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Appendices

Wet Pick-up Calculation.

The percentage wet pick-up value of fabric can be determined by the following method:

1. The initial weight of each sample was measured before padding by electronic balance (± 0.01 g).

2. After padding, each sample was re-weighed.

Then the percentage wet pick-up can be calculated by the equation expressed below:

$$\%\text{wet pick-up} = \frac{\text{weight of wet fabric - initial weight}}{\text{initial weight}} \times 100$$

Laundering Procedure.

1. Apparatus and Materials

1.1 Launder-O-meter for rotating closed containers in a thermostatically controlled water bath at 40± 2 rpm.

1.2 Stainless steel cylinders 500 ml, 7.5 x 12.5 cm.

1.3 Adapter plates for holding cylinders of 1.2 on Launder-O-meter shaft.

1.4 Stainless steel balls.

1.5 Graduated cylinder measuring in milliliters.

1.6 AATCC Standard Reference Detergent 124.

1.7 Distilled water.

2. Test Specimens

2.1 The size of the specimens required is 2.5 x 6.5 in.

2.2 One specimen is needed for each container.

3. Procedure

3.1 The conditions of the tests is as follow:

Temperature = 49°C

Total Liquor Volume = 150 ml

Percent Detergent of Total Volume = 0.2%

No. of Steel Balls = 50

Time = 45 min

3.2 Adjust the Launder-O-meter to maintain the designated bath temperature. Prepare the required volume of wash liquor.

3.3 Add to the cylinder the amount of detergent solution designated in 3.1.

3.4 Add the designated number of steel balls to each container.

3.5 Enter a test specimen into the container.

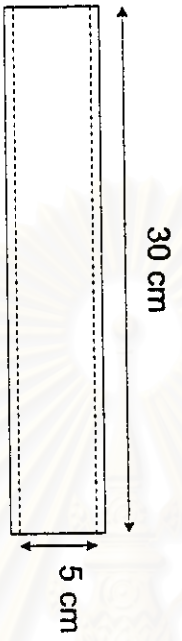
3.6 Clamp the cover on the container. Fasten the containers in the adapters on the rotor of the Launder-O-meter. Place an equal number of containers on each side of the shaft.

3.7 Start the Launder-O-meter and run it at 40±2 rpm for 45 minutes.

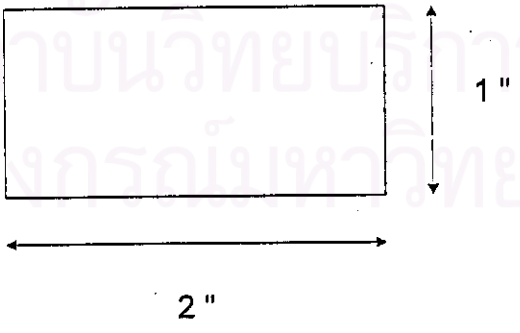
3.8 Stop the machine, remove the containers and empty the contents into a beaker, keeping each test specimen in a separate beaker. Rinse each test specimen three times, in beakers, in distilled water at 40±3°C for one-minute periods with occasional stirring or hand squeezing. Dry the specimens in the oven in which the temperature does not exceed 71°C

3.9 Allow specimen to condition at 65±2% RH and 25±1°C for one hour before evaluating.

Specimen Preparation for Tensile Strength Measurement.



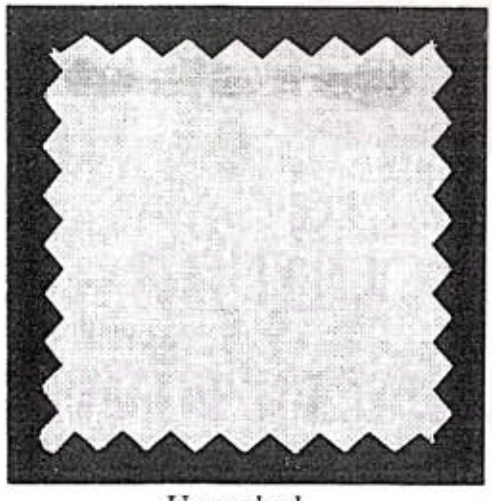
Specimen Preparation for Crease Recovery Testing.



Sample of Fabrics.

Untreated Cotton Fabric (lot A).

Treated Cotton Fabric (lot A)



Unwashed

Washed

Note : Fabrics were treated with 7% citric acid by using mole ratio of citric acid/NaH_2PO_2 at 1 : 2, dried at 95°C for 3 min, cured at 160°C for 1.5 min.

Raw Data of Crease Recovery Measurement.

Table A1. Dry crease recovery angle (DCRA) of untreated fabrics.

Untreated	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
Lot A	f	70	75	68	75	73	71	72	70	74	71	71.9	2.33	3.24	142.1
	w	69	70	67	68	70	69	73	72	71	73	70.2	2.04	2.91	
Lot B	f	64	64	63	59	63	62	67	63	59	65	62.9	2.5	3.93	133
	w	72	72	67	72	70	68	70	71	69	70	70.1	1.73	2.47	
Lot C	f	80	77	82	85	79	78	77	81	81	75	79.5	2.92	3.67	160
	w	80	82	83	82	80	81	79	75	79	84	80.5	2.5	3.17	

Table A2. Wet crease recovery angle (WCRA) of untreated lot A fabric.

Untreated	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
Lot A	f	72	68	68	70	64	69	72	68	66	70	68.7	2.50	3.63	135.8
	w	62	68	66	67	70	66	70	69	68	65	67.1	2.47	3.68	

Table A3. Effect of curing temperature on DCRA of fabrics treated with 5% CA and 5% Na_2HPO_4

Temp.	Time	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
			1	2	3	4	5	6	7	8	9	10				
150c	0.5 min	f	60	68	61	69	66	65	65	64	66	64	64.8	2.78	4.29	128.3
		w	67	62	60	65	62	67	60	65	64	63	63.5	2.55	4.01	
	1.5 min	f	72	77	76	74	75	74	75	81	74	77	75.5	2.46	3.26	144.3
		w	73	70	70	68	70	68	70	69	62	68	68.8	2.82	4.10	
	3.0 min	f	88	84	87	80	90	85	85	84	86	89	85.8	2.90	3.38	159.5
		w	76	72	75	72	78	73	74	70	73	74	73.7	2.26	3.07	
160c	0.5 min	f	80	86	82	81	87	81	73	80	83	84	81.7	3.89	4.76	150.3
		w	75	65	68	65	67	67	73	69	67	70	68.6	3.27	4.77	

Table A3. (Continued)

Temp.	Time	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
			1	2	3	4	5	6	7	8	9	10				
160c	1.5 min	f	81	79	82	77	84	79	80	88	83	77	81	3.40	4.20	157
		w	74	71	76	80	76	81	75	72	77	78	76	3.20	4.21	
	3.0 min	f	91	94	89	85	90	87	88	85	85	89	88.3	2.95	3.34	173.5
		w	87	83	86	80	85	83	85	90	85	88	85.2	2.82	3.31	

Table A4. Effect of citric acid (CA) with various catalysts on DCRA.

Catalysts	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
5%$Na_4P_2O_7$	f	75	81	84	75	85	79	76	75	84	76	79	4.16	5.27	155.7
	w	80	74	80	81	78	74	80	73	70	77	76.7	3.74	4.88	
5%Na_2HPO_4	f	82	84	83	88	82	80	90	85	83	84	84.1	2.96	3.52	161
	w	73	76	72	76	77	87	75	78	74	81	76.9	4.38	5.70	
5%NaH_2PO_2	f	91	96	93	96	99	98	94	97	98	95	95.7	2.50	2.61	190.3
	w	88	95	98	98	97	91	93	93	99	94	94.6	3.50	3.70	
5%NaH_2PO_4	f	89	87	91	85	83	84	85	90	81	87	86.2	3.19	3.70	172.8
	w	82	89	90	85	89	88	85	84	87	87	86.6	2.55	2.94	

Table A5. Effect of ratio of CA/NaH_2PO_2 at 5%CA on DCRA.

CA/NaH2PO2	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
1 : 1.0	f	89	97	95	97	88	96	94	97	94	92	93.9	3.28	3.49	184.2
	w	92	87	87	90	95	90	93	87	89	93	90.3	2.87	3.18	
1 : 1.5	f	92	95	96	95	100	91	97	96	100	96	95.8	2.90	3.03	185.6
	w	89	93	88	89	89	96	84	88	88	94	89.8	3.52	3.92	
1 : 2.0	f	98	90	95	95	92	97	99	97	97	93	95.3	2.87	3.01	186.1
	w	95	93	89	93	90	88	90	92	90	88	90.8	2.35	2.59	

Table A5. (Continued)

CA/NaH_2PO_2	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
1 : 2.5	f	86	91	93	90	89	92	90	89	95	96	91.1	3.00	3.29	184
	w	89	93	92	89	97	95	90	97	88	99	92.9	3.93	4.23	

Table A6. Effect of ratio of CA/NaH_2PO_2 at 10%CA on DCRA.

CA/NaH_2PO_2	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
1 : 1.0	f	105	105	104	103	108	108	103	107	107	107	105.7	1.95	1.84	208.7
	w	100	102	101	100	103	105	107	104	105	103	103.0	2.31	2.24	
1 : 1.5	f	109	110	102	115	102	102	100	105	106	102	105.3	4.74	4.50	210.5
	w	103	112	100	108	112	109	100	108	100	100	105.2	5.12	4.86	
1 : 2.0	f	106	108	107	107	110	110	109	110	108	106	108.1	1.60	1.48	215.1
	w	108	100	99	107	106	110	110	111	108	111	107.0	4.29	4.01	
1 : 2.5	f	104	99	100	95	101	98	101	95	99	102	99.4	2.88	2.89	195.9
	w	92	105	98	93	92	100	95	100	93	97	96.5	4.30	4.46	

Table A7. Effect of concentration of citric acid on DCRA.

%CA	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
5	f	95	93	95	95	90	94	96	93	96	93	94.0	1.83	1.94	186.7
	w	90	91	93	95	90	93	100	85	92	98	92.7	4.27	4.61	
7	f	100	112	105	105	101	104	109	106	101	107	105.0	3.77	3.59	208.1
	w	101	102	104	105	105	106	102	97	103	106	103.1	2.77	2.68	
9	f	110	106	106	110	109	105	105	106	100	99	105.6	3.75	3.55	209.4
	w	98	103	108	104	106	104	108	101	108	98	103.8	3.85	3.71	
11	f	106	110	108	107	103	106	106	112	107	105	107.0	2.54	2.37	212.1
	w	103	107	105	101	110	105	106	104	104	106	105.1	2.42	2.31	

Table A8. Effect of concentration of citric acid on WCRA.

%CA	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
5	f	94	91	92	90	93	91	93	94	95	95	92.8	1.75	1.89	185.1
	w	90	95	93	91	90	91	93	94	92	94	92.3	1.77	1.91	
7	f	98	101	102	101	108	102	108	96	100	97	101.3	4.08	4.03	204.8
	w	97	108	104	105	99	103	100	104	106	109	103.5	3.87	3.74	
9	f	105	104	110	105	110	98	106	99	105	109	105.1	4.12	3.92	208.6
	w	106	98	103	108	107	104	100	104	102	103	103.5	3.06	2.96	
11	f	103	106	106	109	106	108	106	106	107	106	106.3	1.57	1.47	211.3
	w	101	105	106	102	109	106	104	108	105	104	105.0	2.45	2.33	

Table A9. Effect of curing temperature on DCRA at 7%CA.

Temp	Time	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
			1	2	3	4	5	6	7	8	9	10				
150c	120 sec	f	103	102	103	103	101	97	97	98	97	98	99.9	2.73	2.73	198.9
		w	100	99	100	99	104	98	101	95	96	98	99.0	2.54	2.56	
	180 sec	f	98	95	98	102	101	102	101	101	102	99	99.9	2.33	2.33	201.6
		w	97	101	95	102	105	98	106	105	105	103	101.7	3.86	3.80	
160c	60 sec	f	100	96	93	92	99	89	97	92	90	94	94.2	3.71	3.93	188.1
		w	92	93	103	95	90	94	95	90	92	95	93.9	3.73	3.97	
	120 sec	f	100	103	102	104	109	104	106	105	100	103	103.6	2.72	2.62	205.5
		w	99	102	105	102	104	103	99	97	105	103	101.9	2.73	2.68	
170c	50 sec	f	108	110	110	108	107	111	106	107	110	113	109.0	2.16	1.98	216.5
		w	110	109	107	106	111	108	104	109	108	103	107.5	2.55	2.37	
	90 sec	f	114	115	112	114	117	114	115	110	118	118	114.7	2.54	2.22	228.6
		w	118	113	110	115	115	117	110	117	115	109	113.9	3.25	2.85	

Table A10. Effect of curing temperature on WCRA at 7%CA.

Temp	Time	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
			1	2	3	4	5	6	7	8	9	10				
150c	120 sec	f	98	93	88	93	92	90	88	95	95	91	92.3	3.20	3.47	190.3
		w	93	100	101	99	96	95	106	94	101	95	98.0	4.08	4.17	
	180 sec	f	101	101	99	100	101	105	94	99	100	101	100.1	2.73	2.72	200
		w	95	94	100	102	98	101	106	101	104	98	99.9	3.75	3.76	
160c	60 sec	f	96	99	100	98	97	86	98	98	99	94	96.5	4.06	4.21	181.8
		w	85	83	87	83	84	85	87	85	87	87	85.3	1.64	1.92	
	120 sec	f	97	97	102	100	105	95	97	93	100	98	98.4	3.47	3.53	199
		w	99	101	94	100	102	107	105	98	95	105	100.6	4.30	4.27	
170c	50 sec	f	91	96	94	95	100	98	102	100	93	94	96.3	3.56	3.70	193.5
		w	103	96	98	98	95	98	92	95	100	97	97.2	3.01	3.10	
	90 sec	f	99	102	95	101	97	106	95	105	105	97	100.2	4.21	4.20	204.8
		w	108	104	110	105	110	100	97	100	108	104	104.6	4.50	4.30	

Table A11. Effect of repeated laundering on DCRA.

No. of laundering	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
1	f	98	94	95	92	97	93	91	93	93	94	94.0	2.16	2.30	183.7
	w	87	89	90	86	93	90	85	94	89	94	89.7	3.20	3.57	
5	f	78	89	79	83	83	80	87	81	89	83	83.2	3.97	4.77	165.1
	w	86	81	84	82	80	81	79	83	82	81	81.9	2.02	2.47	
10	f	86	77	82	77	85	76	85	81	78	78	80.5	3.81	4.73	159.5
	w	84	79	80	75	83	78	82	78	76	75	79.0	3.23	4.09	

Table A12. Effect of various concentrations of Fixapret COC on DCRA.

Fixapret COC (g/l)	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
60	f	104	100	105	107	105	104	105	109	105	104	104.8	2.30	2.19	206.8
	w	104	106	105	97	103	103	101	97	100	104	102.0	3.16	3.10	
70	f	109	110	110	110	112	108	110	111	101	113	109.4	3.27	2.99	216.2
	w	107	114	106	101	106	110	105	108	103	108	106.8	3.61	3.38	
80	f	116	114	116	114	112	117	120	115	114	119	115.7	2.45	2.12	228.5
	w	113	110	112	116	112	111	118	114	110	112	112.8	2.57	2.28	
90	f	121	113	124	120	118	121	125	122	121	123	120.8	3.39	2.81	247.8
	w	128	125	129	123	126	127	132	124	127	129	127.0	2.67	2.10	
100	f	121	122	114	120	122	124	119	120	120	125	120.7	3.02	2.50	248.6
	w	128	131	132	124	129	128	130	127	123	127	127.9	2.85	2.23	

Table A13. Effect of various ratios of NaH_2PO_2/NaH_2PO_4 on DCRA.

NaH_2PO_2 / NaH_2PO_4	yarn	Rreplication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
20/80	f	101	96	98	99	100	101	101	93	102	98	98.9	2.77	2.80	197.1
	w	101	97	103	96	96	99	92	102	96	100	98.2	3.39	3.45	
40/60	f	105	97	101	99	98	102	102	100	105	104	101.3	2.83	2.79	201
	w	99	102	97	95	101	105	95	97	107	99	99.7	4.06	4.07	
50/50	f	102	109	105	97	101	102	111	107	100	108	104.2	4.49	4.31	202.9
	w	98	98	96	105	95	103	104	96	100	92	98.7	4.24	4.30	
60/40	f	98	106	108	108	107	103	106	98	103	111	104.8	4.29	4.09	204.2
	w	92	94	100	95	101	102	98	101	105	106	99.4	4.62	4.65	
80/20	f	105	105	106	95	106	100	98	101	104	103	102.3	3.71	3.63	205.2
	w	108	104	108	95	104	97	107	107	101	98	102.9	4.86	4.73	

Table A14. Effect of various ratios of NaH_2PO_2/NaH_2PO_4 on WCRA.

NaH_2PO_2 / NaH_2PO_4	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
20/80	f	96	96	93	95	96	101	95	95	99	95	96.1	2.28	2.38	191.4
	w	95	95	95	98	100	97	93	94	91	95	95.3	2.54	2.67	
40/60	f	94	102	98	98	93	99	97	97	97	97	97.2	2.49	2.56	193.9
	w	95	98	97	100	94	95	102	100	93	93	96.7	3.20	3.31	
50/50	f	97	98	97	95	93	102	95	106	98	97	97.8	3.74	3.82	194.9
	w	94	96	100	98	100	102	95	94	93	99	97.1	3.11	3.20	
60/40	f	100	98	99	103	104	100	100	101	98	100	100.3	1.95	1.94	200.7
	w	106	100	94	98	101	105	101	102	100	97	100.4	3.57	3.55	
80/20	f	102	102	103	106	103	104	103	103	103	102	103.1	1.20	1.16	204.9
	w	98	106	103	101	102	101	103	102	101	101	101.8	2.04	2.01	

Table A15. Effect of various ratios of Fixapret COC/CA on DCRA.

Fixapret COC/CA	yarn	Replication										Mean	S.D.	%C.V.	(w+f)
		1	2	3	4	5	6	7	8	9	10				
20/80	f	87	98	99	96	103	105	96	98	100	101	98.3	4.90	4.98	189.7
	w	91	89	93	90	90	87	95	92	92	95	91.4	2.55	2.79	
40/60	f	101	102	101	102	102	103	111	105	102	107	103.6	3.20	3.09	199.7
	w	94	94	100	93	100	98	95	93	98	96	96.1	2.73	2.84	
50/50	f	98	103	104	100	103	108	103	100	105	101	102.5	2.88	2.81	201.1
	w	99	100	95	97	95	102	100	102	97	99	98.6	2.55	2.58	
60/40	f	101	103	105	102	103	101	103	102	104	103	102.7	1.25	1.22	201.4
	w	98	100	98	101	97	100	100	97	99	97	98.7	1.49	1.51	
80/20	f	110	108	102	108	114	105	114	106	109	109	108.5	3.72	3.43	215.8
	w	103	105	111	106	105	111	109	108	110	105	107.3	2.87	2.67	
100/0	f	108	110	112	112	106	105	103	107	108	109	108.0	2.91	2.69	217.7
	w	112	108	112	105	109	113	107	109	112	110	109.7	2.58	2.36	

Raw Data of Breaking Strength Measurement.

Table A16. Breaking strength of untreated lot A fabric.

Untreated	yarn	Replication					Mean	S.D.	%C.V.
		1	2	3	4	5			
Lot A	f	405.096	423.166	389.563	365.457	366.355	389.9	24.95	6.40
	w	463.516	446.934	453.365	434.474	474.282	454.5	15.27	3.36

Table A17. Effect of concentration of citric acid on breaking strength.

CA(%)	yarn	Replication					Mean	S.D.	%C.V.
		1	2	3	4	5			
5	f	262.127	262.423	253.018	254.58		258.0	4.94	1.91
	w	339.258	313.708	345.367	346.404	316.86	332.3	15.83	4.76
7	f	262.908	247.52	252.83	276.769	253.42	258.7	11.53	4.46
	w	333.942	310.425	327.448	336.514	328.19	327.3	10.18	3.11
9	f	265.444	242.984	260.258	251.163		255.0	9.93	3.89
	w	325.867	350.588	326.276	323.763	338.494	333.0	11.41	3.43
11	f	254.371	268.703	239.486	235.852		249.6	15.04	6.03
	w	323.342	332.296	331.867	348.482	351.622	337.5	12.03	3.57

Table A18. Effect of curing temperature on breaking strength at 7%CA.

Temp	Time	yarn	Replication					Mean	S.D.	%C.V.
			1	2	3	4	5			
150c	120 sec	f	265.542	294.62	276.317	274.822	273.181	276.9	10.74	3.88
		w	353.497	349.013	351.175	355.81	347.198	351.3	3.44	0.98
	180 sec	f	263.586	238.671	220.535	249.658	230.32	240.6	16.75	6.96
		w	345.032	324.253	346.094	345.436	334.812	339.1	9.53	2.81

Table A18. (Continued)

Temp	Time	yarn	Replication					Mean	S.D.	%C.V.
			1	2	3	4	5			
160c	60 sec	f	274.272	271.884	268.968	272.966	263.08	270.2	4.45	1.65
		w	356.391	347.948	328.255	349.363	363.738	349.1	13.26	3.80
	120 sec	f	272.553	271.293	232.584	246.653	269.307	258.5	17.96	6.95
		w	292.048	281.631	303.594	309.019	336.134	304.5	20.62	6.77
170c	50 sec	f	259.351	255.551	254.385	260.412	244.701	254.9	6.22	2.44
		w	293.863	324.438	349.89	330.211	341.522	328.0	21.48	6.55
	90 sec	f	229.205	216.748	224.693	220.981	218.886	222.1	4.94	2.22
		w	288.121	305.995	286.54	302.535	314.033	299.4	11.83	3.95

Table A19. Effect of various ratios of Fixapret COC/CA on breaking strength.

Fixapret COC/CA	yarn	Replication					Mean	S.D.	%C.V.
		1	2	3	4	5			
20/80	f	260.483	276.56	269.991	266.99	270.748	269.0	5.87	2.18
	w	352.136	325.46	333.045	338.47	338.066	337.4	9.75	2.89
40/60	f	247.051	259.056	267.715	257.404	268.25	259.9	8.70	3.35
	w	316.157	331.717	326.513	307.794	346.519	325.7	14.85	4.56
50/50	f	264.651	275.021	257.59	233.805		257.8	17.51	6.79
	w	320.759	315.842	303.041	325.768	307.765	314.6	9.28	2.95
60/40	f	241.09	251.987	249.044	219.739	254.696	243.3	14.13	5.81
	w	273.405	316.427	326.967	295.642	305.699	303.6	20.55	6.77
80/20	f	135.219	133.431	131.969	136.777	137.567	135.0	2.32	1.72
	w	233.56	228.005	265.385	259.541	253.707	248.0	16.40	6.61
100/0	f	145.36	132.029	128.875	128.751	130.404	133.1	6.99	5.25
	w	251.39	251.135	236.171	233.998	225.649	239.7	11.29	4.71

BIOGRAPHY

Miss Pranee Rattanawaleedirojn was born in Bangkok, Thailand, on January 11, 1971. She received a Bachelor of Science degree with a major in Chemistry from Kasetsart University in 1993. She started as a graduate student in Department of Material Science with a major in Applied Polymer Science and Textile Technology, Chulalongkorn University in June 1993, and completed the programme in September 1996.