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EVALUATION OF KINEMATIC VISCOSITY, WEAR AND FRICTION OF GENUINE AND NON - GENUINE ENGINE OILS LUBRICATION

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Abstract

This study is identified and evaluate the kinematic viscosity, wear preventive characteristics and coefficient of friction between genuine and non-genuine engine lubrication oil brand. The lubrication oil brand used is Perodua Genuine (PG) oil SAE5W-30. The kinematic viscosity is carried out by Heated Viscometerat 40°C, 60°C and 70°C.The anti-wear properties and the friction characteristics were performed using four ball wear tester at speed 600 rpm and 1200rpm.The results show that the genuine engine oil has high kinematic viscosity, less wear and low friction of coefficient as compared to non-genuine engine oil.

Index Terms—Four-ball tribotester, Wear, Friction, Engine Lubrication

INTRODUCTION

Now day's technology, engine lubrication oil syndicates can duplicate the well-known brands in the Malaysian market such as Perodua, Toyota, Shell, Repsol, Castrol, Nissan and Honda. Many vehicles' owners are unaware of the sale of the non-genuine lubrication oil is not from official dealer ship. Shell Malaysia had conducted laboratory tests based on 12 samples sold in online and hypermarkets in 2018. Based on the testing, it is showed that 4 out of 12 products sold are non-genuine lubrication engine oil. These results make Shell Malaysia Trading Sdn. Bhd. strengthen its cooperation with enforcement agencies for reducing the presence of non-genuine lubricants engine oils to consumers and workshops. The Shell Malaysia had conducted a special product training to enforcement selected officers for sharing the knowledge about the genuine Shell Engine Oils Lubrication [1].The usage of non-genuine engine oils lubrication is not capable to absorb the heat generated. The engine will quickly heat up and it becomes rugged and worn which cause the engine overheating.

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Engine oils lubricating are complex composite mixture of hydrocarbons blended with chemical that known as additives. The main function of additive in engine oils lubrication is to provide a hydrodynamic lubrication on the surface onto which they are distributed [2]. Normally, oils lubricants arecontained80-90% petroleum hydrocarbon concentrate with 10-20% of additives[3].

The main difference in oils is the 'viscosity' or the thickness of the oil. By selecting correct kinematic viscosity used for engine oil will help maximum engine lifespan. Therefore, the Society of Automotive Engineers (SAE) was established a code system for grading motor oils according to viscosity characteristics. As example, engine grade oil SAE 5W-30 able to flow at low temperatures and give better oil cold temperature because of thinner oil [4]. The oil viscosity is changed with temperature. When the temperature is increased, the oil viscosity will decrease due to the molecules of oils are crack into smaller and allowing the oil to become more fluid [5]. The oil of viscosity also changed the wear resistance of an engine. By increasing the wear rate, the engine lifespan will reduce. Therefore, separated the surfaces of the rubbing components by thick oil film will minimize wear resistance. Wear usually occurs in engine on piston rings, cylinders, bearing and cam lobes. However, wear is occurred normally on engine piston rings and engine cylinder liner [4].

METHODOLOGY

Preparation of testing materials

One sample genuine lubrication oil, namely Sample A is purchased from authorize outlets and one sample non-genuine lubrication oil, namely Sample B is purchased through unauthorized channel.

Viscosity test

Heated Viscometer (Fig. 4) is used to identify the viscosity of the lubricants.The viscosity value is taken at three temperature which are 40°C, 60°C and 70°C by using Heated Viscometer (Fig. 1) according to ASTM 445.The 100ml of oil is used for each test and each test is repeated three times for average reading.

Fig.1: Heated Viscometer

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C. Four ball tester.

Four-ball wear tester machine (Fig. 2) was used to determine wear preventive characteristics of lubricating fluid (ASTM D4172) and coefficient of friction of lubrication (ASTM D5183). These experiments were carried out at two speeds 600 rpm and 1200 rpm, load is kept constant at 40 kg (392 N) at temperature 75°C and test duration is set at 60 minutes for each test (Fig. 3). The bearing steel balls are made from chrome alloy steel (AISI standard steel No. E-52100) 12.7mm diameter were used for this test. The bearing steel balls are cleaned before the wear test was conducted by using hydrocarbon solvent (hexane). Fig. 4 shows the four ball tribotester schematic diagram that contains the assembly, collet and ball bearing of the oil cup.

Fig.2: View of Four Ball Tester machine is used(KOEHLER K93190-M)

Fig.3: Duration of testing is set at 60 minutes for each test.

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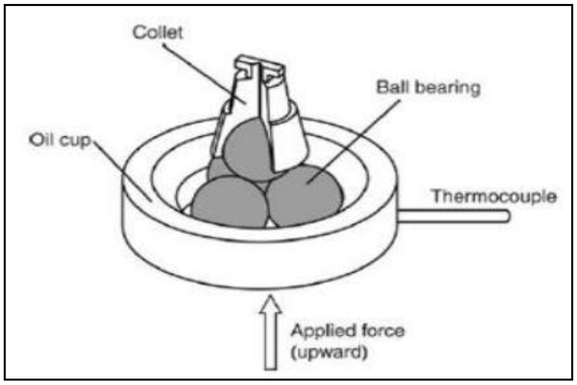

Fig. 4: Main Part of the four-ball tester

Results and Discussion

Kinematic viscosity test.

Table 1: Kinematic Viscosity Results.

	Temperature		
	40°C	**60°C**	**70°C**
Sample A	**75.8 mm^2/s**	**65.7 mm^2/s**	**61.5 mm^2/s**
Sample B	**68.8 mm^2/s**	**61.4 mm^2/s**	**57.9 mm^2/s**

The result values of kinematic viscosity both of samples are showed in Table 1 and Fig. 5. Sample A has shown the high value of kinematic viscosity compared to Sample B at three different temperature. Kinematic viscosity value forSample B at 40°C is low about 10% compared to Sample A, while at 60°C viscosity Sample B is low compared to Sample A about 7%. At temperature 70°C, viscosity Sample B is low about 6% compared to Sample A. In general, Sample A is showing a best lubricity performance compared to Sample B. It is because of Sample A is used high anti-friction and anti-wear ability [4].

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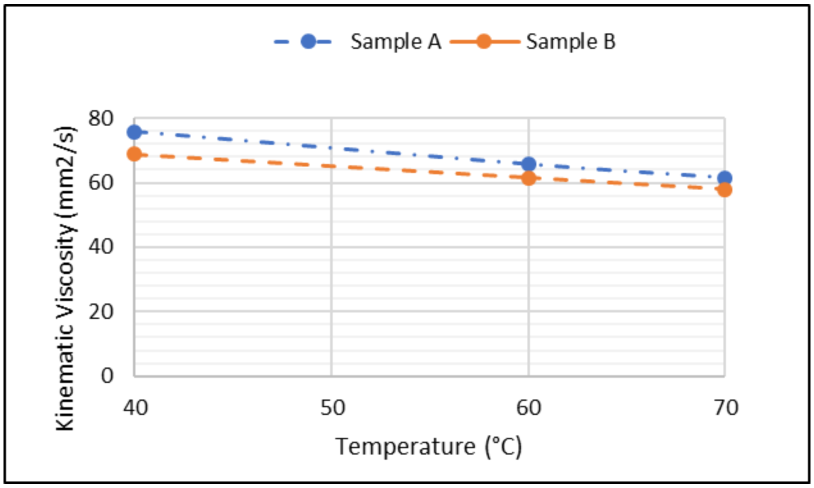

Fig. 5: The comparison of kinematic viscosity between genuine (Sample A) and non-genuine (Sample B)

Wear Scar Diameter

The wear scar diameter has been measured and identified through the microscope to find the scar occurred on the ball bearing (Fig. 6). The average of the wear scar for Sample A and Sample B at speed 600 rpm are showed at Table 2 and at speed 1200 rpm are showed at Table 3.

Fig.6: Image acquisition system.

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Table 2: Results of wear test 600 rpm

Speed (rpm): 600	
Sample	Wear scar diameter (µm)
	Average Diameter
A	181
B	306

At speed 600 rpm, it shows that the average wear scar diameter of Sample B is high about 41% compared to Sample A. The reasonwear car diameter of Sample B high probability due to less contain of antioxidant additive which antioxidant additive can help to form a surface film to reduce metal-to-metal contact and thus reduce wear.In addition to this, antioxidant additives are added into the lubrication oil formulations are to slow down the rate of oxidation for stabilization purpose and enhances other performance of lubricant. Another reason the wear is increased due to less of oxidation stability. Therefore, amount of antioxidant additive in engine oil lubricant must corrected to help preventing direct oxidation of metal surface and surface layer formations, thus reduces friction and wear[4].

At speed 1200 rpm, the wear scar diameter for both samples is increased gradually and found that value is slightly difference which is 6 µm. This is because at speed 1200 rpm, the high pressure is generated, and this high pressure can prevent the contact between metal to metal. During at high speed, thick oil film is generated to make minimal interaction between the oil's lubricant and the metal surface[4].In additional, the thickness of the oil film had a significant impact on the engine oils lubricant anti-wear capability [6].

Speed (rpm): 1200	
Sample	Wear scar diameter (µm)
	Average Diameter
A	593
B	599

Table 3: Results of wear test 1200 rpm.

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Coefficient of Friction

Table 4 showed the result coefficient of friction for Sample A and Sample B at speed 600 rpm and Table 5 at speed 1200 rpm. Sample A is show lowest coefficient of friction at both speeds is due of greater oiliness and able to adhere surfaces of high temperature components. The good lubrication property can reduce energy lost due to friction, giving an engine lower fuel consumption and higher mechanical power output[7].

Table 4: Results of Coefficient friction at 600 RPM.

Speed (RPM): 600	
Sample	**Coefficient of friction (μ)**
A	0.08224
B	0.08552

Table 5: Results of Coefficient friction at 1200 RPM.

Speed (RPM): 1200	
Sample	**Coefficient of friction (μ)**
A	0.12975
B	0.13312

IV. Conclusion

In this experimental, the result of genuine (Sample A) and non-genuine (Sample B) engine oils lubrication is presented and have been discussed in term of Kinematic Viscosity, Wear Scar Diameter and Coefficient of Friction. Following shown the conclusion drawn from this experimental:

1. Value of Kinematic viscosity for sample B (non-genuine lubrication oil) is lower value than sample A (genuine lubrication oil) at three different temperature.It shows that the oil manufacturer for Sample A is used good quality of additives in order to improve the quality and performance of the oil.
2. Sample A is found have a good anti-wear ability when the wear scar diameter is lower than Sample B at 600 rpm.
3. The lowest coefficient of friction is found at sample A where it can reduce energy lost due to friction and able to givegood fuel consumption and higher mechanical power output.

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