UNIVERSITI TEKNOLOGI MARA

DEGRADATION OF AUTO-CATALYTIC EPOXIDATION OF OLEIC ACID DERIVED FROM PALM OIL VIA *IN SITU* PERFORMIC MECHANISM

HAMZAH HAFIZUDDIN BIN HABRI

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ABSTRACT

Epoxidized vegetable oils have a demand in the market and are widely known in oleochemical industry to enhance the end-product and as intermediates in chemical reactions. This study interest shown to epoxidation of oleic acid because of high content of unsaturated fatty acids, and the process breaks the double bond then transforms into reactive oxirane ring without presence of catalyst. The autocatalytic epoxidation of oleic acid was carried out by using in situ generated performic acid to produce epoxidized oleic acid. Performic acid was formed by mixing formic acid (as oxygen carrier) and hydrogen peroxide (as oxygen donor). The epoxidation reactions were conducted by varying the type of oxygen carrier, concentration of hydrogen peroxide, stirring speed and formic acid to oleic acid molar ratio. The results showed that optimum condition included formic acid as the excellent oxygen carrier, 50% concentration of hydrogen peroxide, stirring speed at 400 rpm and molar ratio 2.5:1 formic acid to oleic acid. It was found that a maximum relative conversion to oxirane (RCO) achieved was 87 % at optimal condition. There was a good fit between experiment and simulation values of optimum condition with the slightest difference of ~0.20 based on kinetics study attained. The degradation of epoxidized oleic acid after oxirane ring opening invites hydroxylation reaction take place called alcoholysis and hydrolysis. The hydroxyl value from alcoholysis was 346.9 mg KOH/g while the hydroxyl value of hydrolysis was 296.4 mg KOH/g using autocatalyzed reaction. Moreover, the hydroxyl value can vary depending on molar ratio of alcohol and water towards epoxidized oleic acid. In conclusion, high and low hydroxyl value has their own benefits as intermediate product for polymer application such as flexible polyurethane and rigid polyurethane.

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INTRODUCTION

1.1 Introduction

In this progressive new era, world is narrowed to utilize potential of renewable sources in developing product synthesis. Alternative substances that can be treated chemically rather than petroleum is fats and oils[1]. One of the options is vegetable oils whereas, in general have similar properties or better than petroleum in terms of viscosity, toxicity, flash point, evaporative loss and biodegradable for purpose as base oils for lubricants[2]. Palm oil produced crude oleic acid which consisted of unsaturation fatty properties, accordingly, aided the chemical reaction sites for alteration into useful derivatives. Due to characteristic which more thermally stable than polyunsaturated fats become attractive selections in vegetables oil for producing epoxide[3]. Malaysia is one of exporter of palm oil where it contributes around 40% total palm oil word and unsaturated fatty acid e.g., oleic acid have contained 45% to their fatty acid composition [4].

Among of chemical alterations of fatty acid from vegetable oil was epoxidation process that most suggested way for introducing a new reactive group and useful properties [5]. Epoxidized oils have a demand in the market and are widely known in oleochemical industry to enhance the end-product and as intermediates in chemical reactions[6]. Due to the synthesis of chemical reaction of epoxide, many inventions related to form new products for many other purposes such as polyols, bio lubricant, stabilizers for polyvinyl chloride resins, polyesters, polyurethanes, epoxy resins, and surface coatings The interest of using epoxidation of vegetables oil mainly because of high content of unsaturated fatty acids, and the process breaks the double bond then transform into reactive oxirane ring called epoxides [7]. Since epoxidized vegetable oils have many traits with traditional petroleum-based epoxy thermosets, they present a prospective source of low-cost renewable materials for a variety of industrial applications.

The oxirane rings highly reactive and susceptible to opening, especially when presence of acidic conditions due to the fact that the epoxides act as intermediates for synthesis of other chemicals. Acidic conditions promote ring-opening by protonation of