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APPENDICES

APPENDIX

Appendix A: Critical micelle concentration (CMC) of surfactant

Table A1: Critical micelle concentration and surface tension (σ) of surfactants

Surfactant	%AI	CMC (g AI/L)	Surface tension , σ (mN/m)
NPES-4	32	0.10	28
NPES-10	35	0.28	33
NPES-40	31	0.20	48
FAES-4	31	0.22	23
FAES-12	30	0.22	34
FAES-30	33	0.28	37
FAES-40	32	0.36	43

Table A2: Conversion of %active ingredient (AI) of surfactant (w/w) to active ingredient of surfactant / liter

%AI (w/w)	g AI/L
0.25	2.65
0.35	3.71
0.45	4.77
0.75	7.95
1.05	11.13

Appendix B : Latex specification

Table B1: Specification of latex

Surfactant	% AI (w/w)	Viscosity@25^{0}C (cP)	NV (%)	pH
NPES-4	0.25	60	49.55	8.1
	0.35	80	49.77	8.8
	0.45	74	49.59	8.6
	0.75	86	49.41	8.1
	1.05	134	50.58	8.7
NPES-10	0.25	90	50.83	8.1
	0.35	90	49.85	8.8
	0.45	110	50.33	8.3
NPES-40	0.25	13	43.48	8.4
	0.35	14	43.99	9.0
	0.45	40	49.28	8.5
FAES-4	0.25	67	49.33	9.0
	0.35	90	49.31	8.7
	0.45	124	49.88	8.7
	0.75	183	49.48	8.4
	1.05	240	49.61	8.3
FAES-12	0.35	92	50.61	8.6
FAES-30	0.35	97	50.07	8.3
FAES-40	0.35	14	44.44	9.0
anionic+nonionic[1]	0.35	72	49.68	8.3
anionic+nonionic[2]	0.35	76	50.46	8.6
SPECIFICATION		30-200	49-51	8-9

[1] FAE-40 : FAES-4 1:2.50 w/w ratio

[2] FAE-40 : FAES-4 1:1.33 w/w ratio

Appendix C: Particle size

Table C1: latex particle size and %active ingredient of surfactant

Surfactant	% AI (w/w)	Particle size (nm)				
		1	2	3	Mean	SD.
NPES-4	0.25	149.0	148.8	148.8	148.9	0.12
	0.35	133.4	132.4	134.1	133.3	0.85
	0.45	137.4	138.1	137.5	137.7	0.38
	0.75	123.4	121.8	125.7	123.6	1.96
	1.05	116.4	116.3	115.5	116.1	0.49
NPES-10	0.25	157.5	157.7	158.5	157.9	0.53
	0.35	135.0	134.6	133.8	134.5	0.61
	0.45	138.1	138.6	139.2	138.6	0.55
NPES-40	0.25	601.1	615.1	619.1	611.8	9.45
	0.35	208.4	213.8	213.0	211.7	2.91
	0.45	213.8	211.5	214.8	213.4	1.69
FAES-4	0.25	145.7	145.7	146.6	146.0	0.52
	0.35	136.0	136.4	136.6	136.3	0.31
	0.45	134.3	131.9	134.2	133.5	1.36
	0.75	119.0	119.5	116.8	118.4	1.44
	1.05	118.2	115.5	117.4	117.0	1.39
FAES-12	0.35	151.3	148.6	150.0	150.0	1.35
FAES-30	0.35	231.0	227.2	227.7	228.6	2.06
FAES-40	0.35	724.8	699.4	706.8	710.3	13.06
anionic+nonionic[1]	0.35	152.6	152.8	154.6	153.3	1.10
anionic+nonionic[2]	0.35	187.3	187.7	187.5	187.5	0.20

[1] FAE-40 : FAES-4 1:2.50 w/w ratio

[2] FAE-40 : FAES-4 1:1.33 w/w ratio

Table C2: latex particle size and mole ratio monomer /surfactant (x 10^3)

Surfactant	Mole ratio monomer/ surfactant (x 10^3)	Particle size (nm)				
		1	2	3	Mean	SD.
NPES-4	0.92	149.0	148.8	148.8	148.9	0.12
	0.65	133.4	132.4	134.1	133.3	0.85
	0.51	137.4	138.1	137.5	137.7	0.38
	0.31	123.4	121.8	125.7	123.6	1.96
	0.22	116.4	116.3	115.5	116.1	0.49
NPES-10	1.39	157.5	157.7	158.5	157.9	0.53
	0.99	135.0	134.6	133.8	134.5	0.61
	0.78	138.1	138.6	139.2	138.6	0.55
FAES-4	0.85	145.7	145.7	146.6	146.0	0.52
	0.61	136.0	136.4	136.6	136.3	0.31
	0.47	134.3	131.9	134.2	133.5	1.36
	0.28	119.0	119.5	116.8	118.4	1.44
	0.20	118.2	115.5	117.4	117.0	1.39

Figure C1: Particle size distribution of latex which used 0.25% NPES-4 as surfactant

	Particle size (nm)
1st	149.0
2nd	148.8
3rd	148.8
Mean	148.9

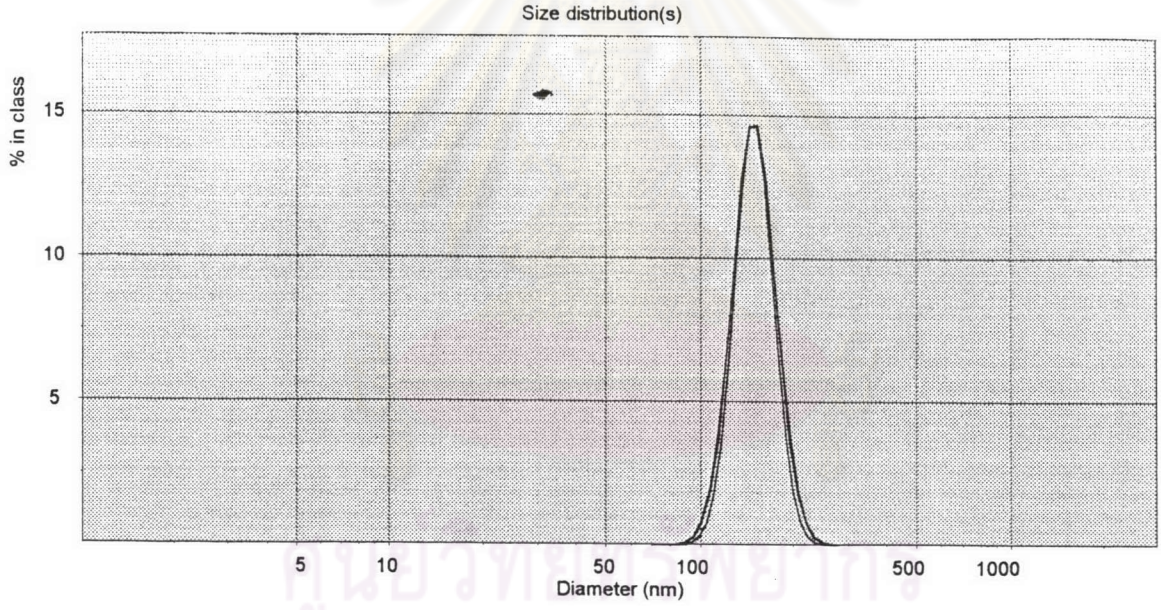


Figure C2: Particle size distribution of latex which used 0.35% NPES-4 as surfactant

	Particle size (nm)
1st	133.4
2nd	132.4
3rd	134.1
Mean	133.3

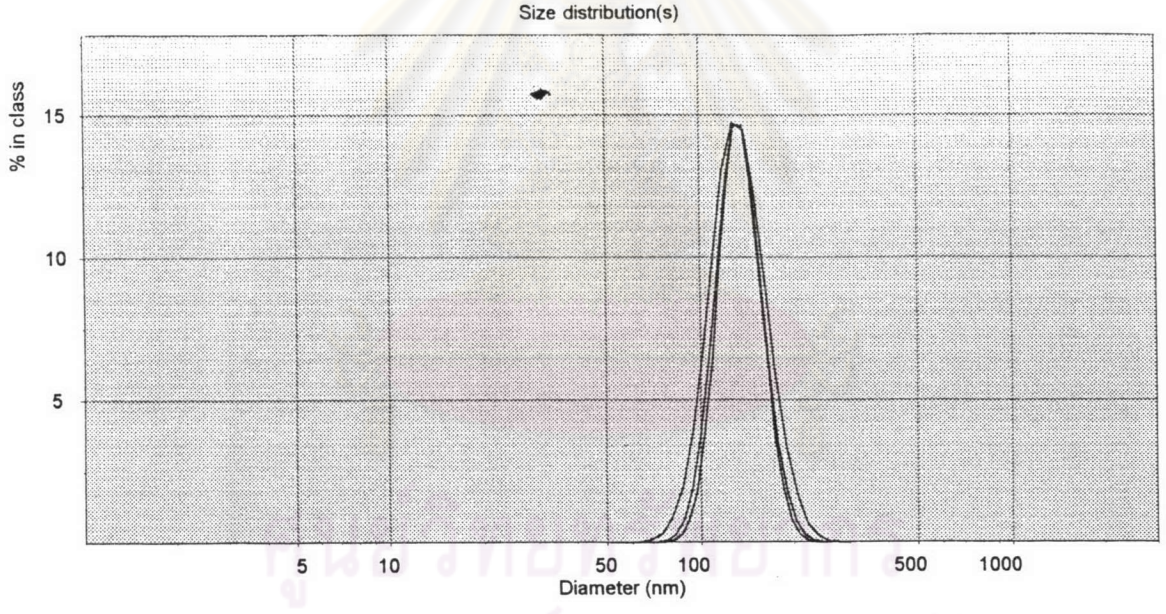


Figure C3: Particle size distribution of latex which used 0.45% NPES-4 as surfactant

	Particle size (nm)
1st	137.4
2nd	138.1
3rd	137.5
Mean	137.7

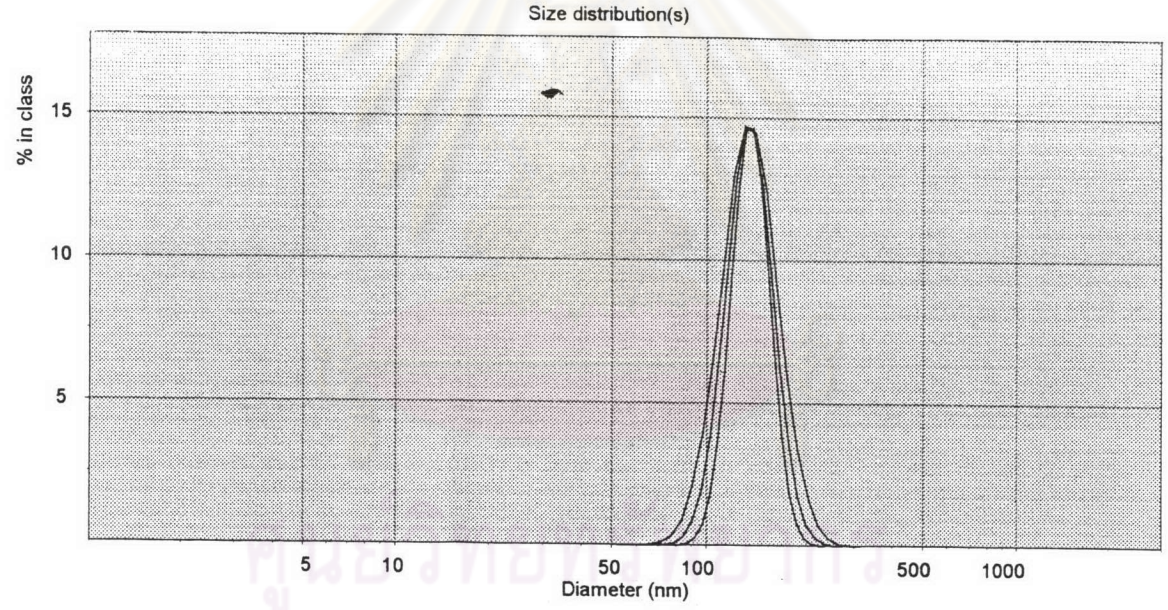


Figure C4: Particle size distribution of latex which used 0.75% NPES-4 as surfactant

	Particle size (nm)
1st	123.4
2nd	121.8
3rd	125.7
Mean	123.6

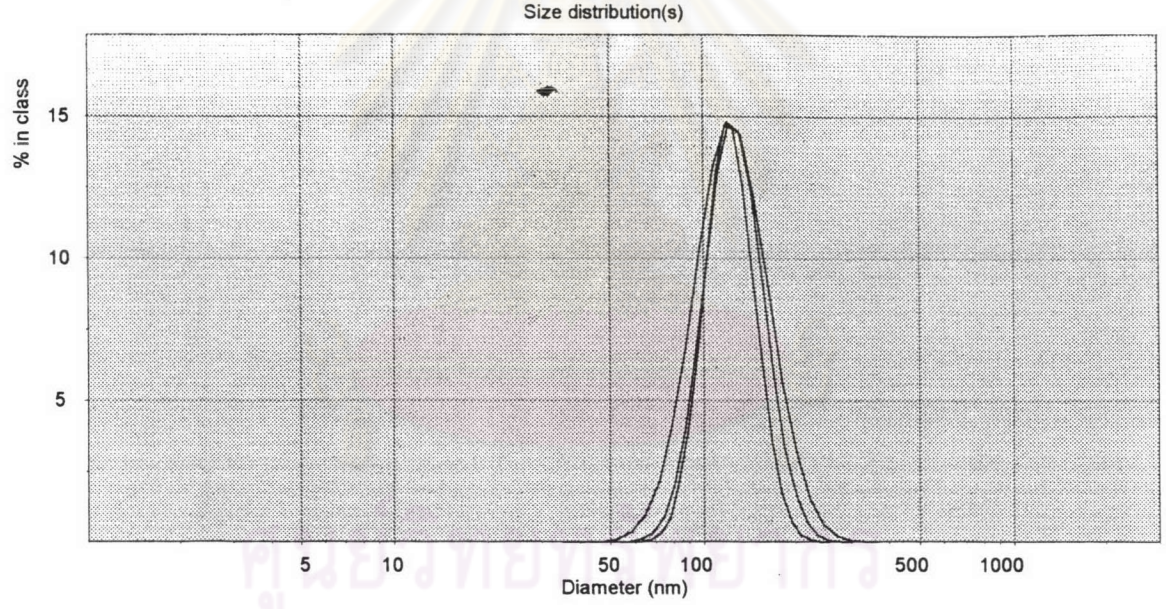


Figure C5: Particle size distribution of latex which used 1.05% NPES-4 as surfactant

	Particle size (nm)
1st	116.4
2nd	116.3
3rd	115.5
Mean	116.1

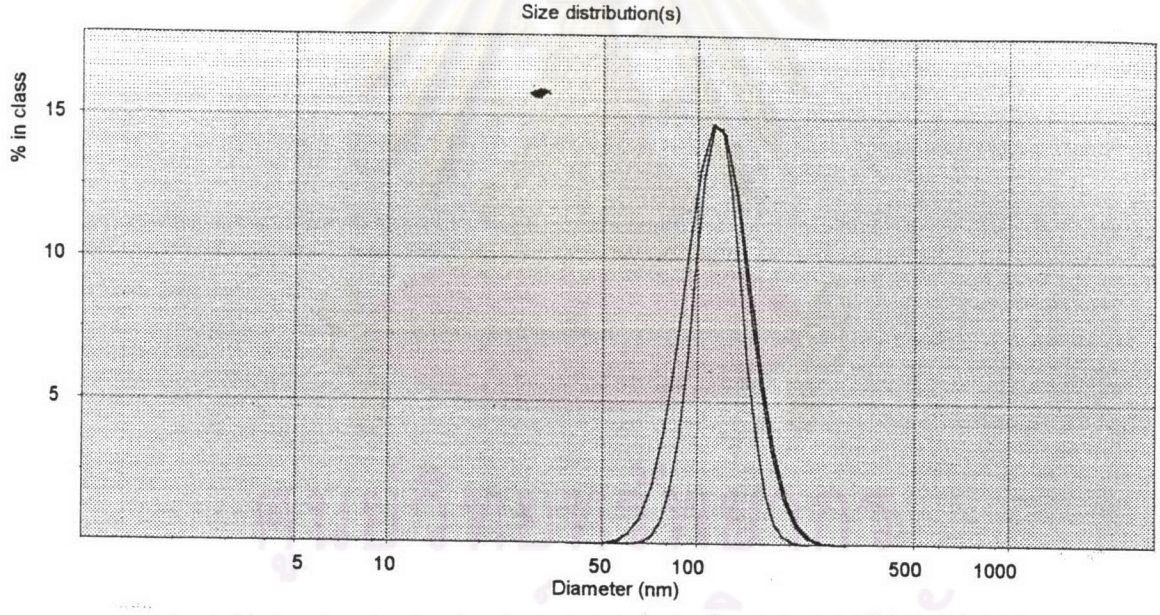


Figure C6: Particle size distribution of latex which used 0.25% NPES-10 as surfactant

	Particle size (nm)
1st	157.5
2nd	157.7
3rd	158.5
Mean	157.9

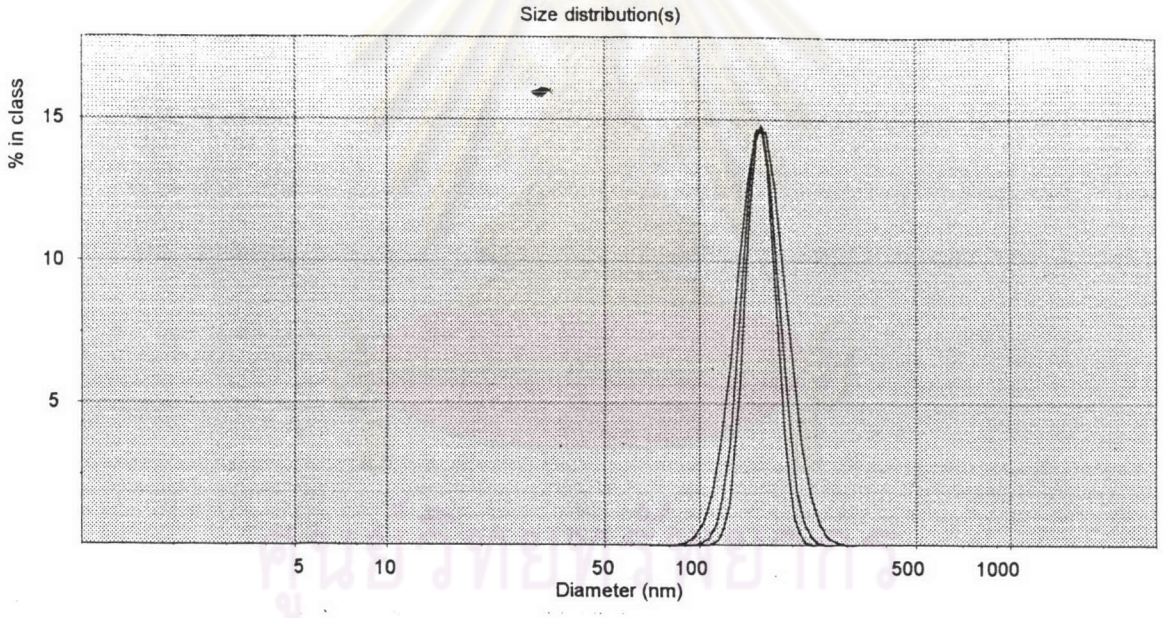


Figure C7: Particle size distribution of latex which used 0.35% NPES-10 as surfactant

	Particle size (nm)
1st	135.0
2nd	134.6
3rd	133.8
Mean	134.5

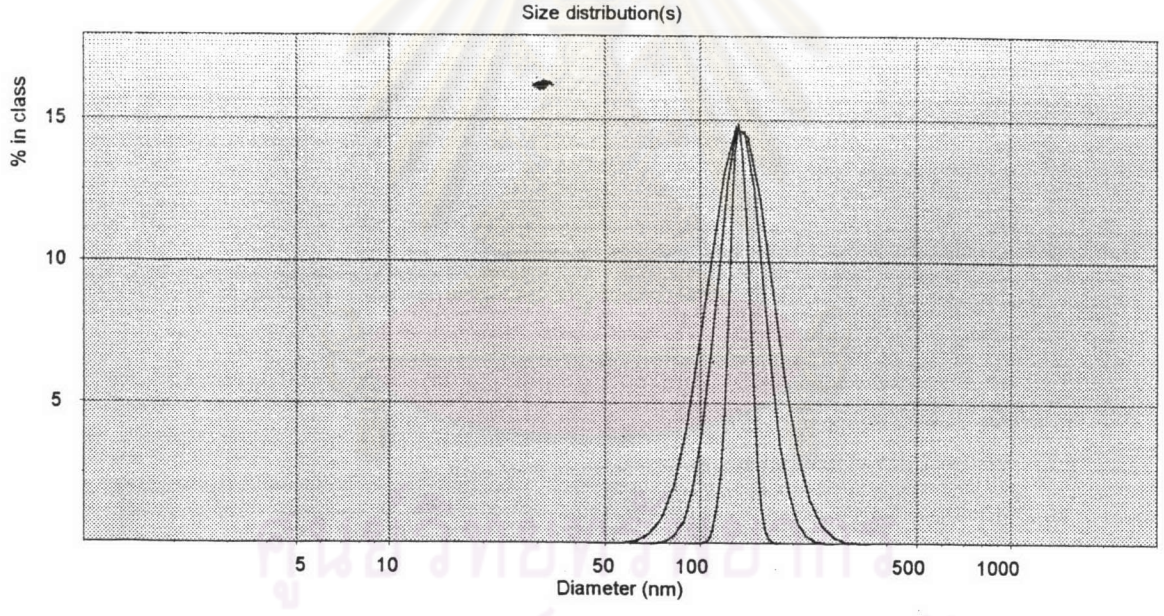


Figure C8: Particle size distribution of latex which used 0.45% NPES-10 as surfactant

	Particle size (nm)
1st	138.1
2nd	138.6
3rd	139.2
Mean	138.6

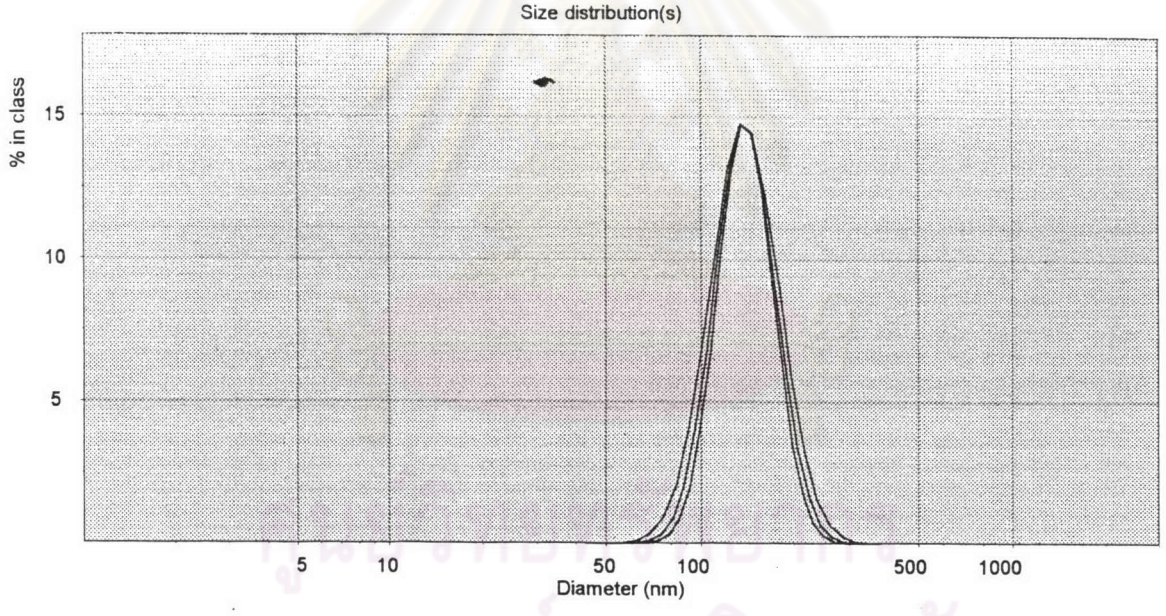


Figure C9: Particle size distribution of latex which used 0.25% NPES-40 as surfactant

	Particle size (nm)
1st	601.1
2nd	615.1
3rd	619.1
Mean	611.8

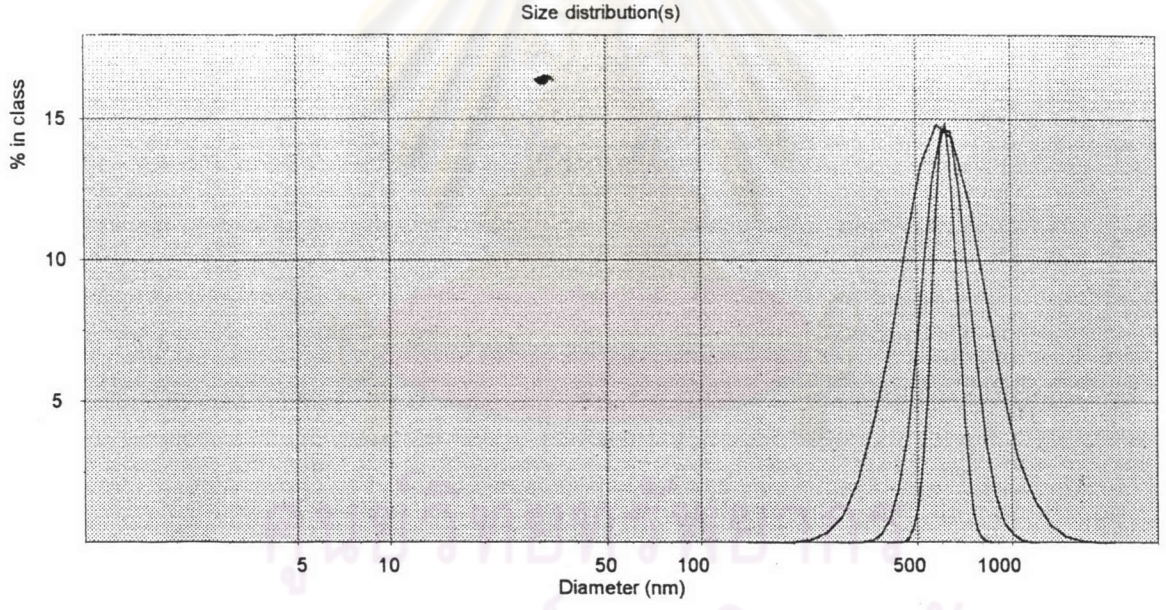


Figure C10: Particle size distribution of latex which used 0.35% NPES-40 as surfactant

	Particle size (nm)
1st	208.4
2nd	213.8
3rd	213.0
Mean	211.7

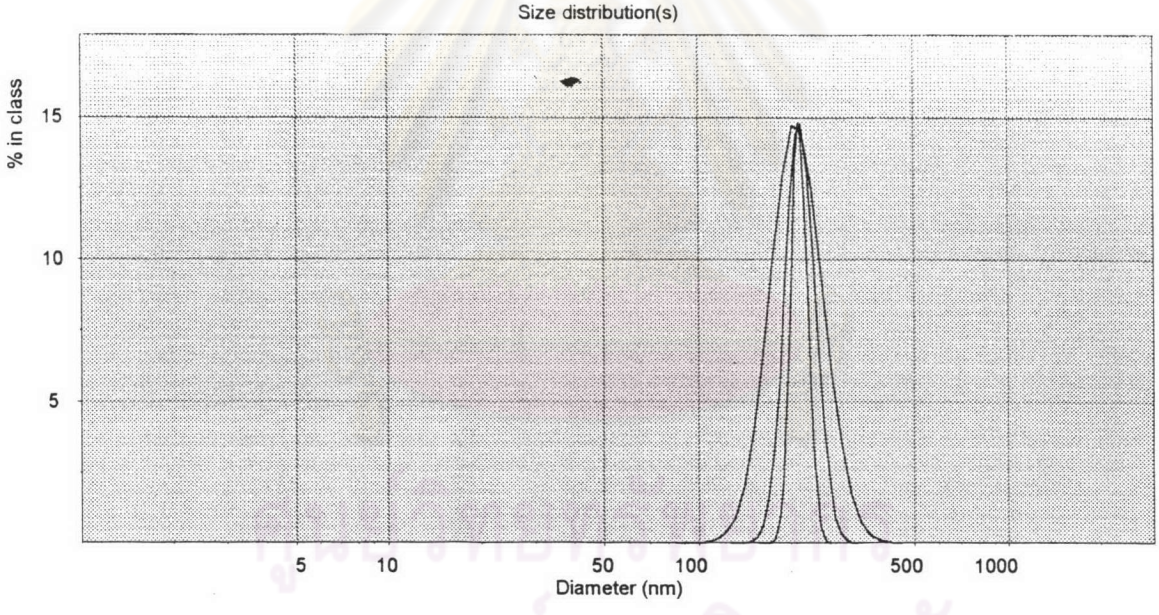


Figure C11: Particle size distribution of latex which used 0.45% NPES-40 as surfactant

	Particle size (nm)
1st	213.8
2nd	211.5
3rd	214.8
Mean	213.4

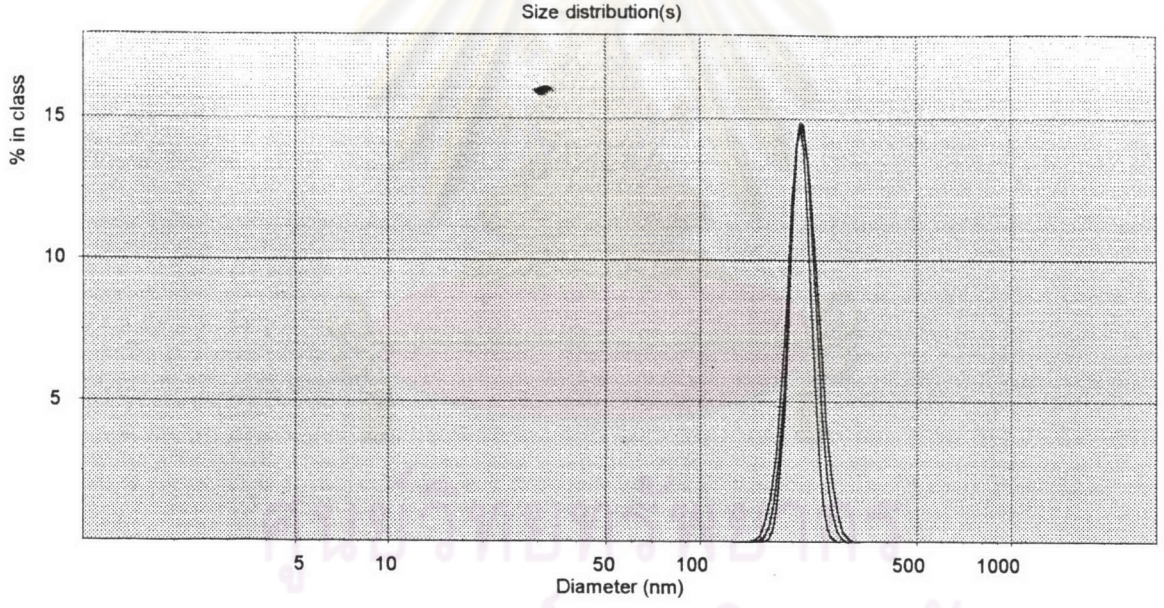


Figure C12: Particle size distribution of latex which used 0.25% FAES-4 as surfactant

	Particle size (nm)
1st	145.7
2nd	145.7
3rd	146.6
Mean	146.0

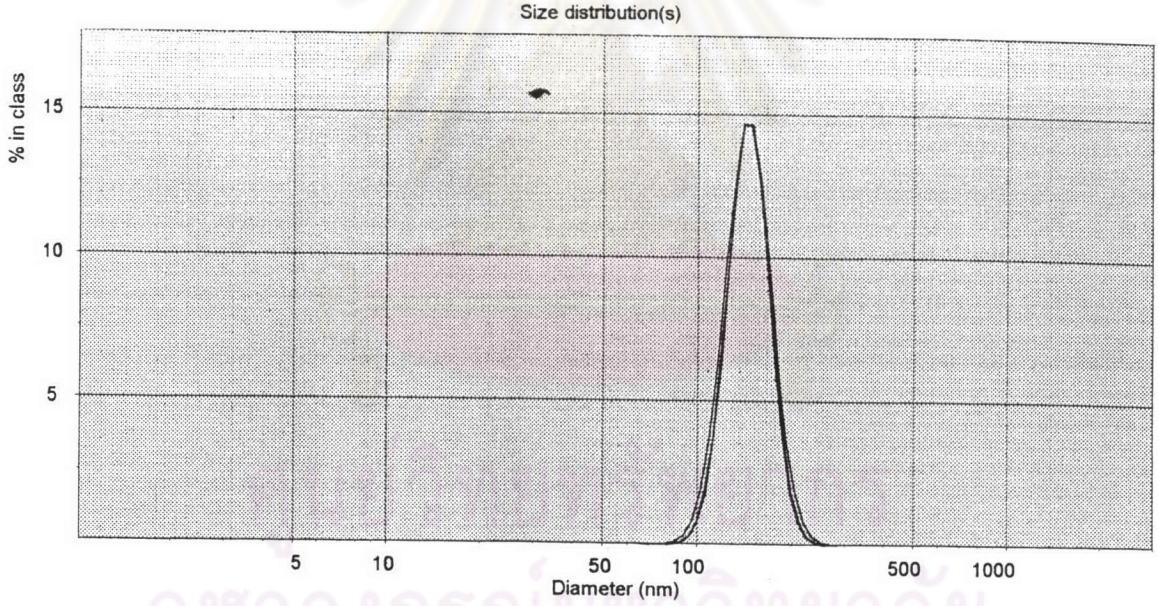


Figure C13: Particle size distribution of latex which used 0.35% FAES-4 as surfactant

	Particle size (nm)
1st	136.0
2nd	136.4
3rd	136.6
Mean	136.3

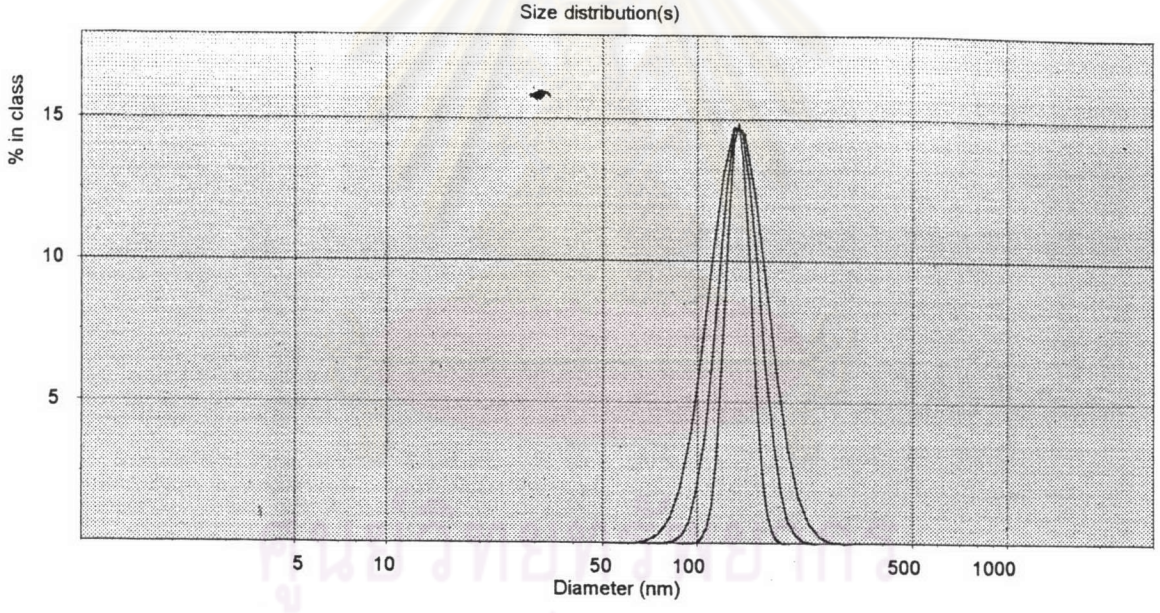


Figure C14: Particle size distribution of latex which used 0.45% FAES-4 as surfactant

	Particle size (nm)
1st	134.3
2nd	131.9
3rd	134.2
Mean	133.5

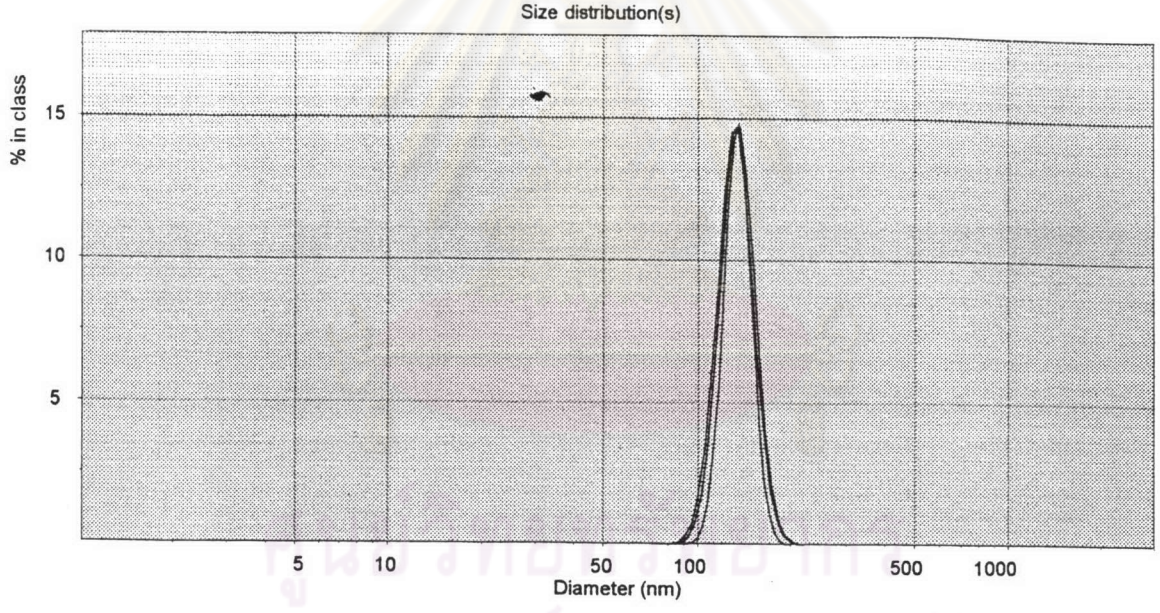


Figure C15: Particle size distribution of latex which used 0.75% FAES-4 as surfactant

	Particle size (nm)
1st	119.0
2nd	119.5
3rd	116.8
Mean	118.4

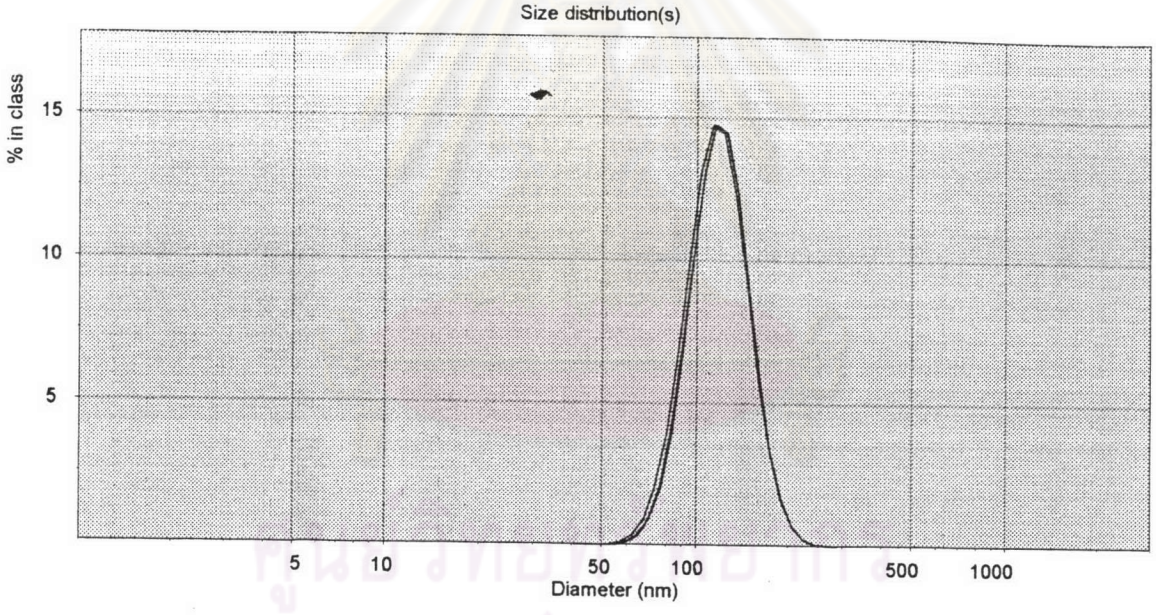


Figure C16: Particle size distribution of latex which used 1.05% FAES-4 as surfactant

	Particle size (nm)
1st	118.2
2nd	115.5
3rd	117.4
Mean	117.0

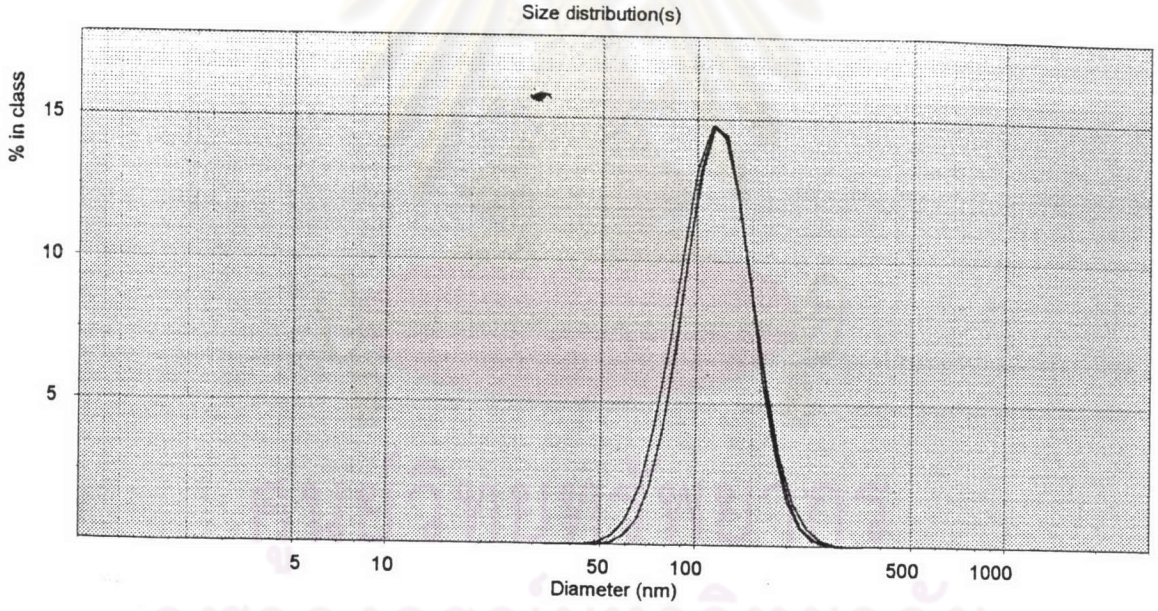


Figure C17: Particle size distribution of latex which used 0.35% FAES-12 as surfactant

	Particle size (nm)
1st	151.3
2nd	148.6
3rd	150.0
Mean	150.0

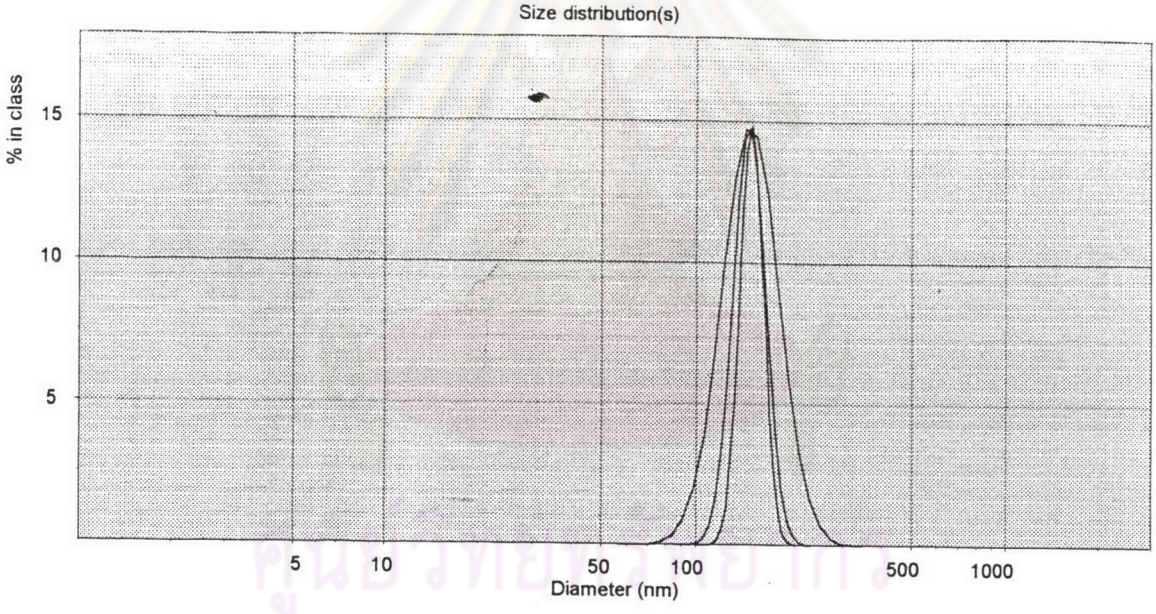


Figure C18: Particle size distribution of latex which used 0.35% FAES-30 as surfactant

	Particle size (nm)
1st	231.0
2nd	227.2
3rd	227.7
Mean	228.6

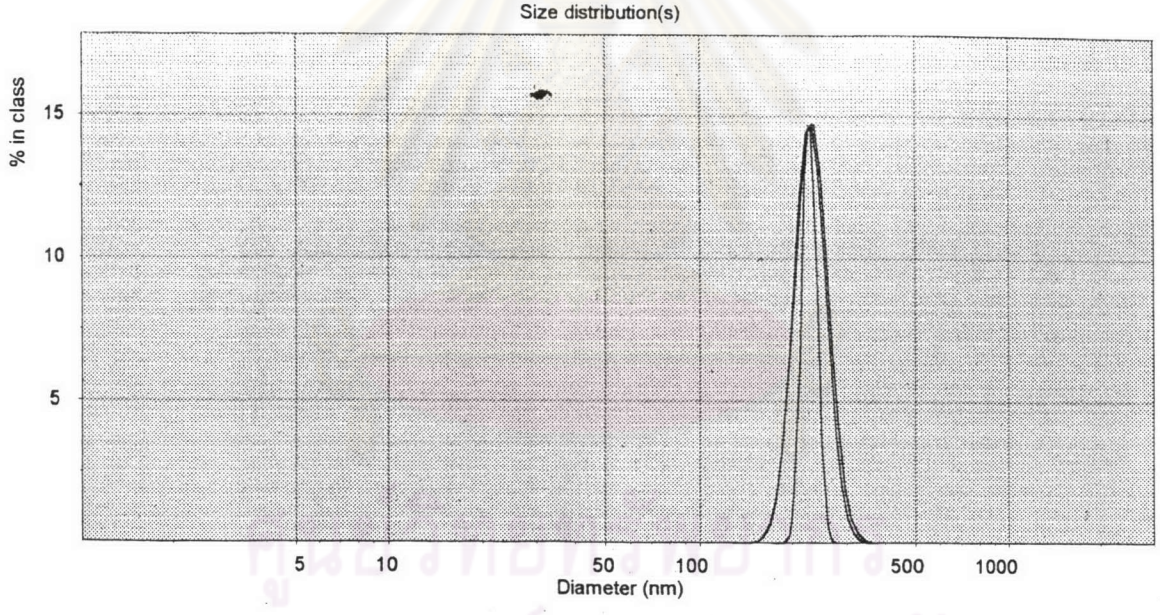


Figure C19: Particle size distribution of latex which used 0.35% FAES-40 as surfactant

	Particle size (nm)
1st	724.8
2nd	699.4
3rd	706.8
Mean	710.3

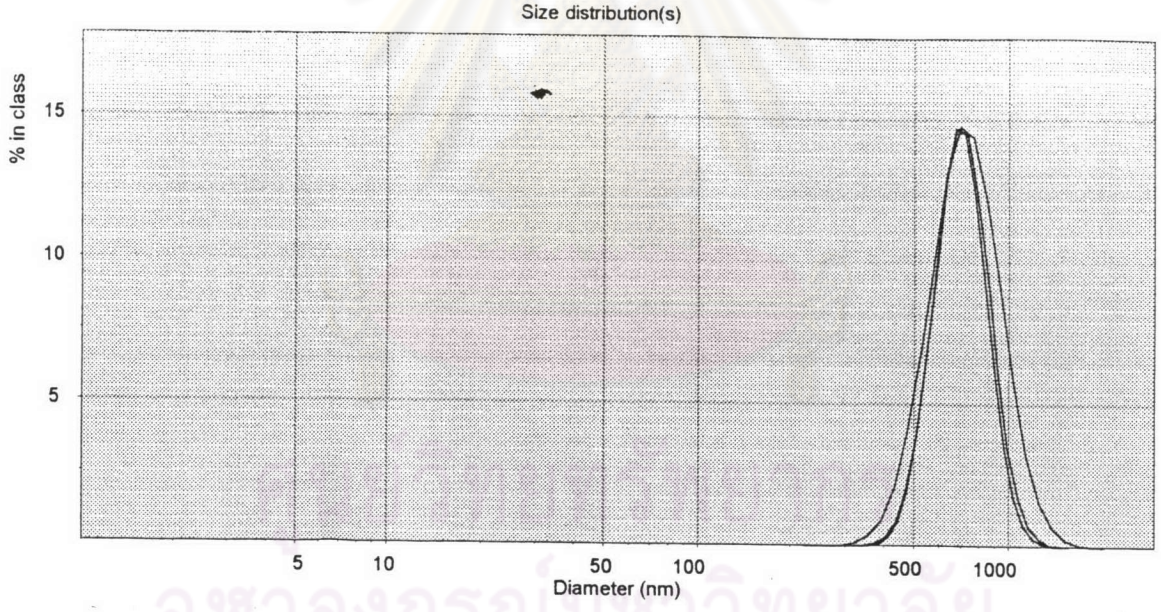


Figure C20: Particle size distribution of latex which used 0.35% of FAE-40 : FAES-4 1:2.50 ratio as surfactant.

	Particle size (nm)
1st	152.6
2nd	152.8
3rd	154.6
Mean	153.3

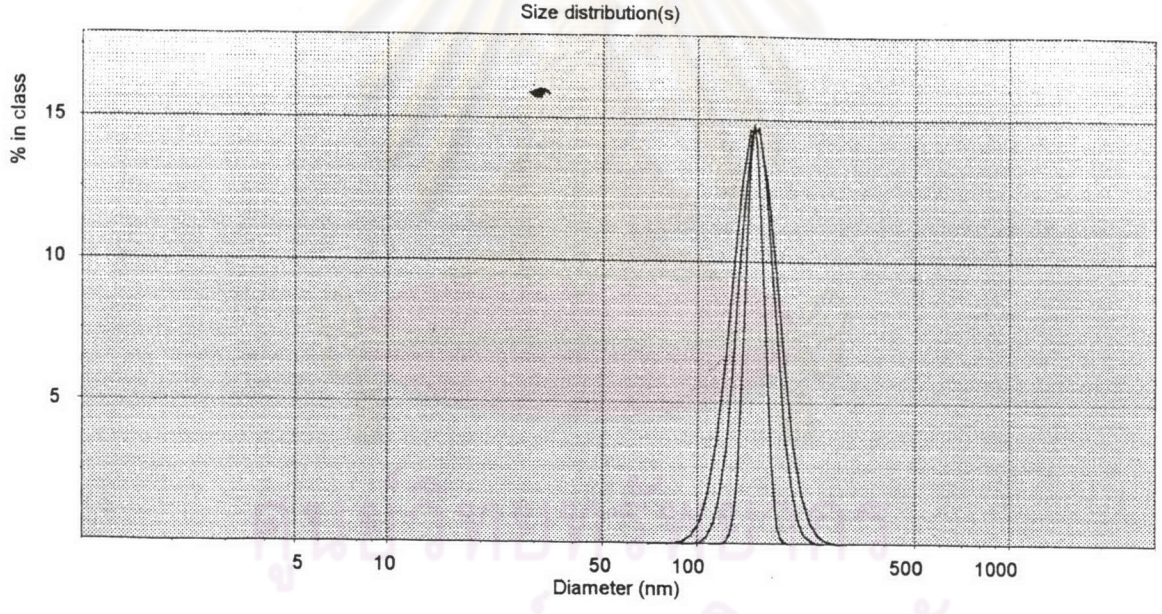
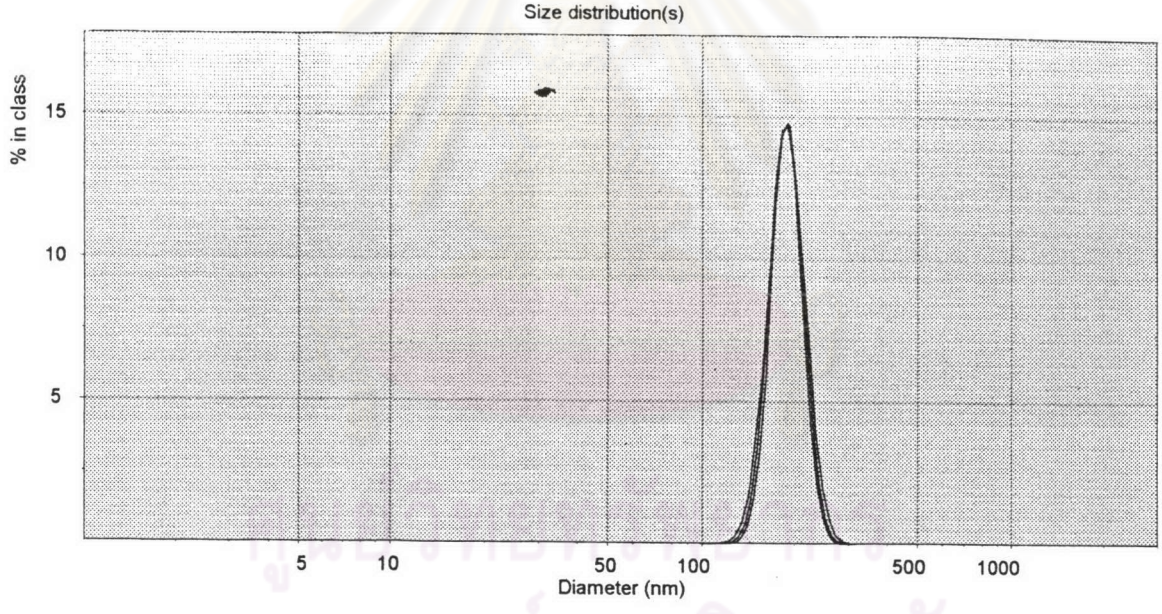


Figure C21: Particle size distribution of latex which used 0.35% of FAE-40 : FAES-4 1:1.33 w/w ratio as surfactant.

	Particle size (nm)
1st	187.3
2nd	187.7
3rd	187.5
Mean	187.5



Appendix D : Molecular weight

Table D1 : Molecular weight of the latices

Surfactant	%active ingredient of surfactant (w/w)	Molecular weight					PDI
		Mn	Mw	MP	Mz	M_{Z+1}	
NPES-4	0.25	76319	370654	152950	1067764	1751527	4.86
NPES-4^{repeat}	0.25	102439	563277	234793	1452940	2144792	5.50
NPES-4	0.35	42501	196332	90970	525952	867309	4.62
NPES-4	0.45	53947	312469	136392	990490	1725583	5.79
NPES-4	0.75	79137	468288	275618	1313076	2052358	5.92
NPES-4	1.05	68216	400801	146652	1100137	1689785	5.88
NPES-4^{repeat}	1.05	45582	189616	83462	550336	966523	4.16
NPES-10	0.25	64567	437905	172858	1526143	2768582	6.78
NPES-10	0.35	66387	323949	156752	897020	1440561	4.88
NPES-10	0.45	62476	324714	148717	1005482	1830932	5.20
NPES-40	0.25	67134	309305	169131	812389	1386563	4.61
NPES-40	0.35	45470	244143	127366	664373	1120025	5.37
NPES-40	0.45	77877	406963	181352	1133632	1882160	5.23
FAES-4	0.25	44055	220599	134015	652053	1193113	5.01
FAES-4^{repeat}	0.25	30315	191160	127501	487552	768663	6.31
FAES-4	0.35	69957	339413	157282	978317	1676063	4.85
FAES-4	0.45	40300	202002	96143	611889	1184280	5.01
FAES-4	0.75	33845	165049	101514	458428	787298	4.88
FAES-4	1.05	28795	192755	98066	642498	1193438	6.69
FAES-4^{repeat}	1.05	37992	224295	104982	676449	1183553	5.90
FAES-12	0.35	91240	421458	208641	1159577	1898190	4.62
FAES-30	0.35	65900	504027	187140	1314294	1951122	7.65
FAES-40	0.35	99732	522774	244982	1373885	2131764	5.24
anionic+ nonionic[1]	0.35	40073	174737	93671	451910	740357	4.36
anionic+ nonionic[2]	0.35	70649	410469	195111	1105218	1771578	5.81

[1] FAE-40 : FAES-4 1:2.50 w/w ratio

[2] FAE-40 : FAES-4 1:1.33 w/w ratio

Figure D1: Molecular weight distribution of latex which used 0.25% NPES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
76319	370654	152950	1067764	1751527	4.86

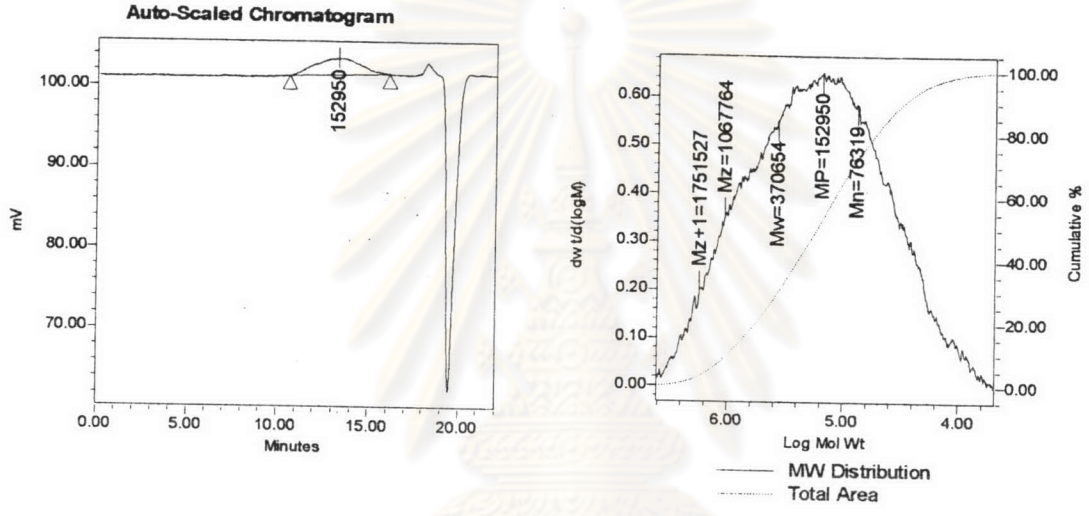


Figure D2: Molecular weight distribution of latex which used 0.35% NPES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
42501	196332	90970	525952	867309	4.62

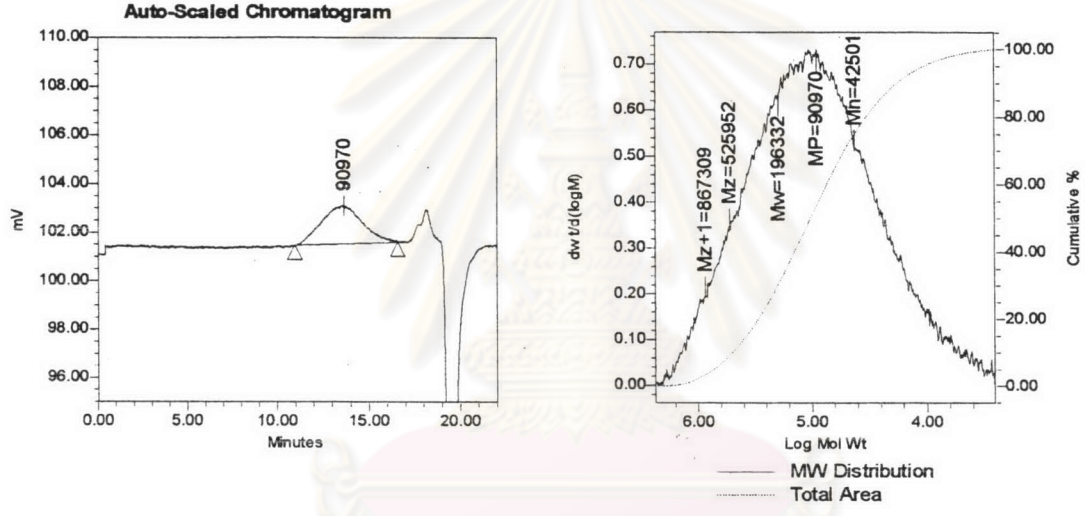


Figure D3: Molecular weight distribution of latex which used 0.45% NPES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
53947	312469	136392	990490	1725583	5.79

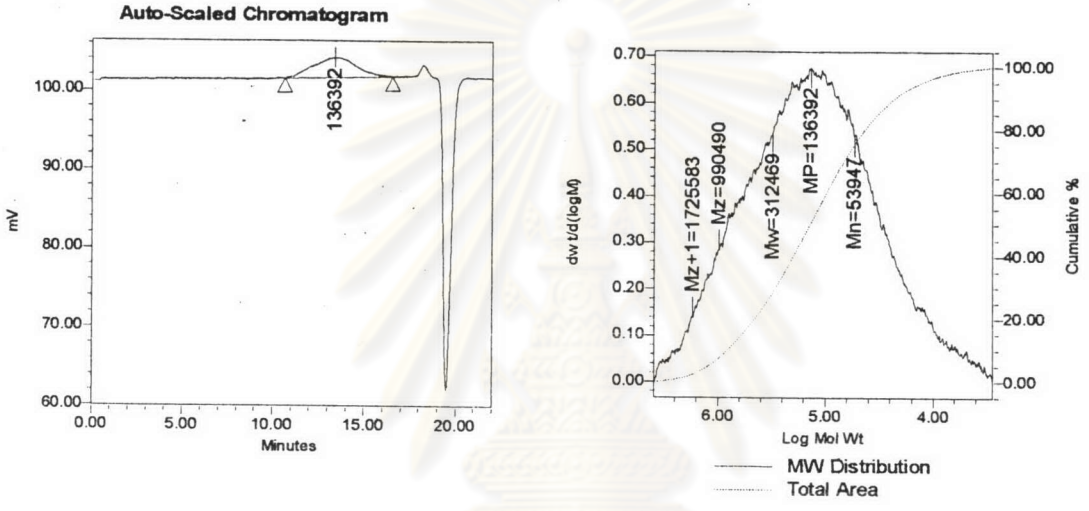


Figure D4: Molecular weight distribution of latex which used 0.75% NPES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
79137	468288	275618	1313076	2052358	5.92

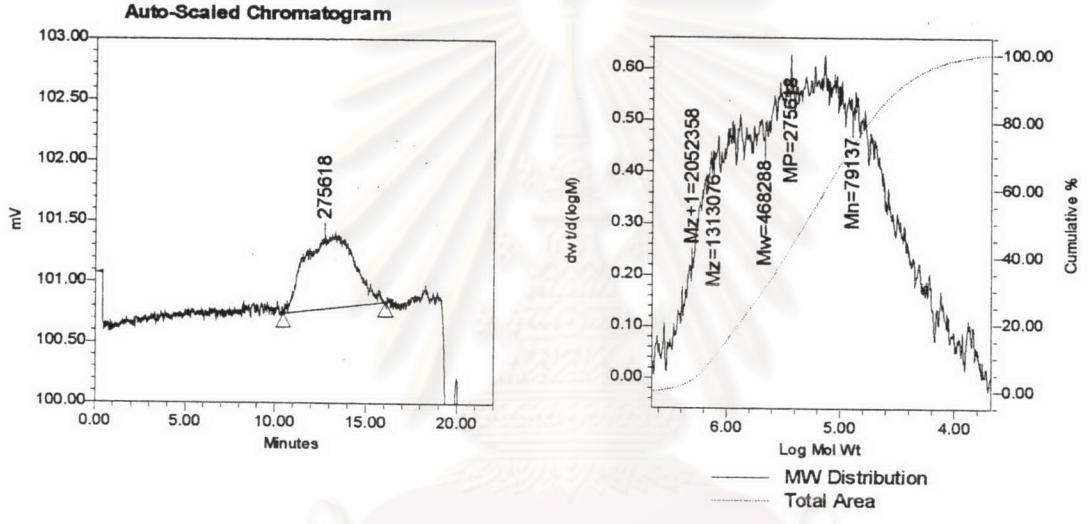


Figure D5: Molecular weight distribution of latex which used 1.05% NPES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
68216	400801	146652	1100137	1689785	5.88

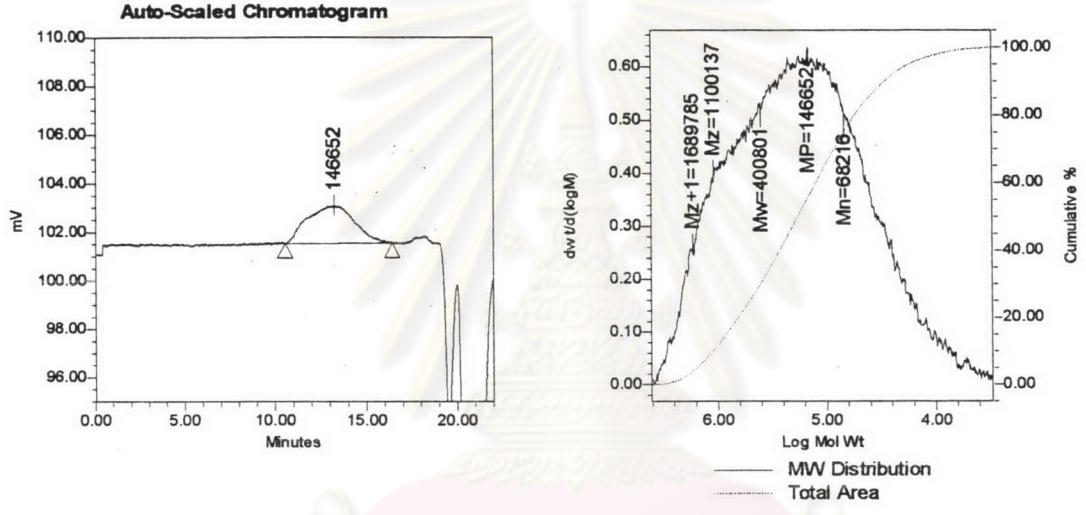


Figure D6: Molecular weight distribution of latex which used 0.25% NPES-10 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
64567	437905	172858	1526143	2768582	6.78

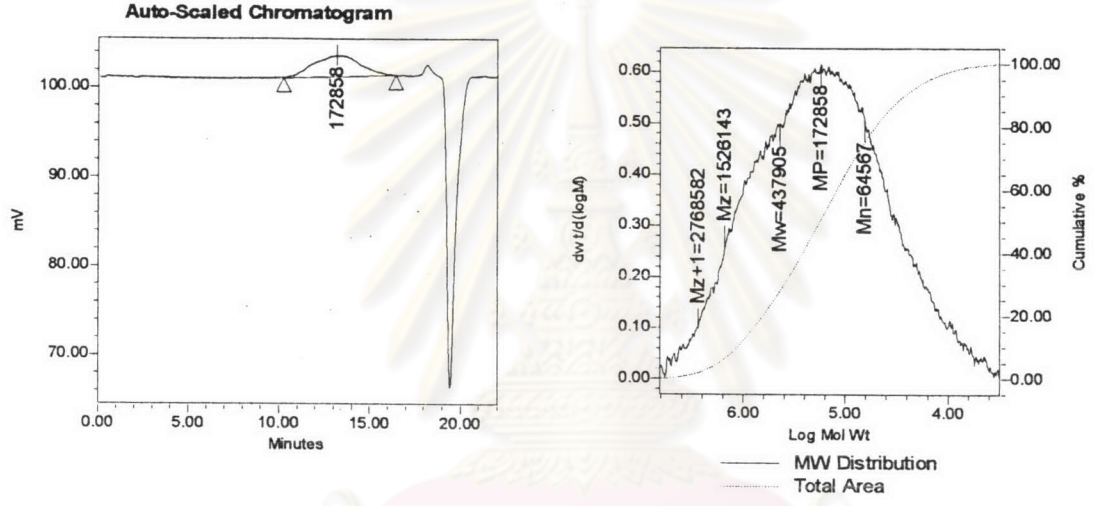


Figure D7: Molecular weight distribution of latex which used 0.35% NPES-10 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
66387	323949	156752	897020	1440561	4.88

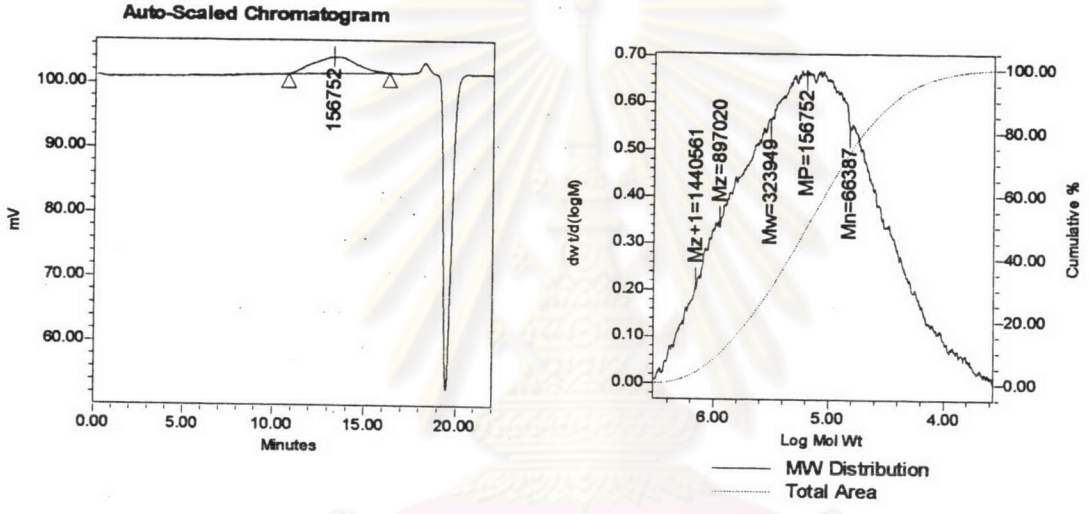


Figure D8: Molecular weight distribution of latex which used 0.45% NPES-10 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
62476	324714	148717	1005482	1830932	5.20

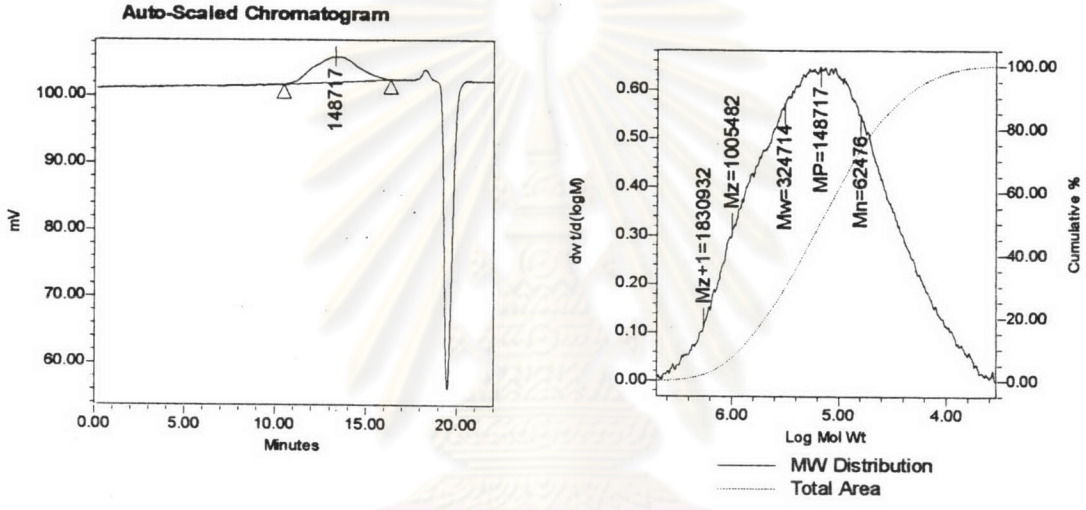


Figure D9: Molecular weight distribution of latex which used 0.25% NPES-40 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
67134	309305	169131	812389	1386563	4.61

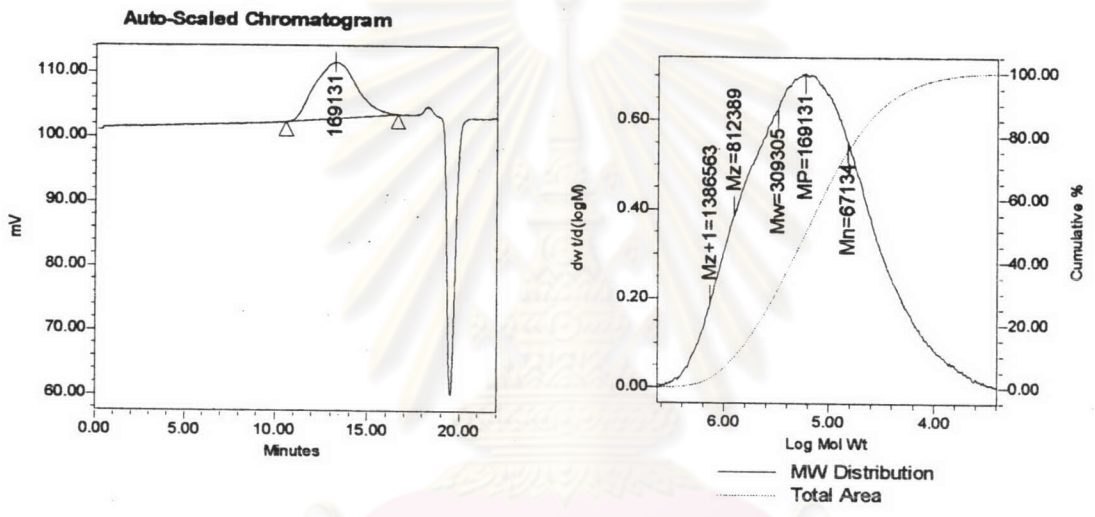


Figure D10: Molecular weight distribution of latex which used 0.35% NPES-40 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
45470	244143	127366	664373	1120025	5.37

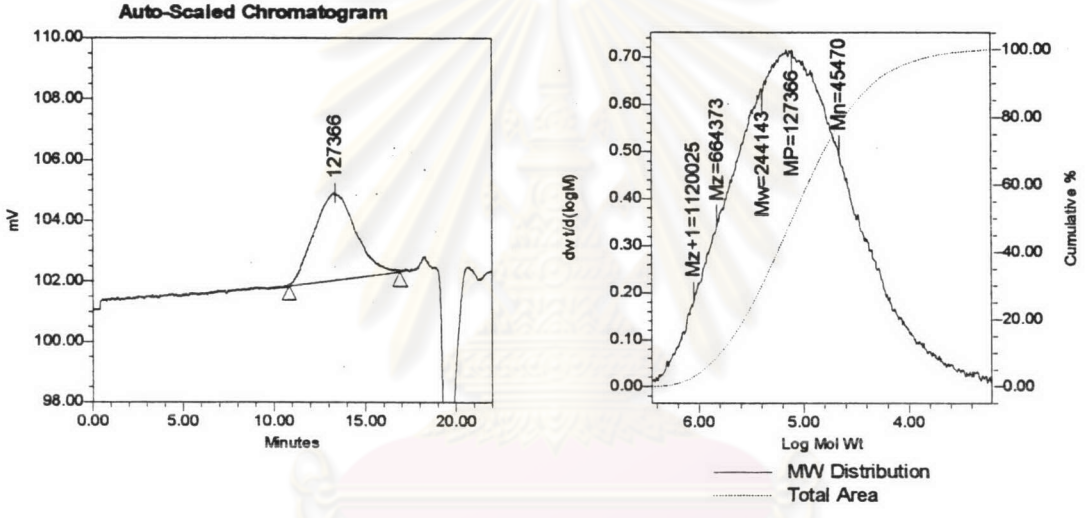


Figure D11: Molecular weight distribution of latex which used 0.45% NPES-40 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
77877	406963	181352	1133632	1882160	5.23

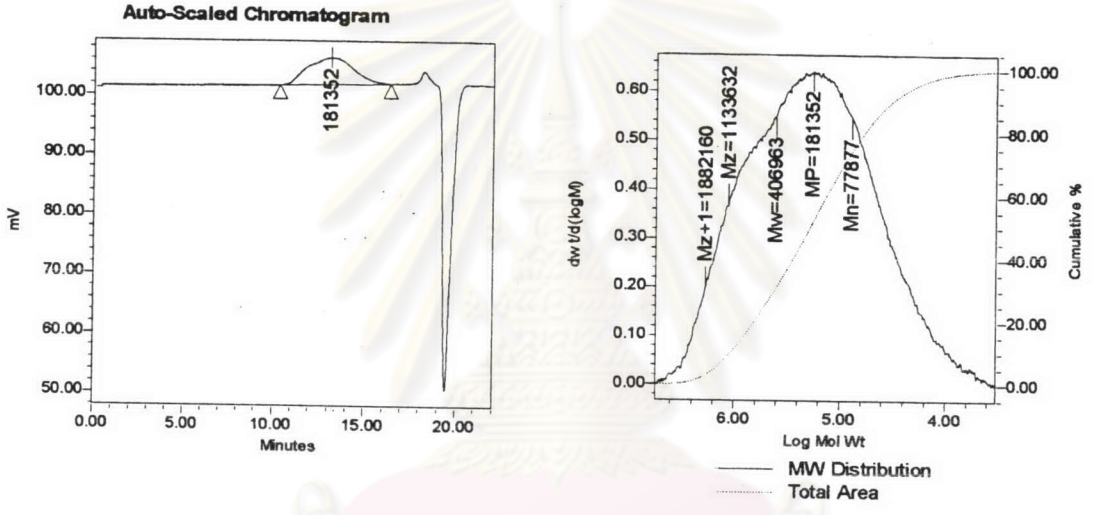


Figure D12: Molecular weight distribution of latex which used 0.25% FAES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
44055	220599	134015	652053	11933113	5.01

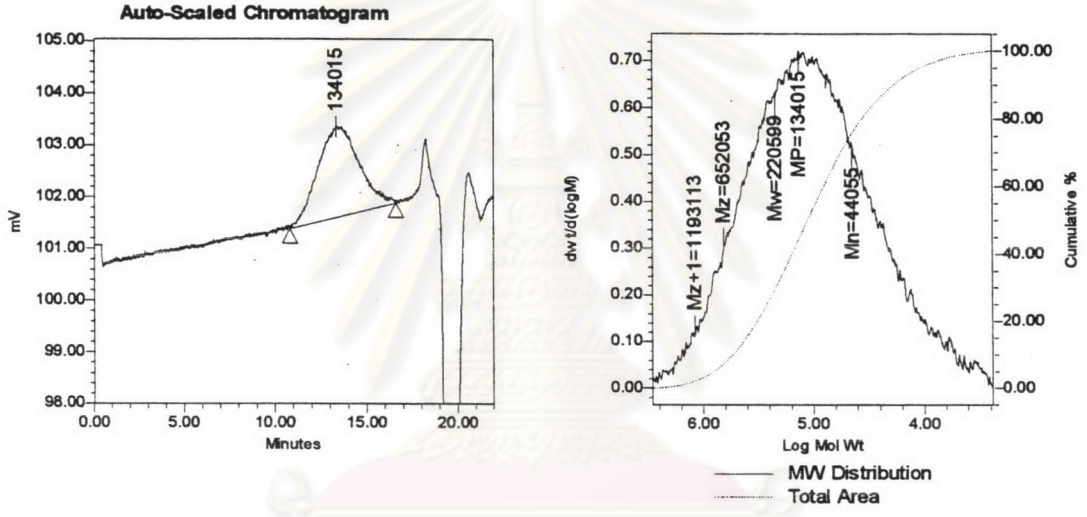


Figure D13: Molecular weight distribution of latex which used 0.35% FAES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
69957	339413	157282	978317	1676063	4.85

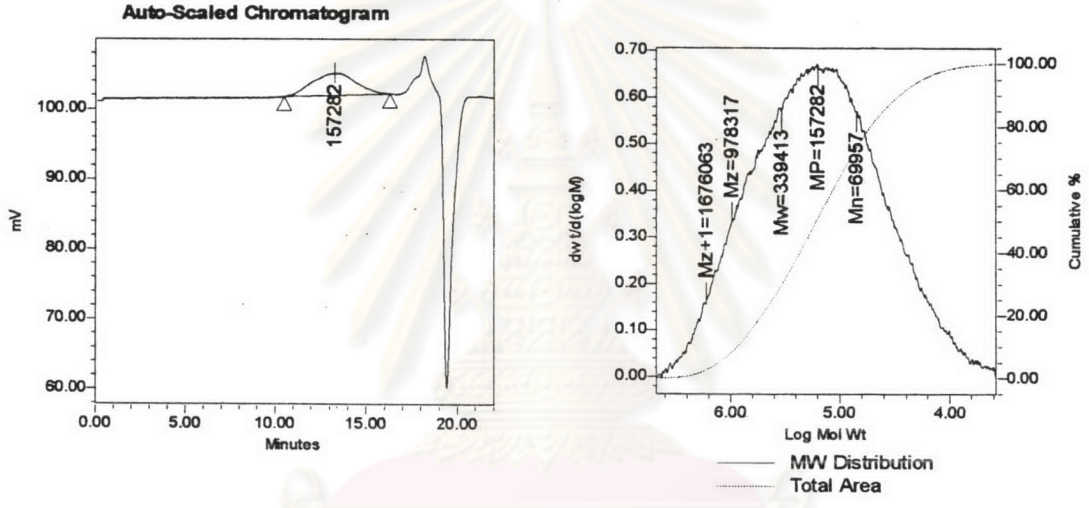


Figure D14: Molecular weight distribution of latex which used 0.45% FAES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
40300	202002	96143	611889	1184280	5.01

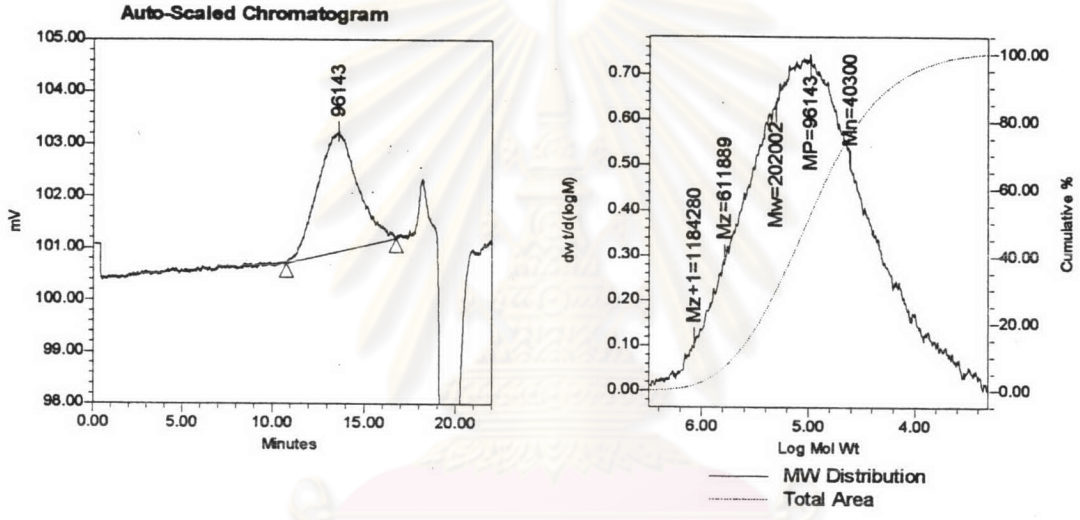


Figure D15: Molecular weight distribution of latex which used 0.75% FAES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
33845	165049	101514	458428	787298	4.88

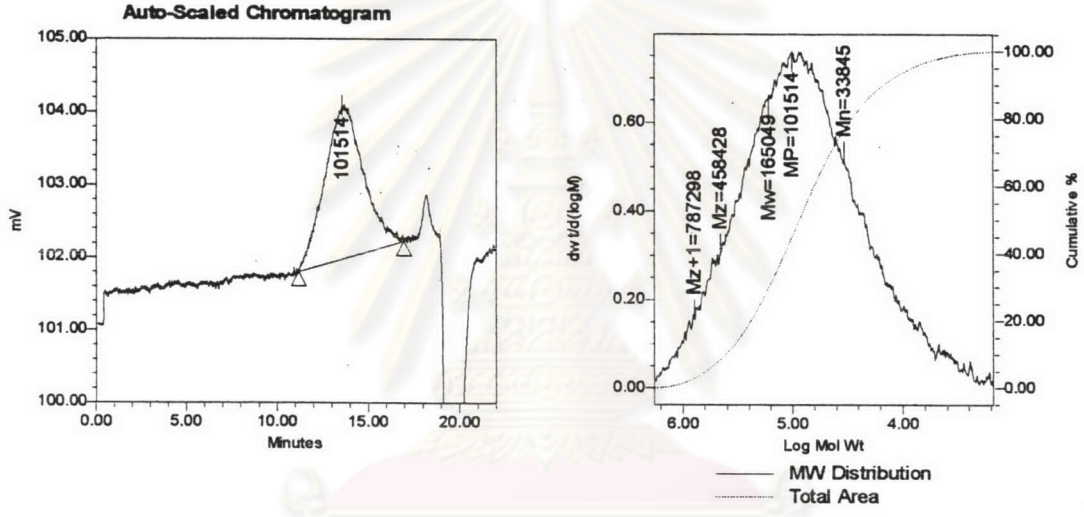


Figure D16: Molecular weight distribution of latex which used 1.05% FAES-4 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
28795	192755	98066	642498	1193438	6.69

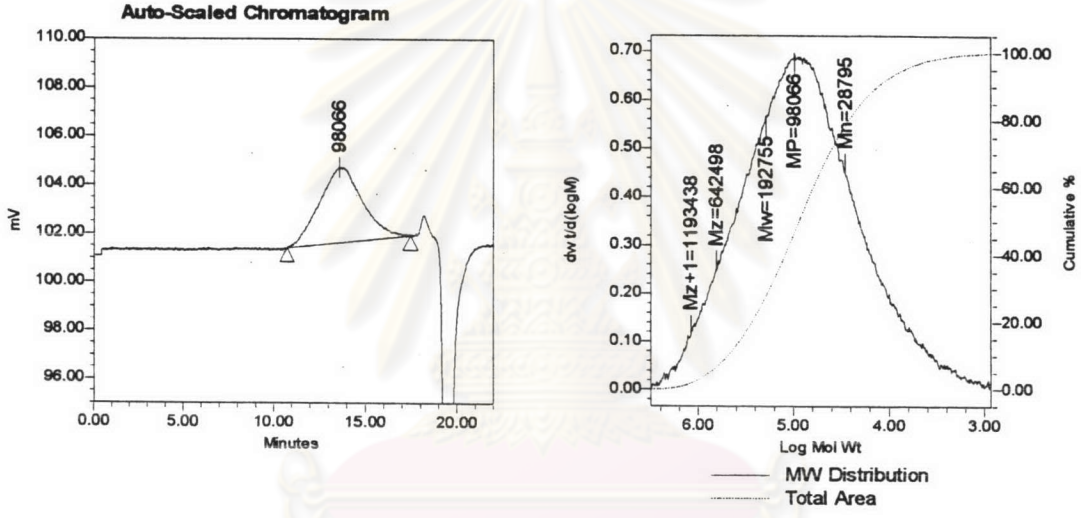


Figure D17: Molecular weight distribution of latex which used 0.35% FAES-12 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
91240	421458	208641	1159577	1898190	4.62

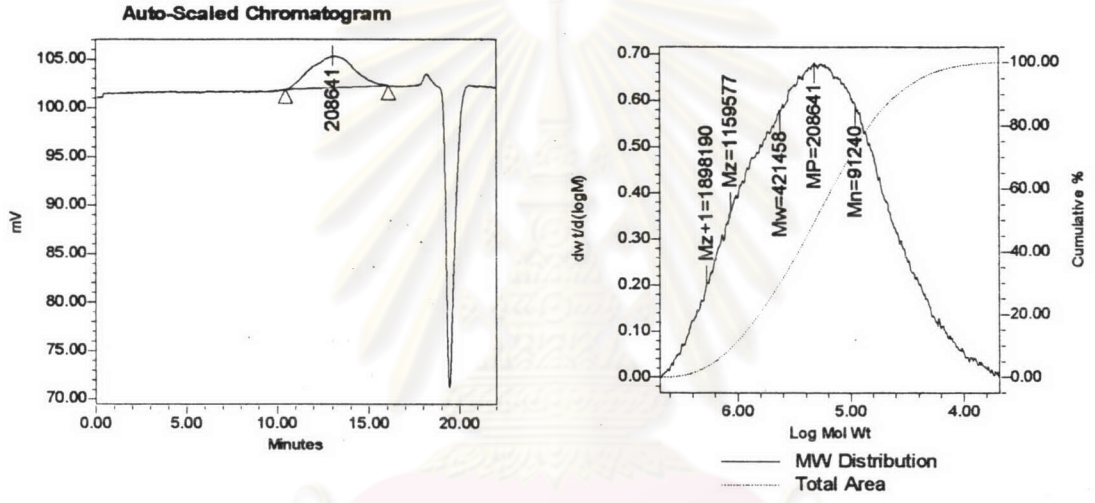


Figure D18: Molecular weight distribution of latex which used 0.35% FAES-30 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
65900	504027	187140	1314294	1951122	7.65

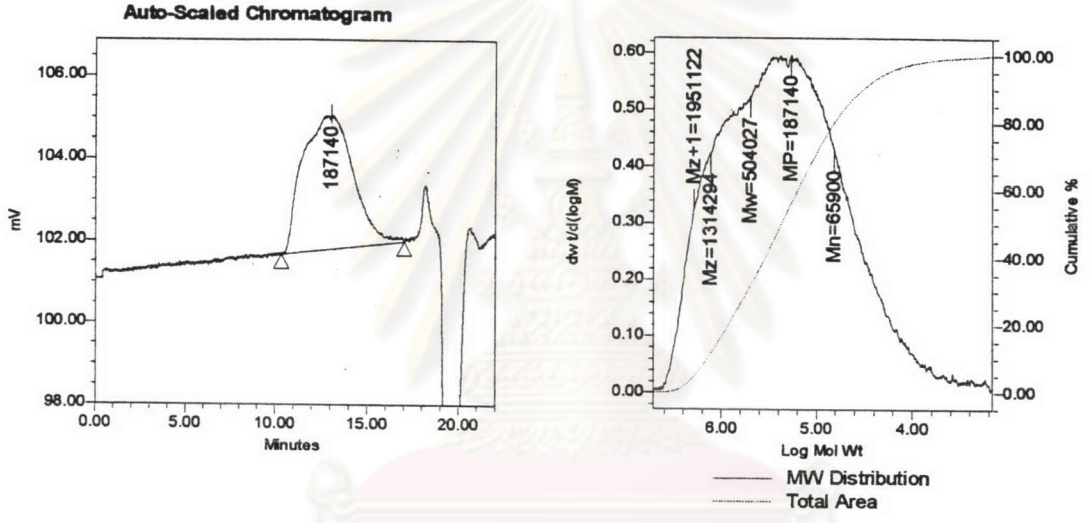


Figure D19: Molecular weight distribution of latex which used 0.35% FAES-40 as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
99732	522774	244982	1373885	2131764	5.24

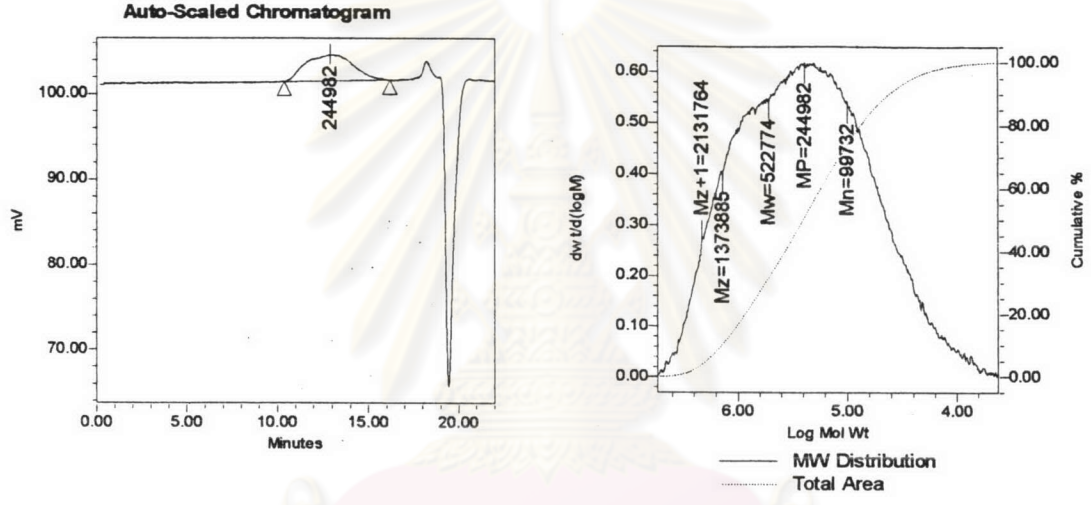


Figure D20: Molecular weight distribution of latex which used 0.35% FAE-40 : FAES-4 1 : 2.5 by weight as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
40073	174737	93671	451910	740357	4.36

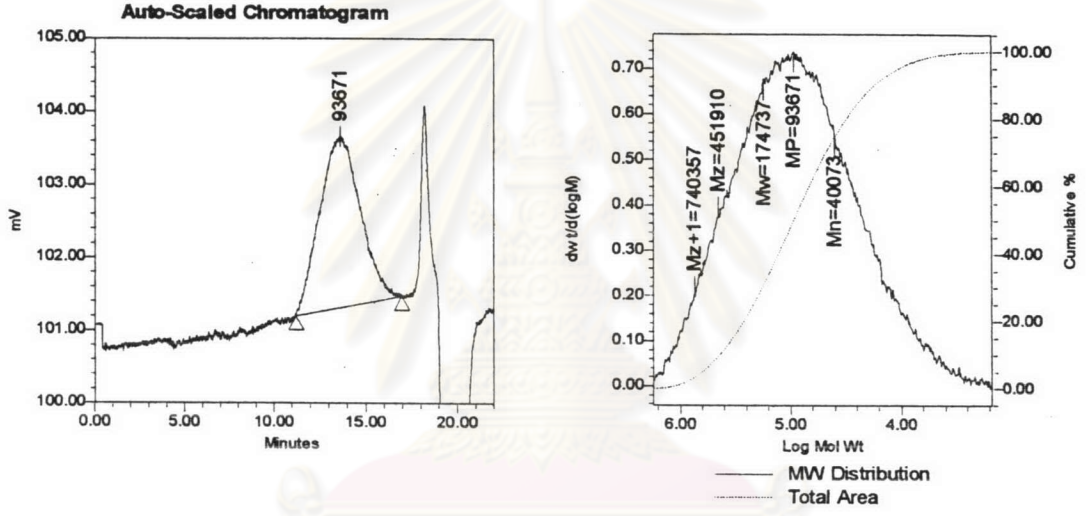
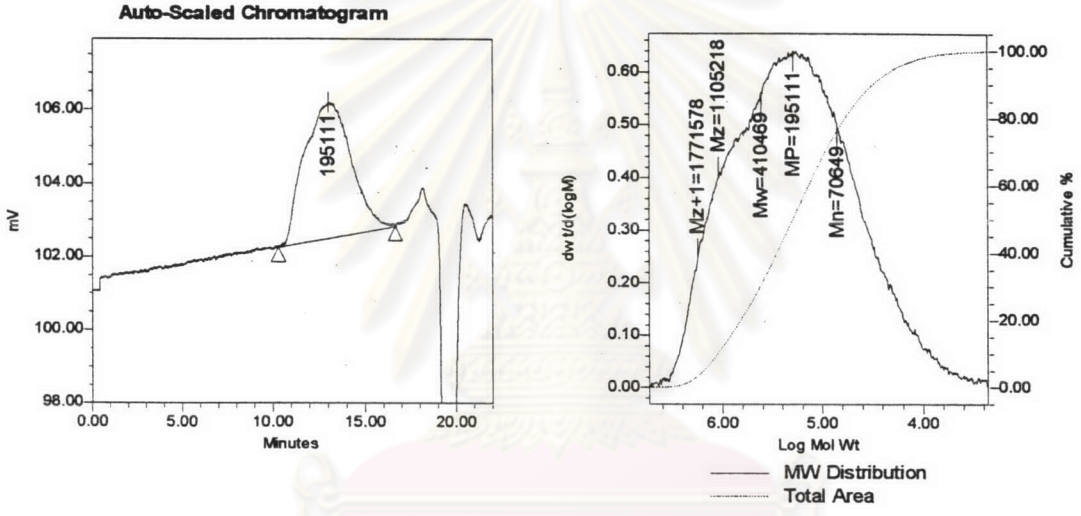


Figure D21: Molecular weight distribution of latex which used 0.35% FAE-40 : FAES-4 1 : 1.33 by weight as surfactant

Mn	Mw	MP	Mz	M_{Z+1}	PDI
70649	410469	195111	1105218	1771578	5.81



Appendix E: Minimum film forming temperature (MFFT)

Table E1: Minimum film forming temperature of the latex.

Surfactant	% AI (w/w)	MFFT (^{0}C)				
		1	2	3	Mean	SD.
NPEO-4	0.25	24.7	24.9	25.5	25.0	0.42
	0.35	26.4	25.1	25.9	25.8	0.66
	0.45	24.3	24.6	24.8	24.6	0.25
	0.75	24.1	24.7	24.4	24.4	0.30
	1.05	24.0	24.7	23.8	24.2	0.47
NPEO-10	0.25	25.8	25.8	25.9	25.8	0.06
	0.35	26.0	25.5	25.8	25.8	0.25
	0.45	25.3	25.8	25.8	25.6	0.29
NPEO-40	0.25	26.5	27.0	26.1	26.5	0.45
	0.35	26.9	26.7	27.1	26.9	0.20
	0.45	26.7	27.0	26.5	26.7	0.25
FAEO-4	0.25	26.4	26.1	25.8	26.1	0.30
	0.35	27.5	26.5	26.8	26.9	0.51
	0.45	27.0	26.7	26.7	26.8	0.17
	0.75	26.5	26.0	26.4	26.3	0.26
	1.05	26.4	25.5	26.0	26.0	0.45
FAEO-12	0.35	26.4	25.5	26.6	26.2	0.59
FAEO-30	0.35	26.7	27.1	27.1	27.0	0.23
FAEO-40	0.35	26.3	27.7	26.9	27.0	0.70
anionic+nonionic[1]	0.35	25.8	26.9	26.4	26.4	0.55
anionic+nonionic[2]	0.35	26.7	26.0	25.7	26.1	0.51

[1] FAE-40 : FAES-4 1:2.50 w/w ratio

[2] FAE-40 : FAES-4 1:1.33 w/w ratio

Appendix F: Gloss value of the dry film

Table F1: Gloss value of the dry film

Surfactant	% AI (w/w)	Gloss of dry film
NPEO-4	0.25	110.0
	0.35	112.8
	0.45	115.0
	0.75	110.4
	1.05	114.3
NPEO-10	0.25	111.1
	0.35	116.4
	0.45	113.2
NPEO-40	0.25	88.8
	0.35	90.7
	0.45	91.9
FAEO-4	0.25	114.6
	0.35	110.4
	0.45	116.6
	0.75	115.1
	1.05	109.4
FAEO-12	0.35	109.1
FAEO-30	0.35	111.8
FAEO-40	0.35	86.6
anionic+nonionic[1]	0.35	114.7
anionic+nonionic[2]	0.35	111.6

[1] FAE-40 : FAES-4 1:2.50 w/w ratio

[2] FAE-40 : FAES-4 1:1.33 w/w ratio

VITA

Miss Hathairat Ungtaworndee was born on May 8, 1976. She received her Bachelor's Degree of Science in Chemistry from Faculty of Science, Chiang Mai University in 1996. She began her Master study in the program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University in 2002, and completed the program in 2004.