

## CHAPTER I

### INTRODUCTION

The petrochemistry of benzene, toluene, and xylenes (BTX) undergoes a strong economic development with the main reason being the increasing use of C<sub>8</sub> aromatics (*p*-xylene, *m*-xylene, *o*-xylene and ethylbenzene). *p*-xylene has been widely used as a chemical intermediate for the production of polyesters, plastics and pharmaceuticals. It is commonly produced by a reforming reaction, along with ethylbenzene and the other xylene isomers, *o*-xylene and *m*-xylene. *p*-xylene is typically about thirty mole percent of the product composition (Miller *et al.*, 2002). Therefore, the separation of *p*-xylene from the C<sub>8</sub> aromatics has become a large-scale process in the industry. As a result, the separation with a high efficiency has been an attractive topic (Guo-Qing *et al.*, 2000).

There are some limitations in the *p*-xylene separation due to the similar physical properties of the C<sub>8</sub> aromatics. For example, because of the close boiling points of these isomers, separation based on distillation is often impractical and uneconomical. Moreover, the crystallization process may suffer from the eutectic problem; therefore, other processes based on zeolitic adsorption have been developed to separate xylenes on a commercial scale (Tournier *et al.*, 2001). The most well known selective adsorption industrial process for xylenes separation is the Parex<sup>TM</sup> process developed by UOP LLC, which is based on selective adsorption in liquid phase on KY and KBaX zeolites as adsorbent with toluene as a desorbent (Varanyanond, 2001).

Membrane based separation processes are recognized as potentially economical alternatives for such the separation, especially membrane pervaporation, which is one of the most promising membrane separation processes for the separation of azeotropic or close boiling mixtures. Membrane materials used for the separation of xylene isomers can be classified into three types: zeolite membranes, polymeric membranes, mediated transport membranes (Schleiffelder and Bickel, 2001). Despite advantages of economical membrane formation, the segmental flexibility of polymers limits their discriminating ability compared to more selective rigid molecular sieving media. Alternatively, mixed matrix materials comprising

molecular sieve entities embedded in a polymer matrix offer the most viable approach around the current limitation on continued economical materials development for this application (Mahajan *et al.*, 1999).

Besides aromatics, hydrocarbon mixtures such as reformat gasoline and pyrolysis gasoline also contain non-aromatics, which can include paraffins, cycloparaffins, olefins, diolefins and organic sulphur compounds (Donnermeyer *et al.*, 1999). Separation of aromatics from hydrocarbons is one of the separation processes in petroleum refining where the membranes may offer significant impact. Current commercial processes such as solvent extraction and partly by extractive distillation are complex and energy intensive.

Previous work with membrane extraction and pervaporation using polyimide and polyimide based-mixed matrix membranes showed some aromatics enrichment but at low membrane fluxes (Santiworawut, 2003). In this work, further investigation on the separation and permeation behavior of xylene isomers and paraffins through silicalite/polyimide mixed matrix membranes were carried out using a membrane pervaporator.