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**Journal of Chemical and Pharmaceutical Research, 2015, 7(9S):46-53**

**Research Article**

**ISSN : 0975-7384**
**CODEN(USA) : JCPRC5**

# The optimization of biopolyol synthesis from liquefaction of rice straw using response surface method

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## ABSTRACT

*Polyol has been widely used as a raw material for polyurethane production which has many applications in daily life such as foam synthesis, thermoset, thermoplastic and coating materials. In general, polyol derived from petroleum based product. As the limiting amount of polyol derived from petroleum and the demand of polyol is increasing, effort is needed to find out alternative raw materials in particular potential feedstock comes from agricultural waste. However, there are limited studies focused on the use of rice straw as material for synthesis of biopolyol. Rice straw is very potential raw material for synthesis of biopolyol as it contains lignocellulose hence through liquefaction process will produce biopolyol. Response surface method was performed to determine the optimal operating condition for the liquefaction process of rice straw indicated by high content of hydroxyl group. The effect of key independent variables of liquefaction temperature, reaction time, concentration of biomass and catalyst on the hydroxyl value of product was quantified. The liquefaction process was performed in a batch reactor equipped with thermometer and reflux condenser using glycerol as a solvent and reactant. A central composite design with four independent variables and one response function was applied to determine the influence of independent variables. The concentration of biomass and acid catalyst has significant effect on the hydroxyl value of biopolyol product. The hydroxyl value is a linear function of biomass and catalyst concentration. The optimal operating condition was achieved at a temperature of 60°C, reaction time of 60 minutes, 3% of biomass concentration and 0.5% of acid catalyst concentration. The viscosities of biopolyol obtained are in the range of 217.5 – 727.5 cP.*

**Keywords**: Biopolyol; Liquefaction; Hydroxyl value; Rice straw

## INTRODUCTION

Indonesia is a tropical country with high amount of natural resources for sustainability of human being in particular agricultural sector. As a result, this sector becomes the main commodity for work and job for local community. The need of local community for food has been fulfilled by agricultural sector as a result of the increasing number of food plant production each year. However, the increasing of productivity in agriculture has resulted in a huge amount of side product agricultural waste. Rice straw is one of agricultural waste product with total number about 20 million tons per year in Indonesia. Therefore, effort is needed to convert agricultural waste product to be valuable product with various benefit for daily life.

So far, rice straw is burnt to reduce the waste but this method cause environmental problems in terms of air pollution. Waste of rice straw contains cellulose (38.48%), hemicellulose (20.51%), acid-insoluble lignin (6.42%) and ash (12.47%) [1]. Polyol has been widely used as a raw material for polyurethane production which has many applications in daily life such as foam synthesis, thermoset, thermoplastic and coating materials [2-3]. In general, polyol derived from petroleum based product. As the limiting amount of polyol derived from petroleum and the demand of polyol is increasing, effort is needed to find out alternative raw materials in particular potential feedstock comes from agricultural waste. There are some researches has utilized various bioresources through liquefaction