CHAPTER 1

INTRODUCTION

1.1 Background

Alkyd resins are polymers resulting from the esterification of a polybasic acid, a polyol and oils or fatty acids. (Kienle & Ferguson,1929a) introduced the word ‘alkyd’ which originated from ‘al’ and ‘kyd’ corresponding to alcohol and ‘cid’ from acid which was later converted to ‘kyd’.

The first alkyd resin was synthesized in the mid-1920s by Kienle, who combined the already known technology of producing polyester resins based on glycerol and phthalic anhydride (the so-called Glyptals). It was found that alkyd resins were produced commercially in full scale starting from the year 1933 at General Electric and it was followed by other companies in 1935 (Hofland,2012).

Ever since, alkyds were already discovered and introduced many years ago. Van Bemmelnz (1856) prepared resins from succinic acid, from citric acid, from a mixture of benzoic and succinic acid, by heating with glycerol. Smith (1901) was the first to synthesis a resin from glycerol and phthalic anhydride and further attempt was taken into account by General Electric to develop more tractable polymer for electrical end uses. The resin was commercially synthesized in 1921 by available raw materials such as glycerol, phthalic anhydride and fatty acid and used as adhesives. The first report on alkyd resin preparation was published by Kienle and Ferguson (1929b).

Nowadays, alkyds have been widely used as synthetic resins in the paint and surface coating industry because of having properties such as good corrosion resistance, rapid dryness, high gloss and easily being applied over poorly treated surface.

Current arising environmental issue leads to the formation of resins by using renewable sources such as vegetable oils. Starting from the year of 1950, alkyd resin producers developed more environmental friendly version of their products based on the concept of producing relatively high acid value alkyds which upon neutralization with amines can be transferred to a form of colloidal solutions in a blend of water and water miscible solvents of glycol ether types. In the 1970s, multi-application water soluble alkyd resins were discovered by Hofland (2012).

1.2 Motivation

Nowadays, the issues of environmental and the depleting of petroleum sources are arising. Imperative actions should be taken to promote sustainable development where the needs and aspirations of present and future generations can be achieved.

Alkyd resins are extensively applied especially in surface coating industry (Bora et al.,2014b). Hence, it will be a promising development to produce resins from renewable sources. Renewable sources such as vegetable oils can be used to replace the depleting petroleum sources in the synthesis of alkyd resins. After much research works, researchers found that vegetable oil based resins are more preferred compared to mineral oils because of its biodegradability (Alam et al.,2014).

Malaysia was the world's second largest producer of palm oil. Palm oil was edible oil which being utilized as cooking oil. Palm oil can be used for polymer preparation. However, its industrial applications in non-food sectors are still hardly found (Islam et al.,2014).

Furthermore, the arising issue of expensive diesel fuel leads to the use of biodiesel to be an alternative fuel. Large amounts of crude glycerol are generated from the biodiesel production. Due to this reason, Pinyaphong et al. (2012) investigated for the production of more valuable products from crude glycerol, such as monoglyceride (MG), instead of dumping in the landfills. Therefore, glycerol becomes one of the main raw materials to synthesis alkyd resins because of its great availability.

Shortening reaction has become a crucial issue in the alkyd resin production. Currently the part of catalyst development was less emphasised in the process of alkyd resin synthesis. The commonly used catalysts in the reaction are homogeneous base catalyst such as NaOH, KOH and $Ca(OH)_2$

which usually needs longer reaction time. As a result, it will cause low production rate and high production cost. Nanostructured heterogeneous catalysts in colloidal form are promising nowadays due to their ultrafine size, high surface area and good dispersion they are explored to overcome the long reaction time problem (Ong et al.,2015). In this context, palm oil based alkyd resin was synthesised over colloidal MgO nanoparticles and its catalytic behaviour was investigated.

1.3 Problem statement

Conventional homogeneous catalyzed reaction using NaOH usually needs longer reaction time. Looking at the economic aspect, the longer the reaction time, the lower the production rate and hence, the higher the production cost. Therefore, catalyst development in alkyd resin synthesis was needed to be improved.

MgO was said to be a potential heterogeneous catalyst in producing monoglyceride due to the participation of strong basic low coordination of O^{2-} in glycerolysis. (Ferretti et al.,2012) However, most of the research was about synthesising MgO nanoparticles in powder form. The homogeneous distribution of MgO powder in glycerol and oil was difficult through direct mixing. Hence, higher amount of catalyst was required to achieve the desired conversion. Although colloidal metal oxide in glycerol or oil could ensure the homogeneous distribution of the catalyst, its activity has never been explored in alkyd resin preparation.

Furthermore, most of the catalysts are used only in the alcoholysis of vegetable oil, but never been utilized in the polyesterification reaction to prepare alkyd resin. Hence, in this work, MgO nano sol will be incorporated into the synthesis of alkyd resin and the catalytic behaviour was being observed.

1.4 Objectives

- To synthesise colloidal MgO nanoparticles in glycerol at room temperature.
- To investigate the catalytic effect of MgO in preparation of alkyd resin.