TRIBOLOGICAL ANALYSIS OF CASHEW NUT SHELL OIL AS BIO LUBRICANT

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Abstract: Lubricant plays an important role in lubrication of components of IC engines and Machining applications. Bio oil is extracted from cashew nut shell and blended with existing lubricant SAE 20W40 in four different blends. Coefficient of friction test is done by Ducom four ball tester. The test is carried out under ASTM D2783. The test is done by varying load and constant rpm 1200. Then inverted microscope was used to measure the wear scar diameter. This analysis examines friction and wear behaviour of bio lubricant.

Keywords: Lubrication; extracted; four ball tester; Coefficient of friction; wear scar diameter; inverted microscope.

I. INTRODUCTION

The huge amount of cashew nut shell is collected and oil is extracted by using oil expeller by crushing method. The shell is exposed in sunlight to make it dry. The existing lubricating oils are collected and properties of existing lubrication oils and raw bio oil is determined. The cashew nut shell oil is blended with existing 20w40 oil with help of stirrer. There are four different proportions of blending is done. The table I shows the properties comparison of various existing bio oils with bio lubricant. The properties of bio lubricant is good and suitable for lubrication purpose.

TABLE I. Properties of bio lubricant and existing oils

PARAMETER	Unit	10W30	20W40	40 grade	BIO LUBRICANT
Density	gm/ml	0.860	0.895	0.925	0.921
Flash point	ºc	235	236	250	248
Fire point	ºc	238	238	254	250
Boiling point	ºc	233	230	248	245
Viscosity index	-	146	120	112	108
Viscosity at 40ºc	cst	65.5	124	137	135
Viscosity at 100ºc	cst	10.8	15	16.5	18
Specific gravity	kg/m3	0.948	0.918	0.948	0.951
Acid value	%	2.05	1.0	5.4	7.0
Pour point	ºc	-40	-30	-25	-45

II. LUBRICANT PREPARATIONS

The different percentages of cashew nut shell oil and SAE 20W40 oil is blended with the help of stirrer. The blend proportions are 10%, 20%, 30% and 40%.

Viscosity test

Viscosity test is done by Redwood Viscometer as per ASTM D-445. Viscosity test is done for four different temperatures.

TABLE II. Viscosity for 20w40 oil and blend samples

Oil Samples	VISCOSITY In cst			
	40º	60º	80º	10º
20W40	124	91.3	37.1	15
B10	117	87.7	39.4	17.8
B20	108	79.8	41.7	14.8
B30	105	88.1	49.2	15.2
B40	120	91.2	51.6	16.5

III. EXPERIMENTAL PROCEDURE

Apparatus

A four ball tribometer is made by Ducom Instruments. Four ball tribometer or four ball wear tester is used for mainly friction and wear test for lubricating oil and lubricating greases. The coefficient of friction is determined under ASTM D2783.

Fig 1. Four ball tribometer

TABLE III. Specification of four ball tribometer

Test speed	300 – 3000 rpm
Test load	0 – 200 Kg
Frictional torque	0 – 16 Nm
Temperature	Ambient to 120 ºC
Power	415 V, 50 Hz

Friction test

The prepared four samples of lubricant is tested under 70ºC and by varying load as 20 kg, 40 kg and 60 kg with constant speed of 1200 rpm. The material of the ball used is steel.

New balls were used for each test, all pieces and balls were first cleaned before experiment. The rollers used for this test is made up of steel balls. The steel ball was first placed in the

oil cup. The oil cup was tightened using a torque wrench to prevent bottom steel balls from moving during the experiments.

The upper spinning ball was locked inside the collected and tightened into the spindle. The test sample of lubricants was poured in the cup assembly and other blended samples are poured later separately. To avoid shocks and vibrations, the test load was applied slowly. The lubricant was heated to a desired temperature, after reaching desired temperature the ball at the top is made to rotate with the help of drive motor. The test balls was rotating at a speed of 1200 rpm.

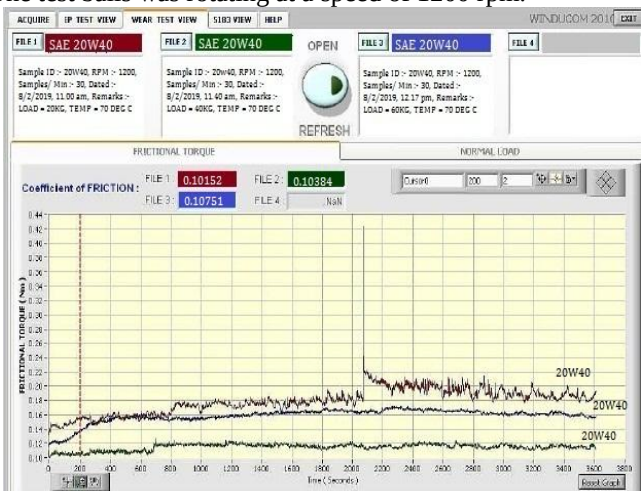

Fig 2. Coefficient friction was SAE 20W40 for different loads

The test process was carried for 30 minutes per sample. The test oils was then drained from oil cup and scar area was wiped using a tissue. After the test balls were removed for the microscopic analysis.

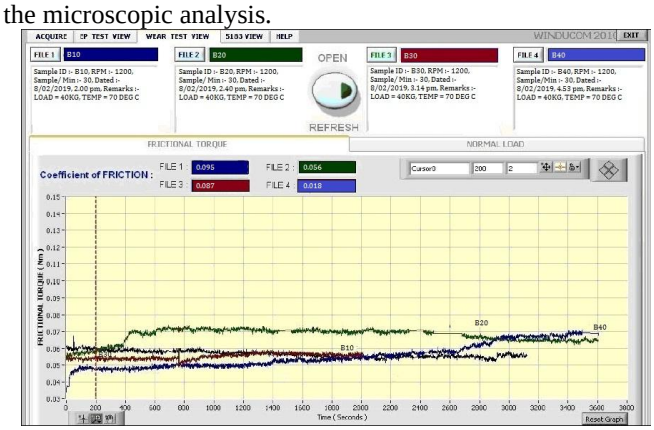

Fig 3. Coefficeint of friction for different samples

For each balls average scar diameters were found and it is tabulated. The same process were carried out for the remaining samples and the results are obtained. The data were recorded by the computer automatically.

TABLE IV. Coefficient of friction values

Load in kg	20W40	B10	B20	B30	B40
20	0.10152	0.0899	0.06552	0.05114	0.01174
40	0.10384	0.09537	0.08732	0.05695	0.01875
60	0.10751	0.10098	0.09126	0.06245	0.00981

Wear scar diameter

Wear scar diameter was analyzed by using inverted microscope it is a type of image acquisition system. The microscopic analysis is done. The wear scar dia have been reduced effectively by various blends. Wear scar image of Lubricating oil is shown in the figure at Magnification 50X.

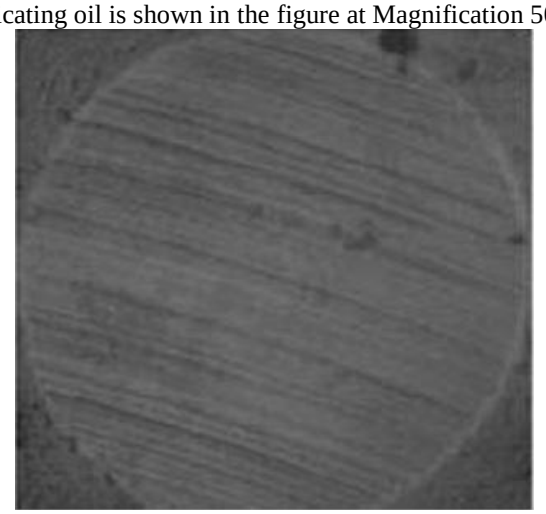

Fig 4. Sample B40

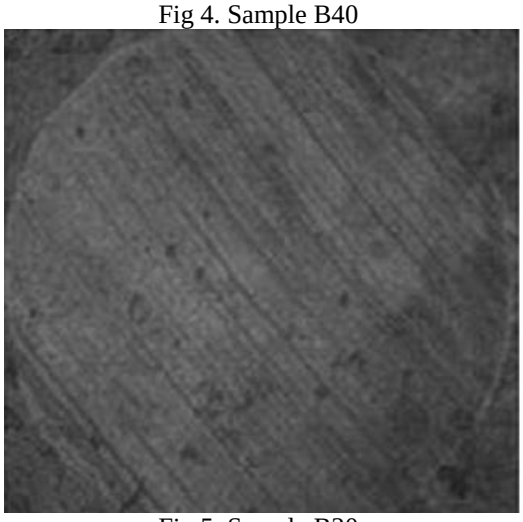

Fig 5. Sample B30

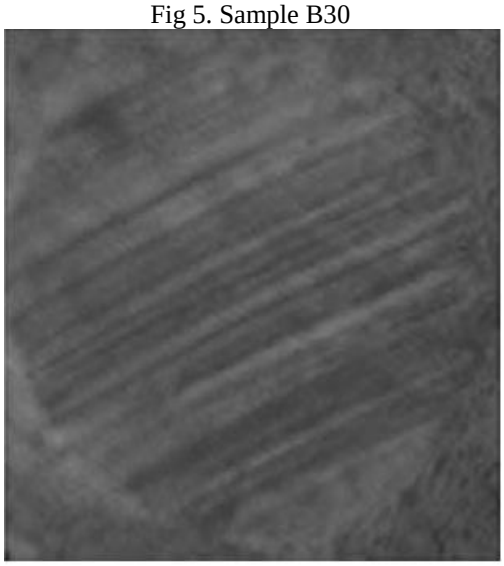

Fig 6. Sample B20

Fig 7. Sample B10

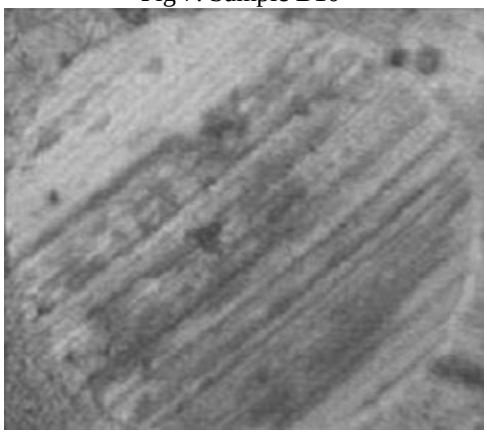

Fig 9. Sample 20W40

Oil samples	Wear scar diameter of ball 1(µm)	Wear scar diameter of ball 2 (µm)	Wear scar diameter of ball 3 (µm)	Average Wear scar diameter (µm)
20W40	509	522	531	520.66
B10	500	454	421	458.33
B20	446	487	437	456.66
B30	419	455	410	428
B40	417	397	373	395.6

TABLE V Measurement of Wear Scar in micron

IV. CONCLUSION

As a result, the viscosity of blend samples were increased at higher temperature and coefficient of friction is also reduced. B30 and B40 blends reduces coefficient of friction and wear scar diameter is also reduced well. B40 gives less coefficient of friction and decreasing wear scar diameter. So B40 blend oil shows good and promising tribological characteristics of lubricant. B40 is very much suited for high temperature applications.

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