



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**TO INVESTIGATE THE FRICTION AND WEAR OF
TRANSMISSION OIL**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

by

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I hereby, declared this report entitled to investigate the friction and wear of transmission oil is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Keperluan kaedah untuk penggunaan semula sisa buangan minyak penghantar automatik adalah sangat penting dalam mengurangkan penggunaan pelincir secara berlebihan kerana ia boleh menyebabkan pengurangan rizab minyak mentah, kenaikan harga minyak mentah dan benda lain yang terlibat dengan penggunaan minyak berasaskan bioteknologi. Tambahan pula, tujuan kajian ini adalah untuk menyiasat dan mengkaji tentang geseran dan parut calar minyak penghantar automatik berdasarkan pekali geseran, kelikatan dan diameter calar untuk sisa buangan minyak penghantar automatik dengan penambahan minyak rawatan X-1R. Nilai kelikatan pada 40 °C dan 100 °C diperolehi dengan menggunakan Brookfield DV-II + Pro viscometer mengikut American Society Testing and Materials (ASTM) standard iaitu ASTM D2770. Kemudian, four ball tester telah dijalankan dengan mengikuti kaedah ciri-ciri pencegahan calar pelincir cecair iaitu ASTM D4172. Parut calar pada permukaan gelas bola telah dilakukan dengan menggunakan Scanning Electron Microscopy (SEM). Hasilnya menggambarkan kelikatan dinamik untuk ATF sisa dengan penambahan 10 vol. % minyak rawatan X-1R menunjukkan nilai yang hampir dengan standard untuk minyak penghantaran baru; manakala diameter parut calar yang kecil menunjukkan di penambahan 15 vol. % minyak rawatan X-1R. Keupayaan minyak rawatan X-1R ATF mempamerkan antioksidan adalah wajar dalam minyak pelincir untuk mengelakkan pengoksidaan.

ABSTRACT

The needs of method for re-use waste Automatic Transmission Fluids is very important in reducing the excessive use of lubricant it can cause the reduction of crude oil reserve, the increasing prices of crude oil and other thing that are involved with the use of bio-based oil. Furthermore, the purpose of the research is to investigate and study about the friction and wear of the transmission fluid based on the coefficient of friction, viscosity and wear scar diameter for waste automatic transmission fluid with addition of X-1R oil treatments. The value of viscosity at 40 °C and 100 °C is obtained by using Brookfield DV-II+Pro viscometer according to American Society Testing and Material (ASTM) standard which is ASTM D2770. Then, four ball testers were conducted by following wear preventive characteristics of lubricating fluid method that is ASTM D4172. Wear scar on the surface of the ball bearing was performed by using Scanning Electron Microscopy (SEM). The result depicts the dynamic viscosity for waste ATF with addition of 10 vol. % X-1R treatments shows the almost standard value to the new transmission oils; while the small wear scar diameter shows at addition of 15 vol. % X-1R treatments. The capability of X-1R ATF treatment exhibits the antioxidant is desirable in lubricating oils to prevent oxidation.

DEDICATION

I dedicate this final year project to my family members and friends for their full support in my studies. Thank you for giving me the opportunity to improve and prove myself throughout my life. Anything great that has gone to my life is cause of your love, example and guidance.

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LIST OF SYMBOLS

°C	-	Temperature in Celsius
Ø, d	-	Diameter
µm	-	Micrometre
µ	-	Coefficient of friction
Vol. %	-	Volume percentage
mm	-	Millimetre
Kg	-	Kilogram
l	-	Litre
rpm	-	Revolution per minutes
cSt	-	Centistokes
cP	-	Centipoise
et al.	-	And others
V	-	Viscosity
min	-	Duration in minutes
N	-	Normal force

LIST OF ABBREVIATIONS

ZDDP	Zinc dialkyldithiophosphate
ATF	Automatic Transmission Fluids
MTF	Manual Transmission Fluids
API	American Petroleum Institute
ASTM	American Standard Testing and Materials
AW	Anti-wear
EP	Extreme Pressure
AO	Antioxidant
FM	Friction Modifier
VI	Viscosity Index
MoS₂	Molybdenum disulphide
SEM	Scanning Electron Microscopy
COF	Coefficient of friction
SAE	Society of Automotive Engineers

CHAPTER 1

INTRODUCTION

1.1 Background

Lubricant is widely used in automobile application to reduce friction and protect surfaces that have a relative movement under the load. Lubricant is a substance that able to reduce friction, minimize wear, cools parts, prevent from corrosion and act as a sealant. The using of lubricant is important in the automobile application like transmission system, internal combustion engine and other mechanical machine application in industrial plant. The using of gear lubricating oil is important for transmission. Usually, in automotive transmission there is a lubrication system or an injection lubricant system.

According to the H.M Mobarak et al, (2014) research, the major goals of lubricant are to minimize wear and heat loss that produce when there are have two mating surface in sliding motion. Then, to avoid from corrosion, oxidation and act as a seal against water, dirt and dust. Lubricants are classified to three types which are liquid, solid and semi-solid. For the hydrodynamic and hydrostatic lubrication utilizing either liquid or gases also included as lubricant.

Basically lubricant contains 90% of base oil and less than 10% for the additive. The purpose of additives in the lubricant is to reduces the friction and wear, increase viscosity and prevent from corrode. The lubricant formula is comprised of the addition of enhancement performance enhancements selected according to the product requirements. For new formulations it must be achieve and pass of the test that include

in licensing guidelines. The presences of lubricant between the surfaces a layer of different material will reduce the frictional force either by becoming gentler the surface or by being able to understand fluid grease, entrained between the two surfaces by their relative movement.

The viscosity is important in the lubricant due to it can affected to the temperature of the lubricant. Viscosity is main properties in any oil and it able to measure through the viscosity index. The lubricant with a higher viscosity index can be superiority for usage over a wide temperature. This means, the higher viscosity in the lubricant it may causes the friction will be decrease.

1.2 Statement of the Purpose

The purpose of the research is to investigate the friction and wear of the transmission fluid from the coefficient of friction, viscosity and wear scar diameter on the surface of the ball bearing.

1.3 Problem Statement

Nowadays, world is concerns about the excessive of energy consumption, so the precaution steps for control the using of energy consumption should be implements to save energy and save the earth. The application of lubricant is not only focuses on the automobile system but it's also has widely used in other application such as machinery and industrial plant. Basically, crude oil is major usage in lubricant for transmission application. The excessive use of lubricant it can cause the reduction of crude oil reserve, the increasing prices of crude oil and other thing that are involved with the use of bio-based oil.

In this era of high technology, there are variable types of transmission fluid that has been introduced by the manufacturer. The manufacturer claim that the product is has been added by additive then it's able to increase the transmission performance and extend the lifespan of transmission system. For the fully synthetic, semi synthetic and mineral based oil, it has been added additives such as zinc dialkyldithiophosphate (ZDDP), friction modifiers, extreme pressure agents and anti-wear additive and etc.

As the renew cycle source, the purification method for restore the physical, chemical and characteristics of lubrication should be used to return to its original function. According to G.S Dang (1997) reported the refining of waste oil has been introduce since last five decades ago. Re-refining is the main treating process for waste oil to remove the contaminant such as corrosion particle, dust, moisture and metallic particle. The common refining process is the solvent or chemical treatment for the separation of lubricants used from contaminant and additives. Generally, the lubricant for transmission system can be produces with relatively simply at low cost. However, to make sure that the reliability of the transmission operation able to extend it lifespan and maintain it function, the lubricant choosing and comparison to the selection of the other machine components in important on the transmission construction.

The focuses of this research is to investigate the friction and wear of waste transmission fluid between the waste transmission fluid with addition of additives or oil treatment. Then, the data will shows various result depend on the concentration of oil formulation between waste ATF and X-1R oil treatment. If the result shows the friction and wear is decreasing so it may able to extend the lifespan of transmission system. Then, waste transmission fluid will be able to reuse again by according to suggested oil samples.

1.4 Objectives

Based on the introduction and the problem statement which stated about the lubricant fluid on the automobile transmission application, the objectives of this study is as follows:

- i. To investigate the friction and wear of waste automatic transmission fluids.
- ii. To study the characteristics and properties of waste automatic transmission fluid with addition of oil treatment.

1.5 Scope

To achieve the objective of this research, there are several scope should be drawn:

- i. Investigating about the friction and wear that occurs on the waste automatic transmission fluids based on the surface of ball bearing after four ball tester standard ASTM D4172 process.
- ii. Identifying the characteristics and performance of waste automatic transmission fluids with and without addition of X-1R oil treatment based on the coefficient of friction, viscosity and wear scar diameter on the ball bearing surfaces by using Brookfield DV-II+Pro viscometer and scanning electron microscope (SEM).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section is a summary from the other sources such as journal, book and any types of paper that is related to this project. The summary in this chapter will identify about the lubricating fluid, transmission oil and its properties in the automotive application, types of lubricants oil and additives responses.

2.2 Lubricant

The gear oil basically prepared for the automobile transmission system, in cases of transfer in the transmission system. Gear oil in transmission system is a fluid lubricant; which to decrease the friction and wear of the gear tooth, minimize the corrosion action of the gear parts and removal of the heat generated by gear operating system (Himanshu D. Patel et al, 2015). The transmission systems in automobile application become failure due to lack of proper and efficient lubricant. Lubricants can classification in a variety of ways. Lubricants are described as mineral oil, synthetic or bio-based fluid. The most widely used lubricants in the lubricant industry are synthetic. The function of lubricant is to minimize the friction and wear of the relative motion surfaces by using other liquid capabilities or types of oil.

Tribology is the science of wear, friction and lubricant. The term of tribology was introduced in 1966 and it has widely used to illustrate the area of activity extending since 1985. In early 16th century, there were several efforts in order to portray the entire