UNIVERSITI TEKNOLOGI MARA

SYNTHESIS OF BIO - LUBRICANT FORM WASTE COOKING OIL (WCO)

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ABSTRACT

The increase of ecological concern inspires research of raw materials from renewable sources in lubricant industry. Therefore biodegradable lubricants produced from natural oils and fats become important. One of solution is by producing biolubricant. Bio-lubricant is a lubricant that use typically natural material such as vegetable oil as their base oil. Lower prices of waste natural oils and fats makes biodegradable lubricants much more competitive on the market. In this work the synthesis of bio-lubricant from waste cooking oil (WCO) through hydrolysis producing free fatty acid (FFA) and chemical esterification of FFA with trimethylolpropane (TMP) will be presented. In hydrolysis step, the operating parameter was observed such as reaction time and temperature of reaction from 30°C to 45°C. The optimum operating condition of hydrolysis reaction was determined where specific reaction time was at 4 hours, 45°C, 250 rpm and oil to water molar ratio, 1:3 and pursued with esterification. In esterification similar parameter was observed and obtained at optimum of, and the effect of temperature to the reaction will be observed. While for esterification process the characteristics of lubricant is studied using gas chromatography. At optimum operating condition, 90°C, 600 rpm and FFA to TMP molar ratio, 3:1, component with highest composition in the bio-lubricant is cyclohexyl isohexyl ester with 71%. Within 4 hours, the conversion of FFA to bio-lubricant reach 81%. Hence, the development of two-step process has a potential to be used industrially as it can tolerate feed stocks containing a wide range of FFA and water and also provide way of waste utilization.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Lubricant is a substances that being applied between two moving surfaces to reduce friction by keeping both surface apart which ultimately reduces heat generated from the surfaces. Furthermore, lubricant also protects surfaces from being wear, corrosion, remove deposits and also remove impurities. Due to increase in industrialization industry and growth in automotive sector, demand in lubricant market is continuously increasing for various application (Chowdhury, Mitra, and Biswas 2013). 70-90% of lubricant consist of base oil while the remaining is mixed with additives that its function is to modify and improve the properties of the base oil relevant to the market demand (Petran 2008). Most of the base oil components produced from non-renewable mineral-based-oil which can be divided into mineral and synthetically formulated from chemicals. These types of resources are unaccepted due to its toxicity and low biodegradability that can cause environmental impact such as contamination of air, soil, drinking water and also will affect human and plant life (Soni and Agarwal 2014). Besides, the production cost of mineral lubricant is high because of petroleum resources reducing. Thus, alternatives sources of raw material to produce lubricant that have same characteristics, marketable and environment friendly is thoroughly being pursued (da Silva 2001).

Bio-based-lubricant typically derived from natural materials such as plant and vegetable oils, animal's fat and organic waste oils (Syaima et al. 2015). The most ultimate reason using natural materials is it is a biodegradable and non-toxic to environment, human and plant. Moreover, this type of oils is a renewable resources and have abundant supply thus it reducing the production cost of bio-lubricant. Most biodegradable lubricant that been produced from natural oils and fats can be more expensive compared to mineral lubricant when using a high quality natural oils and fats (Petran 2008)

Plant-based and vegetable oil is one of the top alternatives that have a great potential to replace the conventional mineral oils to produce bio-lubricant because of the structure similarity of long chained hydrocarbon in mineral oils (Heikal et al.