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APPENDICES

Appendix A

Example chromatograms of upper layer liquid and lower layer liquid which were analyzed by GC.

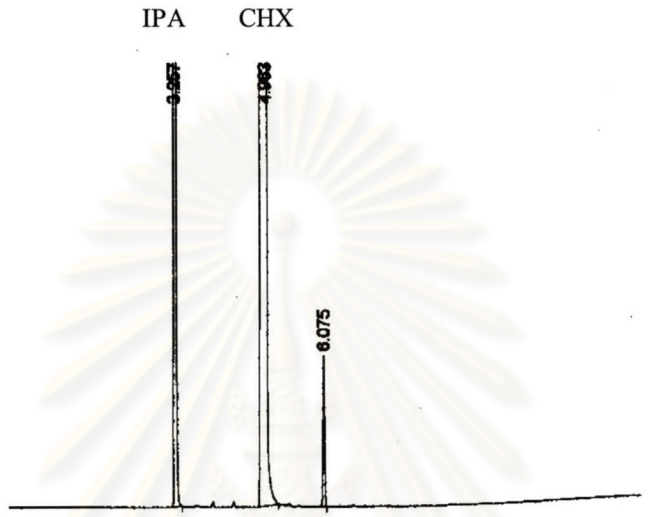


Figure A – 1 GC chromatogram of upper layer liquid.

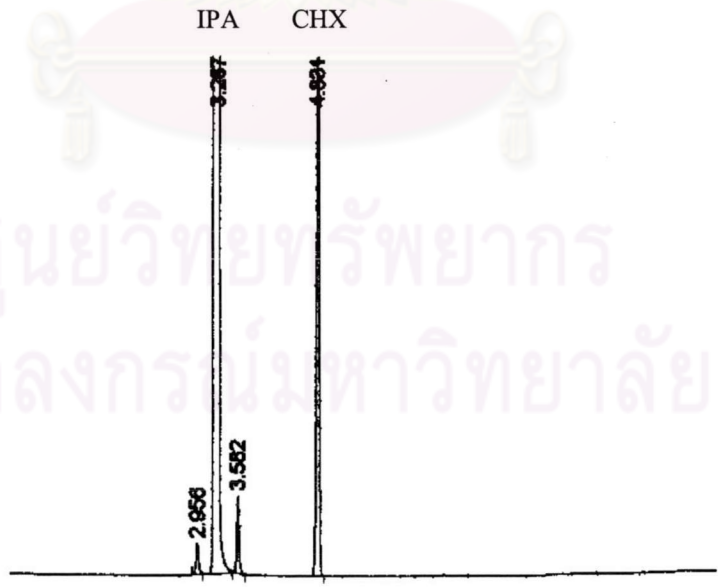


Figure A – 2 GC chromatogram of lower layer liquid.

Appendix B

Example chromatograms of feed, product, CHX phase and water phase, which were analyzed by GC.

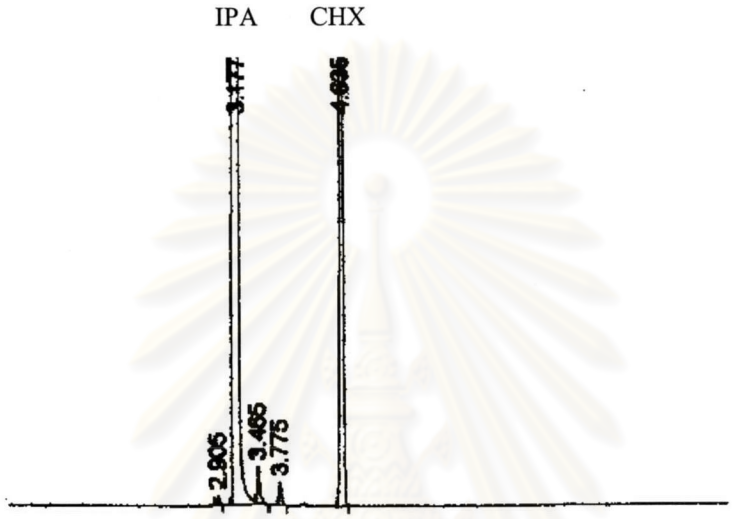


Figure B – 1 GC chromatogram of feed.

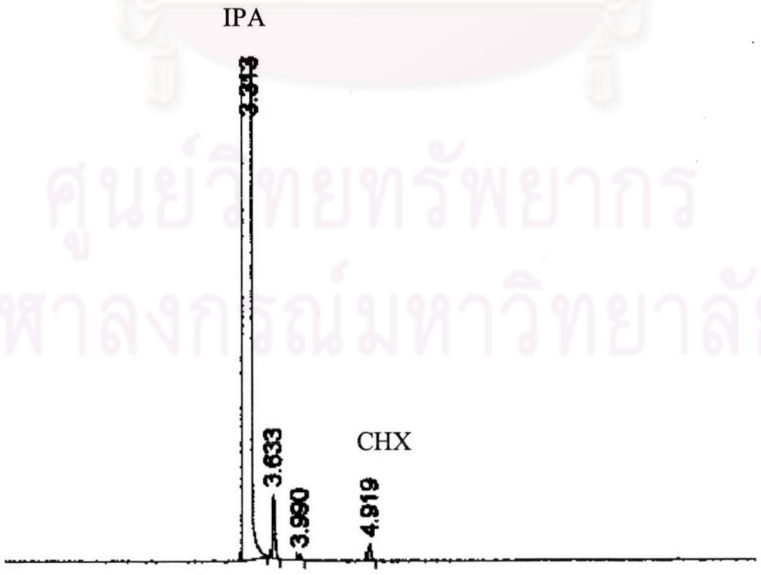


Figure B – 2 GC chromatogram of product.

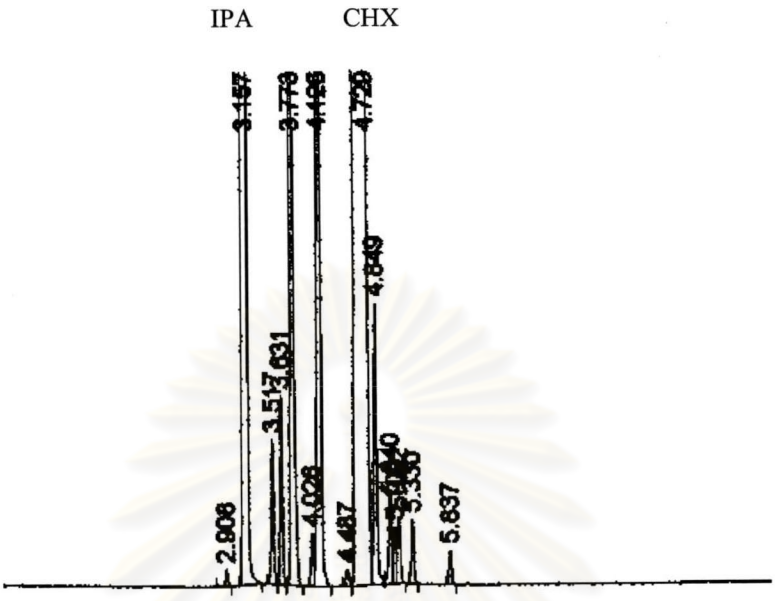


Figure B – 3 GC chromatogram of CHX phase.

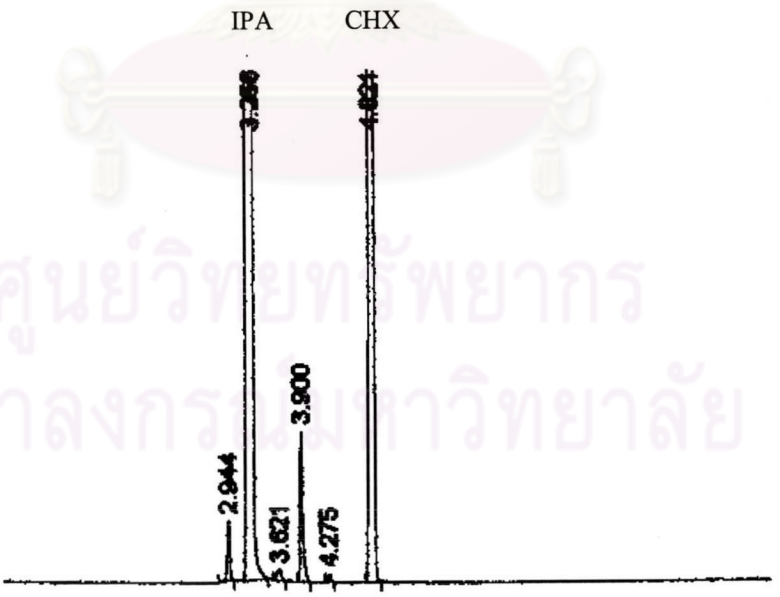


Figure B – 4 GC chromatogram of water phase.

Appendix C

Table C – 1 The temperature around column which operated at feed rate of 8.0, 9.0, 10.5, 11.0 and 12.0 L/min.

Feed rate (L/min.)	Reflux rate (%)	Time (hr.)	Temperature (°C)			
			T_1	T_2	T_3	T_4
8.0	95	2	65.9	68.4	78.2	86.2
		4	66.7	73.4	78.9	86.2
		6	66.8	72.6	79.9	86.0
		8	66.7	72.6	79.1	86.0
9.0	97	2	66.3	71.7	76.8	86.0
		4	66.7	72.5	76.9	86.0
		6	67.1	73.2	80.0	86.1
		8	66.4	72.1	75.1	85.9
10.5	95	2	67.1	68.6	78.6	85.7
		4	66.5	68.2	77.4	85.7
		6	66.8	68.7	79.0	86.2
		8	66.5	67.6	74.8	85.3
11.0	99.5	2	66.4	69.7	78.0	85.8
		4	66.3	67.6	75.3	85.5
		6	67.3	69.4	78.1	86.0
		8	67.1	70.1	78.2	86.2
12.0	100	2	66.1	68.5	76.6	86.0
		4	66.2	67.7	74.2	85.3
		6	66.7	73.7	80.0	86.3
		8	66.9	73.4	79.3	86.3

Appendix D

Table D – 1 The temperature around column which operated at feed rate of 9.5, 10.5, 11.0 L/min. and varied reflux rate in range of 94 – 99 %.

Feed rate (L/min.)	Reflux rate (%)	Temperature (°C)			
		T_1	T_2	T_3	T_4
9.5	94	66.4	69.6	77.0	86.4
	95	66.2	68.2	76.2	86.2
	96	66.3	69.9	76.9	86.3
	97	66.2	69.6	77.6	86.3
	98	66.2	71.0	77.5	86.4
	99	66.4	71.6	77.0	86.3
10.5	94	66.4	71.7	76.5	86.4
	95	66.3	71.9	76.9	86.3
	96	66.4	71.8	77.0	86.5
	97	66.4	72.3	77.8	86.8
	98	66.4	72.0	77.6	86.8
	99	66.5	72.5	79.9	86.6
11.0	94	66.5	69.0	78.8	85.6
	95	66.5	69.4	79.1	85.6
	96	66.4	68.7	77.9	85.6
	97	66.4	68.7	77.5	85.6
	98	66.6	69.3	78.6	85.8
	99	66.5	68.8	77.6	85.6

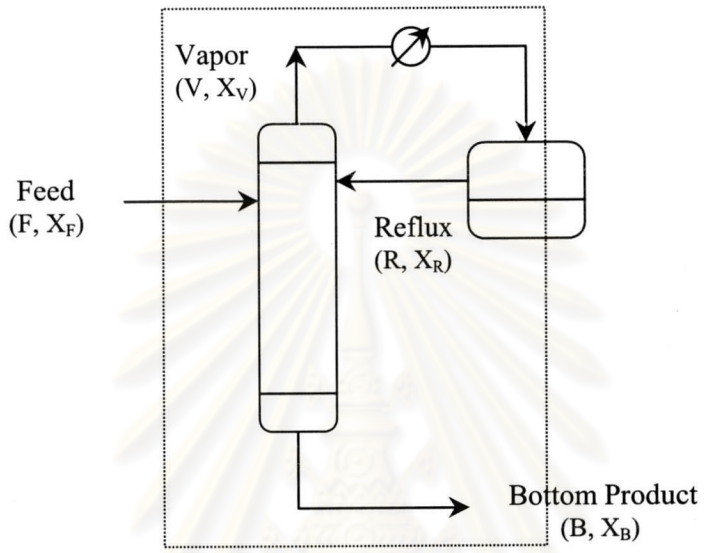
Appendix E

Table E – 1 The temperature around column which operated at feed rate of 9.5, 11.0, 12.5 L/min. and reflux rate was 98%.

Feed rate (L/min.)	Reflux rate (%)	Time (hr.)	Temperature (°C)			
			T_1	T_2	T_3	T_4
9.5	98	2	66.9	68.0	72.0	86.5
		4	69.9	70.9	73.3	88.4
		6	68.9	69.8	72.3	88.0
		8	69.0	69.8	71.7	87.8
11.0	98	2	66.7	72.8	78.0	86.7
		4	66.6	70.9	77.0	86.5
		6	66.7	72.1	77.8	86.7
		8	66.7	72.7	78.0	86.8
12.0	98	2	66.5	71.2	81.4	87.2
		4	66.6	71.2	81.8	87.2
		6	66.5	68.6	78.0	86.8
		8	66.4	70.9	81.9	86.9

Appendix F

Determination of vapor compositions by material balance around azeotropic distillation column.



Material balance when the system was going to steady state at feed rate of 11.0 L/min, 98% reflux rate and product rate of 10.8 L/min.

Compositions (%)	Percent by weight			
	Feed	Product	Reflux	Vapor
IPA	81.856	99.955	13.222	12.128
Cyclohexane	0.812	0.003	84.656	84.165
Water	17.333	0.042	2.122	3.707
Total	100.0	100.0	100.0	100.0

Feed = 11.0 L/min. or 9.13 kg./min.

Bottom product = 10.8 L/min. or 8.47 Kg./min.

Reflux rate = 98%

Input	=	Output
Feed + Reflux	=	Vapor + Bottom product
$F.X_F + R.X_R$	=	$V.X_V + B.X_B$

IPA balance ;

(9.13 x 0.81856) + (98 x 0.13222)	=	$V.X_I$ + (8.47 x 0.99950)	
7.473 + 12.958	=	$V.X_I$ + 8.466	
20.431	=	$V.X_I$ + 8.466	(1)

Cyclohexane balance ;

(9.13 x 0.00812) + (98 x 0.84656)	=	$V.X_C$ + (8.47 x 0.00003)	
0.074 + 82.963	=	$V.X_C$ + 0.00025	
83.037	=	$V.X_C$ + 0.00025	(2)

Water balance ;

(9.13 x 0.17333) + (98 x 0.02122)	=	$V.X_W$ + (8.47 x 0.00042)	
1.582 + 2.080	=	$V.X_W$ + 0.00356	
3.662	=	$V.X_W$ + 0.00356	(3)

(1) + (2) + (3) ;

107.130	=	$V(X_I + X_C + X_W) + 8.470$
V	=	98.660

Therefore ;

X_I	=	0.12128
X_C	=	0.84165
X_W	=	0.03707

VITA

Miss Achara Chumjam was born on February 17, 1973 in Samutsakhorn, Thailand. She received her Bachelor's Degree of Science in Chemistry from the Faculty of Science, Silpakhorn University in 1995. She is working in Reagent Chemical Industry Co., Ltd. She has pursued Master Degree in Program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University since 1999 and finished her study in 2001.