8] "Performance of Vegetable Oil as Lubricant under Extreme Pressure Condition," Procedia Engineering 68 (2013) 172–177, S. Syahrullail, S. Kamitani, and A. Shakirin (2013).
[9]The 9th person is Muhammad Ilman Hakimi. Procedia Engineering 68 (2013) 313–319, Chua Abdullah, Mohd Fadzl Bin Abdollah, Hilmi Amiruddin, Noreffendy Tamaldin and Nur Rashid Mat Nur, (2013) "Optimization of Tribological Performance of hBN/AL2O3 Nanoparticles as Engine Oil Additives."
[10] Chauhan
[11] "Chemical modification of karanja oil for bio-lubricant industrial applications" was presented by Prerna Singh and Dr. V.K. Chhibber at Uttarakhand Technical University, Dehradun, Uttarakhand in 2013. (U.K.)
[12] A Review on the Use of Non-Edible Oil as a Bio-Lubricant in Industrial Applications by Prerna Singh Chauhan and Dr. V K Chhibber, (2013), ISSN 2319-5967 Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 1, January 2013, 299
[13] Dr. BS Kothavale, (2011) "Evaluation of Extreme Pressure Properties of Lubricating Oils Using Four Ball Friction Testing Machine", IJAET/Vol.II/ Issue III/July-September, 2011/56-58.
[14] Tsui, Tsui and Liu (2007) "Experimental examination of tribological characteristics of lubricating oils with nanoparticle additions", Wear 262 (2007) 819–825.