CHAPTER I

INTRODUCTION

Catalytic cracking is the most important and widely used refinery process for converting heavy hydrocarbon molecules into more valuable smaller products or high octane number products such as iso-paraffin, olefin, aromatics. These high valuable products can be used as petrochemical feedstocks or for blending into gasoline to improve its properties such as vapor pressure and octane number etc.

Originally, cracking process was carried out in the absence of catalysts, accomplished thermally. Consequently, the undesirable products has been appeared, the major products were ethylene with much methane and ethane, many n-α-olefin, few branched aliphatic.

During the last four decades a series of continuously improved cracking catalysts have been applied, all of them solid acids. The most important advance in cracking technology in the last three decades has been the development of zeolite catalysts. Nowaday, catalytic cracking process has almost completely replaced thermal cracking because of high octane number products such as C_3 - C_6 branched aliphatic, few n-α-olefin above C_4 and little methane, ethane, ethylene. On top of this, it can be easily manipulated and decreases in drastic way all problems related to pollution.

In early stage of investigation, silica-alumina amorphous catalyst, activated carbon, pure alumina were used to catalyse in catalytic cracking process but these catalyst not only less active than zeolite catalysts, they were also short life caused by the coke deposition.

On the other hand, ZSM-5 catalyst exhibits long life in hydrocarbon conversion, results from its three-dimensional pore structure which reduces the pore blockage with coke. Nevertheless, ZSM-5 is not elected as the main composition but is elected to be an additive composition for the cracking catalyst because of intricate structure and not widely enough of pore opening. Accordingly, the restricted transport has been related with the counter-diffusion of feed and product molecules within framework, the accessible to active acid sites and the configuration of intermediate. In addition, the extreme strength acid sites of ZSM-5 render the overcracking of feed molecules. Mordenite zeolite has two-dimensional structure, consequently results in rapid deactivation by coke deposition.

Recently, Y-type zeolite has been found to exhibit a good catalytic performance for catalytic cracking process because of its unique properties, for instance the main pore structure is uniform three-dimension with widely pore opening enough to admit the large molecules, excellent flexibility structure to control Al content of the structure for possible to optimize active catalyst, high thermal and hydrothermal stability in order to withstand regenerate conditions.

However, the synthesis of Y-type zeolite is a complex process, due to the completely growth of pure crystal of Y-type zeolite is very sensitive to preparation condition. Furthermore the poor crystal has negative effect to the performance of Y-type zeolite catalyst.

In this work, the major attempt will be made on studying various factors affecting the monophasic, and high crystallization of Y-type zeolite. The optimum formula of the catalyst as well as the proper reaction conditions for n-octane cracking into high valuable smaller products useful for further processing unit or increasing octane number will be investigated.

The Objective of This Study

1. To study the preparation method of Y-type zeolite catalyst and the characterization of the prepared catalyst.

2. To study the catalytic performance of prepared catalyst on n-octane conversion to valuable smaller products useful for further processing unit or increasing octane number.

The Scope of This Study

1. Studying the effect of various factors on the preparation of Y-type zeolite catalyst. The studied factors were the mole ratio of H_2O/SiO_2, pH of gel mixture, time and temperature for crystallization of catalyst.

2. Studying the characterization of the prepared catalyst by the following methods:

- Analyzing structure of crystallites by X-ray diffraction, XRD.
- Analyzing shape and size of the crystallites by Scanning Electron Microscope, SEM.
- Analyzing surface areas of the catalysts by BET Surface Areas Measurement.
- Analyzing the acidity of the catalysts by NH_3-Temperature Program Desorption, NH_3-TPD.

3. Searching the optimum form of the catalysts such as H-form , NH_4-form , Na-form.

4. Studying the performance of the prepared catalyst on n-octane conversion to valuable smaller products useful for further processing unit or increasing octane number under the following conditions:

- Space velocity 1,000-5,000 h^{-1}.
- Reaction Temperature 300-600 °C.
- Time on stream.

The reaction products were analyzed by Gas Chromatographs.