

CHAPTER I

INTRODUCTION

The number of strategic, commercial, and economic factors of growing importance of the aromatization of n-hexane to benzene make it particularly interesting. These factors include raw material supply, transportation regulations and price considerations, changes in benzene market demands and the technical, economic, and strategic limitations of existing technology.

Benzene which is one of the most important building blocks in chemical industries is largely used as a raw material in industries, especially in petrochemical industries. Benzene is obtained from destructive distillation of coal, toluene dealkylation, ethylene and propylene production by cracking naphtha or gas oil and petroleum refinery, especially catalytic reforming process. In fact, in the last decades, the first commercial catalytic reforming was stimulated by the wartime demand for high-octane gasoline for propeller-driven aircraft, and for aromatic chemicals such as toluene for use in making trinitrotoluene (TNT). Nowadays, a strong market pressure compels increasing optimization of the present processes. Cost reduction which is often mentioned in industrial processes can be obtained either by setting up new engineering concepts or by using cheaper raw materials (particularly alkanes) and, in some cases, combined with the use of more sophisticated catalysts.

Pt/KL zeolite catalysts which consist of Pt supported on non-acidic materials, zeolite L, were known for many years as a new generation of reforming catalysts because they showed the exceptionally high activity and selectivity for the n-hexane aromatization. A key feature is a low rate of coke fouling, attributed to the particular zeolite channels. Zeolite L is one-dimensional with pores of about 0.74-nm aperture leading to cavities of about

0.48 x 1.24 x 1.07 nm. Zeolite L's superior performance may be associated with a tight confinement in the zeolite channel that forces the n-hexane to bend around. It is also the base catalyst of the Chevron Aromax process which is an alternative to isomerization and reforming as methods of increasing the octane number of light straight-run naphtha and directing to chemical production.

The three most important aspects of the application of any heterogeneous catalyst are activity, selectivity and life. Of these, catalyst life has received the least attention, despite the fact that deactivation can often dictate the viability of a given process.

Not only the coke formation, but sulfur is also the most important cause of catalyst deactivation in industries. A shortcoming for Pt/KL zeolite catalysts is their extremely high sensitivity to even minute concentrations of sulfur (e.g., parts per billion), thus requiring very expensive and complicated sulfur-removal operations. Therefore a strong interest in finding effective catalysts for the aromatization reactions in the presence of sulfur has been investigated.

This project focuses on studying the effect of preparation method on the aromatization activity and sulfur resistance performance over Pt/KL and PtCe/KL zeolite catalysts. Fresh catalysts with different preparation methods were studied. The research was divided into three parts. The first part was to test the catalyst activities using n-hexane as a feed at different reduction and reaction temperatures, 400°C and 500°C, respectively. If reduction was performed at 400°C, the following reaction would also be done at 400°C. It is the same at 500°C. The obtained products were analyzed by Gas Chromatograph. The second part was similar to the first part but mixture of n-hexane and thiophene was used in addition to pure n-hexane in order to investigate sulfur tolerance ability of catalysts. The third part was to characterize fresh and spent catalysts by means of hydrogen chemisorption,

temperature programmed oxidation (TPO) and infrared spectroscopy of adsorbed CO.