CHAPTER I
INTRODUCTION

Demanding market of the aromatics is increasing according to the utilization in many vast petrochemicals and valuable fine chemicals. Aromatics are the important raw materials for a number of the intermediates and polymers.

Benzene, toluene, and xylenes (BTX) are the three basic materials for the production of most intermediates of aromatic derivatives. As a result of demand and supply, the trend of benzene's price has been decreasing. The conversion of benzene into the more valuable aromatics is then economic incentive. The highest market demand of aromatic is *p*-xylene because it can be converted to terephthalic acid (TPA) and dimethyl terephthalate (DMT) for using as a starting material to make fibers, films, and other resins.

Xylene has three isomers which consisting of *o*-xylene, *m*-xylene and *p*-xylene. Commercially *p*-xylene is mostly produced by aromatic extraction of various reforming products, xylene isomerization, toluene disproportionation, toluene or benzene alkylation with alkyl halide, alkene or alcohol, etc. There are no one-step processes that perfectly produce *p*-xylene.

Methylation of benzene with methane is interesting because it utilizes the low cost petroleum source benzene as well as methane. A variety of catalysts have been studied for catalyzing this reaction. However, this process is still not in practice owing to the thermodynamic limitation that comes from high stability of methane and benzene.

Solid acid catalysts are usually used for aromatics alkylation due to the environmentally friendly aspect. Among the different solid acids, zeolites have been extensively evaluated for such a purpose. However, it is still a challenging task to develop a zeolite with suitable reaction condition for benzene methylation. To get high activity and high selectivity with long term stability catalyst, bifunctional catalyst consisting of metal and zeolite support has been studied. In order to develop this reaction, investigating of indium loaded on HZSM-5 zeolite is investigated as the new attractive catalyst seeing that it has high thermal stability and can also provide the aromatic conversion of methylation reaction (Baba *et al.*, 2005). Brønsted acid

sites of zeolite support can affect the catalyst activity as well. One important goal of this work is to evaluate the various SiO_2/Al_2O_3 ratios of ZSM-5 which affect to the conversion and selectivity of benzene methylation with methane. The increasing of SiO_2/Al_2O_3 ratio of zeolite has been demonstrated that benzene can be converted into toluene with low percentage of conversion but high percentage of selectivity (Adebajo and Frost, 2005). The other purpose of this work is to determine the appropriate reaction condition of methylation of benzene with methane with indium-containing ZSM-5 catalysts.