CHAPTER I

INTRODUCTION

Ethylbenzene (EB) is an important raw material in the petrochemical industry for the production of styrene by the catalytic dehydrogenation (Odedairo *et al.*, 2010). Styrene has a vinyl group to polymerize to polystyrene and copolymers that use to produce many products such as rubber, plastic, insulation, fiberglass, automobile parts, food containers, and carpet backing. The ethylbenzene production in 2010 is estimated to be about 34 million metric tons (Degnan *et al.*, 2001).

In Thailand have a large amount of biomass that can convert to alcohol easily. Ethylbenzene (EB) is usually produced by alkylation of benzene with ethylene. Therefore, scientists use ethanol as an alkylating agent substituted for ethylene because the direct use of ethanol has some advantages. A long stable catalyst life and higher yield of alkylbenzene products is observed when alcohol is used (Sridevi *et al.*, 2001).

The commercial processes for benzene alkylation that produce the EB have conventionally been catalyzed by metal halides, usually called Friedel-Craft catalysts. The use of such catalysts causes 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 recognized as the famous Mobil-Badger process.

In the past decades, zeolite-based processes have been introduced and licensed by several manufacturers such as Mobil–Badger, Lummus–UOP, CD Tech and Dow Chemical (Degnan *et al.*, 2001). The competing technologies for EB production between those companies based on zeolite catalysts processes in the petrochemical industry. So that using commercial HZSM-5 zeolites is one of the interesting options that we are looking forward to studying. Moreover, Studying

zeolites in fields such as the fine chemical industry, green chemistry or environmental protection, etc is also of very interest now. (Zhicheng *et al.*, 2012)

Previous studies demonstrated that a commercial HZSM-5 catalyst with SiO_2/Al_2O_3 ratio of ca. 195 gave somewhat high selectivity to EB. The purpose of this work is to study the effect of acid-base properties of synthesized HZSM-5 on the selectivity to EB. The HZSM-5 catalysts were synthesized at a ranging of SiO_2/Al_2O_3 ratio of 157 to 195 with different acidity via hydrothermal synthesis. The catalysts was tested using a fixed bed reactor at different reaction conditions; temperature (450–500°C), weight hourly space velocity (15-20 h^{-1}), and benzene to ethanol ratio (2-6). In addition, the comparison on both catalytic activity and selectivity to ethylbenzene for the catalysts investigated were performed.