CHAPTER 1

INTRODUCTION

1.1 Introduction

Isomerization of low molecular weight paraffins has been commercially applied for many years. The isomerization of n-butane has found widespread application for the preparation of alkylation feed. Fractions containing mainly pentanes and hexanes have not been isomerized to any great extent because octane requirements of the motor gasoline can, in general, be met without isomerization of these fractions.

Abatement of air pollution from motor vehicles has initiated a worldwide drive to gradually remove the anti-knock additives, e.g., tetra-ethyl lead (TEL) and tetra-methyl lead (TML) from motor gasoline during the coming years. Some automobile manufacturers have announced new car models with lower compression ratios, which will be able to run on gasoline with a lower octane number. The drop in octane number of the gasoline by the removal or reduction of the lead anti-knock additives, however, will have to be partially compensated for by replacing low-octane components principally by aromatics and isoparaffins. As a consequence, isomerization capacity for fractions containing C_5/C_6 paraffins will increase.

Through this effort, several widely different isomerization processes have been developed. One of the early processes used an acid halide type of catalyst, either supported on a solid or complexed with a hydrocarbon (Cheney and Raymond, 1946, cited by Beecher and Voorhies, 1969). The next major isomerization catalyst system was the dual-function catalyst which consisted of a hydrogenation-dehydrogenation component (dispersed metal) on an amorphous solid support (cracking component) (Ciapetta and Hunter, 1953). In the 1960's, another catalyst system was reported, which consisted of a dispersed metal on a crystalline aluminosilicate support (Rabo et al., 1961).

Zeolites are a special class of crystalline aluminosilicate compounds which have specific pore dimensions and pore structure. These pores may be tailored to exclude certain reactants and thus obtain high selectivity. In addition, the special acidic and adsorptive properties of the zeolite surface promote specific conversion reactions such as hydrocracking and hydroisomerization.

1.2 Objectives

The main objective of the present work is to carry out a series of experiments on the hydroisomerization of n-heptane using Na-Mordenite, NaY, HY, and ultrastable Y type zeolitic catalysts under various reaction conditions to provide some insight into the performance of such catalysts, and the effects of isomerization conditions.

The main objective can be broken down into the following.

1. To isomerize n-heptane to iso-heptane and other highly branched paraffins.
2. To develop the experimental techniques necessary to carry out the experiments.

3. To test and screen the performance of Na-Mordenite, NaY, HY and ultrastable Y regarding the hydroisomerization of n-heptane under comparable conditions.
4. To investigate the effects of temperature, pressure, and space velocity on the hydroisomerization of n-heptane using the selected catalyst, in order to find the optimum conditions.

1.3 Scope of Work

The scope of the present work encompasses the following tasks.

1. Fabricate a tubular high-pressure reactor unit (design temperature : 400^{O}C; design pressure : 100 bars).
2. Construct a furnace for a reactor unit and determine its temperature profile in order to check the uniformity of the axial temperature distribution in the furnace.
3. Prepare and/or modify catalysts for use in the experiments.
4. Carry out preliminary experiments to screen and select the suitable isomerization catalyst among modified NaY, HY, ultrastable Y and Na-Mordenite zeolites.
5. Carry out experiments to study the effects of temperature, pressure and space velocity using the selected catalyst.