



## CHAPTER I INTRODUCTION

C<sub>8</sub> aromatics that include *p*-xylene, *m*-xylene, *o*-xylene, and ethylbenzene have played an important role in the petrochemical industry development (Tournier *et al.*, 2000). The most important isomer is *p*-xylene, which is used to produce terephthalic acid (TPA), a raw material for the production of polyethylene terephthalate (PET). *o*-Xylene, *m*-xylene, and ethylbenzene are raw materials for phthalic anhydride, isophthalic acid and styrene, respectively. The C<sub>8</sub> aromatic isomers are always produced as a mixture. Thus, the separation of the C<sub>8</sub> isomers is of growing interest in industry (Minceva and Rodrigues, 2004; Santacesarla *et al.*, 1982).

Separation of C<sub>8</sub> aromatic mixtures is an important issue in the petrochemical industry. It is well known that three major methods, extract distillation, crystallization, and adsorption, can be used to separate *p*-xylene from the other C<sub>8</sub> aromatic isomers. Because of their close boiling points, their separation by distillation is impractical and uneconomical. Moreover, separation by crystallization may suffer from the eutectic problem. Thus, the selective adsorption on a zeolite adsorbent is the most attractive industrial process for the separation (Guo *et al.*, 2000; Milewski *et al.*, 1982). The industrial separation of *p*-xylene is generally performed by simulated moving bed (SMB) technology, which is used in UOP's Parex (Broughton *et al.*, 1970), Toray's Aromax (Otani *et al.*, 1973), and IFP's Eluxyl (Ash *et al.*, 1994). In the Parex process, the most successful process, adsorption is performed in the liquid phase with metal-ion-exchanged faujasite type zeolite like KY and BaX (Neuzil, 1976).

The efficiency and capacity of *p*-xylene separation is controlled by several factors such as an exchanged cation, SiO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub> ratio, xylene adsorbed composition, operating temperature, and water content of a zeolite (Limsamutchaikul, 2003). Furthermore, many techniques such as a batch or finite bath method, thermogravimetry (TGA), gas chromatography (GC) (pulse test and breakthrough technique), and gas chromatography-combustion-isotopic ratio mass spectrometer (GC-C-IRMS) were used to measure the adsorption equilibrium of the C<sub>8</sub> aromatics

on zeolites (Santacesaria *et al.*, 1982; Pichon *et al.*, 2000; Limsamutchaikul, 2003; Tournier *et al.*, 2000). Additionally, headspace chromatography has recently been applied for C<sub>8</sub> aromatics adsorption measurement (Buarque *et al.*, 2005). This technique allows the use of a much smaller quantity of liquid and higher ratio of solid to liquid. Moreover, the headspace technique gives high accuracy of the experimental results and is useful for investigating the variation in selectivity in relation to composition (Torres *et al.*, 2001; Luna *et al.*, 2010).

In this work, the liquid phase adsorption of C<sub>8</sub> aromatics, including *p*-xylene and *m*-xylene on NaY, KY, BaX, and BaY zeolites were investigated by headspace chromatography. The effects of temperature on the adsorption were studied by varying the operating temperature in the range of 40 - 120 °C. Mixture composition was also varied. In addition, the experimental result from the headspace chromatography was compared with the conventional batch adsorption method to investigate the applicability of the headspace chromatography for C<sub>8</sub> aromatics adsorption measurement.