CHAPTER I
INTRODUCTION

Xylenes are one of the important aromatic compounds including *o*-, *m*-, and *p*- isomers of dimethyl benzene. Industrial demand for *p*-xylene is considerable because of its importance as a feedstock for producing chemical additives, agricultural chemicals and polymeric material such as terephthalic acid and dimethylterephthalate which are essential intermediates in petrochemical production. Currently, *p*-xylene is predominantly produced by catalytic reforming and toluene disproportionation (Kong *et al.*, 2005).

The alkylation of aromatic hydrocarbons is widely used in the large scale synthesis of petrochemicals. This reaction is a substitution reaction that removes an alkyl group from one molecule to another by using an alkylating agent (Mcketta, 1993). The catalysts and processes have been investigated for commercial plants. The traditional alkylation of toluene uses aluminum chloride as a catalyst so called Fridel-Crafts catalysts. Many problems could arise if using homogeneous catalysts e.g., catalysts cannot be regenerated from process, elimination of used catalyst wastes conduces to growing pollution problems and product streams are contaminated with corrosive compounds (Kaeding *et al.*, 1981). Recently, several processes have been developed by using heterogeneous catalysts, especially zeolite catalysts such as ZSM-5, mordenite, and zeolite Beta.

Alkylation of toluene with methanol, which is also known as toluene methylation, is a very promising alternative method to produce *p*-xylene (Vu *et al.*, 2006). No commercial process is yet in operation for production of *p*-xylene by the methylation of toluene with methanol. However, processes of toluene alkylation with methanol using ZSM-5 catalysts were patented (Ghosh *et al.*, 2007 and Wu *et al.*, 2008). These processes have the possible advantages of increasing *p*-xylene production. Because of the shape-selective and the acidity of ZSM-5, it can be utilized for the alkylation of toluene with methanol.

The purposes of this work were to synthesize HZSM-5 zeolite catalysts by hydrothermal crystallization with SiO_2/Al_2O_3 ratios of 90 and185, and to investigate the reaction conditions of various parameters such as reaction temperature (300 °C to

500 °C), weight hourly space velocity (12 h^{-1} to 40 h^{-1}), and toluene-to-methanol (T/M) molar ratio (1:1 to 4:1) for methylation of toluene with methanol by using the synthesized HZSM-5 catalysts.