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APPENDICES

Appendix A

Table A-1 The Information of Equipment

Equipment	Manufacture	Model
Air compressor	Jun-Air Compressor	Serial No. 624153
Sintered-glass diffuser	Vidhyasom Co., Ltd.	No.0 (160-250 μm) No.1 (100-160 μm) No.3 (16-40 μm)
Mass flow controller	Aalbrog	GFC17

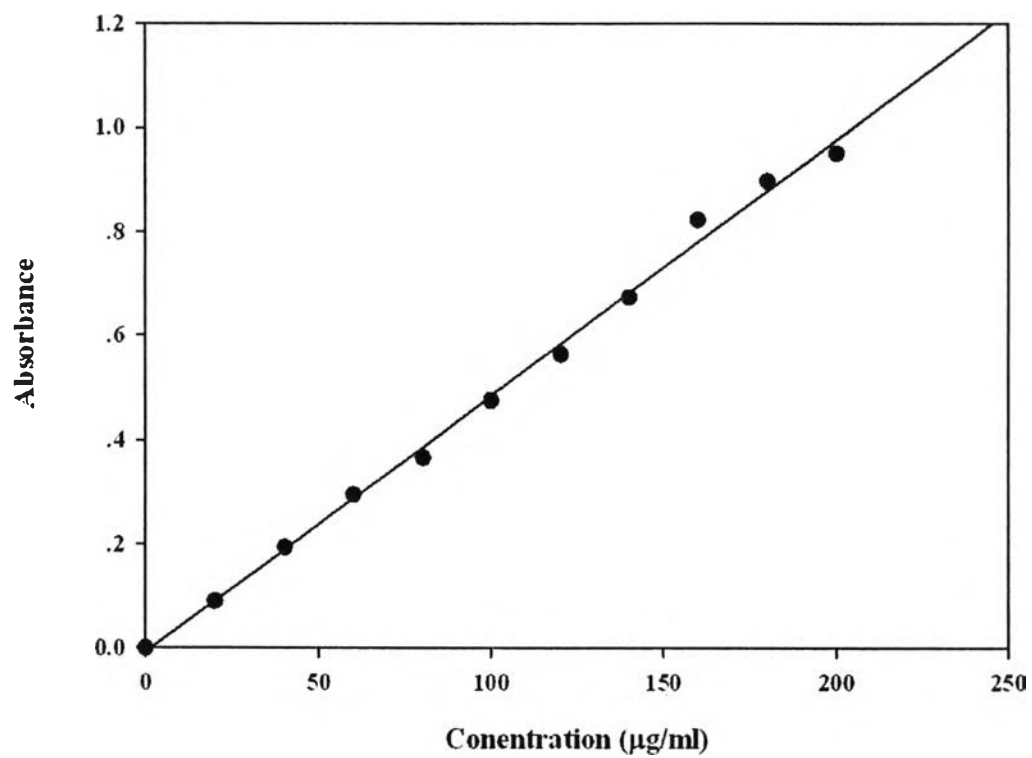
Appendix B Experimental data**Table B1** Standard curve of Rhamnose

Table B2 The results of operational parameter experiment**Conditions:** initial concentration 362.1632 $\mu\text{g/l}$., column height 20 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration ($\mu\text{g/ml}$)	Remain Volume (ml)	Remain Concentration ($\mu\text{g/ml}$)	Mass (μg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	11.76	50	618.0059	45	86.4231	34789.3345	96.0598	3.9402	1.7064	89.2616	85.3215
	9.27	49	623.4566	47	88.2509	34697.1657	95.8053	4.1947	1.7215	88.5472	84.3525
	12.27	48	629.8490	48	91.6461	34631.7648	95.6247	4.3753	1.7391	87.8535	83.4783
50	32.58	82	410.4600	15	90.9953	35022.6495	96.7041	3.2959	1.1334	96.2312	92.9352
	36.25	83	412.8172	13	93.4442	35478.6022	97.9630	2.0370	1.1399	96.6458	94.6088
	34.58	84	407.7090	14	90.3732	35512.7808	98.0574	1.9426	1.1258	96.5065	94.5639
70	49.11	87	390.7976	10	92.4678	34924.0692	96.4319	3.5681	1.0791	97.4468	93.8786
	47.18	87	390.4165	9	92.9079	34802.4066	96.0959	3.9041	1.0780	97.6912	93.7871
	51.06	88	393.8265	11	91.2337	35660.3027	98.4647	1.5353	1.0874	97.2290	95.6937
90	51.17	88	386.8481	8	100.2485	34844.6208	96.2125	3.7875	1.0682	97.7856	93.9980
	50.95	88	387.1705	9	99.3496	34965.1504	96.5453	3.4547	1.0690	97.5311	94.0764
	53.17	87	388.7788	10	100.3943	34827.6986	96.1658	3.8342	1.0735	97.2279	93.3937
110	54.81	89	387.0860	8	107.3387	35309.3636	97.4957	2.5043	1.0688	97.6289	95.1247
	51.51	87	389.0133	10	109.1395	34935.5521	96.4636	3.5364	1.0741	96.9865	93.4500
	52.11	89	387.7837	9	109.2145	35495.6798	98.0102	1.9898	1.0707	97.2859	95.2961

Table B3 The results of operational parameter experiment**Conditions:** initial concentration 362.1632 $\mu\text{g/l.}$, column height 40 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration ($\mu\text{g/ml}$)	Remain Volume (ml)	Remain Concentration ($\mu\text{g/ml}$)	Mass (μg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	7.82	35	844.3268	61	80.2614	34447.3834	95.1156	4.8844	2.3313	86.4814	81.5970
	6.65	36	847.8546	59	78.8643	35175.7593	97.1268	2.8732	2.3411	87.1522	84.2790
	7.07	36	849.3974	60	80.7903	35425.7244	97.8170	2.1830	2.3453	86.6154	84.4324
50	16.22	70	478.2032	26	92.3269	35874.7234	99.0568	0.9432	1.3204	93.3718	92.4286
	17.02	70	478.2605	27	90.1836	35913.1922	99.1630	0.8370	1.3206	93.2766	92.4396
	18.82	69	481.8198	27	92.3289	35738.4465	98.6805	1.3195	1.3304	93.1167	91.7972
70	29.46	78	437.0510	19	89.0685	35782.2795	98.8015	1.1985	1.2068	95.3272	94.1288
	26.5	78	439.2407	18	86.5612	35818.8762	98.9026	1.0974	1.2128	95.6978	94.6004
	27.5	77	438.4408	18	89.4896	35370.7544	97.6652	2.3348	1.2106	95.5522	93.2175
90	46.91	81	418.4669	17	93.4306	35484.1391	97.9783	2.0217	1.1555	95.6144	93.5927
	47.19	82	420.4428	16	92.4056	35954.7992	99.2779	0.7221	1.1609	95.9176	95.1955
	49.28	80	420.9522	18	91.8413	35329.3194	97.5508	2.4492	1.1623	95.4354	92.9862
110	49.86	84	404.3676	13	100.7777	35276.9885	97.4063	2.5937	1.1165	96.3825	93.7889
	48.36	84	402.8779	14	102.6945	35279.4666	97.4132	2.5868	1.1124	96.0302	93.4434
	49.09	85	406.8622	13	103.5884	35929.9362	99.2092	0.7908	1.1234	96.2817	95.4909

Table B4 The results of operational parameter experiment

Conditions: initial concentration 362.1632 µg/l., column height 60 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration (µg/ml)	Remain Volume (ml)	Remain Concentration (µg/ml)	Mass (µg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	4.56	27	1078.6536	70	80.9630	34791.0572	96.0646	3.9354	2.9784	84.3512	80.4158
	5.17	27	1085.7091	68	80.2749	34772.8398	96.0143	3.9857	2.9978	84.9275	80.9418
	6.23	28	1068.7948	67	81.4455	35383.1038	97.6993	2.3007	2.9511	84.9326	82.6320
50	8.94	59	542.1068	37	79.7376	34934.5924	96.4609	3.5391	1.4969	91.8537	88.3146
	10.66	60	546.6593	36	78.1697	35613.6672	98.3360	1.6640	1.5094	92.2297	90.5657
	11.22	61	544.5230	36	77.0895	35991.1250	99.3782	0.6218	1.5035	92.3371	91.7153
70	27.71	76	442.8646	19	73.0152	35044.9984	96.7658	3.2342	1.2228	96.1694	92.9352
	24.17	77	439.3741	19	75.0640	35258.0217	97.3540	2.6460	1.2132	96.0620	93.4159
	25.66	75	443.2012	21	74.3845	34802.1645	96.0953	3.9047	1.2238	95.6868	91.7821
90	43.85	79	421.5975	16	81.0452	34602.9257	95.5451	4.4549	1.1641	96.4195	91.9646
	41.83	78	424.6158	17	81.6016	34507.2596	95.2810	4.7190	1.1724	96.1696	91.4506
	40.02	80	427.7511	16	82.1411	35534.3456	98.1169	1.8831	1.1811	96.3711	94.4880
110	45.49	82	413.2260	15	91.7005	35260.0393	97.3595	2.6405	1.1410	96.2020	93.5615
	44.02	83	414.6972	13	93.1121	35630.3251	98.3820	1.6180	1.1451	96.6577	95.0397
	42.6	82	410.5820	14	90.2561	34931.3096	96.4518	3.5482	1.1337	96.5110	92.9629

Table B5 The results of oil removal**Conditions:** initial concentration 2.667 g/l., column height 20 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Foam Volume (ml)	Foam Concentration (g/ml)	Remain Volume (ml)	Remain Concentration (g/ml)	Mass (g)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	50	2.9600	45	2.4133	256.5985	96.2124	3.7876	1.1099	59.2807	55.4931
	49	2.8367	47	2.6267	262.4532	98.4076	1.5924	1.0636	53.7102	52.1178
	48	3.0000	48	2.3133	255.0384	95.6274	4.3726	1.1249	58.3658	53.9933
50	82	2.5133	15	3.4600	257.9933	96.7354	3.2646	0.9424	80.5399	77.2753
	83	2.4933	13	3.9700	258.5567	96.9466	3.0534	0.9349	80.6487	77.5953
	84	2.5967	14	3.1200	261.8000	98.1627	1.8373	0.9736	83.6220	81.7848
70	87	2.4733	10	4.2200	257.3800	96.5054	3.4946	0.9274	84.1770	80.6824
	87	2.4000	9	5.0800	254.5200	95.4331	4.5669	0.8999	82.8571	78.2902
	88	2.3667	11	4.9400	262.6067	98.4652	1.5348	0.8874	79.6250	78.0902
90	88	2.4467	8	5.9800	263.1467	98.6677	1.3323	0.9174	82.0622	80.7299
	88	2.5300	9	4.2400	260.8000	97.7878	2.2122	0.9486	85.6918	83.4796
	87	2.3133	10	5.3400	254.6600	95.4856	4.5144	0.8674	79.9775	75.4631
110	89	2.4333	8	5.9200	263.9267	98.9601	1.0399	0.9124	82.2422	81.2023
	87	2.3767	10	5.0400	257.1700	96.4267	3.5733	0.8911	81.1024	77.5291
	89	2.3800	9	4.7600	254.6600	95.4856	4.5144	0.8924	83.9370	79.4226

Table B6 The results of oil removal**Conditions:** initial concentration 2.667 g/l., column height 40 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Foam Volume (ml)	Foam Concentration (g/ml)	Remain Volume (ml)	Remain Concentration (g/ml)	Mass (g)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	35	4.1333	61	1.9000	260.5667	97.7003	2.2997	1.5498	56.5429	54.2432
	36	3.9800	61	2.0100	265.8900	99.6963	0.3037	1.4923	54.0270	53.7233
	36	3.5433	60	2.2033	259.7600	97.3978	2.6022	1.3286	50.4312	47.8290
50	70	2.7000	26	2.8550	263.2300	98.6989	1.3011	1.0124	72.1672	70.8661
	70	2.5933	27	2.9100	260.1033	97.5266	2.4734	0.9724	70.5399	68.0665
	69	2.6000	27	3.0550	261.8850	98.1946	1.8054	0.9749	69.0720	67.2666
70	78	2.3233	19	4.2100	261.2100	97.9415	2.0585	0.8711	70.0075	67.9490
	78	2.1600	18	4.7400	253.8000	95.1631	4.8369	0.8099	68.0090	63.1721
	77	2.3000	18	4.8100	263.6800	98.8676	1.1324	0.8624	67.5366	66.4042
90	81	2.3033	17	4.4900	262.9000	98.5752	1.4248	0.8636	71.3798	69.9550
	82	2.2600	16	4.8900	263.5600	98.8226	1.1774	0.8474	70.6637	69.4863
	80	2.0933	18	5.0100	257.6467	96.6054	3.3946	0.7849	66.1867	62.7922
110	84	2.1900	13	5.5125	255.6225	95.8465	4.1535	0.8211	73.1299	68.9764
	84	2.0267	14	6.0750	255.2900	95.7218	4.2782	0.7599	68.1102	63.8320
	85	2.1967	13	5.8750	263.0917	98.6470	1.3530	0.8236	71.3630	70.0100

Table B7 The results of oil removal**Conditions:** initial concentration 2.667 g/l., column height 60 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Foam Volume (ml)	Foam Concentration (g/ml)	Remain Volume (ml)	Remain Concentration (g/ml)	Mass (g)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	27	3.5250	70	2.3567	260.1417	97.5409	2.4591	1.3217	38.1452	35.6862
	27	3.1900	68	2.4900	255.4500	95.7818	4.2182	1.1961	36.5129	32.2947
	28	2.9400	67	2.7000	263.2200	98.6952	1.3048	1.1024	32.1710	30.8661
50	59	3.0033	37	2.3333	263.5300	98.8114	1.1886	1.1261	67.6290	66.4404
	60	2.8033	36	2.5400	259.6400	97.3528	2.6472	1.0511	65.7143	63.0671
	61	2.9900	36	2.1967	261.4700	98.0390	1.9610	1.1211	70.3487	68.3877
70	76	2.3433	19	4.0133	254.3467	95.3681	4.6319	0.8786	71.4086	66.7767
	77	2.2567	19	4.2933	255.3367	95.7393	4.2607	0.8461	69.4138	65.1531
	75	2.0967	21	4.7067	256.0900	96.0217	3.9783	0.7862	62.9396	58.9614
90	79	2.3000	16	4.9300	260.5800	97.7053	2.2947	0.8624	70.4237	68.1290
	78	2.1433	17	5.4900	260.5100	97.6790	2.3210	0.8036	65.0056	62.6847
	80	2.0400	16	4.8100	240.1600	90.0487	9.9513	0.7649	71.1436	61.1924
110	82	2.0900	15	5.7125	257.0675	96.3883	3.6117	0.7837	67.8712	64.2595
	83	2.2000	13	5.4750	253.7750	95.1537	4.8463	0.8249	73.3127	68.4664
	82	2.1000	14	6.2750	260.0500	97.5066	2.4934	0.7874	67.0604	64.5669

Table B8 The results of operational parameter experiment**Conditions:** initial concentration 434.4238 $\mu\text{g/l.}$, column height 60 cm. and sinter glass disk No.0

Air flow rate (ml/min)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration ($\mu\text{g/ml}$)	Remain Volume (ml)	Remain Concentration ($\mu\text{g/ml}$)	Mass (μg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	3.13	18	1921.3701	82	100.2617	42806.1229	98.5354	1.4646	4.4228	81.0750	79.6104
	3.43	17	1933.9536	81	102.4716	41177.4151	94.7863	5.2137	4.4518	80.8938	75.6800
	2.75	17	1936.9152	80	101.4761	41045.6476	94.4830	5.5170	4.4586	81.3130	75.7959
50	7.43	64	593.7357	33	123.7149	42081.6737	96.8678	3.1322	1.3667	90.6023	87.4701
	8.28	63	593.0520	33	120.6462	41343.5985	95.1688	4.8312	1.3651	90.8354	86.0042
	8.17	63	595.4152	34	120.2687	41600.2909	95.7597	4.2403	1.3706	90.5872	86.3469
70	12.13	76	511.4802	23	134.7793	41972.4186	96.6163	3.3837	1.1774	92.8643	89.4806
	12.94	74	511.0317	25	136.5190	41229.3229	94.9058	5.0942	1.1763	92.1437	87.0494
	13.57	76	507.3716	22	135.5201	41541.6824	95.6248	4.3752	1.1679	93.1370	88.7618
90	20.67	83	489.1224	16	134.7103	42752.5258	98.4120	1.5880	1.1259	95.0386	93.4506
	17.43	82	493.2878	15	134.5933	42468.4992	97.7582	2.2418	1.1355	95.3527	93.1109
	18.95	83	491.4182	15	132.7280	42778.6285	98.4721	1.5279	1.1312	95.4171	93.8892
110	30.96	85	478.1724	14	145.1402	42676.6198	98.2373	1.7627	1.1007	95.3226	93.5599
	31.95	88	472.8338	11	142.2752	43174.4004	99.3831	0.6169	1.0884	96.3975	95.7806
	32.27	86	480.6203	13	145.2335	43221.3775	99.4913	0.5087	1.1063	95.6539	95.1452

Table B9 The results of operational parameter experiment**Conditions:** initial concentration 434.4238 µg/l., column height 60 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration (µg/ml)	Remain Volume (ml)	Remain Concentration (µg/ml)	Mass (µg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	6.57	29	1205.6856	68	101.6187	41874.9530	96.3919	3.6081	2.7754	84.0937	80.4856
	7.67	28	1211.1954	69	102.5354	40988.4115	94.3512	5.6488	2.7881	83.7142	78.0654
	8.57	27	1225.6019	68	103.6841	40141.7742	92.4023	7.5977	2.8212	83.7704	76.1727
50	12.67	73	546.6013	25	123.0583	42978.3495	98.9318	1.0682	1.2582	92.9183	91.8502
	17.25	72	547.4019	25	121.6419	42453.9851	97.7248	2.2752	1.2601	92.9998	90.7246
	15.73	70	554.0630	26	121.6596	41947.5617	96.5591	3.4409	1.2754	92.7187	89.2778
70	20.52	80	489.6859	17	126.9095	41332.3313	95.1429	4.8571	1.1272	95.0337	90.1766
	23.5	82	487.4193	16	124.4427	41959.4623	96.5865	3.4135	1.1220	95.4167	92.0032
	21.26	81	487.3937	16	127.2315	41514.5910	95.5624	4.4376	1.1219	95.3140	90.8764
90	33.71	88	474.9887	10	126.5030	43064.0398	99.1291	0.8709	1.0934	97.0880	96.2171
	30.21	86	478.5759	11	128.6401	42572.5706	97.9978	2.0022	1.1016	96.7427	94.7405
	32.58	87	474.5186	10	126.7859	42550.9799	97.9481	2.0519	1.0923	97.0815	95.0296
110	46.46	86	465.1842	12	138.3909	41666.5287	95.9122	4.0878	1.0708	96.1773	92.0894
	45.55	88	469.0359	10	141.1482	42686.6422	98.2604	1.7396	1.0797	96.7509	95.0113
	44.84	89	467.3950	13	139.4407	43410.8855	99.9275	0.0725	1.0759	95.8273	95.7548

Table B10 The results of operational parameter experiment**Conditions:** initial concentration 434.4238 $\mu\text{g/l.}$, column height 60 cm. and sinter glass disk No.3

Air flow rate (ml/min)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration ($\mu\text{g/ml}$)	Remain Volume (ml)	Remain Concentration ($\mu\text{g/ml}$)	Mass (μg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	31.24	79	522.6471	17	100.7513	43001.8908	98.9860	1.0140	1.2031	96.0574	95.0434
	32.58	77	530.2281	17	102.6113	42571.9514	97.9964	2.0036	1.2205	95.9846	93.9809
	31.24	78	526.5499	18	100.1723	42873.9949	98.6916	1.3084	1.2121	95.8494	94.5411
50	55.58	87	479.4827	10	126.6819	42981.8117	98.9398	1.0602	1.1037	97.0839	96.0237
	56.81	86	480.6607	11	128.3646	42748.8292	98.4035	1.5965	1.1064	96.7497	95.1532
	57.06	85	478.5717	11	127.3593	42079.5447	96.8629	3.1371	1.1016	96.7751	93.6380
70	57.67	92	451.2288	7	201.2978	42922.1358	98.8024	1.1976	1.0387	96.7564	95.5589
	55.68	94	449.0672	5	202.8153	43226.3958	99.5028	0.4972	1.0337	97.6657	97.1685
	56.84	93	447.2964	6	201.5656	42807.9578	98.5396	1.4604	1.0296	97.2161	95.7557
90	65.48	92	450.4216	6	203.7023	42661.0046	98.2014	1.7986	1.0368	97.1866	95.3879
	67.28	93	446.8578	7	205.0413	42993.0607	98.9657	1.0343	1.0286	96.6961	95.6618
	66.71	91	455.0809	8	203.4960	43040.3297	99.0745	0.9255	1.0476	96.2526	95.3271
110	71.93	92	447.3191	7	205.6750	42593.0805	98.0450	1.9550	1.0297	96.6859	94.7309
	71.58	90	450.1134	7	204.9697	41944.9962	96.5532	3.4468	1.0361	96.6973	93.2504
	72.09	91	446.7846	6	203.7117	41879.6701	96.4028	3.5972	1.0285	97.1865	93.5893

Table B11 The results of oil removal**Conditions:** initial concentration 2.121 g/l., column height 60 cm. and sinter glass disk No.0

Air flow rate (ml/min)	Foam Volume (ml)	Foam Concentration (g/ml)	Remain Volume (ml)	Remain Concentration (g/ml)	Mass (g)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
30	18	3.7700	82	1.6700	204.8000	96.5582	3.4418	1.7775	35.4361	31.9943
	17	3.5400	81	1.8433	209.4900	98.7694	1.2306	1.6690	29.6040	28.3734
	17	3.8400	80	1.7533	205.5467	96.9103	3.0897	1.8105	33.8677	30.7779
50	64	2.1933	33	1.9440	204.5253	96.4287	3.5713	1.0341	69.7539	66.1826
	63	2.2433	33	2.0440	208.7820	98.4356	1.5644	1.0577	68.1980	66.6337
	63	2.3400	34	1.7480	206.8520	97.5257	2.4743	1.1033	71.9793	69.5050
70	76	1.8933	23	2.5400	202.3133	95.3858	4.6142	0.8927	72.4564	67.8422
	74	1.9333	25	2.4933	205.4000	96.8411	3.1589	0.9115	70.6113	67.4525
	76	1.8000	22	2.9600	201.9200	95.2004	4.7996	0.8487	69.2975	64.4979
90	83	1.6933	16	3.9900	204.3867	96.3634	3.6366	0.7984	69.9010	66.2643
	82	1.7500	15	4.1000	205.0000	96.6525	3.3475	0.8251	71.0042	67.6568
	83	1.6800	15	4.2900	203.7900	96.0820	3.9180	0.7921	69.6605	65.7426
110	85	1.7733	14	4.0375	207.2583	97.7173	2.2827	0.8361	73.3498	71.0671
	88	1.6533	11	5.6000	207.0933	97.6395	2.3605	0.7795	70.9571	68.5966
	86	1.5933	13	5.5750	209.5017	98.7749	1.2251	0.7512	65.8298	64.6047

Table B12 The results of oil removal**Conditions:** initial concentration 2.121 g/l., column height 60 cm. and sinter glass disk No.1

Air flow rate (ml/min)	Foam Volume (ml)	Foam Concentration (g/ml)	Remain Volume (ml)	Remain Concentration (g/ml)	Mass (g)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
0.07	29	3.6000	68	1.4900	205.7200	96.9920	3.0080	1.6973	52.2301	49.2221
	28	3.2280	69	1.7033	207.9140	98.0264	1.9736	1.5219	44.5875	42.6139
	27	3.0960	68	1.7833	204.8587	96.5859	3.4141	1.4597	42.8257	39.4116
0.08	74	2.0900	25	1.9800	204.1600	96.2565	3.7435	0.9854	76.6620	72.9184
	72	2.1933	25	1.9150	205.7950	97.0273	2.9727	1.0341	77.4281	74.4554
	70	2.3500	26	1.7050	208.8300	98.4583	1.5417	1.1080	79.0995	77.5578
0.1	80	1.9833	17	2.5700	202.3567	95.4063	4.5937	0.9351	79.4012	74.8075
	82	1.9733	16	2.7200	205.3333	96.8097	3.1903	0.9304	79.4814	76.2911
	81	1.8800	16	3.1000	201.8800	95.1815	4.8185	0.8864	76.6148	71.7963
0.12	88	1.8000	10	4.5400	203.8000	96.0868	3.9132	0.8487	78.5950	74.6818
	86	1.8500	11	4.2400	205.7400	97.0014	2.9986	0.8722	78.0104	75.0118
	87	1.9033	10	4.0000	205.5900	96.9307	3.0693	0.8974	81.1410	78.0717
0.16	86	1.7933	12	4.4200	207.2667	97.7212	2.2788	0.8455	74.9929	72.7141
	88	1.8000	10	4.9200	207.6000	97.8784	2.1216	0.8487	76.8034	74.6818
	89	1.7867	13	3.7200	207.3733	97.7715	2.2285	0.8424	77.1994	74.9709

Table B13 The results of oil removal**Conditions:** initial concentration 2.121 g/l., column height 60 cm. and sinter glass disk No.3

Air flow rate (ml/min)	Foam Volume (ml)	Foam Concentration (g/ml)	Remain Volume (ml)	Remain Concentration (g/ml)	Mass (g)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
0.07	79	2.2100	17	1.9500	207.7400	97.9444	2.0556	1.0420	84.3706	82.3149
	77	2.1467	17	2.5400	208.4733	98.2901	1.7099	1.0121	79.6417	77.9318
	78	2.0933	18	2.4700	207.7400	97.9444	2.0556	0.9870	79.0382	76.9826
0.08	87	1.9433	10	3.9600	208.6700	98.3828	1.6172	0.9162	81.3296	79.7124
	86	1.9167	11	4.0200	209.0533	98.5636	1.4364	0.9037	79.1513	77.7149
	85	2.0067	11	3.4000	207.9667	98.0512	1.9488	0.9461	82.3668	80.4180
0.1	92	1.8000	7	5.5500	204.4500	96.3932	3.6068	0.8487	81.6832	78.0764
	94	1.9000	5	4.9500	203.3500	95.8746	4.1254	0.8958	88.3310	84.2056
	93	1.7933	6	6.4500	205.4800	96.8788	3.1212	0.8455	81.7539	78.6327
0.12	92	1.8100	6	5.8500	201.6200	95.0589	4.9411	0.8534	83.4512	78.5101
	93	1.7333	7	6.2500	204.9500	96.6289	3.3711	0.8172	79.3729	76.0019
	91	1.7833	8	5.2000	203.8833	96.1260	3.8740	0.8408	80.3866	76.5127
0.16	92	1.7233	7	6.5500	204.3967	96.3681	3.6319	0.8125	78.3828	74.7509
	90	1.7467	7	6.5000	202.7000	95.5681	4.4319	0.8235	78.5479	74.1160
	91	1.8200	6	6.6000	205.2200	96.7562	3.2438	0.8581	81.3296	78.0858

Table B14 The results of operational parameter experiment

Conditions: initial concentration 385.4343 $\mu\text{g/l.}$, column height 60 cm. and sinter glass disk No.0

Solution (ml)	Wetness (g/l)	Foam Volume (ml)	Foam Concentration ($\mu\text{g/ml}$)	Remain Volume (ml)	Remain Concentration ($\mu\text{g/ml}$)	Mass (μg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
25	2.24	5	1504.6842	20	99.4187	9511.7948	98.7125	1.2875	3.9039	94.8412	93.5537
	2.64	6	1455.8003	18	45.3020	9550.2384	99.1115	0.8885	3.7770	97.8844	96.9958
	2.96	5	1527.6407	19	98.5175	9510.0356	98.6942	1.3058	3.9634	95.1436	93.8378
50	3.89	9	1495.2967	41	120.7663	18409.0904	95.5239	4.4761	3.8795	87.1537	82.6775
	3.07	9	1458.0208	40	130.6593	18348.5596	95.2098	4.7902	3.7828	86.4403	81.6501
	3.35	10	1485.2995	40	109.6116	19237.4607	99.8223	0.1777	3.8536	88.6246	88.4469
75	3.10	14	1501.2549	58	134.5445	28821.1487	99.7010	0.2990	3.8950	79.7538	79.4548
	3.39	15	1491.7498	57	110.3472	28666.0360	99.1645	0.8355	3.8703	83.6813	82.8457
	3.87	13	1522.2616	58	140.4921	27937.9449	96.6458	3.3542	3.9495	78.8588	75.5046
100	3.60	18	1433.6517	80	145.5506	37449.7755	97.1625	2.8375	3.7196	69.7898	66.9523
	3.42	18	1453.3974	79	143.2439	37477.4201	97.2343	2.7657	3.7708	70.6402	67.8745
	3.70	17	1471.4864	81	149.6093	37133.6186	96.3423	3.6577	3.8177	68.5592	64.9015
125	3.47	22	1435.9530	98	146.3570	45933.9527	95.3396	4.6604	3.7255	62.7875	58.1271
	3.78	23	1434.7231	96	142.4662	46675.3843	96.8785	3.1215	3.7224	64.5160	61.3945
	3.80	22	1427.0264	96	155.2440	46298.0000	96.0952	3.9048	3.7024	61.3334	57.4287

Table B15 The results of operational parameter experiment**Conditions:** initial concentration 385.4343 $\mu\text{g/l.}$, column height 60 cm. and sinter glass disk No.0

Time (hr)	Foam Volume (ml)	Foam Concentration ($\mu\text{g/ml}$)	Remain Volume (ml)	Remain Concentration ($\mu\text{g/ml}$)	Mass (μg)	Mass balance	% Error	Enrichment Ratio	Biosurfactant removal (%)	Correct Biosurfactant removal (%)
1.0	3	1107.7791	22	281.3914	9513.9474	98.7348	1.2652	2.8741	83.9386	82.6734
	2	1294.4554	22	311.3970	9439.6456	97.9637	2.0363	3.3584	82.2259	80.1897
	3	1148.4850	22	275.5526	9507.6130	98.6691	1.3309	2.9797	84.2719	82.9410
1.5	4	1425.8986	21	180.4864	9493.8096	98.5258	1.4742	3.6995	90.1664	88.6922
	4	1458.7612	20	183.6050	9507.1457	98.6642	1.3358	3.7847	90.4728	89.1371
	3	1501.7447	23	221.4861	9599.4148	99.6218	0.3782	3.8962	86.7833	86.4051
2.0	4	1505.2975	21	157.7640	9334.2349	96.8698	3.1302	3.9055	91.4044	88.2742
	4	1507.3892	20	164.7760	9325.0775	96.7748	3.2252	3.9109	91.4499	88.2246
	4	1510.9837	20	176.5517	9574.9693	99.3681	0.6319	3.9202	90.8388	90.2069
2.5	5	1501.2791	20	95.5416	9417.2275	97.7311	2.2689	3.8950	95.0424	92.7735
	5	1512.4224	19	98.4676	9432.9959	97.8947	2.1053	3.9239	95.1460	93.0408
	6	1418.3618	19	46.4945	9393.5669	97.4855	2.5145	3.6799	97.7080	95.1936
3.0	5	1533.6699	19	98.5557	9540.9086	99.0146	0.9854	3.9791	95.1417	94.1563
	6	1477.7620	18	40.5771	9596.9599	99.5963	0.4037	3.8340	98.1050	97.7014
	5	1512.8554	20	95.4590	9473.4574	98.3146	1.6854	3.9251	95.0467	93.3613
3.5	6	1465.9589	19	40.3563	9562.5232	99.2389	0.7611	3.8034	98.0106	97.2496
	6	1443.3564	18	45.3208	9475.9124	98.3401	1.6599	3.7448	97.8835	96.2236
	6	1425.4432	19	50.3657	9509.6072	98.6898	1.3102	3.6983	97.5172	96.2070
4.0	6	1469.4870	18	39.4538	9527.0909	98.8712	1.1288	3.8125	98.1575	97.0287
	6	1438.4474	18	46.5078	9467.8243	98.2562	1.7438	3.7320	97.8281	96.0842
	6	1476.5793	17	40.7660	9552.4973	99.1349	0.8651	3.8309	98.2020	97.3369

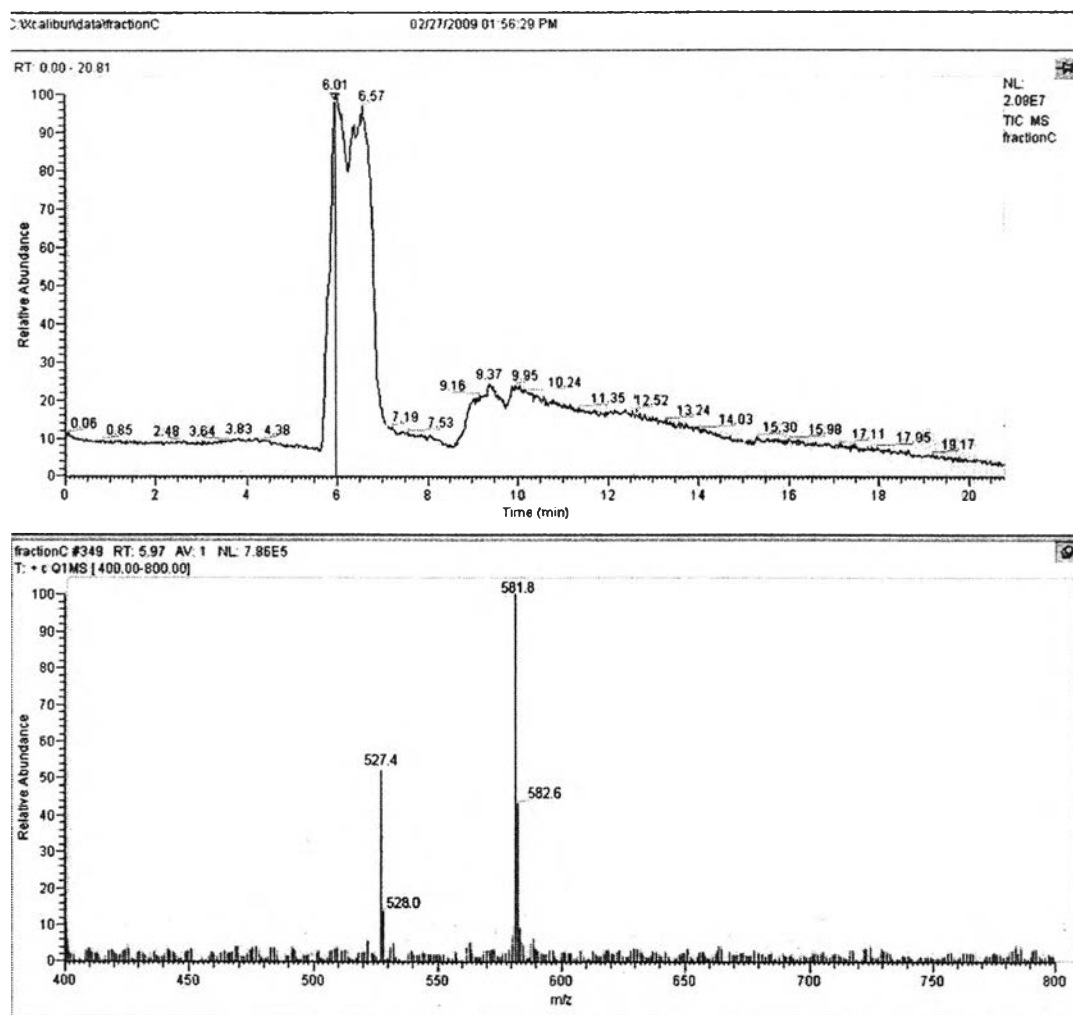


Figure B16 Mass spectrum of fraction C from crude biosurfactant.

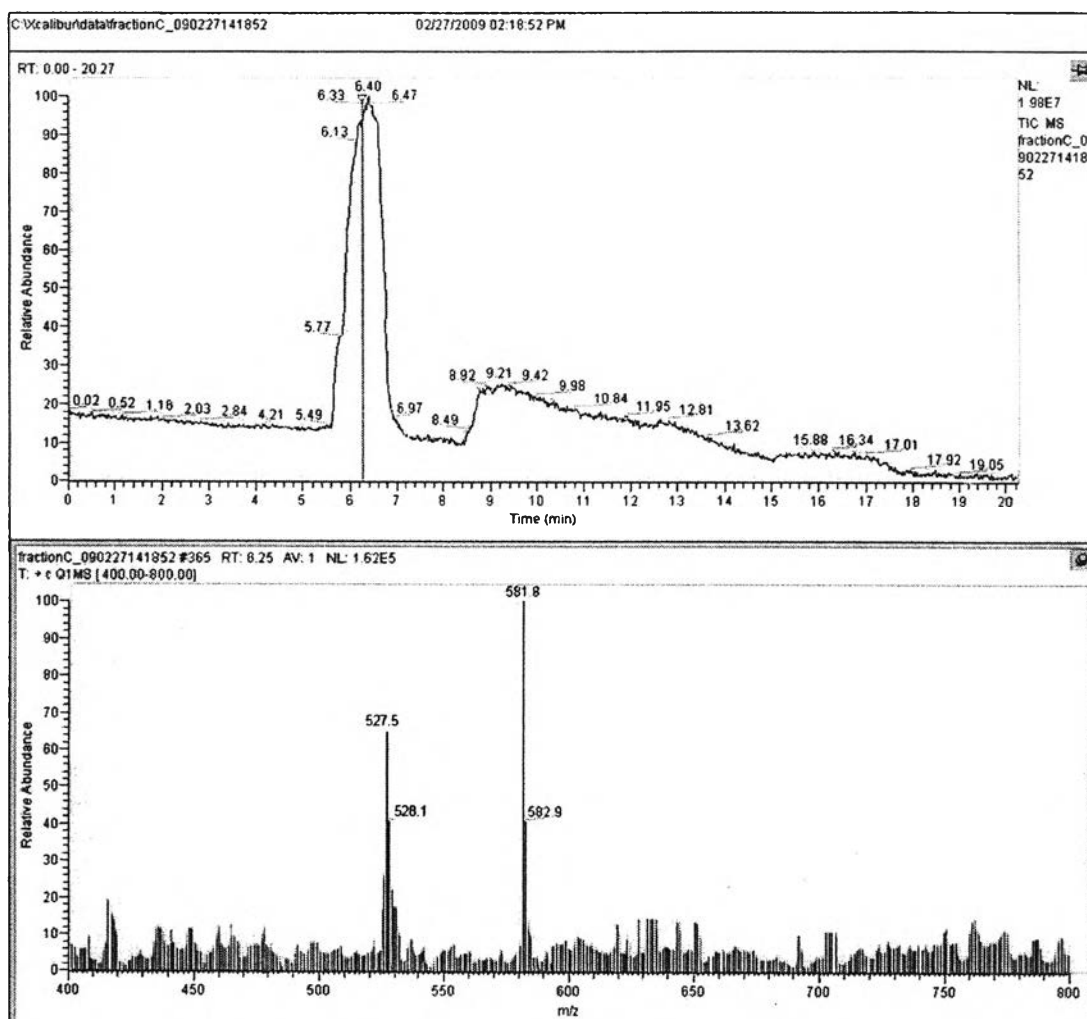


Figure B17 Mass spectrum of fraction C from collapsed foam.

CURRICULUM VITAE

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Proceedings:

1. Sarachat, T., Rujiravanit, R., Chavadej, S. and Abe, M. (2009, April 22) Separation and Partial Purification of Biosurfactants by Foam Fractionation Technique. Proceedings of 15th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

Presentations:

1. Sarachat, T., Rujiravanit, R., Chavadej, S. and Abe, M. (2009, April 22) Separation and Partial Purification of Biosurfactants by Foam Fractionation Technique. Proceedings of 15th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

