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APPENDICES

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APPENDIX A

A. Data of tensile properties

References Method: ASTM D412-98a

Interface Type: LR 5 K/LLOYD

Machine Parameter of test:

Crosshead Speed (mm/min):500

Temperature(°C): 25

Dimensions:

Width (mm): 6

Thickness (mm): 2.5

Gauge Length (mm): 25

Table A.1 Ultimate Elongation of plasticized PVC with GRT and RTR.

Batch	Elongation (%)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
S100	57.2	58.9	56.2	57.3	59.2	57.76	1.13	1.95	2.79
I1	32.2	33.2	34.7	31.2	30.9	32.44	1.39	4.28	3.45
I2	26.7	26.2	25.3	25.6	27.3	26.22	0.72	2.76	1.80
I3	15.2	14.9	14.2	13.6	17.2	15.02	1.22	8.15	3.04
J1	62.8	62.5	62.9	61.2	59.0	61.68	1.47	2.39	3.65
J2	53.9	52.2	50.8	51.2	52.3	52.08	1.08	2.07	2.67
J3	37.2	36.7	33.5	39.8	37.8	37.00	2.04	5.52	5.07
J4	14.2	14.7	11.5	12.2	10.3	12.58	1.65	13.12	4.10

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Table A.2 Ultimate Elongation of Rigid PVC with GRT and RTR.

Batch	Elongation (%)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
R100	13.0	14.2	11.2	13.7	14.5	13.32	1.18	8.82	2.92
R0	9.1	8.8	9.0	9.4	9.3	9.12	0.21	2.34	0.53
R1	8.2	8.5	8.1	8.3	8.9	8.40	0.28	3.37	0.70
R3	9.6	9.8	9.5	9.7	10.1	9.74	0.21	2.11	0.51
R5	8.9	9.0	8.6	9.4	9.1	9.00	0.26	2.90	0.65
G0	11.2	10.9	10.8	11.1	10.2	10.84	0.35	3.23	0.87
G1	10.0	9.6	9.4	8.7	11.2	9.78	0.83	8.44	2.05
G3	11.2	12.3	11.5	9.8	10.9	11.14	0.82	7.33	2.03
G5	8.9	6.7	8.8	8.9	6.3	7.92	1.17	14.73	2.90
E1	11.2	11.0	10.8	13.2	11.8	11.60	0.87	7.48	2.15
E2	11.2	10.4	11.8	10.4	10.9	10.94	0.53	4.82	1.31
E3	9.1	8.8	9.0	9.4	9.3	9.12	0.21	2.34	0.53
E4	4.9	5.0	4.2	4.5	4.7	4.66	0.29	6.21	0.72
E5	11.9	11.8	10.9	13.6	12.8	12.20	0.92	7.57	2.29
E6	10.8	10.5	11.8	12.3	11.0	11.28	0.67	5.92	1.66
E7	9.6	9.8	9.5	9.7	10.1	9.74	0.21	2.11	0.51
E8	8.7	8.5	8.4	8.9	8.2	8.54	0.24	2.83	0.60
E9	6.1	6.5	6.3	6.0	5.9	6.16	0.22	3.50	0.53
F1	12.3	11.8	14.8	13.5	9.3	12.34	1.84	14.91	4.57
F2	11.2	11.8	12.3	10.8	12.5	11.72	0.64	5.49	1.60
F3	12.5	11.2	10.8	9.9	10.3	10.95	0.89	8.14	2.21
F4	11.2	10.9	10.8	11.1	10.2	10.84	0.35	3.23	0.87
F5	7.8	7.6	6.5	6.4	6.9	7.04	0.57	8.07	1.41
F6	12.2	12.9	11.8	12.4	11.7	12.20	0.43	3.55	1.08
F7	10.8	11.3	12.4	11.7	11.3	11.50	0.53	4.63	1.32
F8	10.9	10.7	12.9	12.3	10.2	11.40	1.02	8.98	2.54
F9	11.2	12.3	11.5	9.8	10.9	11.14	0.82	7.33	2.03
F10	8.7	8.8	9.1	8.6	8.9	8.82	0.17	1.95	0.43
F11	6.2	6.1	6.6	5.7	4.9	5.90	0.58	9.77	1.43
G1	8.7	8.5	8.4	8.9	8.2	8.54	0.24	2.83	0.60
G2	13.7	14.9	13.2	12.7	14.8	13.86	0.87	6.27	2.16
G3	16.9	17.3	15.8	16.2	16.4	16.52	0.53	3.19	1.31
G4	31.2	30.9	30.2	31.8	31.4	31.10	0.54	1.73	1.33
G5	14.8	15.2	14.9	16.2	13.8	14.98	0.77	5.14	1.91
G6	12.3	11.2	10.9	13.2	15.1	12.54	1.52	12.11	3.77
G7	11.4	11.2	11.0	10.3	12.4	11.26	0.68	6.04	1.69
H1	8.7	8.8	9.1	8.6	8.9	8.82	0.17	1.95	0.43
H2	16.5	14.2	15.8	16.3	17.3	16.02	1.03	6.43	2.56
H3	25.9	25.3	23.2	24.9	24.8	24.82	0.90	3.62	2.23
H4	30.2	31.8	30.2	29.7	28.2	30.02	1.15	3.84	2.86
H5	13.2	11.8	13.7	15.8	12.3	13.36	1.39	10.40	3.45
H6	14.5	14.2	14.9	13.2	15.5	14.46	0.77	5.30	1.90
H7	20.0	21.3	23.5	19.7	20.2	20.94	1.39	6.64	3.45

Table A.3 Tensile Strength of plasticized PVC with GRT and RTR.

Batch	Tensile Strength (MPa)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
S100	5.2	5.5	5.2	5.5	5.6	5.43	0.16	3.02	0.41
I1	3.6	3.5	3.3	3.3	3.5	3.46	0.12	3.52	0.30
I2	2.7	2.9	2.5	2.4	3.0	2.71	0.21	7.80	0.52
I3	1.7	1.6	1.5	1.8	1.6	1.64	0.10	6.22	0.25
J1	6.0	5.9	6.2	5.9	6.1	6.02	0.12	1.94	0.29
J2	8.4	8.4	8.3	8.4	8.6	8.42	0.10	1.16	0.24
J3	4.8	4.6	4.5	4.4	4.7	4.60	0.14	3.07	0.35
J4	3.2	2.7	2.8	2.7	2.5	2.78	0.23	8.33	0.57



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Table A.4 Tensile Strength of Rigid PVC with GRT and RTR.

Batch	Tensile Strength (MPa)					X	SD	RSD	interval of Confidence at %95
	1	2	3	4	5				
R100	59.3	57.8	58.9	59.4	57.7	58.62	0.73	1.25	1.81
R0	22.1	22.7	21.4	21.9	20.3	21.68	0.81	3.72	2.00
R1	22.4	23.7	25.2	21.9	20.1	22.66	1.72	7.58	4.26
R3	22.2	21.5	20.7	19.8	21.2	21.08	0.80	3.81	1.99
R5	19.2	18.4	17.9	17.6	17.5	18.12	0.62	3.44	1.55
G0	15.2	14.2	16.8	15.2	15.7	15.42	0.84	5.48	2.10
G1	16.0	16.8	16.3	15.1	15.3	15.90	0.63	3.96	1.56
G3	17.3	17.2	18.4	17.8	17.6	17.66	0.43	2.42	1.06
G5	16.2	15.3	14.2	13.9	12.2	14.36	1.35	9.43	3.36
E1	44.8	42.8	40.9	43.5	41.5	42.70	1.40	3.27	3.46
E2	34.5	33.7	32.8	31.7	32.2	32.98	1.01	3.06	2.51
E3	22.1	22.7	21.4	21.9	20.3	21.68	0.81	3.72	2.00
E4	19.2	15.0	23.4	20.8	17.6	19.20	2.84	14.80	7.06
E5	40.2	43.6	40.8	43.2	41.3	41.82	1.34	3.21	3.33
E6	31.1	32.4	32.7	29.8	29.9	31.18	1.21	3.89	3.01
E7	22.2	21.5	20.7	19.8	21.2	21.08	0.80	3.81	1.99
E8	18.7	17.6	19.0	17.6	19.8	18.54	0.85	4.57	2.10
E9	9.2	9.9	10.1	8.6	7.9	9.14	0.82	8.93	2.03
F1	38.0	39.2	39.8	36.5	35.2	37.74	1.70	4.50	4.22
F2	31.3	30.8	33.2	33.8	29.8	31.78	1.50	4.71	3.72
F3	20.3	21.3	23.7	18.6	17.2	20.22	2.24	11.06	5.55
F4	15.2	14.2	16.8	15.2	15.7	15.42	0.84	5.48	2.10
F5	14.3	14.2	12.3	15.6	14.6	14.20	1.07	7.55	2.66
F6	33.2	31.7	33.8	33.2	31.1	32.60	1.02	3.13	2.54
F7	30.3	29.3	30.2	31.7	28.3	29.96	1.13	3.77	2.81
F8	18.6	19.4	19.5	18.9	18.3	18.94	0.46	2.42	1.14
F9	17.3	17.2	18.4	17.8	17.6	17.66	0.43	2.42	1.06
F10	15.2	15.0	14.8	15.5	14.6	15.02	0.31	2.08	0.78
F11	9.3	9.8	8.7	7.8	9.5	9.02	0.71	7.85	1.76
G1	18.7	17.6	19.0	17.6	19.8	18.54	0.85	4.57	2.10
G2	22.4	21.6	22.8	20.2	21.5	21.70	0.89	4.12	2.22
G3	19.3	20.8	18.6	19.9	18.7	19.46	0.82	4.19	2.03
G4	18.9	17.5	18.3	17.6	19.2	18.30	0.68	3.71	1.68
G5	21.2	23.0	19.9	18.7	20.3	20.62	1.44	6.96	3.56
G6	24.3	25.1	26.7	23.9	22.7	24.54	1.33	5.42	3.30
G7	25.8	25.7	25.8	24.5	26.8	25.72	0.73	2.84	1.81
H1	15.2	15.0	14.8	15.5	14.6	15.02	0.31	2.08	0.78
H2	24.9	24.8	26.7	22.6	26.8	25.16	1.54	6.11	3.82
H3	20.9	21.6	21.5	19.7	21.2	20.98	0.69	3.27	1.70
H4	17.2	18.6	16.3	17.7	19.0	17.76	0.97	5.45	2.40
H5	27.9	28.3	26.9	27.5	30.7	28.26	1.30	4.62	3.24
H6	25.3	24.8	23.8	25.8	26.3	25.20	0.86	3.41	2.14
H7	16.2	15.6	18.8	19.6	19.3	17.90	1.66	9.29	4.13

APPENDIX B

B. Data of impact Strength

Table B.1 Impact Strength of Rigid PVC GRT and RTR.

Batch	Impact Strength (J/cm)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
R100	2.2	2.1	2.3	2.3	2.4	2.26	0.10	4.51	0.25
R0	2.8	3.1	3.0	3.2	3.3	3.08	0.17	5.59	0.43
R1	3.0	3.1	3.1	3.2	3.1	3.10	0.06	2.04	0.16
R3	3.3	3.2	3.4	3.3	3.1	3.26	0.10	3.13	0.25
R5	3.1	3.2	3.2	3.0	3.4	3.18	0.13	4.17	0.33
G0	3.6	3.4	3.5	3.2	3.3	3.40	0.14	4.16	0.35
G1	3.5	3.6	3.9	3.2	3.3	3.50	0.24	7.00	0.61
G3	3.8	3.6	3.5	3.3	3.7	3.58	0.17	4.81	0.43
G5	3.3	3.4	3.0	3.3	3.2	3.24	0.14	4.19	0.34
E1	1.9	1.8	1.8	1.9	2.0	1.88	0.07	3.98	0.19
E2	2.4	2.5	2.6	2.6	2.7	2.56	0.10	3.98	0.25
E3	3.0	3.1	2.9	2.8	3.0	2.96	0.10	3.45	0.25
E4	3.1	3.2	2.8	2.9	3.0	3.00	0.14	4.71	0.35
E5	2.6	2.2	2.3	2.6	2.6	2.46	0.17	7.09	0.43
E6	2.7	2.8	2.5	3.0	3.0	2.80	0.19	6.78	0.47
E7	3.5	3.4	3.3	3.2	3.7	3.42	0.17	5.03	0.43
E8	3.9	4.1	3.9	3.3	3.5	3.74	0.29	7.86	0.73
E9	2.8	2.7	3.0	3.3	3.2	3.00	0.23	7.60	0.57
F1	2.3	2.8	2.4	3.0	2.7	2.64	0.26	9.76	0.64
F2	2.7	2.8	2.9	3.2	2.5	2.82	0.23	8.21	0.57
F3	3.1	3.2	3.3	3.4	3.2	3.24	0.10	3.15	0.25
F4	3.3	3.6	3.4	3.3	3.4	3.40	0.11	3.22	0.27
F5	3.3	3.3	3.1	3.4	3.5	3.32	0.13	4.00	0.33
F6	3.0	2.8	2.6	2.7	2.6	2.74	0.15	5.46	0.37
F7	3.0	3.1	2.8	3.3	2.9	3.02	0.17	5.70	0.43
F8	3.5	3.3	3.0	3.6	3.2	3.32	0.21	6.43	0.53
F9	3.6	3.8	3.5	3.7	3.5	3.62	0.12	3.22	0.29
F10	3.9	3.8	3.5	3.7	4.0	3.78	0.17	4.55	0.43
F11	3.5	3.3	3.6	3.4	3.3	3.42	0.12	3.41	0.29

Table B.1 Impact Strength of Rigid PVC GRT and RTR. (Continued).

Batch	Impact Strength (J/cm)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
G1	3.9	4.1	3.9	3.3	3.5	3.74	0.29	7.86	0.73
G2	4.0	3.8	3.5	4.1	3.7	3.82	0.21	5.59	0.53
G3	5.0	4.7	4.1	5.2	4.5	4.70	0.38	8.19	0.96
G4	5.3	5.1	5.5	4.8	4.7	5.08	0.30	5.89	0.74
G5	3.8	4.0	4.2	3.7	3.6	3.86	0.22	5.58	0.53
G6	5.3	5.2	4.7	4.5	5.1	4.96	0.31	6.19	0.76
G7	8.3	7.8	8.1	7.7	8.1	8.00	0.22	2.74	0.54
H1	3.9	4.1	3.9	3.3	3.5	3.74	0.29	7.86	0.73
H2	4.1	4.0	4.3	3.8	4.2	4.08	0.17	4.22	0.43
H3	5.3	4.7	5.0	4.6	5.0	4.92	0.25	5.04	0.62
H4	7.8	7.5	7.3	7.9	7.1	7.52	0.30	3.98	0.74
H5	4.0	3.6	3.9	4.1	3.4	3.80	0.26	6.86	0.65
H6	4.3	4.3	4.2	4.1	3.8	4.14	0.19	4.48	0.46
H7	5.5	5.1	4.7	4.9	5.0	5.04	0.27	5.26	0.66


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APPENDIX C

C. Data of Hardness.

Table C.1 Hardness of plasticized PVC with GRT and RTR.

Batch	Hardness (Shore A)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
S100	29	28	28	27	27	27.8	0.837	3.010	
	28	28	28	27	29	28.0	0.707	2.525	
	28	28	29	27	27	27.8	0.837	3.010	
						27.9	0.793	2.848	2.0
I1	26	26	24	24	24	24.8	1.095	4.417	
	25	25	24	24	25	24.6	0.548	2.227	
	26	25	24	25	24	24.8	0.837	3.374	
						24.7	0.827	3.339	2.1
I2	25	25	24	25	24	24.6	0.548	2.227	
	24	24	24	24	25	24.2	0.447	1.848	
	24	25	23	24	24	24.0	0.707	2.946	
						24.3	0.567	2.340	1.4
I3	24	24	23	23	22	23.2	0.837	3.606	
	24	23	23	23	23	23.2	0.447	1.928	
	23	24	23	22	24	23.2	0.837	3.606	
						23.2	0.707	3.047	1.8
J1	27	26	27	26	25	26.2	0.837	3.193	
	26	26	26	25	27	26.0	0.707	2.720	
	26	26	26	26	27	26.2	0.447	1.707	
						26.1	0.664	2.540	1.648
J2	27	26	26	25	25	25.8	0.837	3.243	
	25	25	26	26	26	25.6	0.548	2.140	
	25	26	25	26	27	25.8	0.837	3.243	
						25.7	0.740	2.875	1.838
J3	25	24	26	24	24	24.6	0.894	3.636	
	25	24	24	24	25	24.4	0.548	2.245	
	25	25	24	24	25	24.6	0.548	2.227	
						24.5	0.663	2.702	1.647
J4	23	24	23	22	24	23.2	0.837	3.606	
	23	24	24	23	23	23.4	0.548	2.341	
	23	24	24	23	24	23.6	0.548	2.321	
						23.4	0.644	2.756	1.599

Table C.2 Hardness of Rigid PVC with GRT and RTR.

Batch	Hardness (Shore D)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
R100	79	79	78	78	77	78.2	0.837	1.070	
	78	78	77	77	79	77.8	0.837	1.075	
	77	78	79	78	79	78.2	0.837	1.070	
						78.1	0.837	1.072	2.1
R0	64	62	63	63	65	63.4	1.140	1.798	
	65	64	62	63	63	63.4	1.140	1.798	
	63	62	65	64	63	63.4	1.140	1.798	
						63.4	1.140	1.798	2.8
R1	69	68	67	67	67	67.6	0.894	1.323	
	68	67	67	68	68	67.6	0.548	0.810	
	69	68	67	67	68	67.8	0.837	1.234	
						67.7	0.760	1.122	1.9
R3	69	69	69	68	68	68.6	0.548	0.798	
	68	68	68	69	69	68.4	0.548	0.801	
	69	68	69	68	69	68.6	0.548	0.798	
						68.5	0.548	0.799	1.4
R5	70	71	71	70	72	70.8	0.837	1.182	
	70	71	70	71	71	70.6	0.548	0.776	
	70	71	72	71	70	70.8	0.837	1.182	
						70.7	0.740	1.046	1.8
G0	57	58	58	59	60	58.4	1.140	1.952	
	58	58	58	59	60	58.6	0.894	1.526	
	60	59	58	57	58	58.4	1.140	1.952	
						58.5	1.058	1.810	2.627
G1	71	71	70	70	70	70.4	0.548	0.778	
	71	70	70	70	70	70.2	0.447	0.637	
	71	71	71	70	70	70.6	0.548	0.776	
						70.4	0.514	0.730	1.277
G3	72	72	71	72	72	71.8	0.447	0.623	
	72	72	71	71	72	71.6	0.548	0.765	
	72	72	72	71	72	71.8	0.447	0.623	
						71.7	0.481	0.670	1.193
G5	73	73	72	72	72	72.4	0.548	0.757	
	73	73	73	72	72	72.6	0.548	0.754	
	72	72	72	72	73	72.2	0.447	0.619	
						72.4	0.514	0.710	1.277

Table C.2 Hardness of Rigid PVC with GRT and RTR, (Continued).

Batch	Hardness (Shore D)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
E1	75	74	74	75	74	74.4	0.548	0.736	
	75	75	74	75	74	74.6	0.548	0.734	
	74	75	74	74	75	74.4	0.548	0.736	
						74.5	0.548	0.736	1.4
E2	69	69	69	69	71	69.4	0.894	1.289	
	70	69	70	69	71	69.8	0.837	1.199	
	71	69	70	69	69	69.6	0.894	1.285	
						69.6	0.875	1.258	2.2
E3	64	62	63	63	65	63.4	1.140	1.798	
	65	64	62	63	63	63.4	1.140	1.798	
	63	62	65	64	63	63.4	1.140	1.798	
						63.4	1.140	1.798	2.8
E4	57	58	58	59	60	58.4	1.140	1.952	
	58	58	58	59	60	58.6	0.894	1.526	
	60	59	58	57	58	58.4	1.140	1.952	
						58.5	1.058	1.810	2.6
E5	77	76	76	75	75	75.8	0.837	1.104	
	75	76	77	76	76	76.0	0.707	0.930	
	76	75	75	76	76	75.6	0.548	0.725	
						75.8	0.697	0.920	1.7
E6	73	72	72	72	72	72.2	0.447	0.619	
	72	73	72	72	73	72.4	0.548	0.757	
	72	73	72	72	72	72.2	0.447	0.619	
						72.3	0.481	0.665	1.2
E7	69	69	69	68	68	68.6	0.548	0.798	
	68	68	69	68	69	68.4	0.548	0.801	
	68	69	69	68	68	68.4	0.548	0.801	
						68.5	0.548	0.800	1.4
E8	66	65	66	65	65	65.4	0.548	0.837	
	64	65	65	66	64	64.8	0.837	1.291	
	65	66	66	65	66	65.6	0.548	0.835	
						65.3	0.644	0.988	1.6
E9	64	63	62	62	62	62.6	0.894	1.429	
	64	63	63	62	62	62.8	0.837	1.332	
	62	62	63	63	62	62.4	0.548	0.878	
						62.6	0.760	1.213	1.9

Table C.2 Hardness of Rigid PVC with GRT and RTR, (Continued).

Batch	Hardness (Shore D)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
F1	79	79	78	78	77	78.2	0.837	1.070	
	78	78	78	79	77	78.0	0.707	0.907	
	78	79	78	79	79	78.6	0.548	0.697	
						78.3	0.697	0.891	1.731
F2	76	76	75	75	75	75.4	0.548	0.726	
	75	75	76	76	77	75.8	0.837	1.104	
	75	75	75	75	76	75.2	0.447	0.595	
						75.5	0.611	0.808	1.516
F3	73	72	72	73	73	72.6	0.548	0.754	
	73	73	73	72	73	72.8	0.447	0.614	
	72	74	73	73	73	73.0	0.707	0.969	
						72.8	0.567	0.779	1.409
F4	57	58	58	59	60	58.4	1.140	1.952	
	58	58	58	59	60	58.6	0.894	1.526	
	60	59	58	57	58	58.4	1.140	1.952	
						58.5	1.058	1.810	2.627
F5	66	66	65	65	65	65.4	0.548	0.837	
	65	65	66	66	66	65.6	0.548	0.835	
	66	66	65	65	66	65.6	0.548	0.835	
						65.5	0.548	0.836	1.360
F6	78	77	77	77	78	77.4	0.548	0.708	
	77	76	78	78	78	77.4	0.894	1.156	
	77	77	77	77	78	77.2	0.447	0.579	
						77.3	0.630	0.814	1.564
F7	77	76	75	75	75	75.6	0.894	1.183	
	75	76	76	75	75	75.4	0.548	0.726	
	77	76	76	75	75	75.8	0.837	1.104	
						75.6	0.760	1.004	1.886
F8	73	74	73	72	74	73.2	0.837	1.143	
	73	73	73	74	74	73.4	0.548	0.746	
	73	73	73	73	74	73.2	0.447	0.611	
						73.3	0.611	0.833	1.516
F9	72	72	71	72	72	71.8	0.447	0.623	
	72	72	72	72	71	71.8	0.447	0.623	
	71	71	72	72	73	71.8	0.837	1.165	
						71.8	0.577	0.804	1.433
F10	69	70	69	70	69	69.4	0.548	0.789	
	69	69	69	69	70	69.2	0.447	0.646	
	70	71	68	69	69	69.4	1.140	1.643	
						69.3	0.712	1.026	1.767
F11	68	69	67	67	67	67.6	0.894	1.323	
	67	67	67	68	68	67.4	0.548	0.813	
	68	67	67	69	67	67.6	0.894	1.323	
						67.5	0.779	1.153	1.934

Table C.2 Hardness of Rigid PVC with GRT and RTR, (Continued).

Batch	Hardness (Shore D)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
G1	66	65	66	65	65	65.4	0.548	0.837	
	64	65	65	66	64	64.8	0.837	1.291	
	65	66	66	65	66	65.6	0.548	0.835	
						65.3	0.644	0.988	1.6
G2	65	67	66	64	64	65.2	1.304	2.000	
	64	65	67	66	65	65.4	1.140	1.743	
	65	64	66	66	66	65.4	0.894	1.368	
						65.3	1.113	1.704	2.8
G3	65	65	62	63	63	63.6	1.342	2.109	
	63	62	64	64	62	63.0	1.000	1.587	
	63	63	63	63	64	63.2	0.447	0.708	
						63.3	0.930	1.468	2.3
G4	62	62	61	61	63	61.8	0.837	1.354	
	61	61	61	62	62	61.4	0.548	0.892	
	62	61	62	62	61	61.6	0.548	0.889	
						61.6	0.644	1.045	1.6
G5	66	66	64	64	65	65.0	1.000	1.538	
	65	65	64	65	66	65.0	0.707	1.088	
	66	65	66	65	64	65.2	0.837	1.283	
						65.1	0.848	1.303	2.1
G6	64	65	63	63	62	63.4	1.140	1.798	
	63	63	64	63	63	63.2	0.447	0.708	
	64	63	62	62	64	63.0	1.000	1.587	
						63.2	0.862	1.364	2.1
G7	60	60	60	60	58	59.6	0.894	1.501	
	60	60	59	59	60	59.6	0.548	0.919	
	60	59	58	59	59	59.0	0.707	1.198	
						59.4	0.716	1.206	1.8

Table C.2 Hardness of Rigid PVC with GRT and RTR, (Continued).

Batch	Hardness (Shore D)					X	SD	RSD	interval of confidence at %95
	1	2	3	4	5				
H1	69	70	69	70	69	69.4	0.548	0.789	
	69	69	69	69	70	69.2	0.447	0.646	
	70	71	68	69	69	69.4	1.140	1.643	
						69.3	0.712	1.026	1.767
H2	70	69	69	68	67	68.6	1.140	1.662	
	68	68	68	68	69	68.2	0.447	0.656	
	69	69	68	68	68	68.4	0.548	0.801	
						68.4	0.712	1.040	1.767
H3	66	67	67	68	65	66.6	1.140	1.712	
	67	66	67	66	67	66.6	0.548	0.822	
	68	67	66	66	66	66.6	0.894	1.343	
						66.6	0.861	1.292	2.137
H4	65	65	64	66	65	65.0	0.707	1.088	
	65	65	65	65	64	64.8	0.447	0.690	
	65	65	66	65	65	65.2	0.447	0.686	
						65.0	0.534	0.821	1.325
H5	67	68	67	66	68	67.2	0.837	1.245	
	67	67	68	68	68	67.6	0.548	0.810	
	67	68	68	67	67	67.4	0.548	0.813	
						67.4	0.644	0.956	1.599
H6	66	65	64	64	64	64.6	0.894	1.385	
	64	64	65	65	66	64.8	0.837	1.291	
	66	66	65	65	64	65.2	0.837	1.283	
						64.9	0.856	1.320	2.125
H7	64	63	63	65	64	63.8	0.837	1.311	
	64	63	64	64	63	63.6	0.548	0.861	
	63	63	64	64	65	63.8	0.837	1.311	
						63.7	0.740	1.161	1.838

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APPENDIX D

D. Data of Weight Swelling

Table D.1 Swelling of GRT and RTR.

Batch	Weight	% weight swelling					X	SD	RSD	interval of confidence at %95
		1	2	3	4	5				
A0	W_w	8.04	7.88	7.16	7.86	8.16	7.82	0.389	4.972	
	w_d	1.52	1.49	1.36	1.49	1.55	1.48	0.073	4.898	
	$(W_w - W_d)/W_d$	428.95	428.86	426.47	427.52	426.45	427.65	1.22	0.29	3.0
A1	W_w	6.97	7.12	7.03	7.02	7.45	7.12	0.193	2.716	
	w_d	1.75	1.79	1.76	1.77	1.88	1.79	0.052	2.930	
	$(W_w - W_d)/W_d$	298.29	297.77	299.43	296.61	296.28	297.67	1.28	0.430	3.2
A3	W_w	5.51	5.89	5.60	5.64	5.77	5.68	0.149	2.626	
	w_d	1.76	1.89	1.80	1.81	1.85	1.82	0.050	2.728	
	$(W_w - W_d)/W_d$	213.07	211.64	211.11	211.60	211.89	211.86	0.731	0.345	1.8
A5	W_w	5.28	5.52	5.29	5.29	5.23	5.32	0.113	2.132	
	w_d	2.23	2.32	2.22	2.21	2.20	2.24	0.048	2.159	
	$(W_w - W_d)/W_d$	136.77	137.93	138.29	139.37	137.73	138.02	0.940	0.681	2.3
B0	W_w	4.74	4.77	4.59	4.58	4.82	4.70	0.109	2.316	
	w_d	2.12	2.13	2.07	2.06	2.16	2.11	0.042	1.996	
	$(W_w - W_d)/W_d$	123.58	123.94	121.74	122.33	123.15	122.95	0.91	0.737	2.2
B1	W_w	4.74	4.59	4.13	4.54	4.74	4.55	0.250	5.500	
	w_d	2.26	2.18	1.96	2.17	2.25	2.16	0.121	5.589	
	$(W_w - W_d)/W_d$	109.73	110.55	110.71	109.22	110.67	110.18	0.67	0.61	1.7
B3	W_w	4.34	4.34	4.32	4.36	4.28	4.33	0.030	0.701	
	w_d	2.15	2.14	2.14	2.16	2.12	2.14	0.015	0.692	
	$(W_w - W_d)/W_d$	101.86	102.80	101.87	101.85	101.89	102.05	0.419	0.411	1.0
B5	W_w	4.16	4.30	4.21	4.32	4.28	4.25	0.067	1.573	
	w_d	2.10	2.19	2.14	2.19	2.18	2.16	0.039	1.823	
	$(W_w - W_d)/W_d$	98.10	96.35	96.73	97.26	96.33	96.95	0.742	0.766	1.8

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Table D.2 Swelling of Rigid PVC with GRT and RTR.

Batch	Weight swelling	Weight Swelling					X	SD	RSD	interval of confidence at %95
		1	2	3	4	5				
R100	W_w	1.22	1.39	1.23	1.24	1.26	1.27	0.070	5.504	
	w_d	1.07	1.26	1.10	1.11	1.11	1.13	0.074	6.593	
	$(W_w - W_d)/W_d$	14.02	10.32	11.82	11.71	13.51	12.28	1.49	12.17	3.7
R0	W_w	1.05	1.41	1.15	1.44	1.22	1.25	0.168	13.375	
	w_d	0.78	1.05	0.85	1.07	0.92	0.93	0.125	13.428	
	$(W_w - W_d)/W_d$	34.62	34.29	35.29	34.58	32.61	34.28	1.003	2.926	2.5
R1	W_w	1.10	1.42	1.27	1.27	1.21	1.25	0.116	9.241	
	w_d	0.83	1.06	0.95	0.96	0.90	0.94	0.085	8.995	
	$(W_w - W_d)/W_d$	32.53	33.96	33.68	32.29	34.44	33.38	0.93	2.791	2.3
R3	W_w	0.99	1.46	1.15	1.44	1.22	1.25	0.199	15.908	
	w_d	0.76	1.13	0.88	1.10	0.94	0.96	0.154	16.043	
	$(W_w - W_d)/W_d$	30.26	29.20	30.68	30.91	29.79	30.17	0.689	2.283	1.7
R5	W_w	1.27	1.31	1.15	1.44	1.22	1.28	0.108	8.489	
	w_d	0.99	1.02	0.89	1.12	0.94	0.99	0.087	8.771	
	$(W_w - W_d)/W_d$	28.28	28.43	29.21	28.57	29.79	28.86	0.629	2.181	1.6
G0	W_w	1.42	1.48	1.14	1.44	1.22	1.34	0.150	11.219	
	w_d	1.02	1.07	0.83	1.05	0.88	0.97	0.108	11.127	
	$(W_w - W_d)/W_d$	39.22	38.32	37.35	37.14	38.64	38.13	0.874	2.291	2.2
G1	W_w	1.68	1.58	1.27	1.29	1.21	1.41	0.210	14.907	
	w_d	1.24	1.16	0.94	0.94	0.91	1.04	0.151	14.553	
	$(W_w - W_d)/W_d$	35.48	36.21	35.11	37.23	32.97	35.40	1.58	4.473	3.9
G3	W_w	1.40	1.30	1.15	1.34	1.12	1.26	0.122	9.646	
	w_d	1.10	1.04	0.89	1.06	0.91	1.00	0.094	9.407	
	$(W_w - W_d)/W_d$	27.27	25.00	29.21	26.42	23.08	26.20	2.317	8.844	5.8
G5	W_w	1.19	1.12	1.15	1.44	1.22	1.22	0.127	10.344	
	w_d	0.94	0.90	0.92	1.15	0.98	0.98	0.101	10.286	
	$(W_w - W_d)/W_d$	26.60	24.44	25.00	25.22	24.49	25.15	0.873	3.473	2.2
E1	W_w	1.30	1.30	1.27	1.29	1.36	1.30	0.034	2.578	
	w_d	1.11	1.11	1.08	1.11	1.16	1.11	0.029	2.586	
	$(W_w - W_d)/W_d$	17.12	17.12	17.59	16.22	17.24	17.06	0.51	2.98	1.3
E2	W_w	1.23	1.30	1.29	1.34	1.14	1.26	0.078	6.173	
	w_d	1.02	1.09	1.09	1.11	0.94	1.05	0.070	6.701	
	$(W_w - W_d)/W_d$	20.59	19.27	18.35	20.72	21.28	20.04	1.20	5.984	3.0
E3	W_w	1.05	1.41	1.15	1.44	1.22	1.25	0.168	13.375	
	w_d	0.78	1.05	0.85	1.07	0.92	0.93	0.125	13.428	
	$(W_w - W_d)/W_d$	34.62	34.29	35.29	34.58	32.61	34.28	1.003	2.926	2.5
E4	W_w	1.33	1.28	1.25	1.34	1.32	1.30	0.038	2.900	
	w_d	0.93	0.90	0.88	0.95	0.92	0.92	0.027	2.950	
	$(W_w - W_d)/W_d$	43.01	42.22	42.05	41.05	43.48	42.36	0.936	2.208	2.3
E5	W_w	0.94	1.23	1.27	1.29	1.21	1.19	0.142	11.969	
	w_d	0.81	1.07	1.09	1.13	1.05	1.03	0.126	12.281	
	$(W_w - W_d)/W_d$	16.05	14.95	16.51	14.16	15.24	15.38	0.93	6.016	2.3
E6	W_w	1.13	1.35	1.17	1.15	1.20	1.20	0.088	7.312	
	w_d	0.95	1.15	0.99	0.97	1.01	1.01	0.079	7.815	
	$(W_w - W_d)/W_d$	18.95	17.39	18.18	18.56	18.81	18.38	0.62	3.394	1.5

Table D.2 Swelling of Rigid PVC with GRT and RTR, (Continued)

Batch	Weight swelling	Weight Swelling					X	SD	RSD	interval of confidence at %95
		1	2	3	4	5				
E7	W_w	0.99	1.46	1.15	1.44	1.22	1.25	0.199	15.908	
	w_d	0.76	1.13	0.88	1.10	0.94	0.96	0.154	16.043	
	$(W_w - W_d)/W_d$	30.26	29.20	30.68	30.91	29.79	30.17	0.689	2.283	1.7
E8	W_w	1.44	1.12	1.11	1.32	1.27	1.25	0.140	11.145	
	w_d	1.09	0.85	0.84	0.99	0.96	0.95	0.104	11.001	
	$(W_w - W_d)/W_d$	32.11	31.76	32.14	33.33	32.29	32.33	0.594	1.837	1.5
E9	W_w	1.21	1.31	1.14	1.27	1.24	1.23	0.064	5.208	
	w_d	0.90	0.98	0.85	0.94	0.93	0.92	0.048	5.269	
	$(W_w - W_d)/W_d$	34.44	33.67	34.12	35.11	33.33	34.14	0.688	2.017	1.7
F1	W_w	1.33	1.35	1.23	1.24	1.26	1.28	0.054	4.251	
	w_d	1.14	1.17	1.06	1.07	1.08	1.10	0.048	4.372	
	$(W_w - W_d)/W_d$	16.67	15.38	16.04	15.89	16.67	16.13	0.55	3.39	1.4
F2	W_w	1.28	1.22	1.27	1.29	1.21	1.25	0.036	2.908	
	w_d	1.06	1.04	1.05	1.10	1.01	1.05	0.033	3.109	
	$(W_w - W_d)/W_d$	20.75	17.31	20.95	17.27	19.80	19.22	1.81	9.433	4.5
F3	W_w	1.38	1.29	1.27	1.26	1.35	1.31	0.052	4.003	
	w_d	1.03	0.98	0.95	0.95	1.01	0.98	0.036	3.636	
	$(W_w - W_d)/W_d$	33.98	31.63	33.68	32.63	33.66	33.12	0.98	2.945	2.4
F4	W_w	1.42	1.48	1.14	1.44	1.22	1.34	0.150	11.219	
	w_d	1.02	1.07	0.83	1.05	0.88	0.97	0.108	11.127	
	$(W_w - W_d)/W_d$	39.22	38.32	37.35	37.14	38.64	38.13	0.874	2.291	2.2
F5	W_w	1.42	1.57	1.35	1.44	1.24	1.40	0.121	8.644	
	w_d	0.96	1.06	0.91	0.98	0.83	0.95	0.085	8.994	
	$(W_w - W_d)/W_d$	47.92	48.11	48.35	46.94	49.40	48.14	0.883	1.834	2.2
F6	W_w	1.10	1.22	1.24	1.26	1.21	1.21	0.062	5.165	
	w_d	0.96	1.06	1.09	1.11	1.05	1.05	0.058	5.475	
	$(W_w - W_d)/W_d$	14.58	15.09	13.76	13.51	15.24	14.44	0.78	5.370	1.9
F7	W_w	1.27	1.29	1.21	1.13	1.20	1.22	0.063	5.184	
	w_d	1.09	1.11	1.05	0.97	1.02	1.05	0.056	5.330	
	$(W_w - W_d)/W_d$	16.51	16.22	15.24	16.49	17.65	16.42	0.86	5.237	2.1
F8	W_w	1.19	1.21	1.14	1.24	1.13	1.18	0.047	3.941	
	w_d	0.99	1.01	0.95	1.04	0.93	0.98	0.044	4.522	
	$(W_w - W_d)/W_d$	20.20	19.80	20.00	19.23	21.51	20.15	0.841	4.174	2.1
F9	W_w	1.40	1.30	1.15	1.34	1.12	1.26	0.122	9.646	
	w_d	1.10	1.04	0.89	1.06	0.91	1.00	0.094	9.407	
	$(W_w - W_d)/W_d$	27.27	25.00	29.21	26.42	23.08	26.20	2.317	8.844	5.8
F10	W_w	1.37	1.43	1.35	1.52	1.24	1.38	0.103	7.474	
	w_d	1.04	1.08	1.03	1.17	0.94	1.05	0.083	7.936	
	$(W_w - W_d)/W_d$	31.73	32.41	31.07	29.91	31.91	31.41	0.963	3.065	2.4
F11	W_w	1.28	1.40	1.43	1.27	1.39	1.35	0.074	5.442	
	w_d	0.96	1.05	1.08	0.95	1.04	1.02	0.058	5.680	
	$(W_w - W_d)/W_d$	33.33	33.33	32.41	33.68	33.65	33.28	0.517	1.554	1.3

Table D.2 Swelling of Rigid PVC with GRT and RTR, (Continued).

Batch	Weight swelling	Weight Swelling					X	SD	RSD	interval of confidence at %95
		1	2	3	4	5				
G1	W_w	1.44	1.12	1.11	1.32	1.27	1.25	0.140	11.145	
	w_d	1.09	0.85	0.84	0.99	0.96	0.95	0.104	11.001	
	$(W_w - W_d)/W_d$	32.11	31.76	32.14	33.33	32.29	32.33	0.594	1.837	1.5
G2	W_w	1.39	1.35	1.27	1.39	1.21	1.32	0.079	6.013	
	w_d	1.05	1.01	0.96	1.04	0.90	0.99	0.062	6.271	
	$(W_w - W_d)/W_d$	32.38	33.66	32.29	33.65	34.44	33.29	0.93	2.781	2.3
G3	W_w	1.59	1.53	1.55	1.49	1.51	1.53	0.038	2.508	
	w_d	1.18	1.15	1.15	1.10	1.13	1.14	0.029	2.583	
	$(W_w - W_d)/W_d$	34.75	33.04	34.78	35.45	33.63	34.33	0.97	2.835	2.4
G4	W_w	1.54	1.33	1.55	1.43	1.32	1.43	0.110	7.680	
	w_d	1.13	0.99	1.14	1.06	0.98	1.06	0.075	7.091	
	$(W_w - W_d)/W_d$	36.28	34.34	35.96	34.91	34.69	35.24	0.841	2.386	2.1
G5	W_w	1.36	1.42	1.37	1.39	1.35	1.38	0.028	2.014	
	w_d	1.01	1.06	1.01	1.05	1.01	1.03	0.025	2.422	
	$(W_w - W_d)/W_d$	34.65	33.96	35.64	32.38	33.66	34.06	1.21	3.549	3.0
G6	W_w	1.48	1.36	1.17	1.15	1.20	1.27	0.143	11.220	
	w_d	1.09	1.01	0.87	0.85	0.88	0.94	0.105	11.158	
	$(W_w - W_d)/W_d$	35.78	34.65	34.48	35.29	36.36	35.31	0.78	2.215	1.9
G7	W_w	1.39	1.27	1.16	1.44	1.22	1.30	0.117	9.008	
	w_d	1.02	0.93	0.85	1.06	0.90	0.95	0.086	9.079	
	$(W_w - W_d)/W_d$	36.27	36.56	36.47	35.85	35.56	36.14	0.427	1.181	1.1
H1	W_w	1.37	1.43	1.35	1.52	1.24	1.38	0.103	7.474	
	w_d	1.04	1.08	1.03	1.17	0.94	1.05	0.083	7.936	
	$(W_w - W_d)/W_d$	31.73	32.41	31.07	29.91	31.91	31.41	0.963	3.065	2.4
H2	W_w	1.35	1.40	1.37	1.39	1.35	1.37	0.023	1.662	
	w_d	1.01	1.05	1.04	1.05	1.03	1.04	0.017	1.615	
	$(W_w - W_d)/W_d$	33.66	33.33	31.73	32.38	31.07	32.44	1.08	3.336	2.7
H3	W_w	1.34	1.35	1.50	1.39	1.50	1.42	0.079	5.574	
	w_d	1.01	1.01	1.13	1.03	1.13	1.06	0.063	5.895	
	$(W_w - W_d)/W_d$	32.67	33.66	32.74	34.95	32.74	33.35	0.98	2.944	2.4
H4	W_w	1.31	1.34	1.55	1.43	1.34	1.39	0.098	7.040	
	w_d	0.97	0.99	1.16	1.07	1.00	1.04	0.078	7.506	
	$(W_w - W_d)/W_d$	35.05	35.35	33.62	33.64	34.00	34.33	0.814	2.370	2.0
H5	W_w	1.50	1.45	1.37	1.40	1.42	1.43	0.050	3.480	
	w_d	1.12	1.09	1.02	1.06	1.06	1.07	0.037	3.497	
	$(W_w - W_d)/W_d$	33.93	33.03	34.31	32.08	33.96	33.46	0.91	2.716	2.3
H6	W_w	1.44	1.36	1.27	1.15	1.24	1.29	0.112	8.643	
	w_d	1.08	1.01	0.94	0.86	0.92	0.96	0.085	8.833	
	$(W_w - W_d)/W_d$	33.33	34.65	35.11	33.72	34.78	34.32	0.75	2.198	1.9
H7	W_w	1.43	1.30	1.17	1.46	1.30	1.33	0.116	8.746	
	w_d	1.06	0.96	0.86	1.08	0.96	0.98	0.089	9.021	
	$(W_w - W_d)/W_d$	34.91	35.42	36.05	35.19	35.42	35.39	0.421	1.189	1.0

APPENDIX E

E. Thermal Properties by DSC of PVC with Tire-rubber wastes (GRT and RTR).

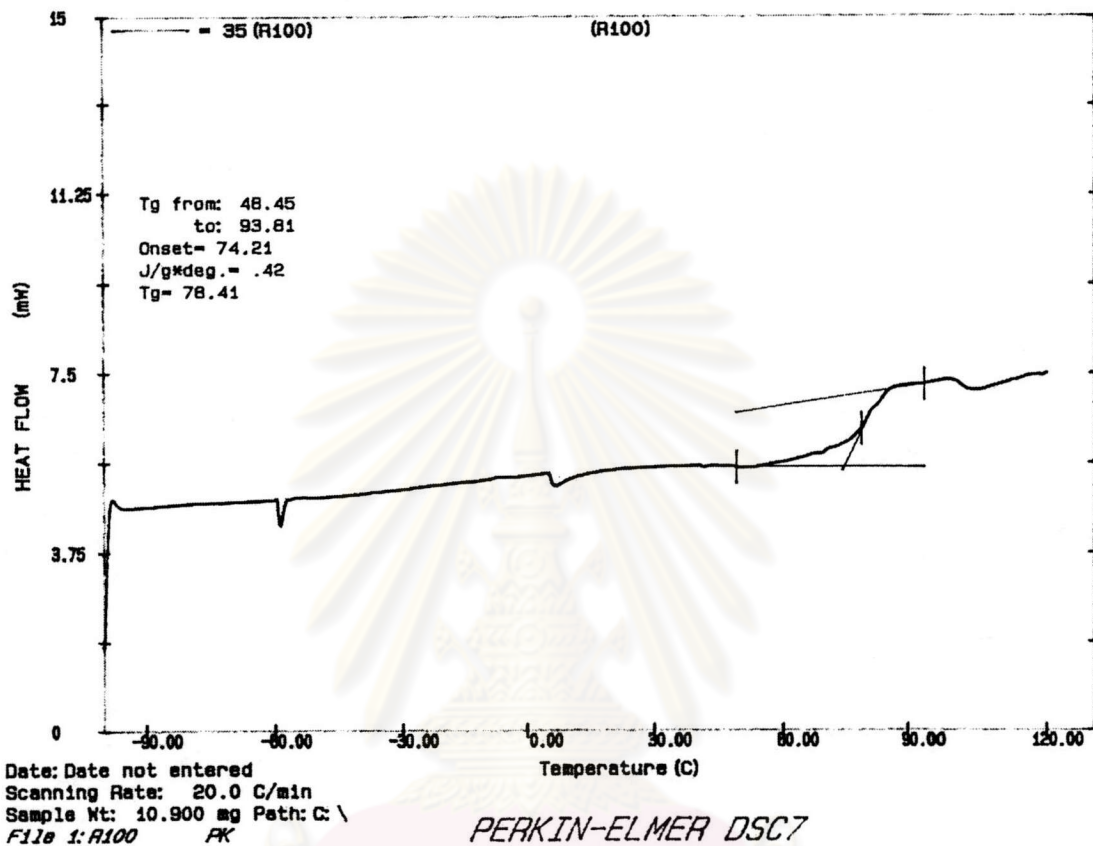


Figure E.1 DSC thermogram on heating curve of R-PVC.

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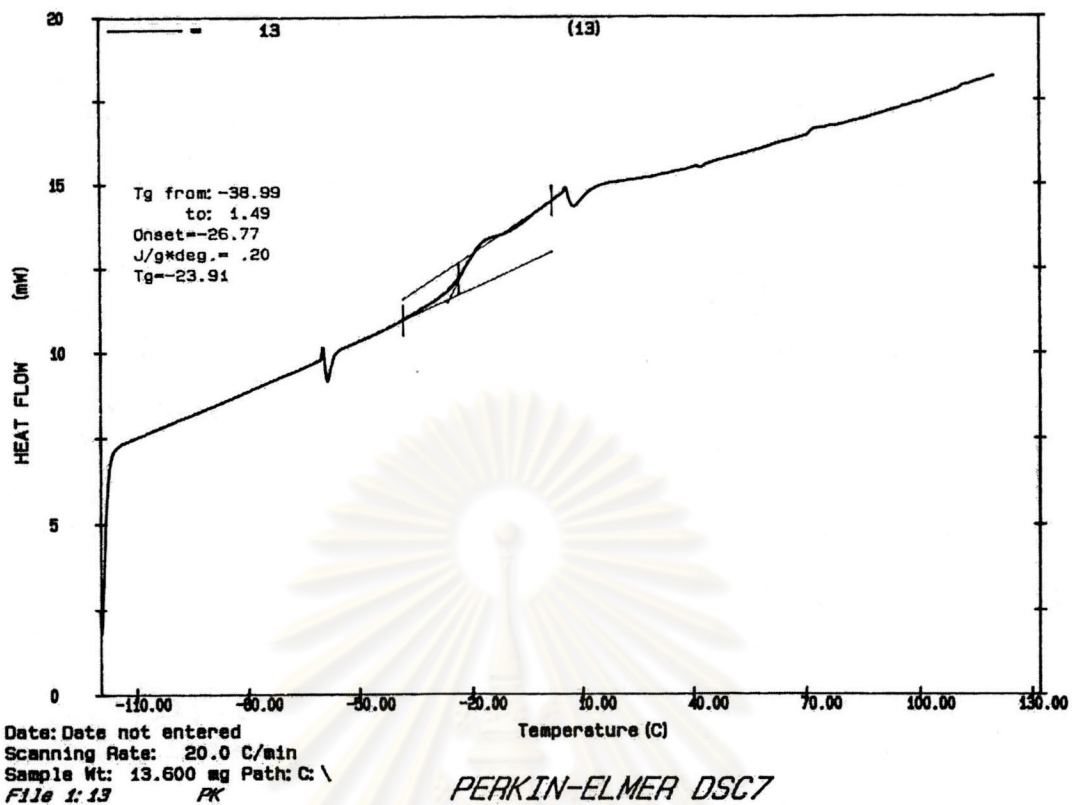


Figure E.2 DSC thermogram on heating curve of nitrile butadiene rubber (NBR).

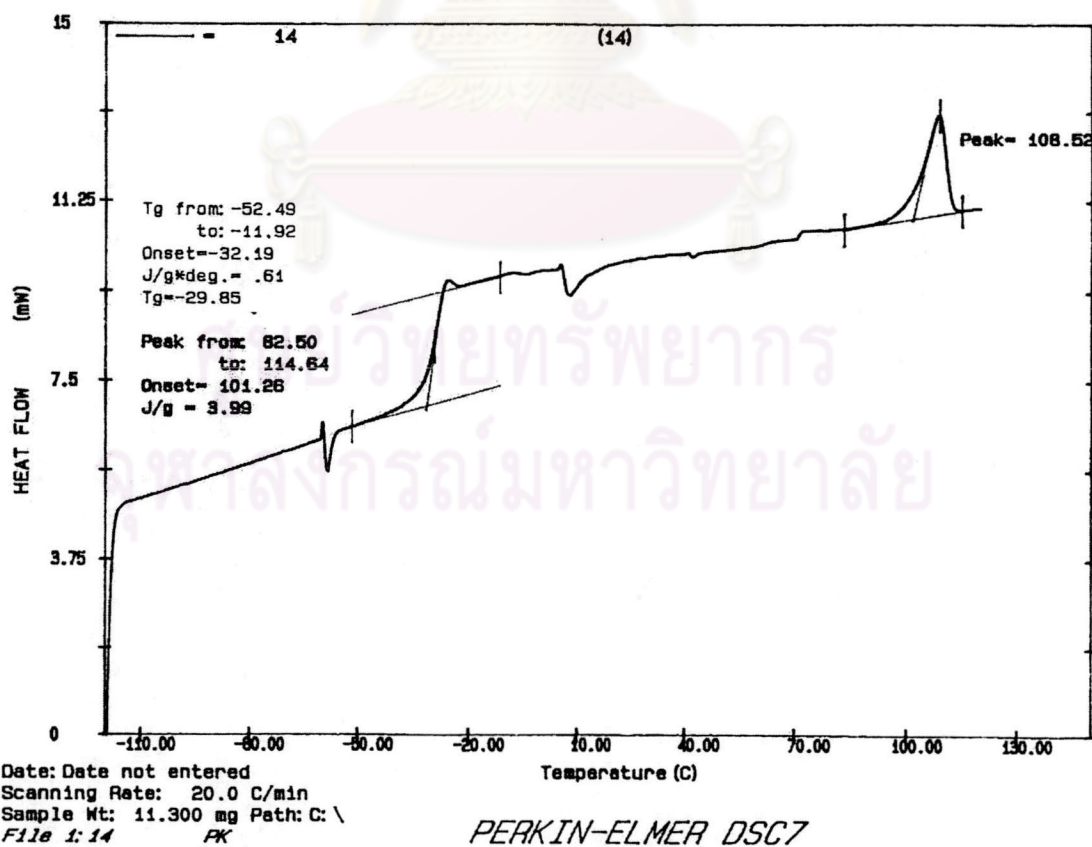


Figure E.3 DSC thermogram on heating curve of chlorosulfonated polyethylene (CSPE).

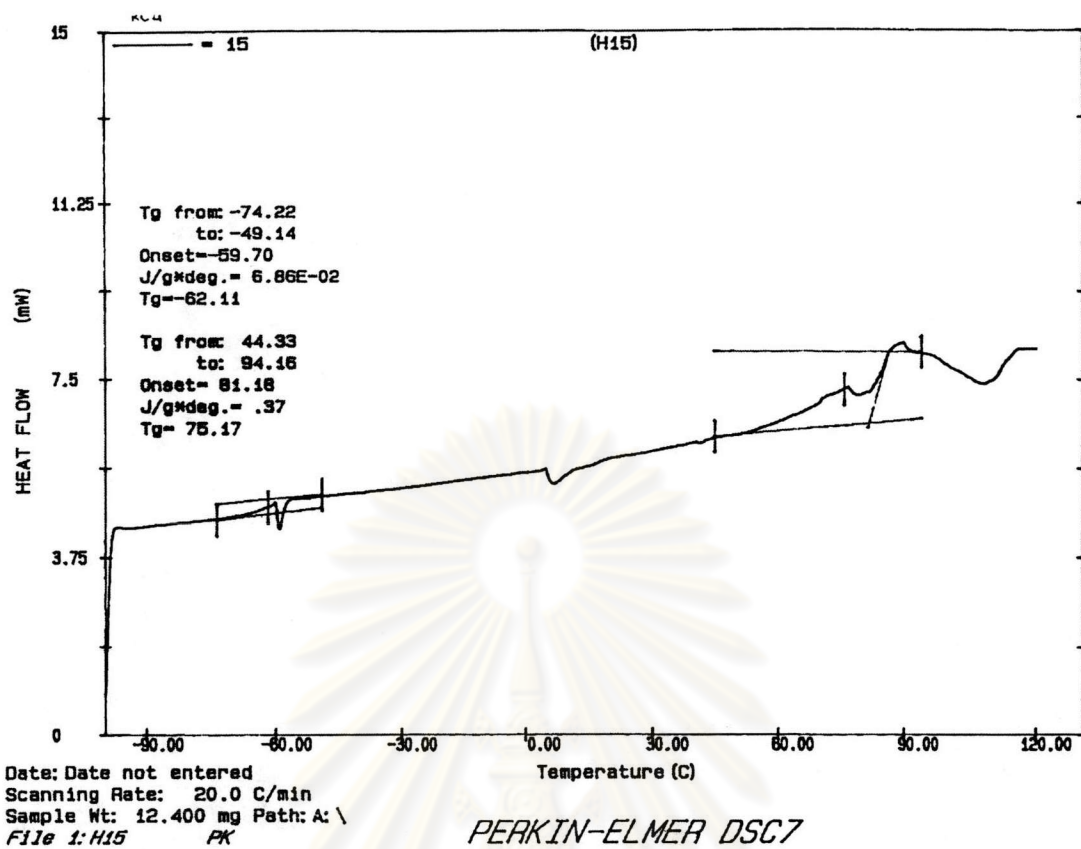


Figure E.4 DSC thermogram on heating curve of R-PVC/CI-RTR, 40 phr.

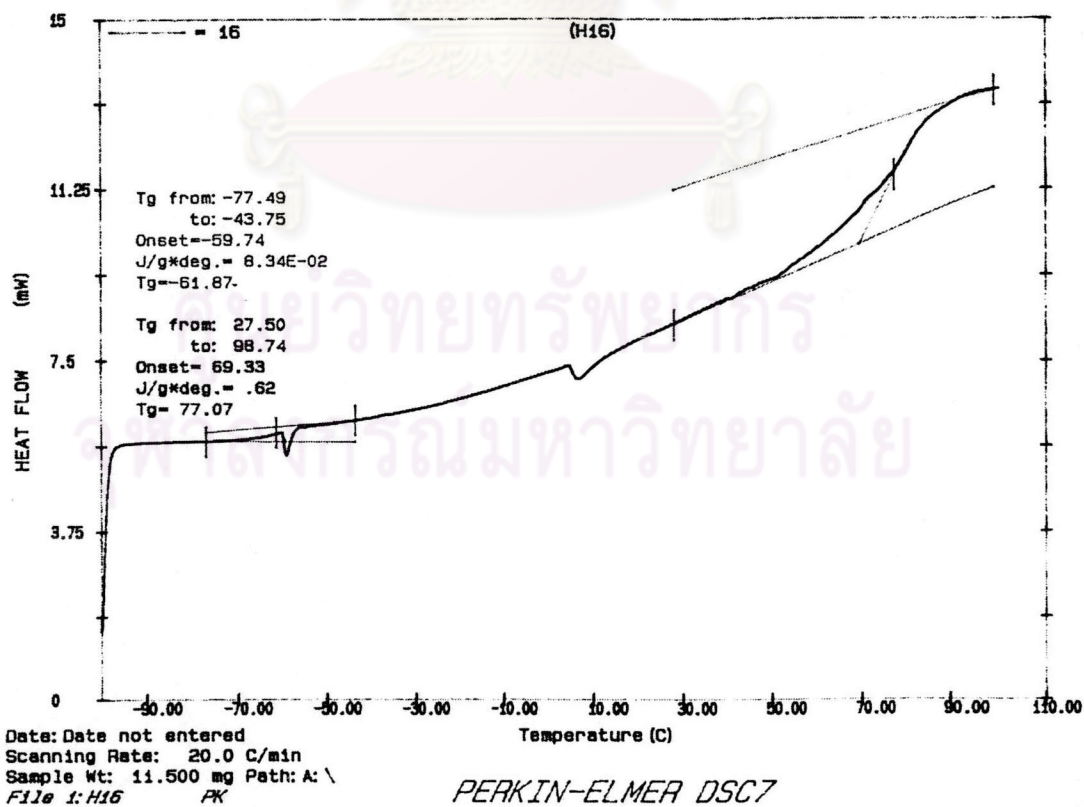


Figure E.5 DSC thermogram on heating curve of R-PVC/CI-GRT, 50 phr.

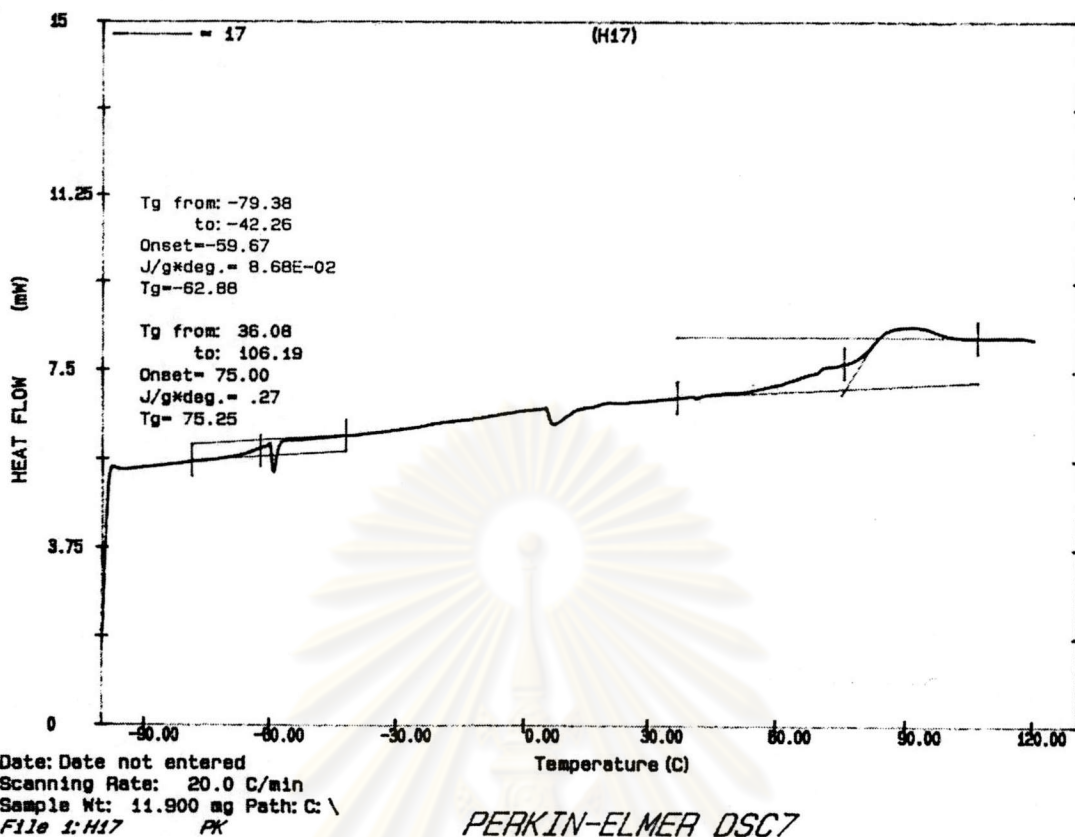


Figure E.6 DSC thermogram on heating curve of R-PVC/Cl-RTR/CSPE, 100/40/10.

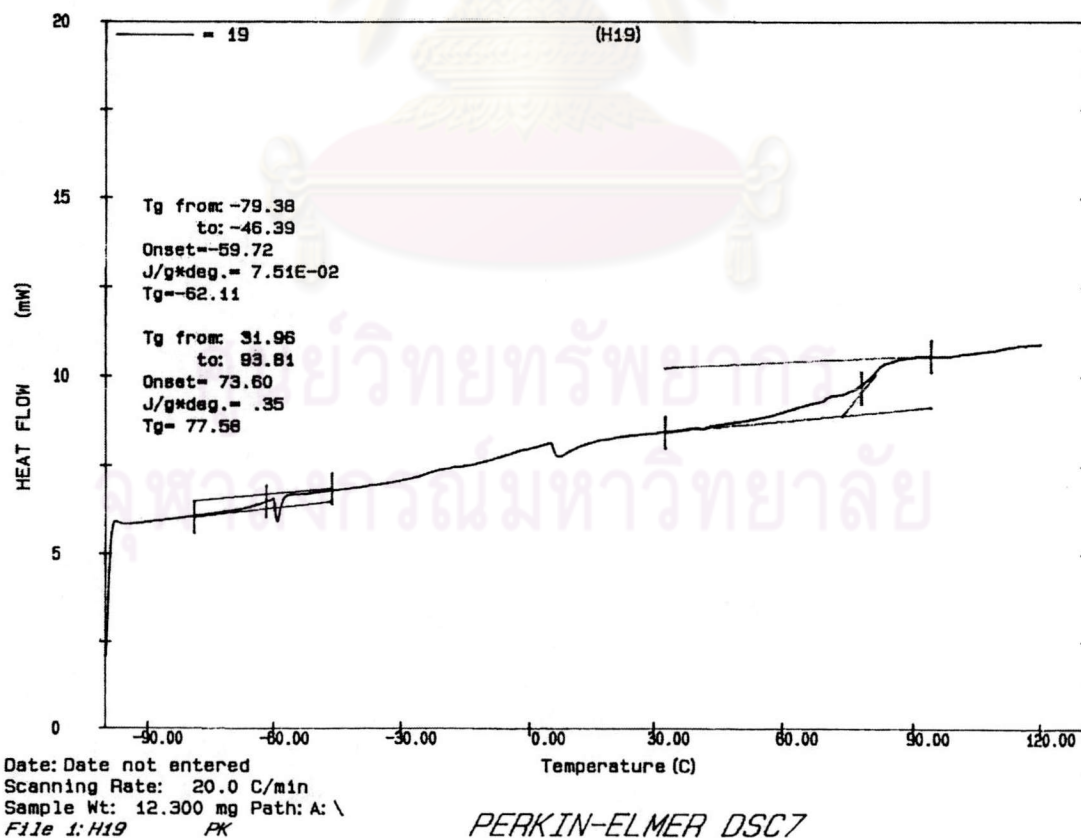


Figure E.7 DSC thermogram on heating curve of R-PVC/Cl-RTR/CSPE, 100/40/20.

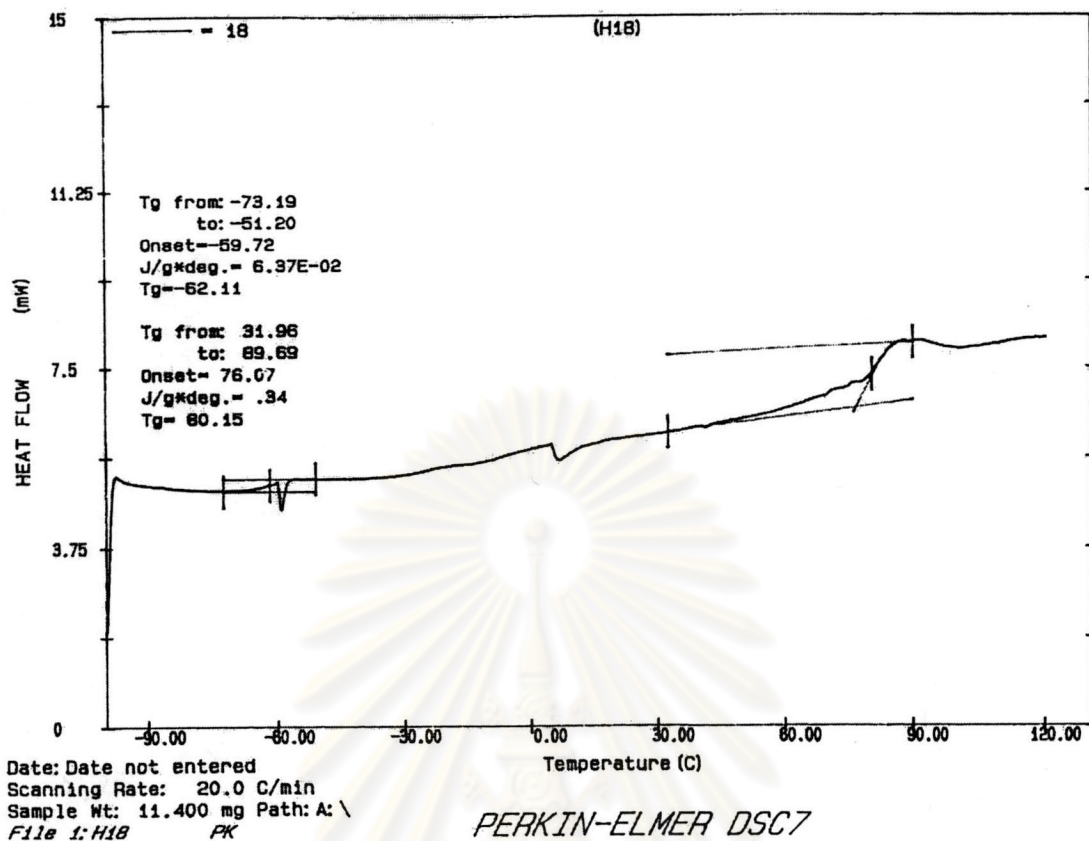


Figure E.8 DSC thermogram on heating curve of R-PVC/Cl-RTR/CSPE, 100/40/30.

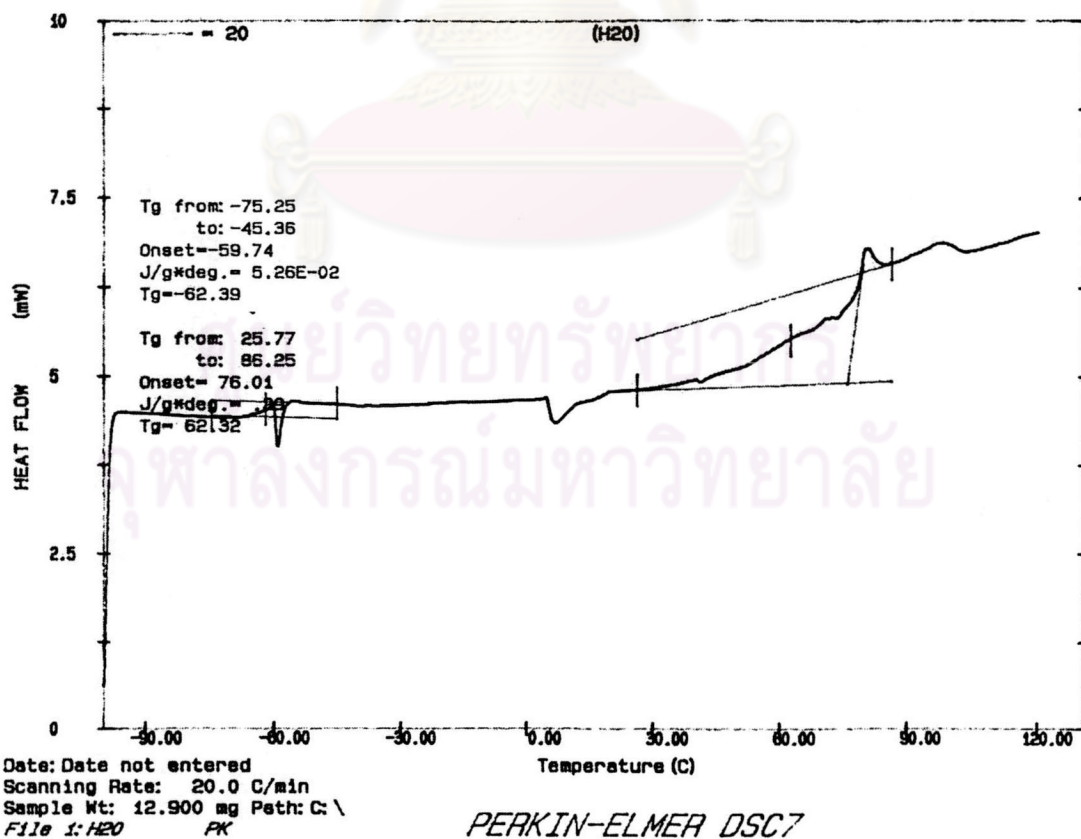


Figure E.9 DSC thermogram on heating curve of R-PVC/Cl-RTR/NBR, 100/40/10.

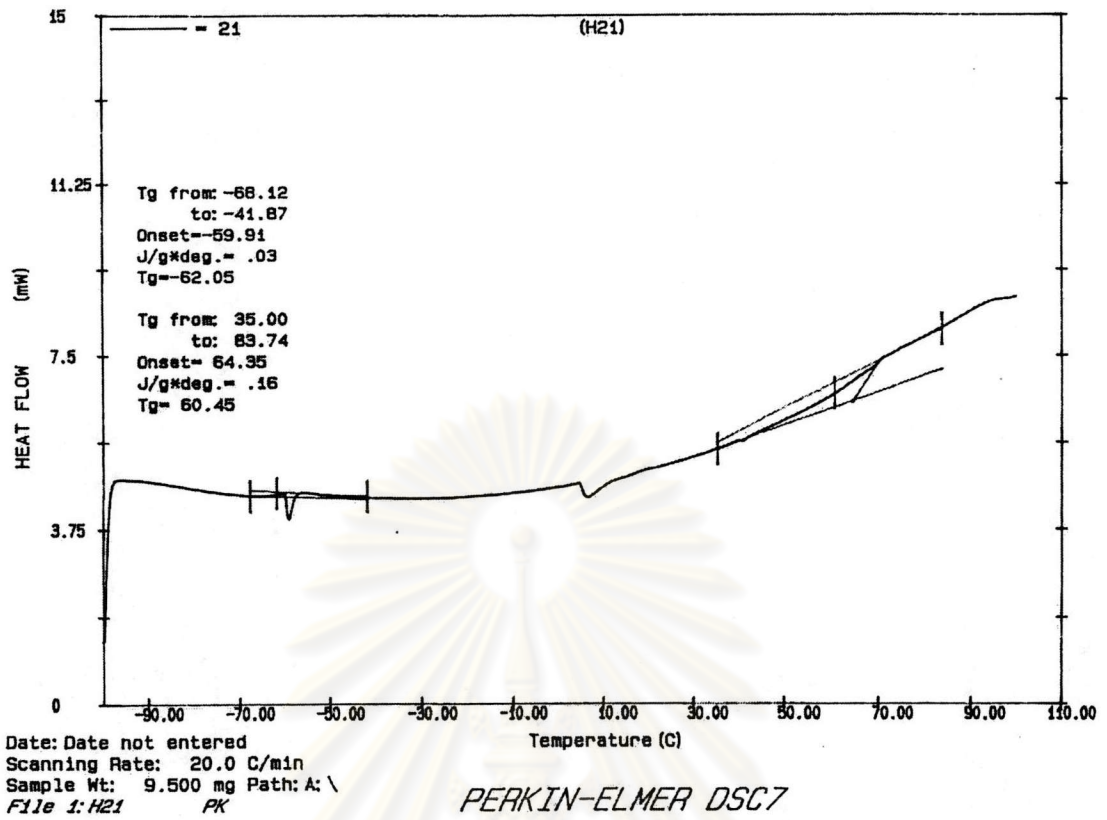


Figure E.10 DSC thermogram on heating curve of R-PVC/Cl-RTR/NBR, 100/40/20.

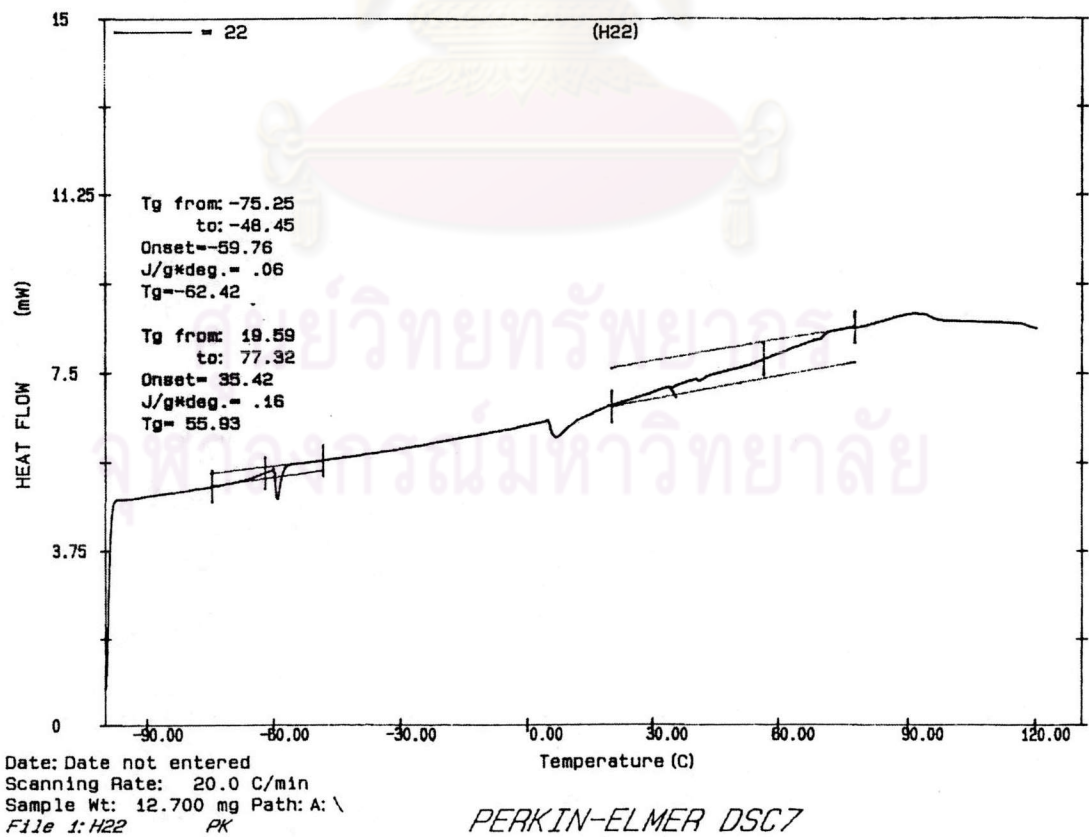


Figure E.11 DSC thermogram on heating curve of R-PVC/Cl-RTR/NBR, 100/40/30.

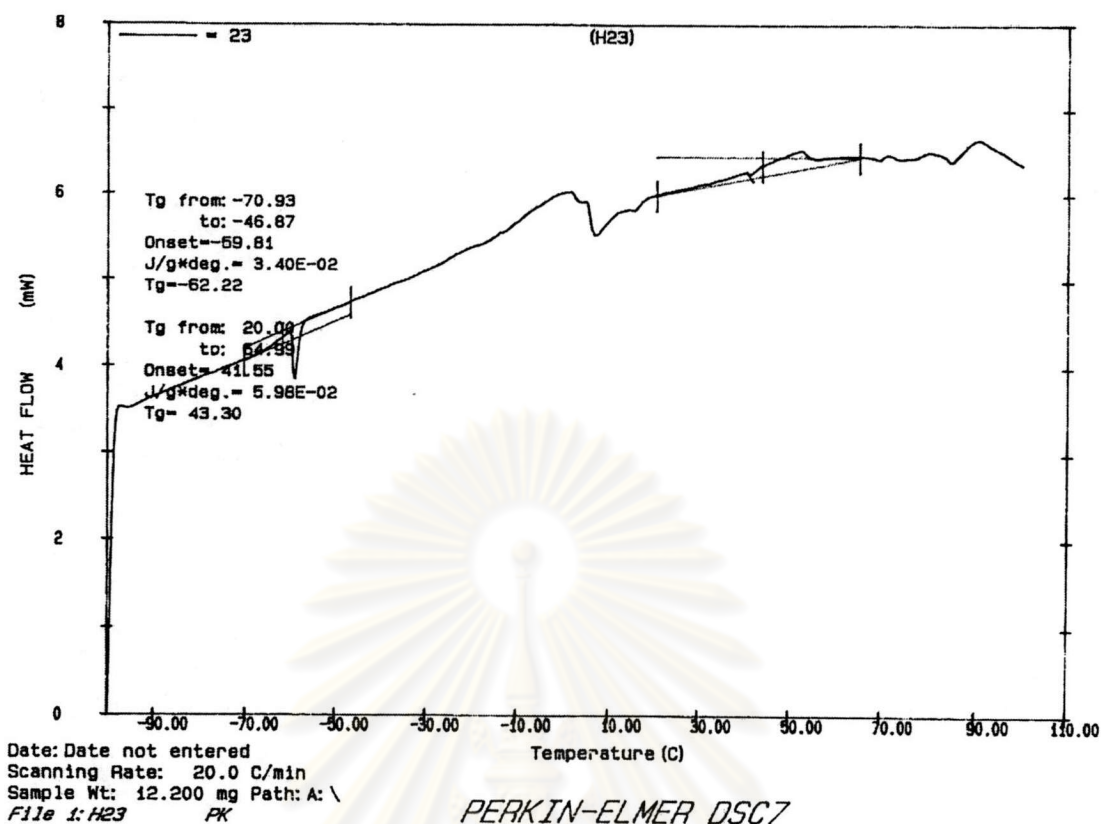


Figure E.12 DSC thermogram on heating curve of R-PVC/Cl-GRT/CSPE, 100/50/10

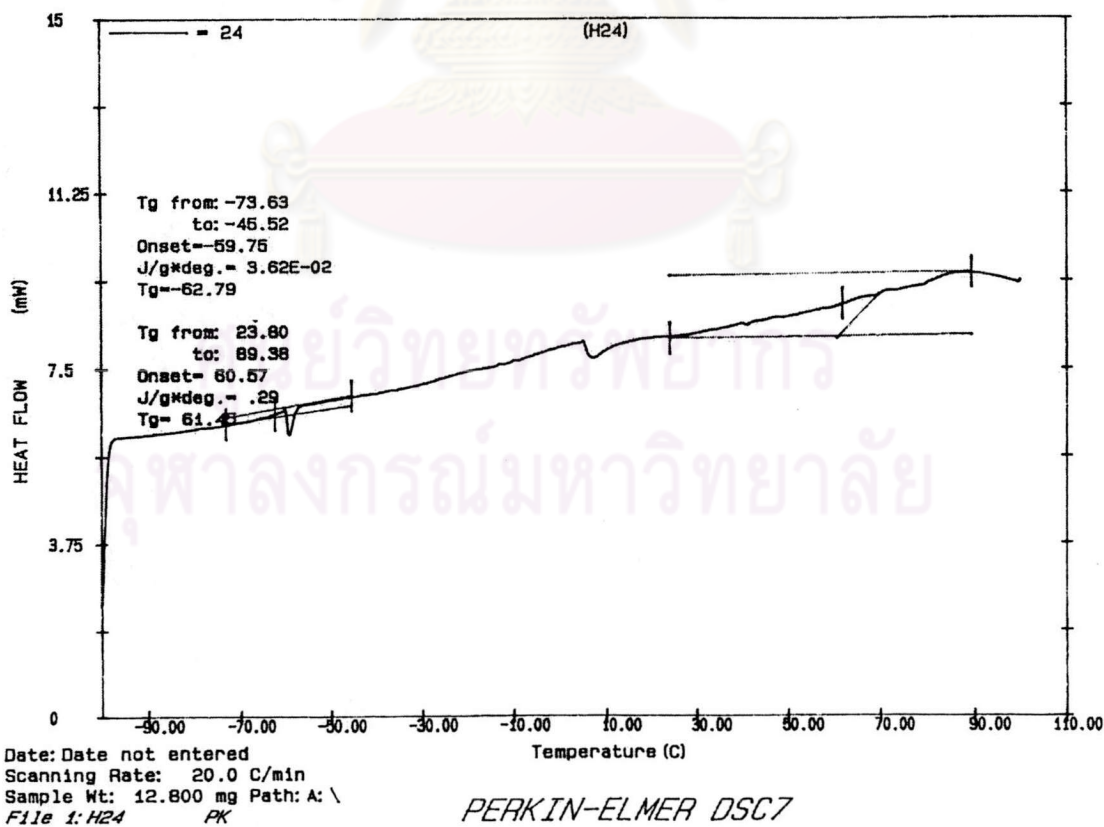


Figure E.13 DSC thermogram on heating curve of R-PVC/Cl-GRT/CSPE, 100/50/20.

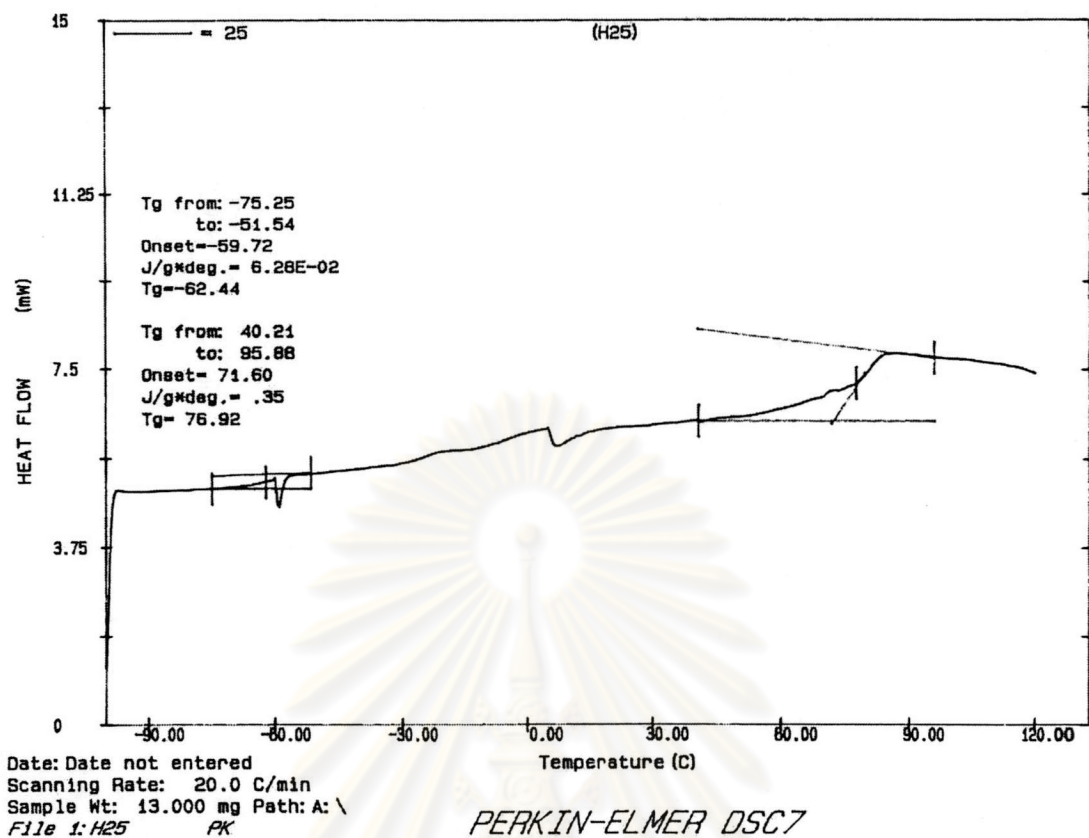


Figure E.14 DSC thermogram on heating curve of R-PVC/Cl-GRT/CSPE, 100/50/30.

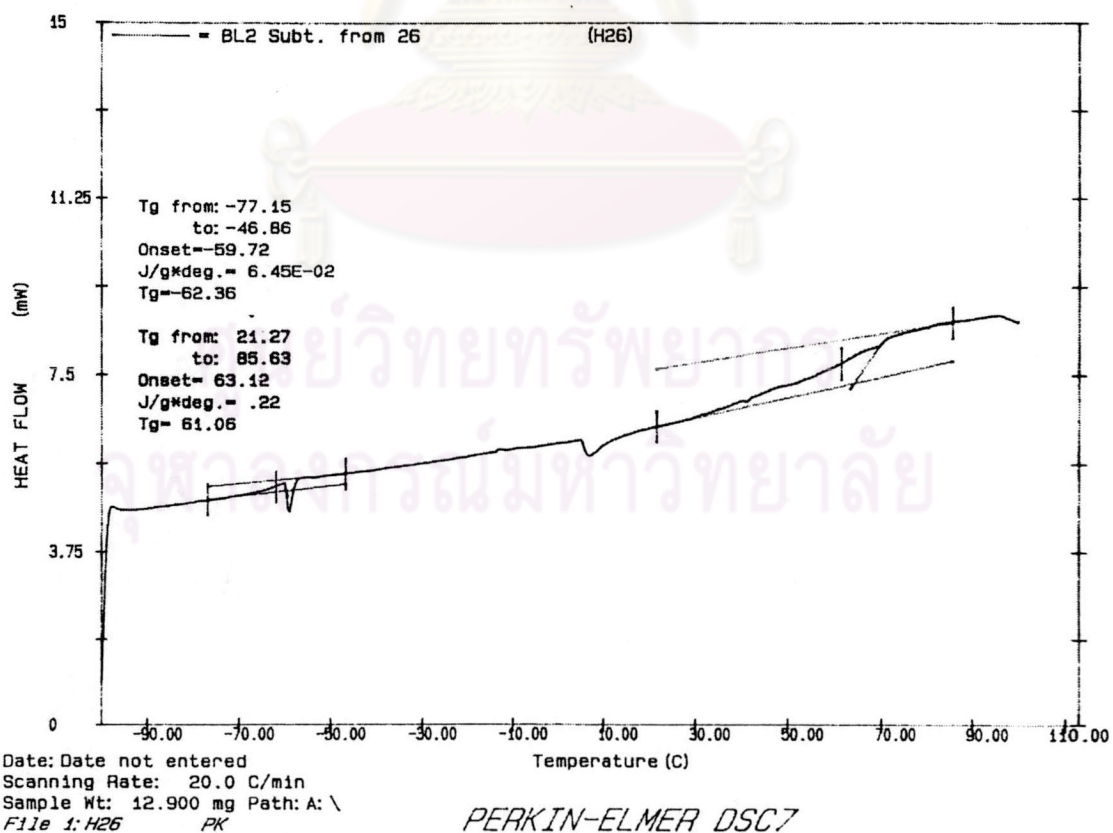


Figure E.15 DSC thermogram on heating curve of R-PVC/Cl-GRT/NBR, 100/50/10.

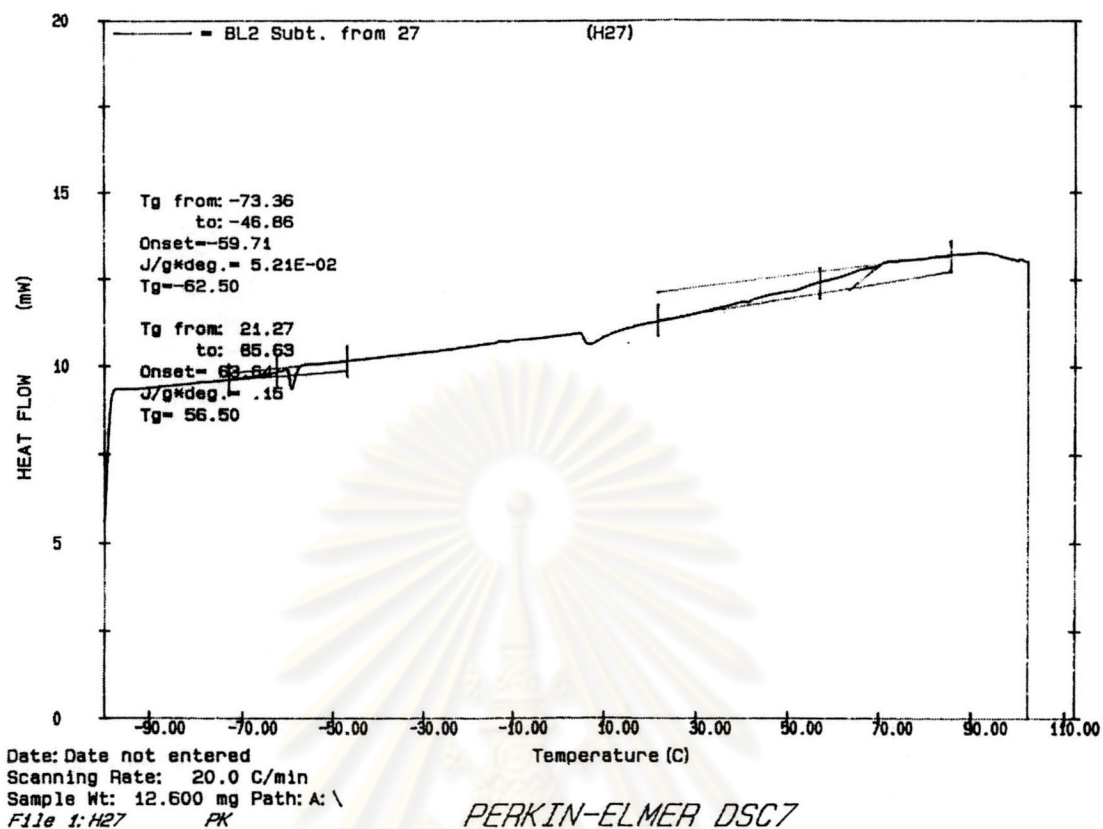


Figure E.16 DSC thermogram on heating curve of R-PVC/Cl-GRT/NBR, 100/50/20.

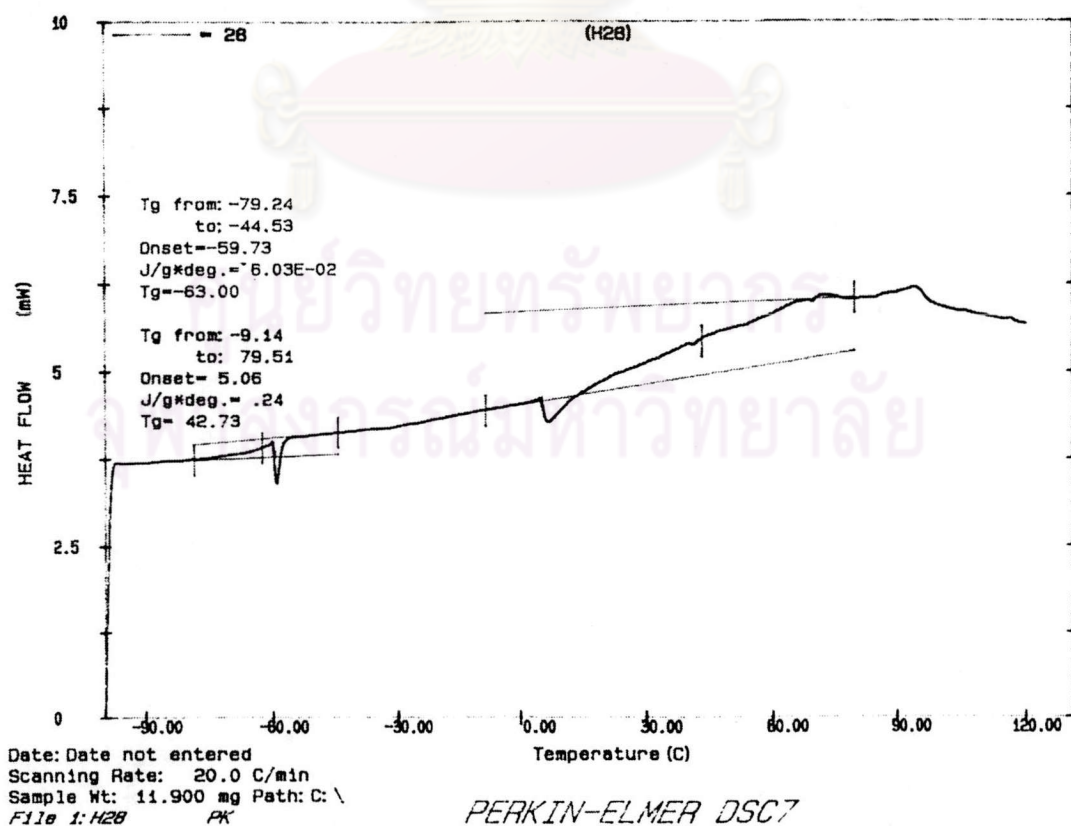


Figure E.17 DSC thermogram on heating curve of R-PVC/Cl-GRT/NBR, 100/50/30.

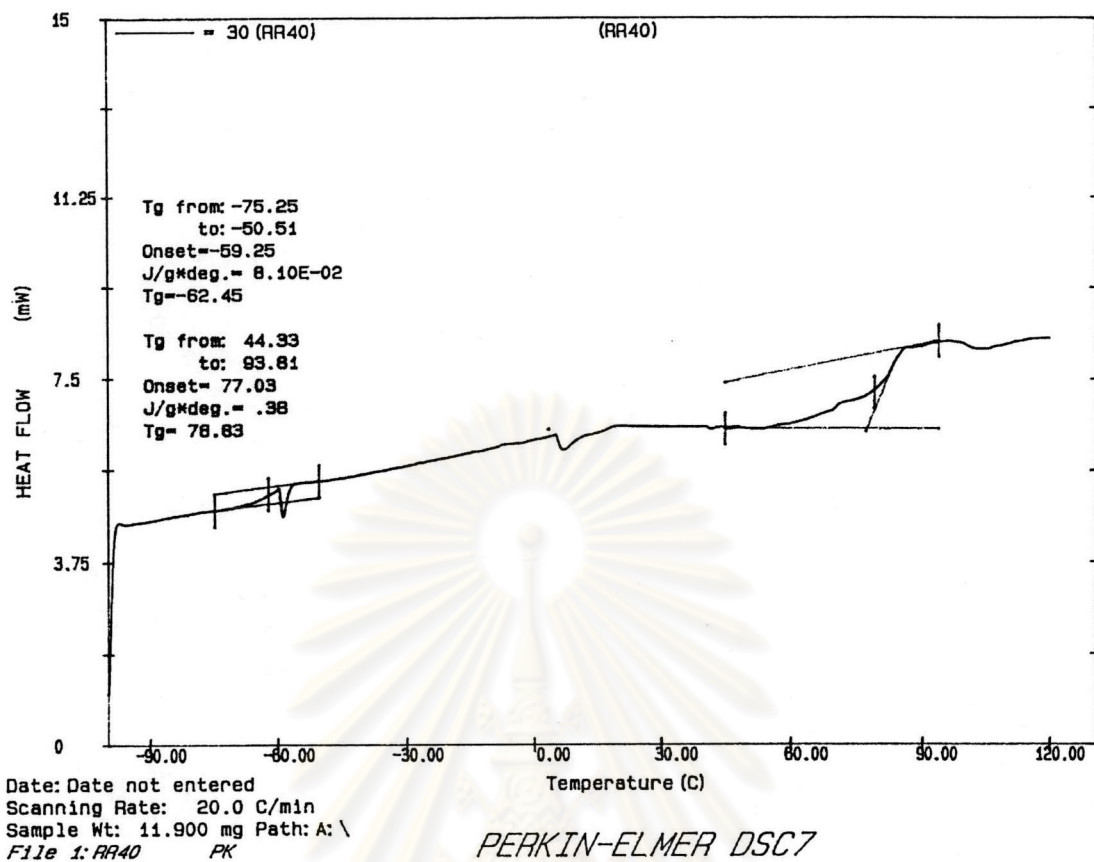


Figure E.18 DSC thermogram on heating curve of R-PVC/RTR, 100/30.

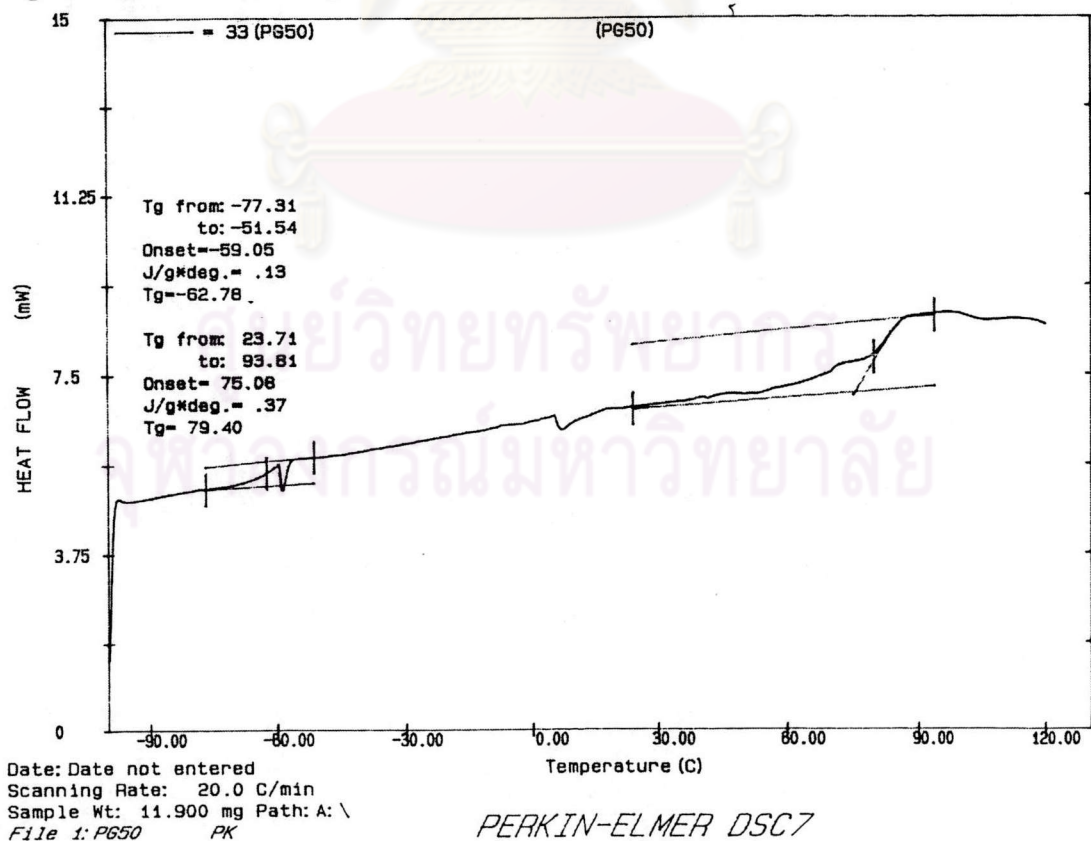


Figure E.19 DSC thermogram on heating curve of R-PVC/GRT, 100/40.

APPDENDIX F

F. Thermal Properties by DMTA of PVC with Tire-rubber wastes (GRT and RTR).

Table F-1 Thermal properties by DMTA of PVC/GRT, 40 phr.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.43	7.16E+08	7.71E+07	0.10768
-76.91	7.36E+08	8.63E+07	0.1172
-73.9	7.41E+08	1.02E+08	0.12773
-70.88	6.91E+08	1.06E+08	0.14382
-68.01	6.87E+08	1.08E+08	0.16759
-65.04	6.79E+08	1.15E+08	0.18458
-62.25	6.62E+08	1.14E+08	0.23006
-58.45	6.51E+08	1.20E+08	0.21675
-56.21	5.63E+08	1.29E+08	0.20484
-53.06	5.65E+08	1.10E+08	0.19575
-50.05	5.50E+08	1.03E+08	0.18812
-46.12	5.36E+08	9.18E+07	0.17099
-44.27	5.08E+08	7.48E+07	0.1573
-41.07	5.11E+08	7.48E+07	0.14646
-38	5.01E+08	5.91E+07	0.13815
-35.07	4.96E+08	5.82E+07	0.1273
-32	4.87E+08	5.88E+07	0.12065
-29.01	4.86E+08	5.47E+07	0.11255
-26.02	4.90E+08	5.30E+07	0.10807
-23.19	4.85E+08	5.06E+07	0.10427
-20.01	4.83E+08	5.18E+07	0.10331
-17.17	4.86E+08	4.93E+07	0.10153
-14.1	4.76E+08	5.04E+07	0.10087
-11	4.75E+08	5.18E+07	0.1002
-7.99	4.89E+08	4.46E+07	0.09629
-5.11	4.79E+08	4.64E+07	0.09174
-1.99	4.74E+08	4.09E+07	0.08617
0.92	4.77E+08	4.12E+07	0.08632
3.9	4.80E+08	3.89E+07	0.08116
7.03	4.77E+08	3.90E+07	0.08176
9.97	4.74E+08	3.50E+07	0.07384
12.98	4.91E+08	3.55E+07	0.07219
15.86	4.92E+08	2.94E+07	0.05969
18.99	4.68E+08	2.74E+07	0.05851
22.01	4.88E+08	2.87E+07	0.05876
24.85	4.84E+08	2.58E+07	0.05342
27.99	4.72E+08	2.76E+07	0.05837
30.94	4.86E+08	3.16E+07	0.055
33.91	4.68E+08	2.35E+07	0.05014
36.9	4.83E+08	2.91E+07	0.06016
39.9	4.67E+08	2.66E+07	0.05688
42.86	4.74E+08	3.26E+07	0.06883
45.9	4.87E+08	2.29E+07	0.06003
48.8	4.74E+08	2.83E+07	0.06567
50.02	4.75E+08	3.26E+07	0.06864

Table F-2 Thermal properties by DMTA of PVC/Cl-GRT, 40 phr with 1 %TCICA
w/v in methanol.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.43	6.73E+08	1.19E+08	0.1264
-76.91	7.04E+08	1.07E+08	0.13161
-73.9	6.97E+08	1.17E+08	0.14488
-70.88	6.93E+08	1.22E+08	0.15912
-68.01	7.01E+08	1.20E+08	0.17166
-65.04	7.28E+08	1.39E+08	0.18074
-62.25	7.18E+08	1.19E+08	0.18637
-58.45	7.47E+08	8.74E+07	0.19074
-56.21	7.13E+08	1.02E+08	0.18337
-53.06	6.67E+08	9.63E+07	0.16452
-50.05	6.40E+08	9.87E+07	0.15427
-46.12	6.22E+08	8.67E+07	0.13957
-44.27	6.26E+08	8.89E+07	0.13502
-41.07	5.90E+08	7.65E+07	0.12975
-38	5.87E+08	8.15E+07	0.11079
-35.07	5.72E+08	5.92E+07	0.10751
-32	5.69E+08	6.81E+07	0.10266
-29.01	5.63E+08	5.72E+07	0.10172
-26.02	5.75E+08	4.77E+07	0.09609
-23.19	5.69E+08	4.62E+07	0.09511
-20.01	5.50E+08	5.86E+07	0.09353
-17.17	5.50E+08	5.21E+07	0.09467
-14.1	5.60E+08	5.74E+07	0.09362
-11	5.45E+08	5.41E+07	0.09019
-7.99	5.46E+08	5.96E+07	0.08792
-5.11	5.45E+08	5.82E+07	0.08373
-1.99	5.40E+08	4.01E+07	0.07428
0.92	5.51E+08	5.65E+07	0.07325
3.9	5.54E+08	4.02E+07	0.07258
7.03	5.41E+08	4.22E+07	0.07397
9.97	5.45E+08	4.34E+07	0.07063
12.98	5.36E+08	3.92E+07	0.06311
15.86	5.40E+08	2.81E+07	0.06197
18.99	5.46E+08	3.84E+07	0.06023
22.01	5.38E+08	2.23E+07	0.05937
24.85	5.20E+08	3.45E+07	0.05627
27.99	5.32E+08	2.80E+07	0.05259
30.94	5.23E+08	3.05E+07	0.05329
33.91	5.34E+08	2.92E+07	0.05472
36.9	5.25E+08	2.81E+07	0.05359
39.9	5.16E+08	3.23E+07	0.06262
42.86	5.15E+08	3.31E+07	0.06427
45.9	5.13E+08	2.96E+07	0.06761
48.8	4.98E+08	3.74E+07	0.07518
50.02	5.10E+08	3.11E+07	0.07103

Table F-3 Thermal properties by DMTA of PVC/Cl-GRT, 40 phr with 3 %TCICA
w/v in methanol.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.43	6.73E+08	1.19E+08	0.1264
-76.91	7.04E+08	1.07E+08	0.13161
-73.9	6.97E+08	1.17E+08	0.14488
-70.88	6.93E+08	1.22E+08	0.15912
-68.01	7.01E+08	1.20E+08	0.17166
-65.04	7.28E+08	1.39E+08	0.18074
-62.25	7.18E+08	1.19E+08	0.18637
-58.45	7.47E+08	8.74E+07	0.19074
-56.21	7.13E+08	1.02E+08	0.18337
-53.06	6.67E+08	9.63E+07	0.16452
-50.05	6.40E+08	9.87E+07	0.15427
-46.12	6.22E+08	8.67E+07	0.13957
-44.27	6.26E+08	8.89E+07	0.13502
-41.07	5.90E+08	7.65E+07	0.12975
-38	5.87E+08	8.15E+07	0.11079
-35.07	5.72E+08	5.92E+07	0.10751
-32	5.69E+08	6.81E+07	0.10266
-29.01	5.63E+08	5.72E+07	0.10172
-26.02	5.75E+08	4.77E+07	0.09609
-23.19	5.69E+08	4.62E+07	0.09511
-20.01	5.50E+08	5.86E+07	0.09353
-17.17	5.50E+08	5.21E+07	0.09467
-14.1	5.60E+08	5.74E+07	0.09362
-11	5.45E+08	5.41E+07	0.09019
-7.99	5.46E+08	5.96E+07	0.08792
-5.11	5.45E+08	5.82E+07	0.08373
-1.99	5.40E+08	4.01E+07	0.07428
0.92	5.51E+08	5.65E+07	0.07325
3.9	5.54E+08	4.02E+07	0.07258
7.03	5.41E+08	4.22E+07	0.07397
9.97	5.45E+08	4.34E+07	0.07063
12.98	5.36E+08	3.92E+07	0.06311
15.86	5.40E+08	2.81E+07	0.06197
18.99	5.46E+08	3.84E+07	0.06023
22.01	5.38E+08	2.23E+07	0.05937
24.85	5.20E+08	3.45E+07	0.05627
27.99	5.32E+08	2.80E+07	0.05259
30.94	5.23E+08	3.05E+07	0.05329
33.91	5.34E+08	2.92E+07	0.05472
36.9	5.25E+08	2.81E+07	0.05359
39.9	5.16E+08	3.23E+07	0.06262
42.86	5.15E+08	3.31E+07	0.06427
45.9	5.13E+08	2.96E+07	0.06761
48.8	4.98E+08	3.74E+07	0.07518
50.02	5.10E+08	3.11E+07	0.07103

Table F-4 Thermal properties by DMTA of PVC/Cl-GRT, 40 phr with 5 %TCICA
w/v in methanol.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.43	8.42E+08	1.25E+08	0.13874
-76.91	8.97E+08	1.12E+08	0.13975
-73.9	9.08E+08	1.07E+08	0.14007
-70.88	9.20E+08	1.27E+08	0.14636
-68.01	9.20E+08	1.38E+08	0.14994
-65.04	9.36E+08	1.18E+08	0.15256
-62.25	9.43E+08	1.44E+08	0.15673
-58.45	8.88E+08	1.17E+08	0.16273
-56.21	8.66E+08	1.11E+08	0.16093
-53.06	8.41E+08	1.16E+08	0.14854
-50.05	8.21E+08	9.13E+07	0.13816
-46.12	8.00E+08	1.03E+08	0.11834
-44.27	7.69E+08	8.93E+07	0.11004
-41.07	7.93E+08	6.74E+07	0.10493
-38	7.40E+08	8.51E+07	0.09506
-35.07	7.61E+08	7.02E+07	0.09234
-32	7.41E+08	4.62E+07	0.08641
-29.01	7.27E+08	6.17E+07	0.08483
-26.02	7.33E+08	6.42E+07	0.07761
-23.19	7.27E+08	5.37E+07	0.0739
-20.01	7.12E+08	6.80E+07	0.06948
-17.17	7.15E+08	4.25E+07	0.06642
-14.1	7.09E+08	4.93E+07	0.06352
-11	7.00E+08	4.45E+07	0.06355
-7.99	7.11E+08	5.26E+07	0.06006
-5.11	7.01E+08	4.06E+07	0.05792
-1.99	6.79E+08	4.40E+07	0.05572
0.92	7.05E+08	5.21E+07	0.05092
3.9	6.89E+08	3.71E+07	0.0538
7.03	6.65E+08	4.47E+07	0.05119
9.97	6.67E+08	4.27E+07	0.04907
12.98	6.98E+08	3.29E+07	0.04706
15.86	6.57E+08	4.53E+07	0.04894
18.99	7.03E+08	3.37E+07	0.04799
22.01	6.48E+08	5.71E+07	0.04609
24.85	6.99E+08	2.80E+07	0.04007
27.99	6.71E+08	2.62E+07	0.03903
30.94	6.88E+08	2.90E+07	0.04214
33.91	6.81E+08	3.54E+07	0.04004
36.9	6.92E+08	2.91E+07	0.04198
39.9	6.63E+08	1.68E+07	0.04538
42.86	6.95E+08	3.51E+07	0.05045
45.9	6.76E+08	4.54E+07	0.05121
48.8	6.48E+08	3.48E+07	0.05372
50.02	6.69E+08	3.61E+07	0.05392

Table F-5 Thermal properties by DMTA of PVC/RTR, 30 phr.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.3	8.72E+08	1.08E+08	0.12371
-75.85	8.67E+08	1.30E+08	0.12756
-74.24	8.97E+08	1.17E+08	0.13002
-70.95	9.17E+08	1.23E+08	0.13451
-67.9	9.36E+08	9.95E+07	0.13502
-65.13	9.48E+08	9.95E+07	0.13576
-62.1	8.97E+08	1.23E+08	0.13741
-59.27	9.01E+08	1.16E+08	0.13409
-56.02	9.24E+08	1.21E+08	0.13076
-53.03	9.24E+08	1.17E+08	0.1265
-50.05	9.30E+08	1.20E+08	0.12235
-47.01	8.96E+08	9.96E+07	0.11865
-44.12	8.91E+08	9.92E+07	0.11034
-41.03	8.78E+08	7.54E+07	0.09742
-38.14	8.70E+08	7.90E+07	0.09082
-35.11	8.92E+08	7.75E+07	0.08684
-32.06	8.58E+08	6.63E+07	0.08401
-29.07	8.79E+08	5.65E+07	0.08032
-26.08	8.60E+08	6.62E+07	0.07694
-23.17	8.75E+08	5.91E+07	0.07467
-20.02	8.55E+08	6.15E+07	0.07201
-17.11	8.58E+08	5.86E+07	0.06832
-14.1	8.61E+08	6.79E+07	0.06786
-11.09	8.76E+08	5.94E+07	0.06523
-8.02	8.75E+08	5.78E+07	0.06452
-5.15	8.73E+08	5.88E+07	0.06367
-2.07	8.74E+08	5.91E+07	0.06285
0.97	8.80E+08	5.85E+07	0.06167
3.96	8.83E+08	5.05E+07	0.060123
6.9	8.78E+08	5.07E+07	0.05676
9.99	8.81E+08	5.63E+07	0.05484
12.98	8.90E+08	4.61E+07	0.0518
15.89	8.78E+08	4.69E+07	0.05123
18.89	8.63E+08	4.36E+07	0.05052
21.98	8.81E+08	4.29E+07	0.04867
24.87	8.70E+08	4.51E+07	0.04781
27.91	8.72E+08	4.08E+07	0.04765
30.84	8.59E+08	4.78E+07	0.04756
33.97	8.55E+08	4.05E+07	0.04742
36.88	8.55E+08	5.03E+07	0.04745
40.07	8.35E+08	3.97E+07	0.04752
43.03	8.42E+08	4.57E+07	0.04726
45.86	8.29E+08	4.96E+07	0.04784
48.9	8.24E+08	3.78E+07	0.04588
50.34	8.17E+08	3.54E+07	0.04329

Table F-6 Thermal properties by DMTA of PVC/Cl-RTR, 30 phr with 1 %TCICA
w/v in methanol.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.3	9.94E+08	1.47E+08	0.11736
-75.85	1.03E+09	1.27E+08	0.12245
-74.24	1.04E+09	1.37E+08	0.12436
-70.95	1.05E+09	1.31E+08	0.12586
-67.9	1.10E+09	1.52E+08	0.12686
-65.13	1.06E+09	1.25E+08	0.12986
-62.1	1.04E+09	1.40E+08	0.13471
-59.27	1.03E+09	1.31E+08	0.13065
-56.02	9.99E+08	1.27E+08	0.12576
-53.03	9.75E+08	1.14E+08	0.11732
-50.05	9.48E+08	9.32E+07	0.11043
-47.01	9.39E+08	9.55E+07	0.10723
-44.12	9.43E+08	6.08E+07	0.10067
-41.03	9.65E+08	6.68E+07	0.09562
-38.14	9.38E+08	7.53E+07	0.09082
-35.11	9.34E+08	8.16E+07	0.08684
-32.06	9.30E+08	7.21E+07	0.08345
-29.07	9.22E+08	7.74E+07	0.07921
-26.08	9.23E+08	6.96E+07	0.07542
-23.17	9.17E+08	6.64E+07	0.07345
-20.02	9.32E+08	5.97E+07	0.07156
-17.11	9.19E+08	6.28E+07	0.06834
-14.1	9.27E+08	5.04E+07	0.06423
-11.09	9.08E+08	5.86E+07	0.06145
-8.02	9.25E+08	5.53E+07	0.05987
-5.15	9.13E+08	5.70E+07	0.056789
-2.07	9.17E+08	4.05E+07	0.05342
0.97	9.14E+08	4.57E+07	0.05234
3.96	8.90E+08	4.44E+07	0.05088
6.9	8.85E+08	4.77E+07	0.05387
9.99	9.01E+08	3.97E+07	0.04521
12.98	9.06E+08	3.01E+07	0.04115
15.89	8.53E+08	4.29E+07	0.03678
18.89	8.87E+08	3.50E+07	0.03467
21.98	8.48E+08	4.80E+07	0.03012
24.87	8.78E+08	3.48E+07	0.02845
27.91	8.44E+08	5.16E+07	0.02686
30.84	8.66E+08	2.33E+07	0.02646
33.97	8.77E+08	2.18E+07	0.0258
36.88	8.55E+08	2.22E+07	0.02534
40.07	8.56E+08	4.22E+07	0.02595
43.03	8.45E+08	2.38E+07	0.02621
45.86	8.36E+08	3.61E+07	0.02676
48.9	8.42E+08	3.28E+07	0.02695
50.34	8.23E+08	4.72E+07	0.02728

Table F-7 Thermal properties by DMTA of PVC/Cl-RTR, 30 phr with 3 %TCICA
w/v in methanol.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.3	1.26E+09	8.38E+07	0.07763
-75.85	1.24E+09	9.62E+07	0.08065
-74.24	1.23E+09	1.02E+08	0.08244
-70.95	1.23E+09	8.94E+07	0.08593
-67.9	1.20E+09	9.94E+07	0.10346
-65.13	1.16E+09	1.14E+08	0.11278
-62.1	1.12E+09	1.19E+08	0.12761
-59.27	1.09E+09	1.10E+08	0.12689
-56.02	1.02E+09	1.31E+08	0.12067
-53.03	9.83E+08	1.17E+08	0.11718
-50.05	9.70E+08	1.15E+08	0.11245
-47.01	9.27E+08	1.16E+08	0.10664
-44.12	8.96E+08	1.11E+08	0.10464
-41.03	8.84E+08	9.58E+07	0.10164
-38.14	8.51E+08	1.09E+08	0.10045
-35.11	8.54E+08	9.53E+07	0.09909
-32.06	8.64E+08	8.31E+07	0.09709
-29.07	8.39E+08	7.98E+07	0.09309
-26.08	8.11E+08	9.86E+07	0.09001
-23.17	8.16E+08	8.54E+07	0.08563
-20.02	7.98E+08	9.10E+07	0.08268
-17.11	8.05E+08	7.54E+07	0.08075
-14.1	7.86E+08	7.36E+07	0.07865
-11.09	7.82E+08	6.70E+07	0.07808
-8.02	8.03E+08	6.88E+07	0.07702
-5.15	8.07E+08	6.37E+07	0.07664
-2.07	7.84E+08	6.31E+07	0.07565
0.97	8.17E+08	6.08E+07	0.07443
3.96	8.35E+08	6.63E+07	0.07947
6.9	8.05E+08	6.10E+07	0.07581
9.99	8.56E+08	4.94E+07	0.06978
12.98	8.29E+08	6.86E+07	0.06478
15.89	8.65E+08	4.52E+07	0.06087
18.89	8.28E+08	5.07E+07	0.05646
21.98	8.59E+08	4.48E+07	0.0522
24.87	8.25E+08	5.70E+07	0.0523
27.91	8.49E+08	5.09E+07	0.05105
30.84	8.18E+08	5.86E+07	0.05087
33.97	8.62E+08	4.36E+07	0.05062
36.88	8.24E+08	6.84E+07	0.05128
40.07	8.26E+08	5.20E+07	0.05246
43.03	8.30E+08	4.49E+07	0.05404
45.86	8.16E+08	4.73E+07	0.05399
48.9	8.08E+08	4.66E+07	0.05367
50.34	8.14E+08	4.14E+07	0.05288

Table F-8 Thermal properties by DMTA of PVC/Cl-RTR, 30 phr with 5 %TCICA
w/v in methanol.

Temp (°C)	E' (Pa)	E'' (Pa)	tan_delta
-80.3	1.10E+09	1.41E+08	0.07523
-75.85	1.07E+09	1.44E+08	0.08297
-74.24	1.12E+09	1.03E+08	0.08995
-70.95	1.13E+09	1.23E+08	0.09876
-67.9	1.06E+09	1.27E+08	0.11546
-65.13	1.05E+09	1.29E+08	0.12109
-62.1	1.04E+09	1.31E+08	0.12616
-59.27	1.05E+09	1.37E+08	0.12465
-56.02	1.02E+09	1.33E+08	0.12256
-53.03	1.00E+09	1.19E+08	0.11905
-50.05	9.80E+08	1.07E+08	0.11056
-47.01	9.58E+08	1.00E+08	0.10435
-44.12	9.75E+08	9.70E+07	0.10247
-41.03	9.81E+08	9.09E+07	0.10079
-38.14	9.51E+08	8.44E+07	0.09882
-35.11	9.76E+08	8.15E+07	0.09554
-32.06	9.63E+08	7.64E+07	0.09195
-29.07	9.78E+08	6.00E+07	0.09026
-26.08	9.64E+08	7.27E+07	0.08845
-23.17	9.83E+08	6.92E+07	0.08456
-20.02	9.50E+08	6.69E+07	0.0795
-17.11	9.69E+08	7.52E+07	0.07856
-14.1	9.45E+08	6.39E+07	0.07667
-11.09	9.42E+08	6.83E+07	0.07656
-8.02	9.41E+08	6.61E+07	0.076012
-5.15	9.34E+08	5.66E+07	0.075867
-2.07	9.20E+08	6.07E+07	0.075768
0.97	9.17E+08	6.10E+07	0.07567
3.96	9.10E+08	5.70E+07	0.07753
6.9	9.03E+08	5.70E+07	0.07223
9.99	9.02E+08	5.21E+07	0.06898
12.98	9.02E+08	4.81E+07	0.06774
15.89	8.78E+08	4.47E+07	0.06534
18.89	8.89E+08	4.75E+07	0.06348
21.98	8.83E+08	4.11E+07	0.0629
24.87	8.86E+08	4.31E+07	0.06247
27.91	8.65E+08	4.75E+07	0.06187
30.84	8.56E+08	3.00E+07	0.061687
33.97	8.34E+08	4.40E+07	0.06167
36.88	8.53E+08	4.12E+07	0.061598
40.07	8.40E+08	4.32E+07	0.061
43.03	8.33E+08	5.11E+07	0.05935
45.86	8.24E+08	3.94E+07	0.05788
48.9	8.15E+08	4.54E+07	0.05565
50.34	8.16E+08	4.19E+07	0.05367

VITA

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