CHAPTER I
INTRODUCTION

The alkylation of aromatic hydrocarbons is widely used in the large scale synthesis of petrochemicals, and a great variety of fine chemicals and intermediates. The feature of the reaction is the replacement of a hydrogen atom of an aromatic compound by an alkyl group derived from an alkylating agent (Ertl *et al.*, 1997). The most important alkylbenzene, ethylbenzene (EB), is usually produced by alkylation of benzene with ethylene. Some investigations have observed other alkylating agents as substituted for ethylene. The direct use of ethanol as an alkylating agent has some advantages. A long stable catalyst life and higher yield of alkylbenzene products is observed when alcohol is used. Moreover, the direct use of ethanol in the manufacture of ethylbenzene is also economical significance to many countries where biomass derived alcohol is an additional raw material for the manufacture of chemicals (Sridevi *et al.*, 2001).

The commercial processes for benzene alkylation have conventionally been catalyzed by metal halide, usually called Friedel-Craft catalysts. The use of catalysts has many problems such as handling, safety, waste disposal and corrosion. Recently, several commercial processes have been developed by using solid acid catalysts, especially zeolite. Among the zeolite catalysts, ZSM-5 zeolite may be the best catalyst for the alkylation of benzene with ethylene because of its special structure and its surface acidity (Li *et al.*, 2009). The alkylation of benzene in a fixed-bed reactor in the vapor phase using a ZSM-5 based catalyst is the famous Mobil-Badger process.

The purpose of this work is to find the optimum conditions for the ethylation of benzene to ethylbenzene by using commercial HZSM-5 zeolite catalysts with SiO_2/Al_2O_3 ratios of 23 to195. The activity and selectivity of the catalysts will be tested in a fixed-bed continuous down-flow reactor. Several effects such as reaction temperature (300 °C to 500 °C), weight hourly space velocity (5 h^{-1} to 20 h^{-1}), and benzene to ethanol ratio (1 to 4) will be investigated. Moreover, the stability of catalysts will also be determined. The catalysts will be characterized by XRF, XRD, NH_3-TPD, BET, TG/DTA, and TPO techniques.