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APPENDIX A
Experimental Data

Table A 1 The results of steady-state experiment under operational condition[CTAB] = 0.5 CMC; feed flow rate = 50 ml/min; air flow rate = 80 L/min; foam height = 60 cm and number of tray = 5

Time (hr)	Concentration (μM)					
	Effluent	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
0	2137.41	2137.41	2137.41	2137.41	2137.41	2137.41
1	286.45	160.98	115.71	158.87	111.62	366.84
2	99.22	68.13	70.41	67.61	130.00	406.35
3	115.49	65.80	85.55	84.54	130.80	371.78
4	134.03	56.55	71.94	80.61	133.38	393.46
5	104.89	74.60	59.43	83.69	162.60	411.29
6	117.71	71.34	82.45	76.09	141.14	409.92
7	102.78	79.24	79.65	89.67	157.27	406.90

Table A 2 The results of Operational zone under operational condition [surfactant] = 0.5 CMC; foam height = 60 cm and feed tray number 5

Air Flow Rate (LPM)	Maximum Feed Flow Rate (ml/min)					Minimum Feed Flow Rate (ml/min)				
	Water	DTAB	TTAB	CTAB	CPB	Water	DTAB	TTAB	CTAB	CPB
50	180	300	320	330	340	40	40	40	40	40
60	200	350	360	370	370	25	30	30	30	30
70	210	370	380	390	400	25	30	30	30	30
80	230	380	400	400	410	25	30	30	30	30
90	220	360	380	390	400	25	30	30	30	30
100	220	350	360	370	390	25	30	30	30	30
110	220	330	340	350	350	25	30	30	30	30

Table A 3 The experimental data of foam ability and foam stability of surfactants

Surfactant	Foam Stability(min)	Foam Ability (L/min)
CPB	101.99	1.29
CTAB	53.87	1.21
TTAB	26.62	1.18
DTAB	14.25	1.10

Table A 4 Data of surface tension of CTAB

CTAB Concentration (mM)	surface tension (dyne/cm ³)
0.05	70.95
0.10	58.40
0.15	55.83
0.20	53.29
0.23	51.54
0.30	47.42
0.40	41.17
0.50	42.04
0.60	40.11
0.70	37.31
0.80	36.06
0.90	35.96
1.00	34.84
2.00	36.24
3.00	32.94
4.00	33.50
6.00	32.56
8.00	33.79
10.00	33.66
12.00	32.66
14.00	33.45
16.00	33.67
18.00	33.76
20.00	32.65
22.00	32.54
24.00	32.56
26.00	33.57
28.00	33.07
30.00	32.66

Table A 5 Data of surface tension of TTAB

TTAB Concentration (mM)	surface tension (dyne/cm ³)
0.20	67.59
0.23	64.10
0.30	63.88
0.40	62.89
0.50	62.24
0.60	58.40
0.70	57.83
0.80	58.21
0.90	55.68
1.00	50.64
1.50	49.30
2.00	46.33
2.50	42.47
3.00	38.08
3.50	36.00
3.60	35.87
3.70	36.13
3.80	37.14
3.90	37.03
4.00	36.30
6.00	36.38
8.00	37.34
10.00	36.45
12.00	37.65
14.00	37.54
16.00	36.56
18.00	37.55
20.00	36.99
22.00	37.35
24.00	37.43
26.00	36.92
28.00	37.23
30.00	36.85

Table A 6 Data of surface tension of DTAB

DTAB Concentration (mM)	surface tension (dyne/cm ³)
1	66.95
2	62.30
3	59.49
4	54.38
5	51.44
6	47.15
7	45.69
8	42.40
9	42.59
10	42.63
11	40.08
12	40.16
13	35.98
14	36.11
15	37.17
16	36.98
17	36.67
18	35.71
19	35.17
20	35.75
21	35.65
22	35.65
23	35.01
24	35.26
25	35.71
26	35.71
27	35.41
28	35.66
29	35.41
30	35.66

Table A 7 Data of surface tension of CPB

CPB Concentration (mM)	surface tension (dyne/cm ³)
0.06	67.25
0.08	65.58
0.1	62.45
0.2	57.13
0.3	52.25
0.4	48.15
0.5	44.17
0.6	36.16
0.7	36.3
0.8	36.68
0.9	36.96
1	36.57
3	36.16
5	36.83
7	35.78
10	35.82
12	35.56
14	35.45
16	35.54
18	35.87
20	35.52
22	35.32
24	35.78
26	35.81
28	35.68
30	35.57

Table A 8 The experimental data of the CTAB concentration in the effect of feed flow rate at 40 L/min of air flow rate

feed flow rate (ml/min)	%surfactant recovery	enrichment ratio
40	91.31	14.26
60	90.75	11.94
80	89.76	8.86
100	88.28	6.99

Table A 9 The experimental data of the CTAB concentration in the effect of feed flow rate at 60 L/min of air flow rate

feed flow rate (ml/min)	%surfactant recovery	enrichment ratio
40	94.02	7.21
60	95.32	7.47
80	93.83	7.36
100	91.33	7.05

Table A 10 The experimental data of the CTAB concentration in the effect of air flow rate at 40 ml/min of feed flow rate

air flow rate (L/min)	%surfactant recovery	enrichment ratio
40	91.31	14.26
60	94.02	7.21
80	95.01	6.15
100	95.04	6.01

Table A 11 The experimental data of the CTAB concentration in the effect of air flow rate at 60 ml/min of feed flow rate

air(L/min)	%surfactant recovery	enrichment ratio
40	90.75	11.94
60	95.32	7.47
80	96.00	6.56
100	96.58	6.10

Table A 12 The experimental data of the TTAB concentration in the effect of feed flow rate at 40 L/min of air flow rate

Feed flow rate (mL/min)	%surfactant recovery	enrichment ratio
40	73.33	3.70
60	47.13	3.65
80	37.92	3.02
100	35.43	3.01

Table A 13 The experimental data of the TTAB concentration in the effect of feed flow rate at 60 L/min of air flow rate

feed (mL/min)	%surfactant recovery	enrichment ratio
40	84.85	3.11
60	84.74	1.51
80	86.30	1.31
100	85.35	1.22

Table A 14 The experimental data of the TTAB concentration in the effect of air flow rate at 40 ml/min of feed flow rate

air flow (L/min)	%surfactant recovery	enrichment ratio
40	73.33	3.70
60	84.85	3.11
80	86.90	2.31
100	87.21	2.13

Table A 15 The experimental data of the TTAB concentration in the effect of air flow rate at 60 ml/min of feed flow rate

air flow (L/min)	%surfactant recovery	enrichment ratio
40	47.13	3.65
60	84.74	1.51
80	76.43	1.19
100	75.23	1.11

Table A 16 The experimental data of the DTAB concentration in the effect of feed flow rate at 40 L/min of air flow rate

feed flow (ml/min)	%surfactant recovery	enrichment ratio
40	12.63	1.77
60	7.58	1.51
80	5.57	1.42

Table A 17 The experimental data of the DTAB concentration in the effect of feed flow rate at 60 L/min of air flow rate

feed flow (ml/min)	%surfactant recovery	enrichment ratio
40	55.91	0.96
60	19.42	1.23
80	7.90	1.23

Table A 18 The experimental data of the DTAB concentration in the effect of air flow rate at 40 ml/min of feed flow rate

air flow (L/min)	%surfactant recovery	enrichment ratio
40	12.63	1.77
60	55.91	0.96
80	75.28	1.05

Table A 19 The experimental data of the DTAB concentration in the effect of air flow rate at 60 ml/min of feed flow rate

air flow (L/min)	%surfactant recovery	enrichment ratio
40	7.58	1.51
60	19.42	1.23
80	66.79	1.05

Table A 20 The experimental data of the CPB concentration in the effect of feed flow rate at 40 L/min of air flow rate

feed flow (ml/min)	%surfactant recovery	enrichment ratio
40	88.96	64.33
60	84.60	53.05
80	86.53	33.26
100	85.78	32.53

Table A 21 The experimental data of the CPB concentration in the effect of feed flow rate at 60 L/min of air flow rate

feed flow (ml/min)	%surfactant recovery	enrichment ratio
40	91.21	73.96
60	92.06	43.94
80	93.75	33.40
100	93.86	32.57

Table A 22 The experimental data of the CPB concentration in the effect of air flow rate at 40 ml/min of feed flow rate

air flow (L/min)	%surfactant recovery	enrichment ratio
40	88.96	64.33
60	91.21	73.96
80	93.06	86.12
100	94.68	87.56

Table A 23 The experimental data of the CPB concentration in the effect of air flow rate at 60 ml/min of feed flow rate

air flow (L/min)	%surfactant recovery	enrichment ratio
40	84.60	53.05
60	92.06	43.94
80	93.89	37.89
100	94.67	36.12

Table A 24 The experimental data of the surfactant concentration in the effect of tail length of surfactant at 40 ml/min of feed flow rate and 40 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CTAB	91.31	14.26
TTAB	73.33	3.70
DTAB	12.63	1.77

Table A 25 The experimental data of the surfactant concentration in the effect of tail length of surfactant at 40 ml/min of feed flow rate and 60 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CTAB	95.32	7.47
TTAB	84.85	3.11
DTAB	55.91	0.96

Table A 26 The experimental data of the surfactant concentration in the effect of tail length of surfactant at 60 ml/min of feed flow rate and 60 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CTAB	95.32	7.47
TTAB	84.74	1.51
DTAB	19.42	1.23

Table A 27 The experimental data of the surfactant concentration in the effect of tail length of surfactant at 60 ml/min of feed flow rate and 80 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CTAB	96.00	6.56
TTAB	76.43	1.19
DTAB	66.79	1.05

Table A 28 The experimental data of the surfactant concentration in the effect of tail length of surfactant at 40 ml/min of feed flow rate and 80 L/min of air flow rate (optimum condition)

surfactant	%surfactant recovery	Enrichment Ratio
CTAB	95.01	6.15
TTAB	86.90	2.31
DTAB	75.28	1.05

Table A 29 The experimental data of the surfactant concentration in the effect of pyridine group at the head group of surfactant at 40 ml/min of feed flow rate and 40 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CPB	88.96	64.33
CTAB	91.31	14.26

Table A 30 The experimental data of the surfactant concentration in the effect of pyridine group at the head group of surfactant at 40 ml/min of feed flow rate and 60 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CPB	91.21	82.67
CTAB	95.32	7.47

Table A 31 The experimental data of the surfactant concentration in the effect of pyridine group at the head group of surfactant at 60 ml/min of feed flow rate and 60 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CPB	92.06	43.94
CTAB	95.32	7.47

Table A 32 The experimental data of the surfactant concentration in the effect of pyridine group at the head group of surfactant at 60 ml/min of feed flow rate and 80 L/min of air flow rate

surfactant	%surfactant recovery	enrichment ratio
CPB	93.89	37.89
CTAB	96.00	6.56

Table A 33 The experimental data of the surfactant concentration in the effect of pyridine group at the head group of surfactant at 40 ml/min of feed flow rate and 80 L/min of air flow rate

surfactant	%surfactant recovery	Enrichment Ratio
CPB	86.53	33.26
CTAB	95.01	6.15

Table A 34 The experimental data of the foam stability and foamability in the effect of salinity

CTAB salt (M)	Foam Stability(min)	Foam Ability (L/min)
0.00	53.87	1.21
0.02	45.39	1.11
0.04	48.40	1.11
0.06	66.08	1.11
0.10	95.69	1.16
0.40	457.16	0.96

Table A 35 The experimental data of critical micelle concentration in the effect of salinity

CTAB Concentration (mM)	Surface Tension (dyne/cm ³)				
	salt 0.00 M	salt 0.02 M	salt 0.06 M	salt 0.1 M	salt 0.4 M
0.05	55.25	52.77	56.25	46.53	70.95
0.10	50.53	46.78	48.47	41.67	58.40
0.15	46.41	41.54	43.54	39.79	55.83
0.20	44.41	41.26	44.54	41.05	53.29
0.23	45.00	40.35	44.47	37.45	51.54
0.30	41.59	40.99	41.87	38.53	47.42
0.40	39.29	39.87	39.85	36.79	41.17
0.50	40.59	39.46	39.27	36.29	42.04
0.60	39.42	38.25	37.49	36.27	40.11
0.70	38.24	38.06	38.59	35.71	37.31
0.80	38.44	37.31	38.27	36.04	36.06
0.90	37.66	36.72	38.27	36.68	35.96
1.00	38.08	37.84	37.55	36.55	34.84
2.00	37.96	36.07	36.39	35.45	36.24
3.00	37.17	36.12	35.52	34.71	32.94
4.00	37.31	35.67	35.40	34.85	33.50
6.00	37.34	35.33	35.32	34.31	32.56
8.00	37.59	35.31	35.23	34.32	33.79
10.00	37.32	35.21	35.23	34.23	33.66
12.00	37.32	35.23	35.23	34.12	32.66
14.00	37.43	35.12	35.23	34.12	33.45
16.00	37.21	35.34	35.24	34.52	33.67
18.00	37.12	35.22	35.23	34.22	33.76
20.00	37.12	35.23	35.23	34.23	32.65
22.00	37.21	35.23	35.34	34.23	32.54
24.00	37.21	35.23	35.23	34.21	32.56
26.00	37.13	35.22	35.32	34.21	33.57
28.00	37.31	35.13	35.23	34.12	33.07
30.00	37.12	35.23	35.34	34.12	32.66

Table A 36 The experimental data of recovery of CTAB in the effect of salinity at 40 ml/min feed flow rate and 40 L/min of air flow rate

salt concentration (M)	%surfactant recovery	enrichment ratio
0.00	91.31	14.26
0.02	94.54	76.83
0.06	94.81	44.61
0.10	95.73	46.35
0.40	95.29	30.58

Table A 37 The experimental data of recovery of CTAB in the effect of salinity at 40 ml/min feed flow rate and 60 L/min of air flow rate

salt concentration (M)	%surfactant recovery	enrichment ratio
0.00	94.02	7.21
0.02	95.89	50.68
0.06	94.91	50.89
0.10	95.21	45.67
0.40	95.57	54.04

Table A 38 The experimental data of recovery of CTAB in the effect of salinity at 40 ml/min feed flow rate and 80 L/min of air flow rate

salt concentration (M)	%surfactant recovery	enrichment ratio
0.00	95.01	6.15
0.02	96.65	47.52
0.06	96.46	46.70
0.10	96.35	45.88
0.40	96.22	45.23

Table A 39 The experimental data of recovery of CTAB in the effect of salinity at 60 ml/min feed flow rate and 60 L/min of air flow rate

salt conc (M)	%surfactant recovery	enrichment ratio
0.00	95.32	6.08
0.02	95.46	23.45
0.06	95.57	24.76
0.10	96.97	25.25
0.40	96.89	25.13

Table A 40 The experimental data of recovery of CTAB in the effect of feed flow rate at salt (NaCl) concentration 0.1 and 60 L/min of air flow rate

feed flow rate(ml/min)	%surfactant recovery	enrichment ratio
40.00	95.21	45.67
60.00	96.97	25.25
80.00	97.11	24.45

Table A 41 The experimental data of recovery of CTAB in the effect of feed flow rate at salt (NaCl) concentration 0.02 and 60 L/min of air flow rate

feed flowrate(ml/min)	%surfactant recovery	enrichment ratio
40.00	95.89	50.68
60.00	95.46	23.45
80.00	96.57	22.40

Table A 42 The experimental data of recovery of CTAB in the effect of air flow rate at salt (NaCl) concentration 0.1 and 40 ml/min of feed flow rate

air flowrate(L/min)	%surfactant recovery	enrichment ratio
40.00	95.73	46.35
60.00	95.21	45.67
80.00	96.35	45.88

Table A 43 The experimental data of recovery of CTAB in the effect of air flow rate at salt (NaCl) concentration 0.02 and 40 ml/min of feed flow rate

air flowrate(L/min)	%surfactant recovery	enrichment ratio
40.00	94.54	76.83
60.00	95.89	50.68
80.00	96.65	47.52

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Presentations:

1. Soonsinpai, K., Chavadej, S. and Haver, J. (2007, November 21-24) Recovery of Surfactant from Water Using Multi-Stage Foam Fractionation: Effect of Tail Length of Surfactant at The 5th Eco-Energy and Materials Science and Engineering Symposium, Pattaya, Thailand.
2. Soonsinpai, K., Chavadej, S. and Haver, J (2008, April 23) Recovery of Surfactant from Water Using Multi-Stage Foam Fractionation: Effect of Tail Length, Head Group, and Salinity at The 14th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

