UNIVERSITI TEKNOLOGI MARA

POLYMERIZATION OF LACTIDE TO POLYLACTIC ACID BY USING HOMOGENOUS AND HETEROGENOUS CATALYST ON THE EFFECT OF TEMPERATURE

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ABSTRACT

Polylactic acid (PLA) shows a promising alternative to petroleum-based polymers such as plastics. Catalyst such as tin octoate is most common and widely used in synthesizing of PLA in the industrial application using ring-opening polymerization method. The polymerization take place in homogenous phase where the catalyst and the lactide are mixed in liquid phase to form the PLA. However, this method become problematic for the product because the catalyst will remain in the PLA and causes the degradation of the catalyst. The objectives of the research are to investigate the production of PLA by using homogenous and heterogenous catalysts with variation of temperature from 110°C to 130°C and to characterize the PLA produced by using Ultraviolet Visible (UV-Vis) Spectrophotometer and Fourier Transform Infrared Spectroscopy (FTIR). From the result collected, it can be concluded that the synthesis using heterogenous catalyst is better than homogenous catalyst with high concentration and the optimum production of PLA produced is at the highest concentration which is 90.1 ppm with temperature of 130°C by using heterogenous catalyst.

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CHAPTER 1
INTRODUCTION

1.1 RESEARCH BACKGROUND

Presently, the worldwide production of plastics had been dominated by petroleum-based polymers(Vitkevicius, 2017). Due to environmental and economical that related to waste disposal concern, the biodegradable polymers were introduced. Another reason of using the biodegradable polymers is the price of petroleum nowadays is quite high and will continuously increase in the future. The first polymer that can replace the non-biodegradable polymers is Poly (glycolic acid) (PGA) then followed by Polylactic acid (PLA)(Schmitt, 1971). According to Dubey et al (2016) and Leenslag & Pennings (1987), the polylactic acid has received more attention time by time as it has been used in biomedical application in the form of implants because of high performances in biodegradability and biocompatibility. This biodegradable polymer can easily degrade and thus can save the country from the environmental pollution(Mehta, Kumar, Bhunia, & Upadhyay, 2005). The polymers can be degraded by simple method which is hydrolysis of the ester bonds that do not require the enzymes thus can prevent inflammatory reactions.

There are many ways to produce the polylactic acid. However, all the methods are not easy to perform as the polylactic acid synthesis need rigorous control of certain condition which are temperature, pressure, pH, catalyst and time for the polymerization process. The methods are ring opening polymerization of lactide, polycondensation and enzymatic polymerization of lactic acid. The polycondensation is the cheapest routes but difficult in production of high molecular weight of polylactic acid. Among all these methods, ring opening polymerization is widely used in industry due to high molecular weight that can be achieved. This method used lactide as monomer to form polymer in the presence of catalyst(Lasprilla, Martinez, Lunelli, Jardini, & Filho, 2012).

The production of polylactic acid can be either with homogenous or heterogenous catalyst. Commonly, production with homogenous catalyst is favourable in making pharmaceutical products because of high activity and also selectivity. Unfortunately, the separation of catalyst from the product still remains challenge(Vural Gürsel, Noël, Wang, & Hessel, 2015). Because of the issue, the production by using heterogenous catalyst is being working out nowadays in