REFERENCES

Berg, J. C. (1993). Surfactant science series volume 49: Wettability. New York: Marcel Dekker.

Bigelow, W. C., and Brockway, L. O. (1956). Variation of contact angle and structure with molecular length and surface density in adsorbed films of fatty acids. Journal of Colloid Science, 11, 60-68.

Borchardt, J. K. (1994). Mechanistic insigths into de-inking. Colloid and Surfaces A: Physicochemical and Engineering Aspects, 88, 13-25.

Buckton, G., Darcy, P., and McCarthy, D. (1995). The extent of errors associated with contact angles 3. The influence of surface roughness effects on angles measured using a Wilhelmy plate technique for powders. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 95, 27-35.

Chandra, S., di Marzo, M., Qiao, Y. M., and Tartarini, P. (1996). Effect of liquid-solid contact angle on droplet evaporation. Fire Safety Journal, 27(2), 141-158.

Chintanasathien, C. (1993). Precipitation in solutions containing mixture of synthetic anionic surfactant and soap I. Effect of sodium octanoate on hardness tolerance of sodium dodecyl sulfate. M.S. Thesis in Petrochemical Technology, Petroleum and Petrochemical College, Chulalongkorn University.

Draelos, Z. D. (1998). Cosmetic, skin care products, and the dermatologic surgeon. Dermatol Surg., 24, 543-546.

Drelich, J., Miller, J. D., Kumar, A., and Whitesides, G. M. (1994). Wetting characteristics of liquid drops at heterogeneous surface. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 93, 1-13.

Jackson, E. M. (1994). Soap: a complex category of products. American. Journal. Contact Dermatitis, 5, 173-175.

Garrett, P. R. (1993). Surfactant science series volume 45: Deforming, New York: Marcel Dekker.

Garti, N., and Zour, H. (1997, Mar.). The effect of surfactants on the crystallization and polymorphic transformation of glutamic acid. Journal of Crystal Growth, 172, 486-498.

Hind, A. R., Bhargava, S. K., and Grocott, S. C. (1999). The surface chemistry of Bayer process solids: a review. Colloid and Surfaces A: Physicochemical and Engineering Aspects, 146, 359-374.

Homma, Y., Tomita, M., and Aizawa, N. (1997, Apr.). Effect of surfactant on Ge crystallization on Si in solid phase epitaxy. Surface Science, 376, 1419-1423.

Horr, T. J., Ralston, J., and Smart, R. St. C. (1995). The use of contact angle measurements to quantify the adsorption density and thickness of organic molecules on hydrophilic surfaces. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 97, 183-196.

Kemen, K. M. (1996). Liquid detergents containing anionic surfactant, carboxylate builder, proteolytic enzyme, and alkanol amine. Biotechnology Advances, 14, 356-357.

Lin, C. H., Gabas, N. and Canselier, J. P. (1998). Prediction of growth morphology of aminoacid crystals in solutionI. α-Glycine. Journal of Crystal Growth, 191(4), 803-810.

Lin, F. Y. H. (1995). The effect of surface heterogeneity on the drop size dependence of contact angles. Chemical Engineering Science, 50(16), 2633-2639.

Neumann, A. W., and Spelt, J. K. (1996). Surfactant science series volume 63: Applied surface thermodynamics. New York: Mearcel Dekker.

Paterson, A., Robin, M., Fermigier, M., Jenffer, P., and Hulin, J. P. (1998). Effect of density and spatial distribution of wetting heterogeneities on contact angle. Journal of Petroleum Science and Engineering, 20, 127-132.

Pugh, R. T. (1996). Foaming, foam films, antifoaming and defoaming. Advance in Colloid and Interface Science, 64, 67-142.

Riviello, A. E. (1997). Surfactant Behavior in the Mechanisms of Ink Removal from Secondary Fiber in Flotation Deinking. Dissertation of University of Oklahama.

Rodriguez, C. H., and Scamehorn, J. F. Surfactant and Detergent, In Press.

Rosen, M. J. (1989). Surfactants and interfacial phenomena, chapter 6. New York: John Wiley.

Scamehorn, J. F., and Harwell, J. H. (1993). Precipitation of Surfactants Mixture, chapter 10, New York: Marcel Dekker.

Shiao, S. Y., Chhabra, V., Patist, A., Free, M. L., Huibers, P. D. T., Gregory, A., Patel, S., and Shah, D. O. (1998). Chain length compatibility effects in mixed surfactant systems for technological applications. Advances in Colliod and Interface Science, 74, 1-29.

Stein, H. N. (1996). Surfactant science series volume 58: The preparation of dispersions in liquids, chapter 2. New York: Marcel Dekker.

Wang, J., Ee, L. S., Ng, S. C., Chew, C. H., and Gan, L. M. (1997, Jan.). Reduced crystallization temperature in a microemulsion derived zirconia precursor. Materials Letters, 30, 119-124.

Zettlemoyer, A. C. (1968). Hydrophobic surfaces. Journal of Colloid and Interface Science, 28(3/4), 343-369.

APPENDICES

APPENDIX A

Experimental Data of Contact Angle Study with Time

Table A-1 The measuring contact angle of sodium dodecyl sulfate (SDS) at [SDS] = 1 M, solution volume = 20 μl.

Time (min)	Contact angle (degree)
10	41
20	41
30	41
40	41
50	41
60	41
70	41
80	41
90	41
100	41
110	41
120	41
130	41
140	41

Table A-2 The measuring contact angle of sodium octanoate (SO) at [SO] = 2 M, solution volume = 20 μl.

Time (min.)	Contact angle (degree)
10	35
20	35
30	35
40	35
50	35
60	35
70	35
80	35
90	35
100	35
110	35
120	35

Table A-3 The measuring contact angle of sodium dodecanoate at concentration = 0.1 M, solution volume = 20 μl.

Time (min.)	Contact angle (degree)
10	29
20	29
30	29
40	29

Table A-4 The measuring contact angle of $Ca(DS)_2$ as varying composition of DS^- and calcium ion.

	Contact angle (degree)			
Tim (min.)	$[DS^-]= 2.35 \times 10^{-4}$	$[DS]= 4.82 \times 10^{-4}$	$[DS]= 5.15 \times 10^{-4}$	$[DS^-]= 9.29 \times 10^{-5}$
Initial	33	35	30	37
10	33	35	30	37
20	33	35	30	37
30	33	35		37
40	33	35		
50	33	35		

Table A-5 The measuring contact angle of CaO_2 by varying composition of octanoate (O^-) and calcium ion.

	Contact angle (degree)			
Time (min.)	$[O^-]$= 0.02 M	$[O^-]$= 0.056 M	$[O^-]$= 0.08 M	$[O^-]$= 0.097 M
Initial	52	53	50	52
10	52	53	50	52
20	52	53	50	52
30	52	53	50	52
40	52	53	50	52
50	52	53	50	52
60	52	53	50	52
70	52	53	50	52
80	52	53	50	
90	52	53	50	
100	52	53	50	
110	52		50	
120	52		50	
130	52			
140	52			
150	52			

Table A-6 The measuring contact angle of calcium dodecanoate by varying composition of dodecanoate and calcium ion.

	Contact angle (degree)			
Time (min.)	[dodec]= 1.11×10^{-5} M	[dodec] = 1.23×10^{-5} M	[dodec]= 2.3×10^{-5} M	[dodec]= 2.88×10^{-5} M
Initial	55	55	54	55
10	55	55	54	55
20	55	55	54	55
30	55	55	54	55
40	55	55	54	55
50	55	55	54	55
60	55	55		
70	55	55		
80	55	55		

APPENDIX B

Experiments Data of the Advancing Contact Angle and Receding Contact Angle

Table B-1 The advancing angle and receding angle of fatty acids (C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

Fatty acids	Volume (μl)	Advancing angle	Receding angle
Decanoic acid (C_{10})	10	62	
	20	62	
	30	62	
	40	62	30
	50	62	33
	60	62	46
	70	62	54
	80		61
	90		63
Dodecanoic acid (C_{12})	10	78	
	20	80	33.5
	30	78	36
	40	81.5	45.5
	50	82	50
	60	82.5	59
	70	81	66
	80		77
	90		89
Tetradecanoic acid (C_{14})	10	86	
	20	87	23.5
	30	87	35.5
	40	87	44
	50	86	49
	60	87	57
	70	83	69
	80		74
	90		80.5

Table B-1 (Cond't) The advancing angle and receding angle of fatty acids (C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

Fatty acids	Volume (μl)	Advancing angle	Receding angle
Hexadecanoic acid (C_{16})	10	85	
	20	88	15
	30	87.5	29
	40	87	44
	50	87	53
	60	86	55
	70	86	60
	80		63
	90		78
Octadecanoic acid (C_{18})	10	94	
	20	95	28
	30	91	41
	40	92	55
	50	91	56.5
	60	90	75
	70	91	79
	80		88
	90		90

Table B-2 The advancing angle and receding angle of sodium salt of fatty acids (C_8, C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

Chemicals	Volume (μl)	Advancing angle	Receding angle
Sodium decanoate (C_{10})	10	18	
	20	20	
	30	22	6.5
	40	22	10
	50	22	13.5
	60	25	17
	70	28	19.5
	80	28	26
Sodium dodecanoate (Sigma, C_{12})	10	30	
	20	34	9
	30	35	15
	40	35	20
	50	35	25
	60	35	33.5
	70	35.5	35
Sodium tetradecanoate (C_{14})	10	62	
	20	59.5	
	30	61.5	10
	40	61.5	17
	50	59	27
	60	59	29.9
	70	59	39
	80	60	48
Sodium hexadecanoate (C_{16})	10	61.5	
	20	70	13.5
	30	67.5	22
	40	70	30
	50	77	37
	60	77	46
	70	80	65
	80	80	78
Sodium octadecanoate (C_{18})	10	64	
	20	71	16
	30	78	18
	40	78	30
	50	79	39.5
	60	79	49
	70	80	58
	80	81	67

Table B-2 (Cont'd) The advancing angle and receding angle of sodium salt of fatty acids (C_8, C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

		Advancing contact angle					Receding contact angle				
Chemical	Volume (ul)	Time 1	Time 2	Time 3	Time 4	Average	Time 1	Time 2	Time 3	Time 4	Average
NaC_8	10	35	35			35					
(free acid)	20	40	35			37.5		4			4
	30	43	45			44	12	9			10.5
	40	43	45			44	12.5	10			11.25
	50	44	45			44.5	15	15			15
	60	45	45			45	23	20			21.5
	70	44	45			44.5	25	28			26.5
	80	44	45			44.5	29	39			34
NaC_8	10	50	71.5	57	55	61.2					
(Sigma)	20	97	74	71	70	71.7	12		16		14
	30	90	76	77	75	76	28.5	20	27	30	28.5
	40	94	75	76	75	75.3	38.5	27.5	36	34	36.2
	50	99	80	78	75	77.7	47.5	34	44	42	44.5
	60	107	85	76	76	79	60.5	50	55	53	56.2
	70		85	78	78	80.3	73	53.5	65	63	67
	80		85	79	78	80.7		64	76	70	70
NaC_{12}	10	42	36.5			39.25					
(free acid)	20	47	46			46.5					
	30	51	49			50	10	13			11.5
	40	51	52			51.5	18	21.5			19.75
	50	51	54			52.5	23	26			24.5
	60	53	56			54.5	35	38			36.5
	70	53	56			54.5	40	43			41.5
	80	55	56			55.5	45	48			46.5

Table B-3 The advancing angle and receding angle of calcium salt of fatty acids (C_8, C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

Chemicals	Volume (μl)	Advancing angle	Receding angle
Calcium decanoate (C_{10})	10	30	
	20	43	
	30	44	
	40	46	
	50	46	15
	60	44.5	21
	70	43	24
	80	43	32
	90		41
Calcium dodecanoate (C_{12} from Na salt)	10	86.5	
	20	85	48
	30	88	54
	40	86	59
	50	88	67
	60	89	81
	70	90	85
	80	90	90
Calcium tetradecanoate (C_{14})	10	66	
	20	71	31
	30	71	34
	40	73	47
	50	74	52
	60	75	58
	70	77	63
	80	82	73
	90		74

Table B-3 (Cont'd) The advancing angle and receding angle of calcium salt of fatty acids (C_8, C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

Chemicals	Volume (μl)	Advancing angle	Receding angle
Calcium	10	74	
hexadecanoate (C_{16})	20	75	
	30	77	32
	40	81	42
	50	81	51
	60	81	61
	70	80	63
	80	81	70
	90		77
Calcium	10	77	
octadecanoate (C_{18})	20	80	49
	30	82	53
	40	80	58
	50	83	63
	60	81	64
	70	85	67
	80	85	79
	90		84

Table B-3 (Cont'd) The advancing angle and receding angle of calcium salt of fatty acids (C_8, C_{10}, C_{12}, C_{14}, C_{16}, and C_{18}) at T = 30 ^{0}C.

		Advancing contact angle					Receding contact angle				
Chemical	Volume (ul)	Time 1	Time 2	Time 3	Time 4	Average	Time 1	Time 2	Time 3	Time 4	Average
CaC_8	10	83	85			84					
(free acid)	20	83	85			84	32	30			31
	30	85	86			85.5	50	51			50.5
	40	86	86			86	71	69			70
	50	86	86			86	78	79			78.5
	60	85	88			86.5	84.5	84			84.25
	70	86	87.5			86.75	83	85			84
	80	88	88			88	86	88			87
CaC_8	10	77	80	77		78					
(Sigma)	20	76	86	80		80.7	28	26	25		26.3
	30	78	86	82		82	40	39	40		39.7
	40	77	87	82		82	56	50	50		52
	50	77	87	85		83	67	58.5	63		62.8
	60	80	83	86		83	76	70.5	75		73.8
	70	80	85	86		83.7	80	75	78		77.7
	80	80	88	86		84.7	80	87	85		84
CaC_{12}	10	82	85			83.5					
(free acid)	20	80	85			82.5	23	27			25
	30	83	85			84	30	35			32.5
	40	80	85			82.5	40	50			45
	50	85	85			85	54	57			55.5
	60	85	85			85	63	68			65.5
	70	85	86			85.5	79	80			79.5
	80	87	87			87	82	86			84

Table B-4 The advancing angle and receding angle of anionic surfactants at T = 30 ^{0}C.

		Advancing angle					Receding angle				
Chemical	Volume (ul)	Time 1	Time 2	Time 3	Time 4	Average	Time 1	Time 2	Time 3	Time 4	Average
$Ca(DS)_2$	10	55	56.5	45	55	52.2					
	20	60	57	52	55	54.7			11		11
	30	56	54	52	55	53.7	26	14	18	17	16.3
	40	56	54	51	50	51.7	26	23	26	24	24.3
	50	54	52	54.5	51	52.5	37	28	32.2	32	30.7
	60	57	57	52	56	55.0	45	37	39.5	41	39.2
	70	64	56.5	55	55	55.5	55	43	47	48	46.0
	80	64	56.5	55	55	55.5	62	47	55	53	51.7
SDS	10	70	72	81		74.3					
	20	90	72	83		81.7			34		34
	30	84	84	80		82.7		30	41		35.5
	40	84	95	86		88.3	45	30	42		39
	50	86.5	109	95		96.8	50	49	50		49.7
	60	97	67	99		98	57	54	63		58
	70	99	78	63		99	57	59	70		62
	80		80	70			60	78	77		71.7

Table B-5 The advancing angle and receding angle as varying composition between DS^- and Ca^{2+} of $Ca(DS)_2$ at T = 30 ^{0}C.

[DS^-] M	Volume (µl)	Advancing angle	Receding angle
2.35×10^{-4}	10	44	
	20	43.5	
	30	46	8
	40	46	12
	50	46	17
	60	46	23
	70	46.5	33
	80		42
4.82×10^{-4}	10	43	
	20	46	6.5
	30	46	13
	40	46	18
	50	47	26.5
	60	45	30
	70	42	37
	80		46
5.15×10^{-4}	10	45	
	20	46	7.5
	30	49	13.5
	40	47	20
	50	47	27
	60	46.5	35
	70	44	42
9.29×10^{-3}	10	44	
	20	45	5.5
	30	47	11
	40	47	17
	50	47	25
	60	46	31
	70	44.5	38
	80		41

Table B-6 The advancing angle and receding angle as varying composition between octanoate (O^-) and Ca^{2+} of calcium octanoate (CaO_2).

		Advancing angle					Receding angle				
[O⁻] M	Volume	Time 1	Time 2	Time 3	Time 4	Average	Time 1	Time 2	Time 3	Time 4	Average
0.02	10	76	75			75.5					
	20	83	75	75		77.7	19	22			20.5
	30	89	75	76		80.0	31.2	29	31		30.4
	40	86	80	80		82.0	42.5	47	48		45.8
	50	90	87	85		86	56	53	51		53.3
	60	90	88	85		86.5	59.7	62	62		61.2
	70	90	88	88		88	71	72	72		71.7
	80		88	88		88	78	81	82		80.3
0.056	10	64	69	64		65.7	7.5				
	20	71	72	72		71.7	20.5				
	30	67	72	64		67.7	31	32.5	30		31.2
	40	67	74	66		69	44.5	39	38		40.5
	50	67	74	68		69.7	55	48	48		50.3
	60	67	74	68		69.7	63	57	56		58.7
	70	67	74	67		69.3	75	60	61		65.3
	80		74	68		71	81	75	67		71
0.08	10	74	54	61.5		63.2					
	20	74	57	79		70.0	10	36			10
	30	68	60	62		63.3	19	42	17.5		18.3
	40	67	60	62		63.0	25	49	26		25.5
	50	66	64	64		64.7	32	60	32.5		32.3
	60	63	64	64		63.7	38	67	42		40.0
	70	62	65	65		64.0	42.5	73	53		47.8
	80		65.5	65			61	87	57		59.0
0.097	10	77	60	61		66					
	20	79	70	69		69.5		30			
	30	77	70	69		69.5	15	33	16		16
	40	77	65	70		67.5	25.5	39	27		26
	50	76	66	70		68.0	30	46	30		30
	60	77	66	70		68.0	40.5	55	40		40
	70	77	68	70		69.0	49	65	50		50
	80		68	70		69.0	61.5	67	65		63

Table B-7 The advancing angle and receding angle as varying composition between dodecanoate and Ca^{2+} of calcium dodecanoate.

[dodecanoate] M	Volume (μl)	Advancing angle	Receding angle
1.23×10^{-4}	10	86.5	
	20	85	48
	30	88	54
	40	86	59
	50	88	67
	60	89	81
	70	90	85
	80	90	90
2.30×10^{-4}	10	90	
	20	89	38
	30	90	40
	40	91	57
	50	91	70
	60	105	79
	70	104	85
	80	105	88
2.88×10^{-4}	10	90	
	20	107	25
	30	106	40
	40	102	50
	50	90	69
	60	90	75
	70	88	86
	80	90	86

Table B-8 The data of advancing and receding contact angles in cycling.

Chemical	Volume (μl)	$1^{st}\ \theta_A$	$1^{st}\ \theta_R$	$2^{nd}\ \theta_A$	$2^{nd}\ \theta_R$	$3^{rd}\ \theta_A$
CaC_{12} (from free fatty acid)	10	60	11	11	11	11
	20	66	27	35	34	31
	30	80	38	45	38	42
	40	82	49	56	47	54
	50	82	63	67	53	60
	60	83	72.5	68	61	74
	70	83	78	79	75	80
	80	83	83	82	82	82

APPENDIX C

Figure of Contact Angle with Time

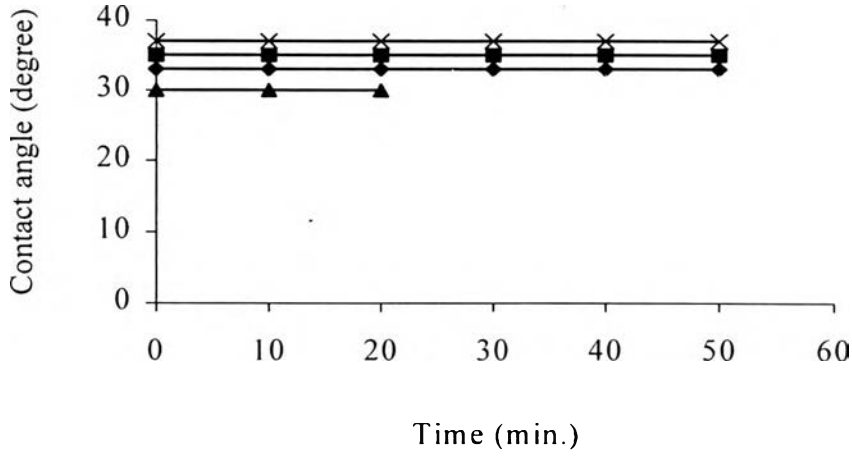

Figure C-1 The contact angle of $(Ca(DS)_2)$ as varying composition of DS^- and Ca^{2+} at 30 °C, (◆) [SDS] = 2.35 x 10^{-4} M and $[Ca^{2+}]$ = 1.15 x 10^{-4} M, (■) [SDS] = 4.82 x 10^{-4} M and $[Ca^{2+}]$ = 2.37 x 10^{-5} M, (▲) [SDS] = 5.15 x 10^{-4} M and $[Ca^{2+}]$ = 4.19 x 10^{-6} M, (x) [SDS] = 9.29 x 10^{-4} M and $[Ca^{2+}]$ = 2.11 x 10^{-6} M.

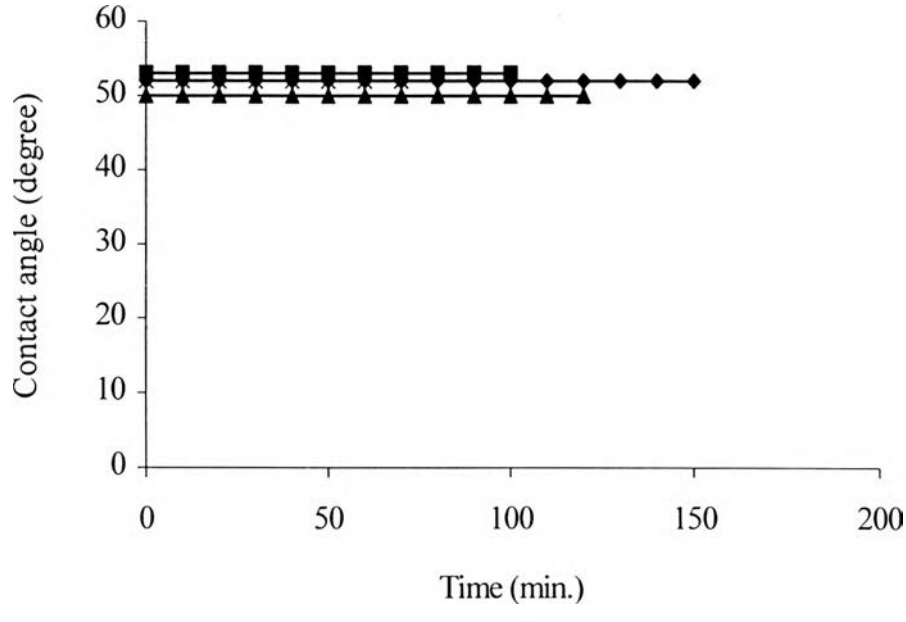

Figure C-2 The contact angle of CaO_2 as varying composition of O^- and Ca^{2+} at 30 °C, (◆) [SO] = 0.02 M and $[Ca^{2+}]$ = 1.94 x 10^{-4} M, (■) [SO] = 0.056 M and $[Ca^{2+}]$ = 4.23 x 10^{-5} M, (▲) [SO] = 0.08 M and $[Ca^{2+}]$ = 6.68 x 10^{-7} M, (x) [SO] = 0.097 M and $[Ca^{2+}]$ = 3.13 x 10^{-6} M.

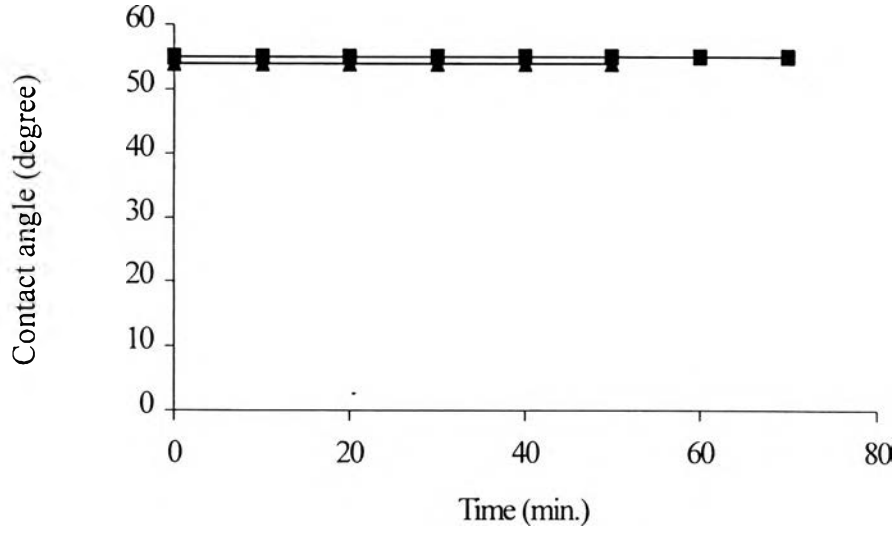

Figure C-3 The contact angle of calcium dodecanoate as varying composition of dodecanoate and Ca^{2+} at 30 ^{o}C, (◆) [dodec] = 1.11 x 10^{-4} M and [Ca^{2+}] = 2.08 x 10^{-6} M, (■) [dodec] = 1.23 x 10^{-4} M and [Ca^{2+}] = 1.76 x 10^{-6} M, (▲) [dodec] = 2.30 x 10^{-4} M and [Ca^{2+}] = 1.54 x 10^{-6} M, (x) [dodec] = 2.88 x 10^{-4} M and [Ca^{2+}] = 2.00 x 10^{-6} M.

APPENDIX D

Figure of Advancing (θ_A) and Receding (θ_R) Contact Angle as a Function of Volume Surfactant Solution

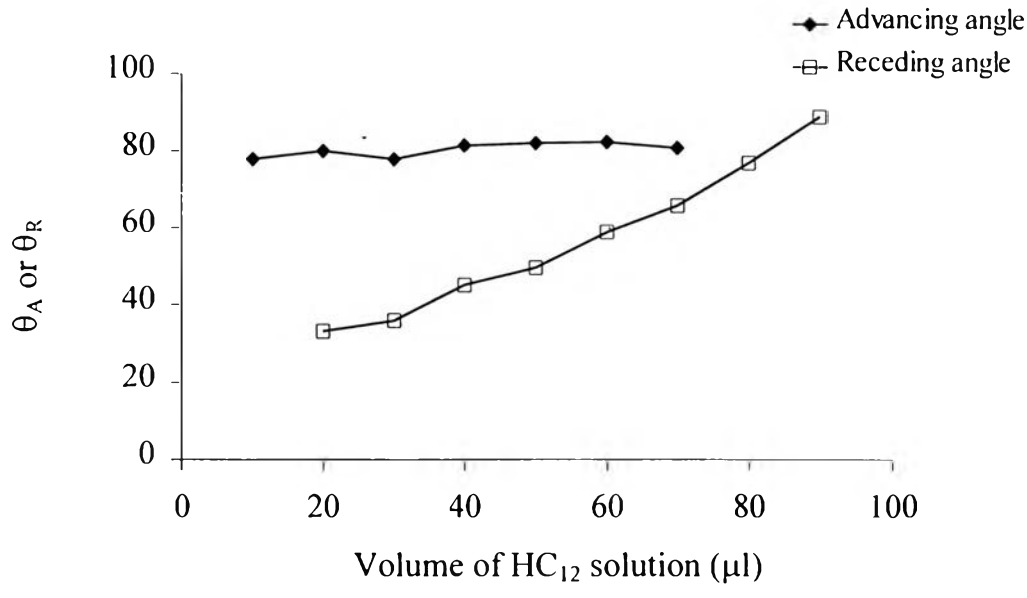

Figure D-1 The advancing and receding angles of dodecanoic acid (C_{12}) at 30 °C.

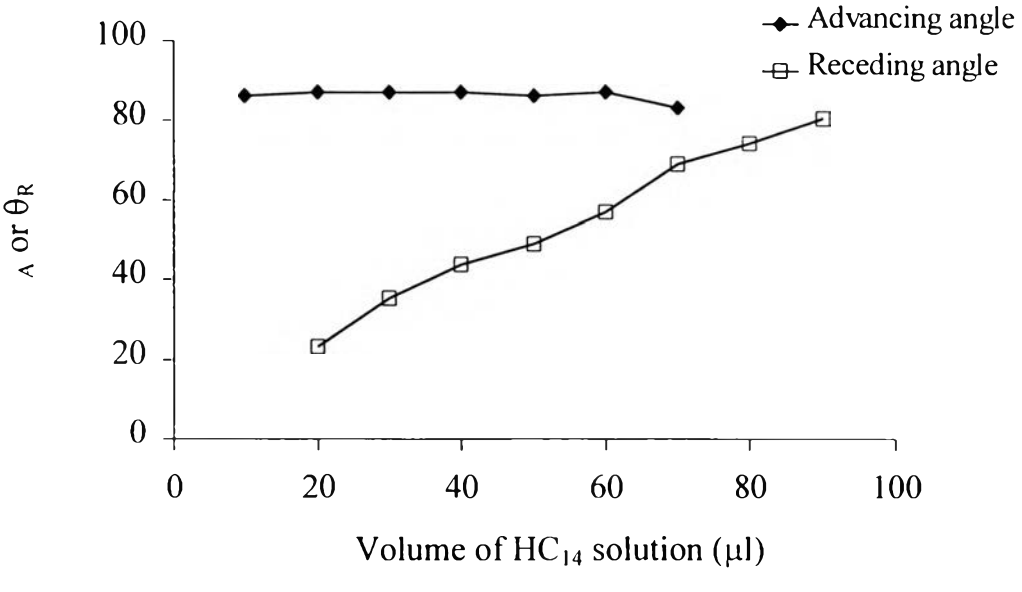

Figure D-2 The advancing and receding angle of tetradecanoic acid (C_{14}) at 30 °C.

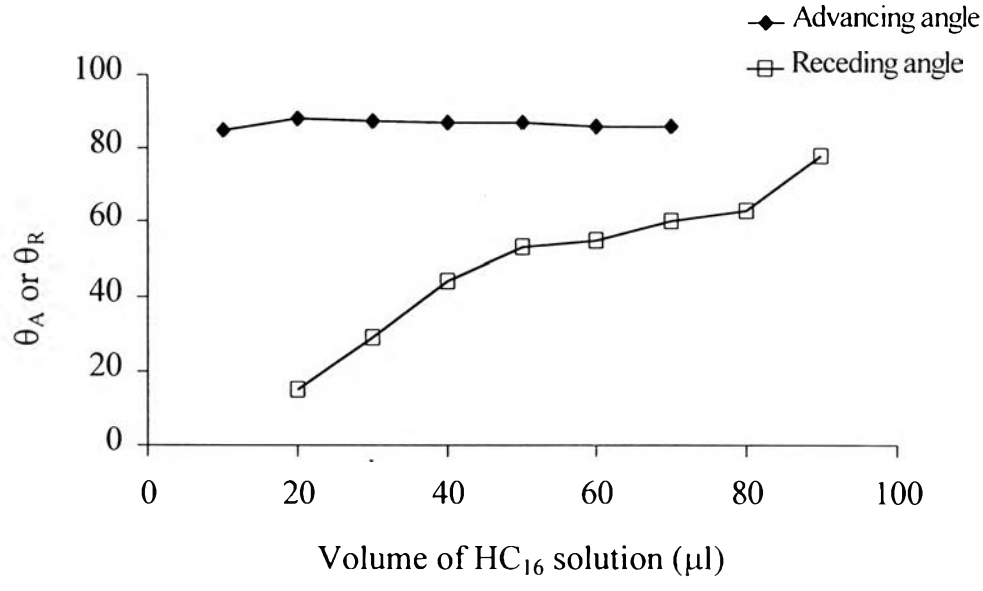

Figure D-3 The advancing and receding angles of hexadecanoic acid(C_{16}) at 30 °C.

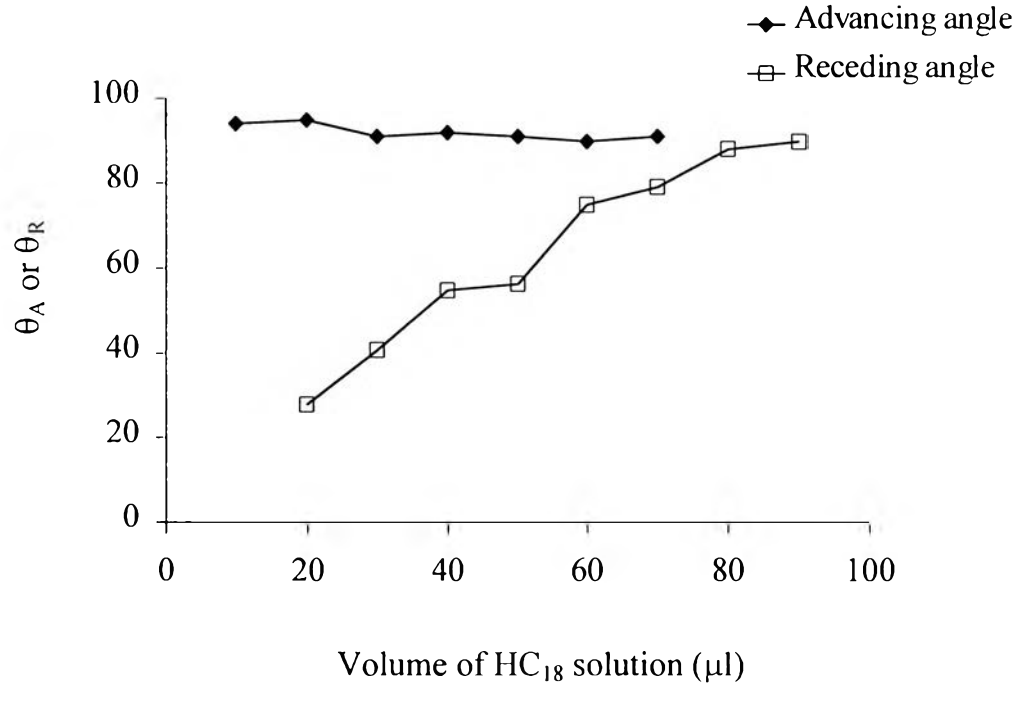

Figure D-4 The advancing and receding angles of octadecanoic acid (C_{18}) at 30 °C.

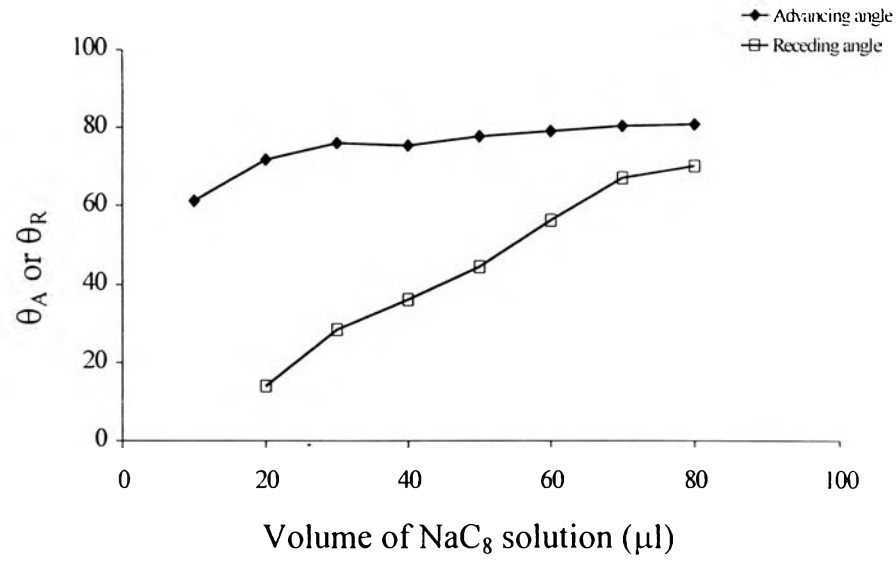

Figure D-5 The advancing and receding angles of sodium octanoate (C_8) at 30 °C.

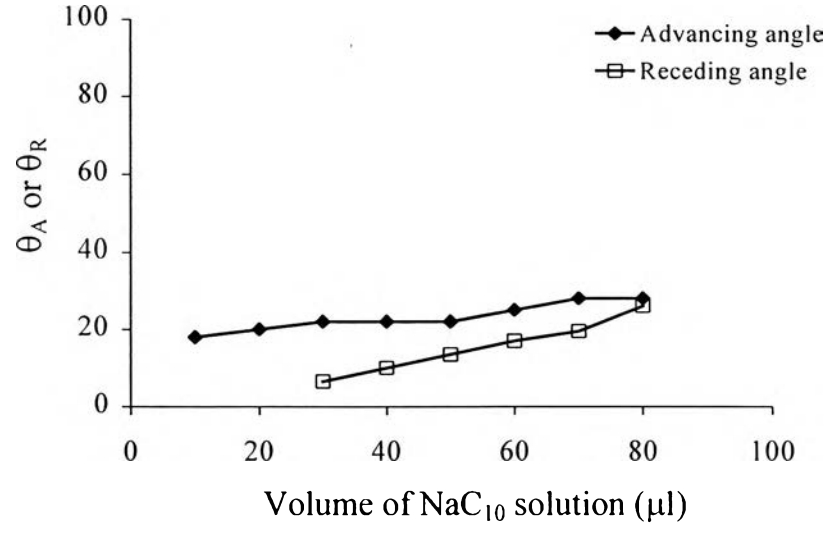

Figure D-6 The advancing and receding angles of sodium decanoate (C_{10}) at 30 °C.

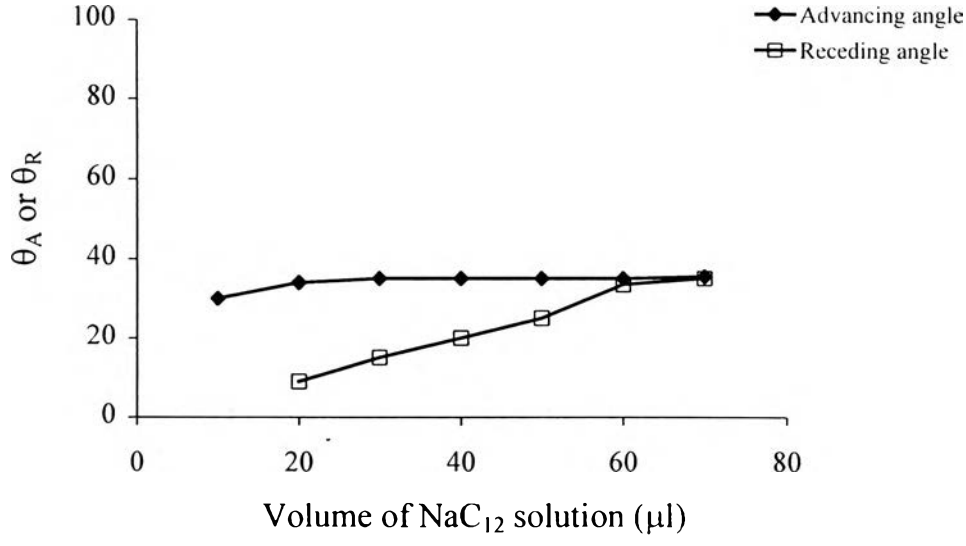

Figure D-7 The avancing and receding angles of sodium dodecanoate (C_{12}) at 30 °C.

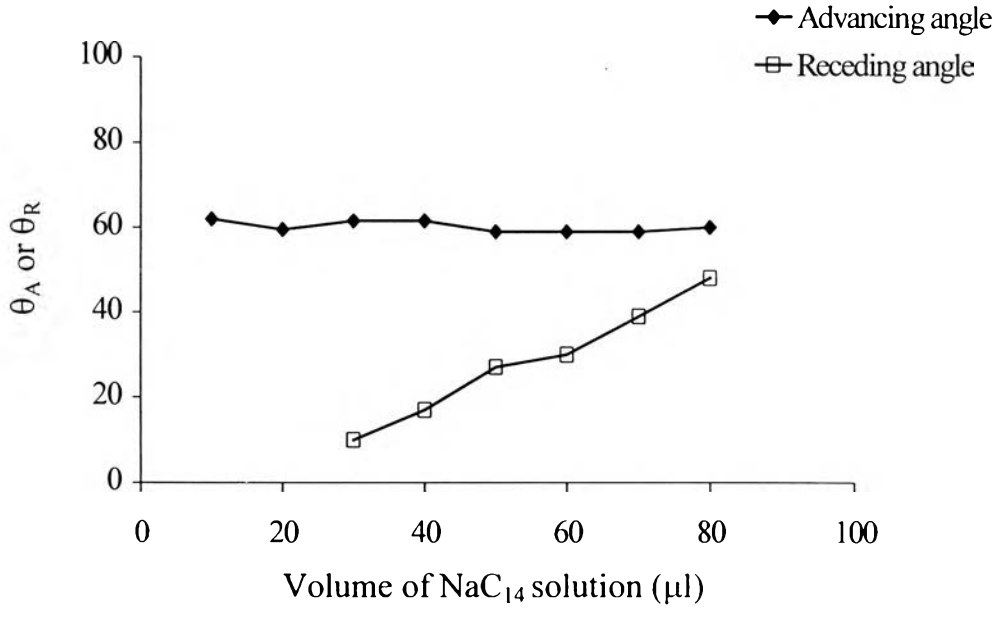

Figure D-8 The advancing and receding angles of sodium tetradecanoate C_{14}) at 30 °C.

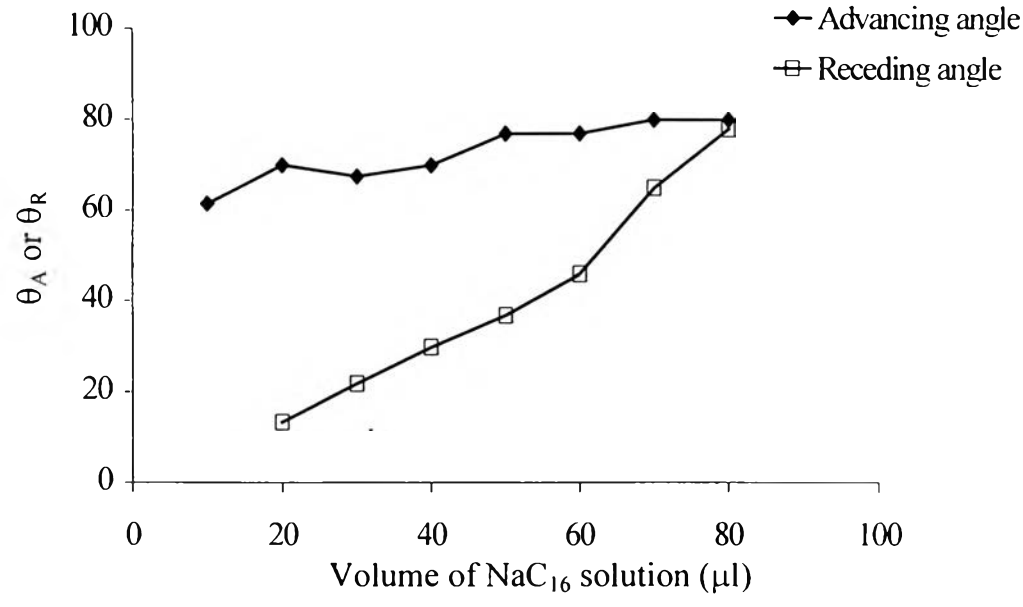

Figure D-9 The advancing and receding angles of sodium hexadecanoate (C_{16}) at 30 °C.

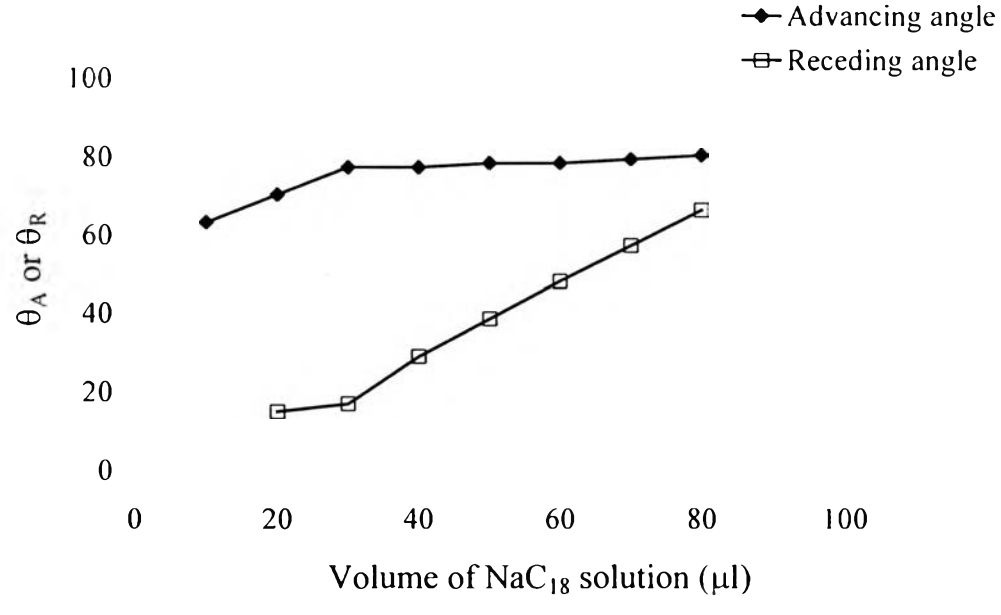

Figure D-10 The advancing and receding angles of sodium octadecanoate (C_{18}) at 30 °C.

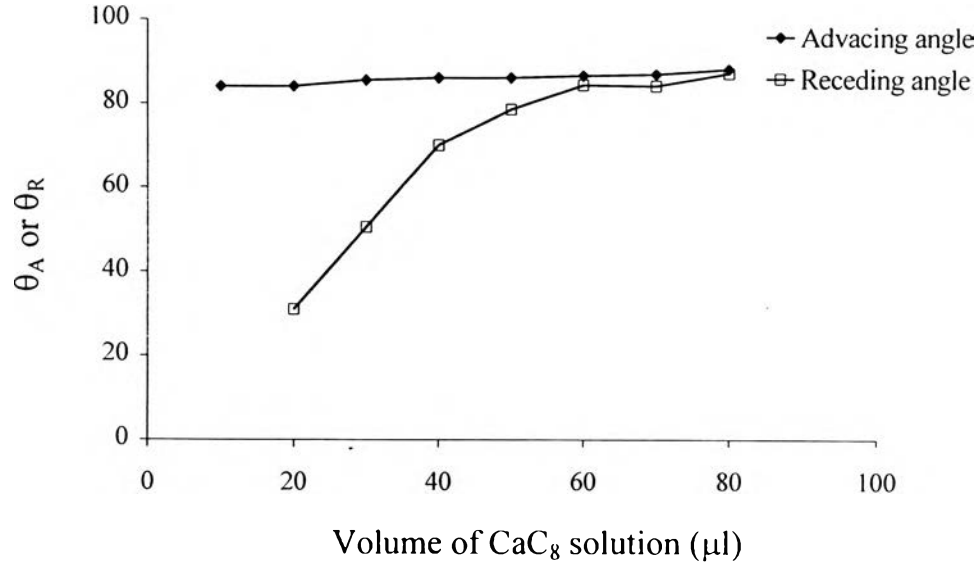

Figure D-11 The advancing and receding angles of calcium octanoate (C_8) at 30 °C.

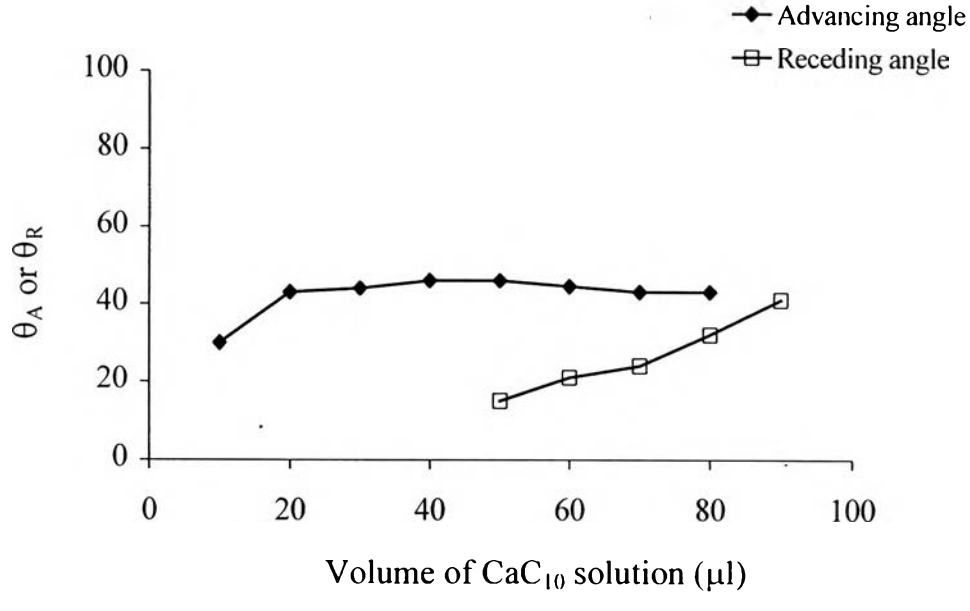

Figure D-12 The advancing and receding angles of calcium decanoate (C_{10}) at 30 °C.

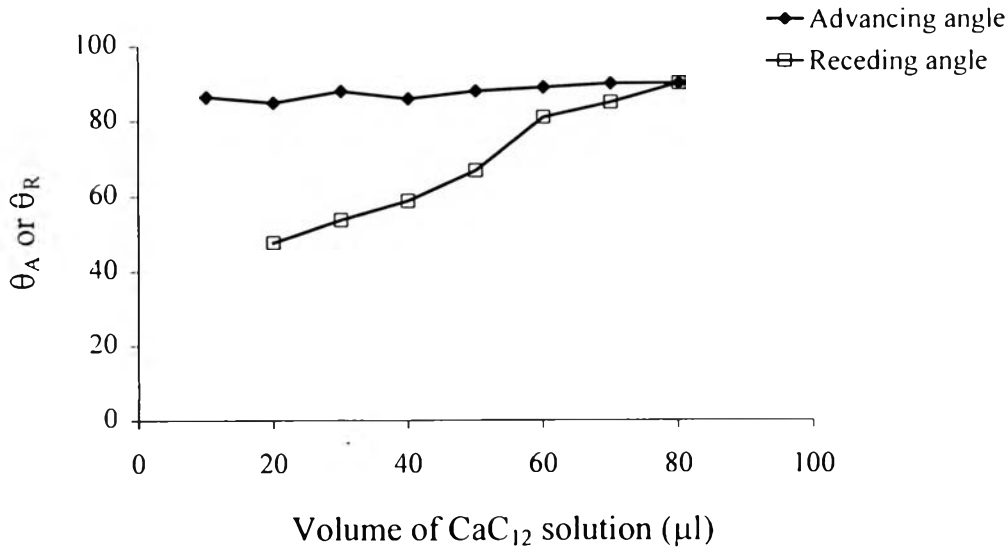

Figure D-13 The advancing and receding angles of calcium dodecanoate (C_{12}) at 30 °C.

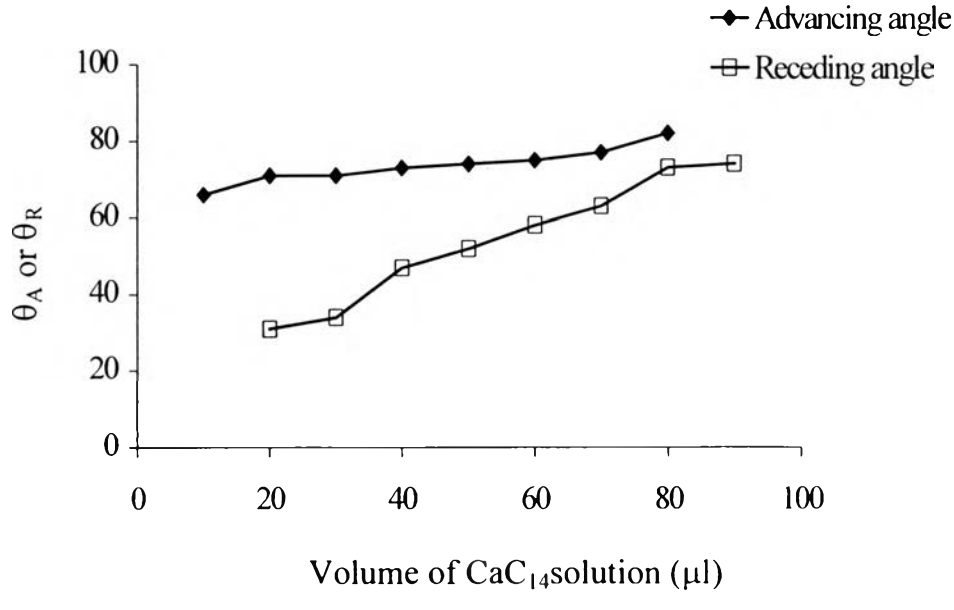

Figure D-14 The advancing and receding angles of calcium tetradecanoate (C_{14}) at 30 °C.

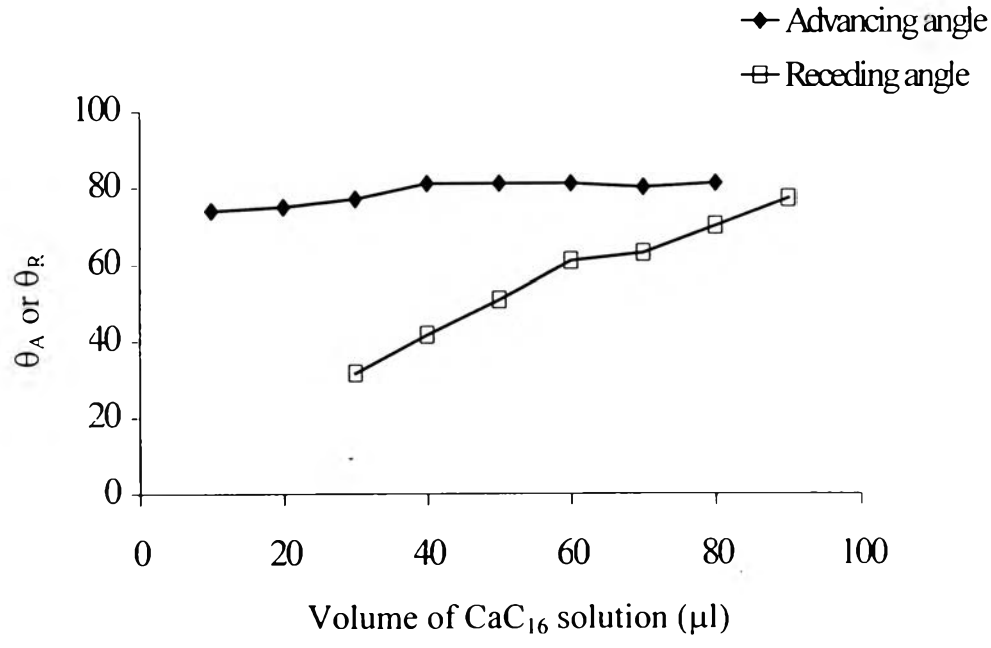

Figure D-15 The advancing and receding angles of calcium hexadecanoate (C_{16}) at 30 °C.

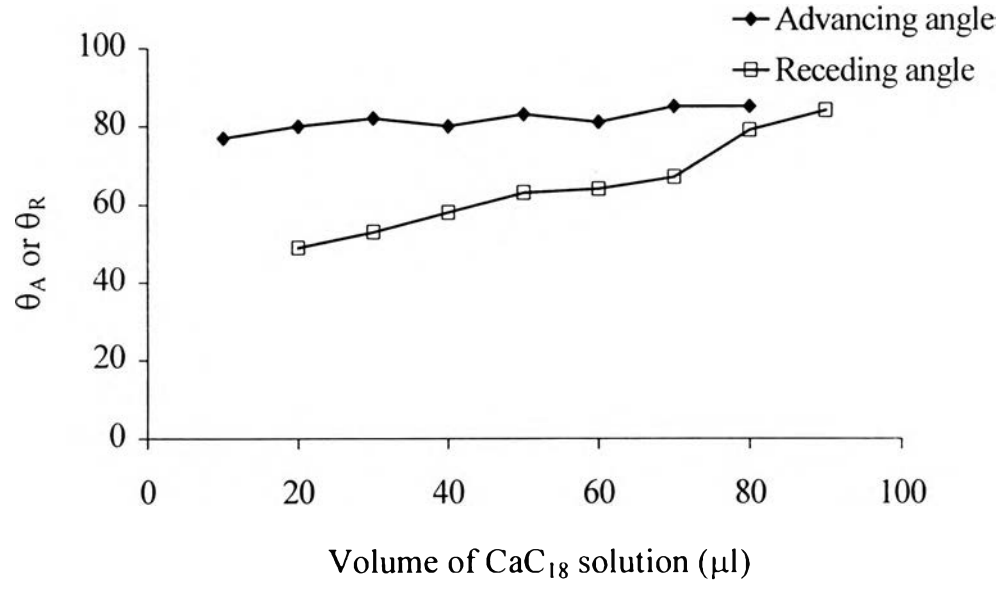

Figure D-16 The advancing and receding angles of calcium octadecanoate (C_{18}) at 30 °C.

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