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APPENDICES

Appendix A Experimental Data of Microemulsion Formation

1. Solubilization parameter (SP)

The solubilization parameter of oil (SP_o) and water (SP_w) are designed as :

$$SP_o = \frac{V_o}{M_s} \quad \text{and} \quad SP_w = \frac{V_w}{M_s} \quad (A.1)$$

Where V_o = volume of oil solubilized

M_s = weight of surfactants

V_w = volume of water solubilized

2. Experiment data of solubilization parameter

Table A-1 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 0.1 wt% Alfotera and 5 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			Ms	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	35.52	0	33.31	68.83	0.5161	0	0.4839	0.2674	19.2990	0.6004
2	0.5	35.55	0	33.46	69.01	0.5151	0	0.4849	0.2674	19.2649	0.5663
3	1	36.25	0	33.1	69.35	0.5227	0	0.4773	0.2674	19.5479	0.8493
4	1.5	36.05	0	32.14	68.19	0.5287	0	0.4713	0.2674	19.7708	1.0722
5	2	36.41	0	32.27	68.68	0.5301	0	0.4699	0.2674	19.8257	1.1271
6	3	20.53	18.82	28.89	68.24	0.3008	0.276	0.4234	0.2674	7.4476	2.8662
7	4	26.07	18.9	23.64	68.61	0.3800	0.275	0.3446	0.2674	4.4886	5.8132
8	5	28.3	15.69	24.96	68.95	0.4104	0.228	0.3620	0.2674	3.3492	5.1608
9	10	31.32	0	37.24	68.56	0.4568	0	0.5432	0.2674	1.6146	20.3132
10	15	31.1	0	37.62	68.72	0.4526	0	0.5474	0.2674	1.7741	20.4727

Table A-2 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 0.3 wt% Alfotera and 5 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			M _s	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	35.07	0	33.12	68.19	0.5143	0	0.4857	0.3023	17.0128	0.4730
2	0.5	35.3	0	33.98	69.28	0.5095	0	0.4905	0.3023	16.8550	0.3151
3	1	36.1	0	32.47	68.57	0.5265	0	0.4735	0.3023	17.4155	0.8756
4	1.5	36.13	0	31.7	67.83	0.5327	0	0.4673	0.3023	17.6201	1.0802
5	2	37.01	0	31.67	68.68	0.5389	0	0.4611	0.3023	17.8259	1.2860
6	3	17.94	22.65	27.46	68.05	0.2636	0.333	0.4035	0.3023	7.8191	3.1913
7	4	24.82	23.43	20.05	68.3	0.3634	0.343	0.2936	0.3023	4.5188	6.8290
8	5	27.68	17.62	23.63	68.93	0.4016	0.256	0.3428	0.3023	3.2561	5.1998
9	10	31.19	0	36.82	68.01	0.4586	0	0.5414	0.3023	1.3692	17.9091
10	15	30.74	0	37.17	67.91	0.4527	0	0.5473	0.3023	1.5661	18.1059

Table A-3 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 0.5 wt% Alfotera and 5 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			Ms	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	34.96	0	32.2	67.16	0.5205	0	0.4795	0.3371	15.4419	0.6096
2	0.5	35.26	0	33.28	68.54	0.5144	0	0.4856	0.3371	15.2609	0.4285
3	1	36.35	0	31.94	68.29	0.5323	0	0.4677	0.3371	15.7902	0.9578
4	1.5	36.49	0	32.4	68.89	0.5297	0	0.4703	0.3371	15.7130	0.8806
5	2	37.64	0	31.16	68.8	0.5471	0	0.4529	0.3371	16.2294	1.3970
6	3	18.6	22.1	28.25	68.95	0.2698	0.321	0.4097	0.3371	6.8300	2.6782
7	4	24.65	17.69	26.38	68.72	0.3587	0.257	0.3839	0.3371	4.1916	3.4448
8	5	27.45	18.15	23.56	69.16	0.3969	0.262	0.3407	0.3371	3.0583	4.7268
9	10	30.57	0	37.81	68.38	0.4471	0	0.5529	0.3371	1.5704	16.4028
10	15	30.99	0	38.17	69.16	0.4481	0	0.5519	0.3371	1.5399	16.3723

Table A-4 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 1.0 wt% Alfotera and 5 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			Ms	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	34.05	0	34.04	68.09	0.5001	0	0.4999	0.3371	11.7886	0.0017
2	0.5	34.7	0	33.31	68.01	0.5102	0	0.4898	0.3371	12.0278	0.2409
3	1	35.79	0	33.4	69.19	0.5173	0	0.4827	0.3371	12.1940	0.4071
4	1.5	36.46	0	31.73	68.19	0.5347	0	0.4653	0.3371	12.6045	0.8176
5	2	37.39	0	31.01	68.4	0.5466	0	0.4534	0.3371	12.8863	1.0994
6	3	12.33	30.08	26.42	68.83	0.1791	0.437	0.3838	0.3371	7.5640	2.7382
7	4	22.58	29.58	15.83	67.99	0.3321	0.435	0.2328	0.3371	3.9579	6.2932
8	5	28.13	0	40.02	68.15	0.4128	0.000	0.5872	0.3371	2.0564	13.8433
9	10	30.21	0	38.52	68.73	0.4395	0	0.5605	0.3371	1.4251	13.2120
10	15	31.22	0	37.92	69.14	0.4515	0	0.5485	0.3371	1.1422	12.9291

Table A-5 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 0.1 wt% Alfotera and 3 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			Ms	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	35.05	0	33.29	68.34	0.5129	0	0.4871	0.1674	30.6378	0.7692
2	0.5	35.33	0	34.06	69.39	0.5092	0	0.4908	0.1674	30.4152	0.5467
3	1	35.97	0	33.22	69.19	0.5199	0	0.4801	0.1674	31.0557	1.1871
4	1.5	35.19	0	33.29	68.48	0.5139	0	0.4861	0.1674	30.6973	0.8287
5	2	36.15	0	32.63	68.78	0.5256	0	0.4744	0.1674	29.8686	1.5286
6	3	26.09	11.49	30.61	68.19	0.3826	0.168	0.4489	0.1674	7.0127	3.0530
7	4	30.61	9.4	28.8	68.81	0.4448	0.137	0.4185	0.1674	3.2946	4.8660
8	5	30.87	4.9	32.92	68.69	0.4494	0.071	0.4793	0.1674	3.0221	1.2393
9	10	32.91	0	35.64	68.55	0.4801	0	0.5199	0.1674	1.1895	31.0581
10	15	33.53	0	35.81	69.34	0.4836	0	0.5164	0.1674	0.9821	30.8507

Table A-6 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 0.1 wt% Alfotera and 5 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			Ms	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	34.96	0	32.2	67.16	0.5205	0	0.4795	0.2674	19.4670	0.7684
2	0.5	35.26	0	33.28	68.54	0.5144	0	0.4856	0.2674	19.2387	0.5402
3	1	36.35	0	31.94	68.29	0.5323	0	0.4677	0.2674	19.9061	1.2075
4	1.5	36.49	0	32.4	68.89	0.5297	0	0.4703	0.2674	19.8087	1.1101
5	2	37.64	0	31.16	68.8	0.5471	0	0.4529	0.2674	20.4597	1.7611
6	3	18.6	22.1	28.25	68.95	0.2698	0.321	0.4097	0.2674	8.6103	3.3763
7	4	24.65	17.69	26.38	68.72	0.3587	0.257	0.3839	0.2674	5.2841	4.3427
8	5	27.45	18.15	23.56	69.16	0.3969	0.262	0.3407	0.2674	3.8554	5.9589
9	10	30.57	0	37.81	68.38	0.4471	0	0.5529	0.2674	1.9798	20.6784
10	15	30.99	0	38.17	69.16	0.4481	0	0.5519	0.2674	1.9412	20.6398

Table A-7 Volume fractions of water, middle, and oil phase and solubilization parameters of oil and water phases in microemulsion formation with 0.1 wt% Alfotera and 8 wt% Tergitol at different NaCl concentrations by using an oil to water ratio of 1:1

Sample number	%NaCl	Phase height (cm)			Total phase height (cm)	Relative volume			Ms	Solubilization	
		Water	Middle	Oil		Water	Middle	Oil		Sp _w	Sp _o
1	0.1	36.42	0	34.04	70.46	0.5169	0	0.4831	0.4174	12.3835	0.4046
2	0.5	35.58	0	33.64	69.22	0.5140	0	0.4860	0.4174	12.3146	0.3357
3	1	36.12	0	32.81	68.93	0.5240	0	0.4760	0.4174	12.5541	0.5752
4	1.5	37.36	0	31.7	69.06	0.5410	0	0.4590	0.4174	12.9607	0.9818
5	2	15.24	23.79	29.58	68.61	0.2221	0	0.4311	0.4174	6.6573	1.6499
6	3	22.64	20.41	25.9	68.95	0.3284	0.296	0.3756	0.4174	4.1123	2.9795
7	4	25.27	18.37	24.75	68.39	0.3695	0.269	0.3619	0.4174	3.1265	3.3087
8	5	28.29	20.98	19.09	68.36	0.4138	0.307	0.2793	0.4174	2.0642	5.2885
9	10	29.53	23.49	16.1	69.12	0.4272	0	0.2329	0.4174	1.7435	6.3985
10	15	30.61	0	37.66	68.27	0.4484	0	0.5516	0.4174	1.2370	13.2159

Appendix B Experimental Data of Detergency Experiment

1. %Detergency (%D)

The detergency performance can be determined by %Detergency; it is calculated from the following equation:

$$\% \text{ Detergency} = [(A-B) / (Co-Bo)] \times 100$$

where A = average reflectance of the soiled swatches after washing

B = average reflectance of the soiled swatches before washing

Co = average reflectance of the unsoiled swatches before washing

2. %Oil Removal

The oil removal is calculated from the calibration curve for colored motor oil.

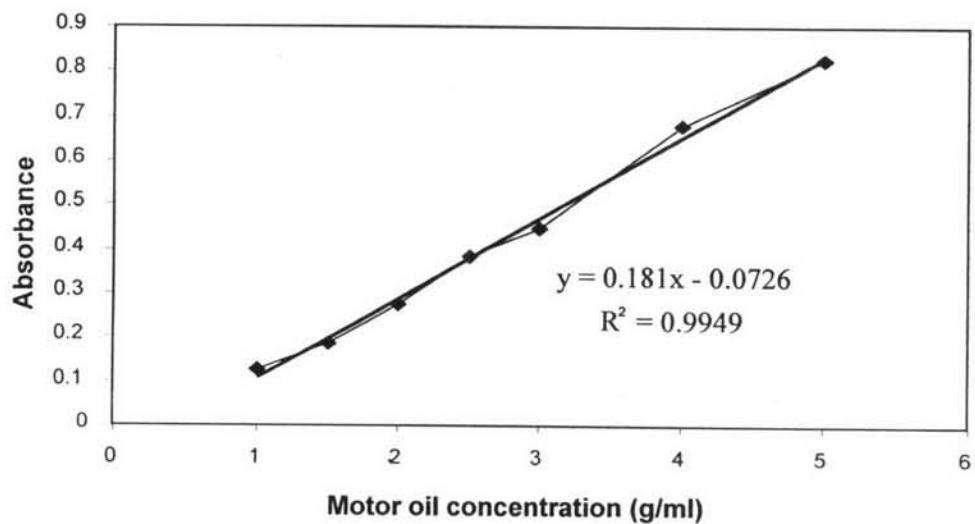


Figure B-1 Relationship between colored motor oil concentration and the absorbance measured at 520 nm.

Table B-1 Relationship between colored motor oil concentration and the absorbance measured at 520 nm

Motor oil concentration (g/ml)	Absorbance
1	0.128
1.5	0.189
2	0.275
2.5	0.384
3	0.45
4	0.68
5	0.824

3. Experiment data of detergency performance

Table B-2 Total oil removal at the different Tergitol concentration as a function of salinity, (a) 0.1% wt Alfotera and 3% wt Tergitol, (b) 0.1% wt Alfotera and 5% wt Tergitol, (c) 0.1% wt Alfotera and 8% wt Tergitol.

a		b		c	
%NaCl	% total oil removal	%NaCl	% total oil removal	%NaCl	% total oil removal
2	46.41	1	43.48	2	52.740
4	63.94	2	57.38	4	67.325
5	70.25	4	65.46	5	71.325
10	73.29	5	71.81	10	77.911
15	75.25	6	72.82	15	76.876
		12	76.11	20	74.712
		15	77.25		
		20	71.70		

Table B-3 Total oil removal as a function of salinity using the selected formulation, 0.1% wt Alfotera and 5% wt Tergitol, at 0.1% active surfactant

%NaCl	% total oil removal
1	43.48
2	57.38
4	65.46
5	71.81
6	72.82
12	76.11
15	77.25
20	71.70

Table B-4 Total oil removal as a function of active concentration the selected formulation , (a) 0.1% Alfotera and 5% Tergitol, at 5% salinity and (b) Commercial liquid detergent

a		b	
%Active	% total oil removal	%Active	% total oil removal
0.1	76.873	0.1	27.99
0.2	76.269	0.2	30.26
0.3	82.973	0.3	41.71
0.4	82.973	0.4	59.13
0.5	81.881	0.5	63.99

Table B-5 Total oil removal as a function of active concentration the selected formulation, (a) 0.1% wt Alfotera and 5% wt Tergitol, at 5% salinity, (b) No surfactant

a		b	
Temperature in °C	% total oil removal	Temperature in °C	% total oil removal
20	59.416	20	6.263
30	82.973	30	9.690
40	83.712	40	13.810
50	82.423	50	12.556
60	77.089	60	16.437

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