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APPENDIX

A1. Sample preparation

A1.1 Multi-component Pulse Test

Table A.1 Sample preparation for the Multi-component Pulse Test

component	wt., g.	Density, g/ml.	Volume, ml.
p-xylene	20	0.8610	23.229
m-xylene	20	0.8684	23.031
o-xylene	20	0.8970	22.297
ethylbenzene	20	0.8670	23.068
n-C_9	20	0.7217	27.712

The 120 ml, approximately, of stock solution for using in the Dynamic Adsorption Multi-component Pulse Test was prepared followed Table A.1 above.

Table A.2 Zeolite used in the Multi-component Pulse Test

zeolites	Amount, g.
Mg2.0X	43.4
Ca2.0X	45.9
Sr2.0X	48.0
Ba2.0X	55.1
Mg2.5X	52.3
Ca2.5X	46.4
Sr2.5X	50.9
Ba2.5X	51.6
MgY	43.9
CaY	43.6
SrY	47.0
BaY	51.6

A1.2 Multi-component Breakthrough Test

Table A.3 Sample preparation for the Multi-component Breakthrough Test

component	wt., g.	Density, g/ml.	Volume, ml.
p-xylene	20	0.8610	23.229
m-xylene	40	0.8684	46.062
o-xylene	20	0.8970	22.297
ethylbenzene	13	0.8670	15.379
n-C_9	7	0.7217	9.237

The 120 ml, approximately, of stock solution for using in the Dynamic Adsorption Multi-component Breakthrough Test was prepared followed Table A.1 above.

Table A.4 Zeolite used in the Multi-component Breakthrough Test

zeolites	Amount, g.
Mg2.0X	43.4
Ca2.0X	45.9
Sr2.0X	48.0
Ba2.0X	55.1
Mg2.5X	52.3
Ca2.5X	46.4
Sr2.5X	50.9
Ba2.5X	51.6
MgY	43.9
CaY	43.6
SrY	47.0
BaY	51.6

A2. Selectivity calculation

A2.1 Multi-component Pulse Test

Data obtained from experiment was relative effluent concentration of each component. The relative concentration were plotted versus effluent volume as showed in Figure A.1.

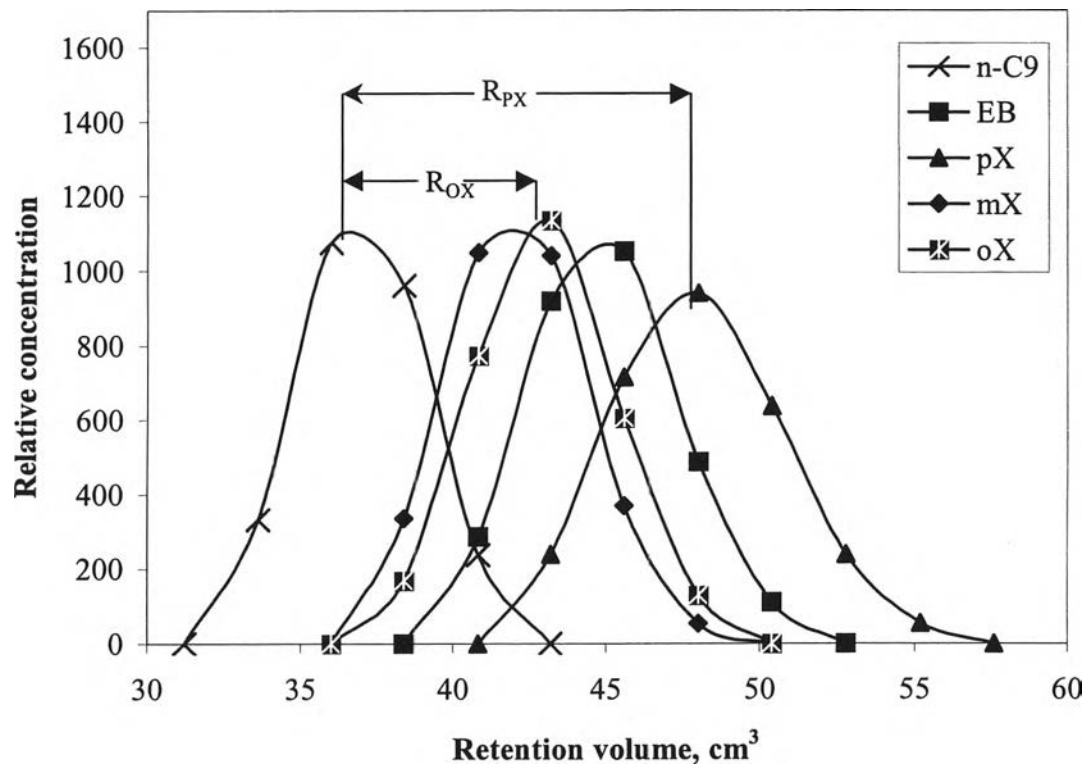

Figure A.1 A schematic of Multi-component pulse test.

Selectivity is a ratio of net retention volume. For example, the *p*-xylene selectivity with respect *o*-xylene can be calculated from the ratio of net retention volumes of *p*-xylene, R_{PX}, to *o*-xylene, R_{OX}.

$$\alpha_{PX/OX} = \frac{R_{PX}}{R_{OX}} \qquad \text{(A1)}$$

The net retention volume of each componenet was measured by using the index of the tracer peak as the zero origin. As showed in FigureA.1, R_{px} is a distance from center of tracer, nonane, peak to a center of *p*-xylene peak.

The *p*-xylene selectivity with respect to the other components, ethylbenzene and *m*-xylene, can be calculated in the same way.

The selectivity can be calculated from the net retention volume. Because the net retention volume of any component is ideally proportional to its distribution coefficient, i.e., its concentration in the adsorbed phase divided by its concentration in the unadsorbed phase, the calculated quantity is essentially equivalent to selectivity as defined separations carried out in a liquid system (Kulprathipanja, 2001)

In this work, Sorbex Database was used for calculating selectivity from Pulse Test technique. It is a soft ware that was developed and provided by UOP, LLC.

A2.2 Multi-component Breakthrough test

From Breakthrough curve, there are adsorption zone and desorption zone as showed in Figure A.2. Selectivity can be calculated both in these 2 zones. All selectivities reported in this work were calculated from adsorption zone. Selectivity can be calculated by using the same principal as in Pulse Test technique. By finding the rato of net retention volume of two components. Firstly, the area under adsorption curve of the components A_{tracer}, A_A and A_B were calculated. The constant height in breakthrough region of each curve, H_{tracer}, H_A and H_B was measured. Consequently, the adsorbed volume of each component was calculated as

$$L_A = \frac{A_A}{H_A} \qquad \text{(A3)}$$

By subtracting L_{tracer} from L of component, the adsorbed volume of each component was obtained. The selectivity of component B with respect to component A was defined as the ratio of adsorbed volume A to adsorbed volume B

$$\alpha_{B/A} = \frac{L_{tracer} - L_B}{L_{tracer} - L_A} \quad \text{(A4)}$$

By using the same method, the *p*-xylene selectivity with respect to the others, *m*-xylene, *o*-xylene and ethylbenzene, was calculated.

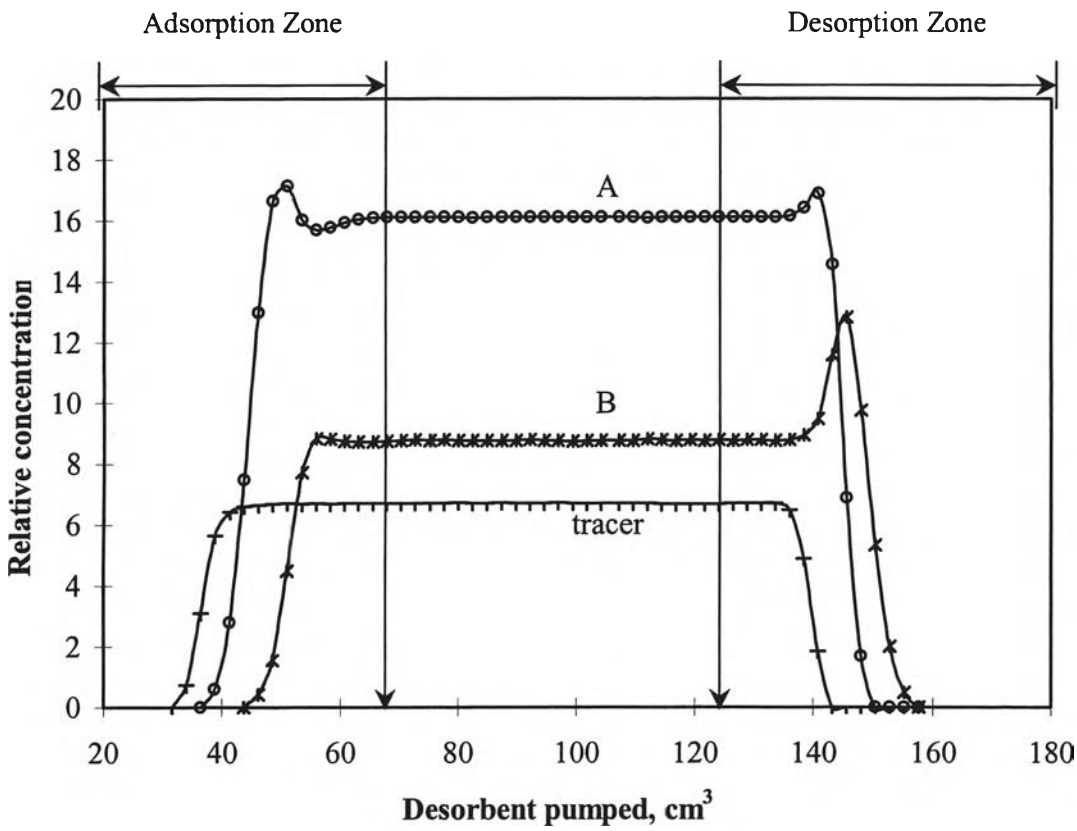

Figure A.2 A schematic of Multi-component Breakthrough Test.

A3. Heat of adsorption calculation

According to equation (4.2), parameters of adsorption model were calculated by using a solver function in Microsoft Excel. The calculation of each component was based on a set of temperature: 100, 120, 150, 177 °C. Ethylbenzene, *o*-xylene and *m*-xylene, subscript 2, were calculated by comparing with *p*-xylene, subscript 1.

Table A.5 Adsorption parameters of *p*-xylene and ethylbenzene

Temperature	k_1	k_2	K_{01}	H_1	K_{02}	H_2	Selectivity
373	0.2388	0.1519	1.8809	1.199	1.2129	0.970	1.572488
393	0.2973	0.1817	1.8809	1.199	1.2129	0.970	1.636708
423	0.3876	0.204	1.8809	1.199	1.2129	0.970	1.900194
450	0.3162	0.204	1.8809	1.199	1.2129	0.970	1.550387

Table A.6 Adsorption parameters of *p*-xylene and *m*-xylene

Temperature	k_1	k_2	K_{01}	H_1	K_{02}	H_2	Selectivity
373	0.3591	0.1519	2.0589	1.199	0.8991	0.842	2.364343
393	0.4158	0.1817	2.0589	1.199	0.8991	0.842	2.288982
423	0.5115	0.204	2.0589	1.199	0.8991	0.842	2.507917
450	0.4073	0.204	2.0589	1.199	0.8991	0.842	1.996713

Table A.7 Adsorption parameters of *p*-xylene and *o*-xylene

Temperature	k_1	k_2	K_{01}	H_1	K_{02}	H_2	Selectivity
373	0.3776	0.1519	2.0841	1.199	0.8408	0.814	2.486089
393	0.4501	0.1817	2.0841	1.199	0.8408	0.814	2.477554
423	0.5451	0.204	2.0841	1.199	0.8408	0.814	2.672646
450	0.4152	0.204	2.0841	1.199	0.8408	0.814	2.035549

CURRICURUM VITAE

Name: Ms. Suwanna Limsamutchaikul

Date of Birth: Jun 4, 1979

Nationality: Thai

University Education:

1997-2000 Bachelor Degree of Science in Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand.