



CHAPTER I INTRODUCTION

Basic starting raw materials in petrochemical industry consist of methane, ethylene, propylene, butylenes, benzene, toluene, and xylene. The highest value chemical among all of them is xylene, which have three isomers; *o*-xylene, *m*-xylene and *p*-xylene. The most important isomer is *p*-xylene that can be separated from mixed xylene by either crystallization or zeolite adsorption, and mainly used to produce terephthalic acid, which is a monomer for polyester.

The commercial productions of xylene are included in the benzene, toluene, xylene (BTX) production which can be either the catalytic reforming or the pyrolysis of gasoline. Moreover, there are several other attempts to produce xylene especially *p*-xylene such as toluene disproportionation, alkylation of benzene or toluene with alkyl halide, alkene or alcohol, aromatization of light olefin or paraffin, isomerization of mixed xylene, etc. However, there are no one-step processes that perfectly produce that preferred aromatic.

Direct methylation of benzene by methane is suggested due to availability of benzene and methane. There is an idea to include the methylation unit as a part of aromatic complex as shown in Figure 1.1. However, because methane and benzene are relatively thermodynamically stable, it is difficult to obtain a high conversion and yield for the direct methylation process to become economically feasible.

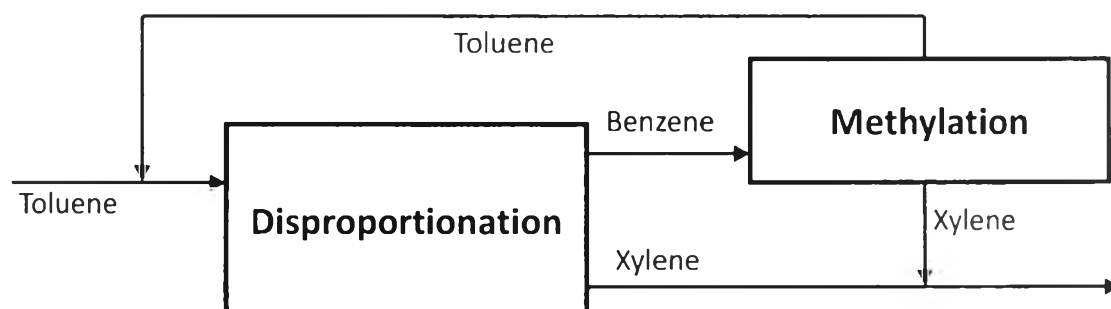


Figure 1.1 The model for inserting benzene methylation unit

Therefore, searching for the suitable catalyst and reaction conditions for methylation of benzene is interesting. Bifunctional catalyst consisting of metal and zeolite support is typically utilized to activate methane. It has been demonstrated that benzene can be converted into toluene and xylene in the presence of methane (He *et al.*, 1994, Adebajo *et al.*, 2000). Indium loaded on HZSM-5 zeolite is an attractive catalyst because it can initiate the reaction and also has high thermal stability. The purpose of this work is to investigate the activity of indium-containing ZSM-5 catalysts for methylation of benzene with methane in various reaction conditions.