

CHAPTER I

INTRODUCTION

Until recently, the enhancement of motor fuels octane rating, allowing the production of high performance automotive by the addition of lead compounds or aromatics, but both of these methods are now unfashionable and under scrutiny due to their deleterious environmental effects. As a result, the oil industry has been forced to look for new ways of increasing the motor octane number (M.O.N.), and the addition of oxygenates (e.g., MTBE), giving 'unleaded fuels' is currently preferred since it is thought that this produces cleaner emissions. However, a further alternative is to utilize the isomerization reaction to increase the value of the straight chain alkanes, which are a major constituent in some crude oil fractions, and thus increase the octane rating without the need for additives, as shown in Table 1.1. This reaction must be carried out with a high selectivity to the branched alkanes, while minimizing the amount of hydrocrack to light hydrocarbons. Furthermore, the aromatization of alkanes must be avoided for the reasons already mentioned. [1]

During World War II, due to the great need of high - octane aviation fuel, some isomerization plants were built, using aluminum chloride as a catalyst. The process was expensive and the disposal of the sludge formed was a severe problem. [2]

In the 1950's these processes were replaced by the use of bifunctional catalysts composed of a dispersed noble metal on a classic support such as chloride alumina or silica-alumina [3,4] and several plants [5,6,7] using this type of catalyst were built.

The process using chloride alumina as support operates as 400°C, too high a temperature, from the thermodynamical point of view, which limits the conversion and favours the hydrocarbon side reactions (cracking).

Table 1.1 Octane numbers of some hydrocarbons

No. C atoms	Hydrocarbon	M.O.N.
4	Butane	89.1
	Methylpropane	99.0
5	Pentane	61.9
	Methylbutane	90.3
6	Hexane	26.0
	2-Methylpentane	73.5
	3-Methylpentane	74.3
	Benzene	98.0
	2,2-Dimethylbutane	93.4
	2,3-Dimethylbutane	94.3
7	Heptane	0.0
	2-Methylhexane	45.0
	3-Methylhexane	55.8
	3-Ethylpentane	69.3
	2,3-Dimethylpentane	89.0
	8	Octane
2-Methylheptane		23.8
3-Methylheptane		35.0
2,2,4-Trimethylpentane		100.0

Consequently, the need to discover other catalysts, active at low temperatures and not easily contaminable, was very urgent. It was also important to operate at a temperature sufficiently high to obtain good conversions, close to equilibrium, with high yields of 2,2-dimethylbutane, 2,3- dimethylbutane, 2- methylpentane and 3- methylpentane.

Beta zeolite is a 12-member ring (12 MR) tridirectional zeolite, with two different types of channels having about 7.0 and 5.5 Å [8]. It can be synthesized within a large range of silica-to-alumina ratio (12-200) [9]. This zeolite may offer

interesting opportunities as a catalyst, since it combines three important characteristics: large pores, high silica- to-alumina synthesis ratio, and a tridirectional network of pores [10]. High silica zeolites are known to be important potential catalysts on account of their high thermal, hydrothermal and acid stabilities, and good resistance to aging and hydrophobicity [9]. In addition, the dimensions of one type of pores (5.5 Å) can give a certain level of shape selectivity [11]. This has been shown to apply to the isomerization and transalkylation of xylenes [9,12], to the alkylation of toluene by methanol [13], and to the condensation of benzene and formaldehyde [10], or combination with BF_3 it can be used to alkylate i-butane with alkenes to obtain alkylated products [14,15]. Furthermore, the isomerization processes were run over bifunctional Beta zeolite consisting of highly dispersed metals [9,12]. The balancing of the hydrogenation-dehydrogenation function and the acidity was of great importance to achieve optimum catalytic performance in isomerization.

Therefore, this work aims to investigate the synthesis of Beta zeolite and the performance of Beta zeolite for isomerization of n-hexane. The optimum catalyst for n-hexane conversion reaction as well as proper conditions were studied.

The Objective of This Study

To study the synthesis of Beta zeolite for isomerization of hexane.

The Scope of This Study

1. Study the synthesis of Beta zeolite
2. Characterize the prepared catalyst by following methods :
 - Analyzing the structure of catalyst by X-Ray Diffraction (XRD)
 - Analyzing shape and size of crystallites by Scanning Electron Microscope (SEM)
 - Analyzing surface areas of the catalysts by BET Surface Area Measurement.
 - Analyzing the acidity of the catalysts by NH₃-Temperature Programmed Desorption (NH₃-TPD)
3. Investigate the performance of the prepared catalysts on the hexane conversion to its isomers under the following conditions :
 - Atmospheric pressure
 - Ratio of SiO₂/Al₂O₃ in gel 25-50
 - Reaction temperature 150-300° C
 - Space velocity 400-3200 h⁻¹

The reaction products were analyzed by gas chromatographs.