CHAPTER I

INTRODUCTION

I.1. Background

Indonesia is one of the largest countries consuming palm cooking oil after China and India (J.Kaatz, 2013). The consumption of palm cooking oil in Indonesia in 2015 was 5.2 million tons (Kontan, 2015), and as a result Indonesia also produced high used cooking oil (UCO). It was reported around 4 million tons of oil is produced in Indonesia per year (Kayun *et al*., 2007). This UCO cause environmental problem since it has high chemical oxygen demand (COD) and inhibit oxygen transfer if it is covering water surface. As a result, oxygen content in the aquatic system is depleted and breaking the food chain in the ecosystem. UCO in soil is also dangerous contaminant since it is insoluble, persistent, and laced with toxic chemicals and heavy metal (Smith, 1974).

UCO contains high free fatty acids and triglyceride that can be utilized as biodiesel feedstock (Hambali *et al*., 2008). Free fatty acid in UCO can be converted into fatty acid alkyl ester (biodiesel) by esterification, and triglyceride can also be converted into biodiesel via transesterification reaction. Esterification is a chemical reaction between fatty acid and alcohol to form ester and water as by-product. Transesterification is chemical process of exchanging the organic group of an ester with the organic group of an alcohol. Both reactions usually need base or acid catalyst.

Currently commercial production of biodiesel in Indonesia uses edible feedstock such as palm oils (Crabbe *et al*., 2001), soybean (Cao *et al*., 2005), corn (Pimentel and Patzek, 2005), and coconut oils (Jitputti *et*

al., 2006). It is unfavorable since it creates competition between edible oil supply and biodiesel feedstock. This competition result on uncontrollable price and supply chain of edible oil. Non-edible oil or UCO is better alternative for biodiesel feedstock compare to edible oil.

Utilization of UCO as biodiesel feedstock has some challenges since it need pretreatment to remove its moisture content (Setiawati and Edwar, 2012). This pretreatment is crucial since the presence of water in UCO hydrolyze triglyceride become free fatty acid. High level of free fatty acid content cause saponification reaction and the conversion of UCO into biodiesel become lower.

In this study, the conversion of UCO into biodiesel was conducted through esterification and transesterification in non-catalytic condition using subcritical methanol process. Subcritical methanol process can accelerate the rate of biodiesel production from UCO. In this process, moisture content removal was not needed, since in this condition water in the oils will dissociate into the ions that will act as the catalyst (Gunawan *et al*., 2014). This process is more efficient since pretreatment step was eliminated and non-catalytic reaction reduce the step of biodiesel separation and purification; therefore it is a novel method.

I.2. Objectives

1. To study the effect of the ratio of methanol and UCO, the temperature and pressure variation on the yield of biodiesel from UCO using subcritical methanol process.
2. To identify the FAME content of biodiesel from UCO obtained from subcritical methanol process.

3. To study the optimum condition of subcritical methanol process to produce biodiesel from UCO using ANOVA (Analysis of Variance) statistic method.

I.3. Research Limitation

The UCO in this research is palm oil.