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Signature :..............................

Supervisor : Dr. Hady Effendy

Date :...27/05/2010.....

" I declared that this project repor entitled " Analysis Performance of New Lubricant for Motorcycles" is written by me and is my own effort except the ideas and summaries which I have clarified their source."

Signature : ....

Name of Candidate : AHMAD FAIZ BIN HAMZAH

Date : 24/5/10

ANALYSIS OF NEW LUBRICANT PERFORMANCE FOR MOTORCYCLE

AHMAD FAIZ BIN HAMZAH

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ABSTRACT

These analyses of lubricant use types of the engine oil in motorcycle, there are three types of engine oils are normal (20W-40), semi synthetic(15W-40) and fully synthetic (15W-50). To analysis the performance of the lubricant, the method use is Four Ball Tester (extreme pressure) E.P machine to obtain the result. From this experiment there are two brands X and Y with the same grade is analysis to be compared the quality. The test uses the applied load to give different size of scar diameter to the ball. The size of the scar will be compare to analysis the result based on the graph of applied load versus scar diameter will be obtained. The load in this test is increased until reach the welded point that shows the maximum load can be applied to the lubricant. The results that compare from the analysis shows the maximum load (welded point) is at 160 kg for grade 20W-40, for 15W-40 and 15W-50 can reach the 200kg until 250kg load. The friction analysis also shows how the lubricant prevent the steel ball from wear, the less friction produce the higher quality of lubricant.

ABSTRAK

Analysis ke atas pelincir adalah dengan menggunakan jenis minyak enjin pada motorsikal. Terdapat tiga jenis minyak enjin iaitu minyak biasa (20W-40), minyak separuh sintetik(15W-40), dan minyak sepenuhnya sintetik(15W-50). Bagi menganalisa minyak ini teknik yang digunakan adalah menggunakan ujian "Four Ball Tester (extreme pressure E.P)". daripada ujian ini terdapat dua jenama iaitu X dan Y akan dibandingkan untuk menentukan jenama yang lebih berkualiti. Bagi mendapatkan keputusan ujian ini menggunakan tindakan beban untuk memberikan perbezaan saiz diameter calar pada permukaan sampel bola. Saiz akan dibandingkan untk dianalisa keputusan yang berdasarkan kepada graf tindakan beban melawan diameter calar. Beban didalam ujian ini akan ditambah sehingga berjumpa titik perlekatan besi yang menunjukan beban maksimum yang boleh dikenakan keatas pelincir. Keputusan yang dibandingkan dari hasil kajian menunjukan beban maksimum (titik perlekatan) adalah pada 160 kg bagi gred pelincir 20W-40, untuk 15W-40 dan 15W-50 menunjukan kemampuan menahan beban sehingga 200kg dan 250 kg.

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CHAPTER 1

INTRODUCTION

1.1 Background

This project focuses on the analysis of the lubricant. The lubricant have many function and important to the industries, machinery and tools. This project analyzes how the lubricants work to the machine to prevent from damage. From the analysis the lubricant performance can be compare. To observe the performance of the lubricant between temperature and load, Four Ball Tester machine will give the result based on the size of scar, the variable test of different load and temperature to give different result of wear size.

In this analysis the engine oil use in motorcycle is one type of lubricant use in the test to analysis the performance. The types of oil engine use in motorcycle are normal oil, semi synthetic oil and fully synthetic oil. These three types of oil engine give different performance on motorcycles, but the function of these oils are same, protect engine component from unwelcome friction that can cause the damage to the engine.

The four ball test is the one of method to analysis lubricant by extreme pressure (E.P) load and measures the friction reducing ability, antiwear property and extreme-pressure property of different type of lubricants. From the test result, this test method can distinguish not only the property of different type of lubricants.

1.2 Problems statement

Lubricant is the important material use in automotive component. The lubricant is use in engine to give better performance during the engine begins to starts and running. There are different types of lubricants use in motorcycles engine, each type of lubricant has their own performance. The lubricant function to protect, protect engine, clutch and gears from unwelcome friction.

The struggle to develop appropriate test methods for engine oils has been a long, expensive, and technically sophisticated effort. However, a comparison of engine durability, oil properties, effectiveness of current test methods, and current values for oil-change intervals suggests that the struggle has, to a great extent, been successful. There are some methods and test evaluation to analysis lubricant, the test can be used to compare between the oil characteristic and performance, to determine the difference of the quality and performance.

1.3 Objective

The objectives of this project are as follows:

a) Determined the potential and performance of new lubricant with Four Ball Tester.
b) To analysis and compare the effect of different grade of engine oils and observes the relationship between the lubricant performance and the applied load.
c) To compare quality and performance two brands of lubricant that has same grades.
d) To analysis the ability of the lubricant to prevent from the high friction.

1.4 Scope

The scope that focus in this project are:

a) Analysis the literature review that related to lubricant analysis and test.
b) Determination the lubricant performance and relation to friction and load, using experiment "Four Ball Tester".
c) Analysis the result of the extreme pressure and effect of the different grades of lubricant to the lubricant.

1.5 Project summary

According to the problem statement, objectives and scope of the project, a simple analysis to the lubricant needs to be run to get the data. The data can be getting using the experimental test by Four Ball Tester machine. In this experiment the analysis focus on three types of oil engine use in motorcycles, the types of oils are normal oil (20W-40), semi synthetic (15W-40) and fully synthetic oil (15W-50). The data based on the performance of the lubricant, the performance of the lubricant can be analyzed by comparing the result of scar diameter from the ball. The load is increased follow by ASTM standard load until reach the weld point. From the result the graph of applied load versus scar diameter can be obtained. From the software that install from the manufacture, the graph for analysis the friction also can be obtained. This test is based on American Society for Testing and Materials (ASTM). The ASTM standards for Four Ball Test (E.P) are ASTM D2569 and D2738. To run this test the procedure must follow with this ASTM standard.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review in this section just a summary from the other sources, such as journal, books and any paper that related to this project. In this chapter the summary is include about the lubricant process, the standard use for lubricant, lubricant test evaluation and the function of lubricant to the tools and machine.

2.2 Lubricant Process

According to D.M Pirro and A.A Wessol (2001) from the " Lubricants Fundamentals Second Edition, Revise and Expanded : Refining Processes and Lubricant Base Stocks", Petroleum, or crude oil, is refined to make many essential products used throughout the world in homes and industry. These products include gas burned as fuel, gasoline, kerosene, solvents, fuel oil, diesel fuel, lubricating products, and industrial specialty products, (waxes, chemicals, asphalt, and coke). Usually, crude oil is refined in two stages: refining of light products and refining of lubricating oils and waxes. Two basic refining processes are separation and conversion. The separation process selects certain desirable components by distillation, solvent extraction, and solvent dewing.

The conversion process involves changing the chemical structure of certain undesirable crude oil components into desirable components. Conversion processes also include a degree of removal of nondesirable species. The types of refining process are discussed in this chapter following brief general discussions of crude oil handling and its initial fractionation into light products, vacuum gas oil, and residuum.

Crude oils are found in a variety of types ranging from light-colored oils, consisting mainly of gasoline, to black, nearly solid asphalts. Crude oils are very complex mixtures containing very many individual hydrocarbons or compounds of hydrogen and carbon. These range from methane, the main constituent of natural gas with one carbon atom, to compounds containing 50 or more carbon atoms .(The boiling ranges of the compounds increase roughly with the number of carbon atoms.Typical boiling point ranges for various crude oil fractions are as follows:

a. Far below 0°F (–18°C) for the light natural gas hydrocarbons with one to three carbon atoms.
b. About 80–400°F (27–204°C) for gasoline components.
c. 400–650°F (204–343°C) for diesel and home heating oils Higher ranges for lubricating oils and heavier fuels.

Thus, crude oil samples will generally show carbon content ranging from 83 to 87%, and hydrogen content from 11 to 14%.The remainder is composed of elements such as oxygen, nitrogen, and sulfur, and various metallic compounds. An elemental analysis, therefore, gives little indication of the extreme range of physical and chemical properties that actually exists, or of the nature of the lubricating base stocks that can be produced from a particular crude oil through conventional refining techniques.

From this book explain about process of the crude oil to form variable oil and gas, the crude is pumped through a tubular furnace (Figure 2.1) where it is heated and partially vaporized. The refinery furnace usually consists of connected lengths of pipe heated externally by gas or oil burners. The mixture of hot liquid and vapour from the furnace enters a fractionating column. This is a device that operates at slightly above atmospheric pressure and separates groups of hydrocarbons according to their boiling ranges. The fractionating column works because there is a gradation in temperature from bottom to top so that, as the vapours rise toward the cooler upper portion, the higher boiling components condense first. As the vapor stream moves up the column, lower boiling vapors are progressively condensed. Trays are inserted at various levels in the column to collect the liquids that condense at those levels.

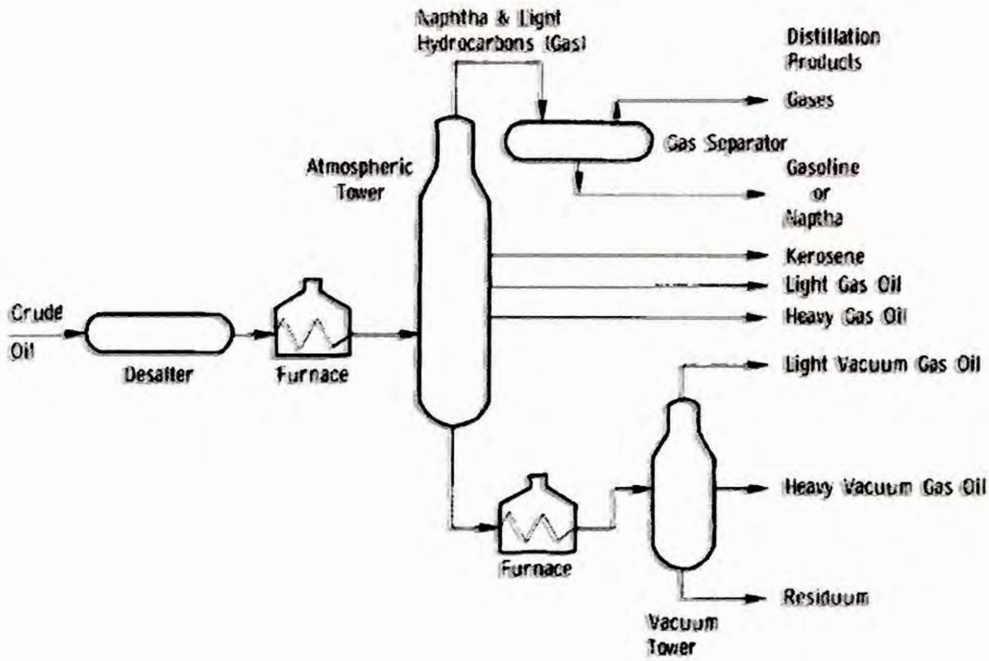

Figure 2.1: Crude distillation unit
(source: D.M Pirro and A.A Wessol (2001))

From this book, the term "lubricating oils" is generally used to include all the classes of lubricating materials that are applied as fluids. Lubricating oils are composed of base oils plus additives to enhance specific characteristics. In the remainder of this section, the term "base stock" replaces "base oil"; the two are synonymous. On a volume basis, the vast majority of the world's lubricating base stock is obtained by refining distillate or residual fractions obtained directly from crude oil Lubricating base stocks are made from the more viscous portion of the crude oil, which remains after removal by distillation of the gas oil and lighter fractions. They have been prepared from crude oils obtained from most parts of the world. Although crude oils from various parts of the world differ widely in properties and appearance, there is relatively little difference in their elemental analysis

From the table 2.1, its shows two base stocks that are similar in viscosity, the most important physical property of a lubricant. The base stock on the left is made from naphthenic crude. This type of crude is unusual because it contains essentially no wax. In fact, the very low pour point, -50°F (-46°C), of this stock results from the unique composition of the compounds in the crude, no processing has been employed to reduce the pour point.

In contrast, the stock on the right required dewaxing to reduce its pour point from about 80°F (27°C) to 0°F (-18°C). One other important difference between these base stocks is shown by the differences in viscosity index. While both oils have similar viscosities at 100°F (38°C), the viscosity of the naphthenic oil will change with temperature much more than the viscosity of the paraffin stock. This is reflected in the lower viscosity index (VI) of the naphthenic oil. For products that operate over a wide temperature range, such as automotive engine oils, the naphthenic stock would be less desirable. Generally, naphthenic base stocks are used in products that have a limited range of operating temperature and call for the unique composition of naphthenic crudes, with the resultant low pour point. Long-term supply of naphthenic crudes is uncertain, and alternatives are being sought to replace these base stocks as the supply diminishes.

Table 2.1 : Lube Base Stocks (source: D.M Pirro and A.A Wessol (2001))

Crude type	**Naphthenic**	**Paraffinic**
Viscosity SUS at 100°F (cSt at 38°C)	100 (20.53)	100 (20.53)
Pour point, °F(°C)	-50 (-45.5)	0 (-18)
Viscosity index	15	100
Flash point,° F (°C)	340 (171)	390 (199)
Gravity, API	24.4	32.7
Color (ASTM)	1.5	0.5

2.3 Lubricant and their composition

According to book G.W. Stachowiak, A.W batchelor, Engineering Tribology series 24, Oils can be of two different origins, the biological and non-biological, and this provides a vast array of hydrocarbon compounds. These substances are usually present as complex mixtures and can be used for many other purposes besides lubrication, that is the control of wear and friction. Modern technology places severe demands on lubricants, so the selection and formulation of appropriate mixtures of hydrocarbons for the purposes of lubrication is a very skilled and complex process. Most natural oils contain substances which can hinder their lubrication properties, but they also contain compounds essential to the lubrication process. Lubricants made from natural or mineral oils are partly refined and partly impure. The balance between impurity and purity is critical to the oxidation stability of the oil and it varies depending on the application of the lubricant

Lubricant additives are chemicals, nearly always organic or organometallic, that are added to oils in quantities of a few percent by weight to improve the lubricating capacity and durability of the oil. This practice gained general acceptance in the 1940 and has since developed to provide an enormous range of additives. Specific purposes of lubricant additives are:

a) Improving the wear and friction characteristics by provision for adsorption and extreme pressure (E.P) lubrication.
b) Improving the oxidation resistance.
c) Control of corrosion.
d) Control of contamination by reaction products, wear particles and other debris, reducing excessive decrease of lubricant viscosity at high temperatures.

These additives can be divided into the following groups, a adsorption or boundary additives, anti-wear additives, Extreme Pressure additives.

Type of additive	Advantages and functions	Chemical substance
Adsorption or boundary additives	Friction Modifiers since they are often used to prevent slip-stick phenomena. The molecules are attached to the surface by the polar group to form a carpet of molecules, as shown in Figure 2.2, which reduces friction and wear.	The esters and amines of the same fatty acids. sulphurized fatty acid derivatives, phosphonic acids or N-acylated sarcosines. Stearic acid derivatives such as methyl and ethyl stearates are also used.
anti-wear additives	It was originally developed as an anti-oxidant and detergent, but it was found later that this compound also acted as an antiwear and mild extreme pressure additive. Figure 2.4 shows how influence of load and temperature on the effectiveness of ZnDDP	Zinc dialkyldithiophosphate (ZnDDP), figure 2.3 shows ZnDDp structure, tricresylphosphate or other phosphate esters.
Extreme Pressure additives.	Designed to react with metal surfaces under extreme conditions of load and velocity, i.e. slowly moving, heavily loaded gears. Under these conditions operating temperatures are high and consequently the metal surfaces are hot.	dibenzyldisulphide, phosphosulphurized isobutene, trichlorocetane and chlorinated paraffin, sulphurchlorinated sperm oil, sulphurized derivatives of fatty acids and sulphurized sperm oil, cetyl chloride, mercaptobenzothiazole,

Figure 2.2: Adsorption lubrication mechanism by boundary additives

(Source: G.W.Stachowiak and A.W. Batchelor, 1993)

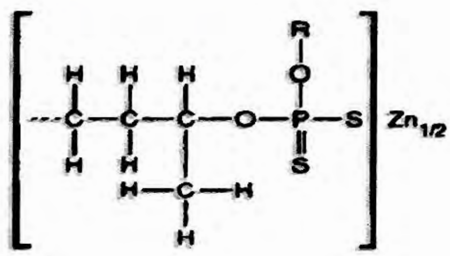

Figure 2.3: Chemical structure of zinc dialkyldithiophosphate (ZnDDP)

(Source: G.W.Stachowiak and A.W. Batchelor, 1993)

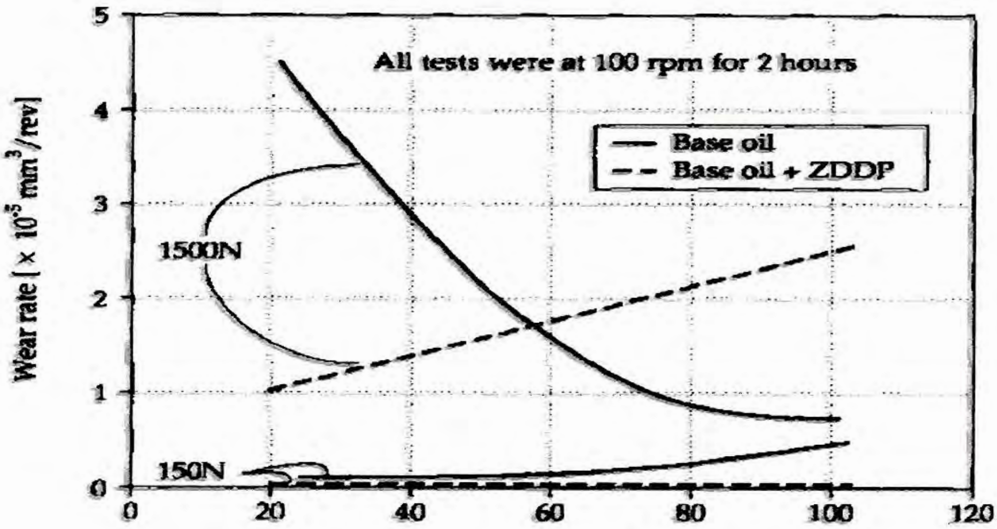

Figure 2.4: Influence of load and temperature on the effectiveness of ZnDDP on wear rates.

(Source: G.W.Stachowiak and A.W. Batchelor, 1993)