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APPENDIX A

Calibration Data for Gel Permeation Chromatography at room temperature.

Gel Permeation Chromatography (GPC) is the technique that separated molecules by using the different elution time due to different size of polymer molecules. The smaller molecules can go through the pore of gel and then elute from the column later than the larger molecules. GPC can provide more information than other technique.

Table A1 Calibration data of GPC show the retention time of the standard polystyrene with known molecular weight at room temperature

Retention time (min)	Specified Molecular Weight	Calculated Molecular Weight
16.10	3840000	3493153
16.25	2890000	2827384
17.20	706000	814607
17.80	355000	401011
18.50	190000	187430
19.25	96400	88905
20.30	37900	34536
21.25	18100	15830
21.85	9100	9926
22.45	5970	6305
23.50	2980	2890
23.50	2630	2890
25.80	500	484

Calibration Type : Narrow Standards

Curve type : Cubic

Equation of Curve : $\log MW = +3.56E+01 - 3.50E+00*R + 1.37E-01*R^2 - 1.97E-03R^3$

where R = retention time (min)

Correlation Coefficient : $r^2 = 0.99894976$

Standard Error of Estimate : 0.04565770

Table A2 The slice detail of polystyrene from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Heigh (Microvolts)	Slice Area (microvolt s-sec)	Cumulation Area point
1	15.95	4344998	115	697	0.02
2	16.03	3851915	176	811	0.05
3	16.12	3419407	217	1010	0.09
4	16.20	3039530	321	1327	0.14
5	16.28	2705419	396	1985	0.20
6	16.37	2411177	591	2836	0.30
7	16.45	2151715	794	4025	0.45
8	16.53	1922614	1108	5640	0.64
9	16.62	1720068	1479	7493	0.91
10	16.70	1540776	1950	9701	1.25
11	16.78	1381862	2487	12488	1.69
12	16.87	1240839	3096	15522	2.23
13	16.95	1115542	3839	18926	2.90
14	17.03	1004077	4525	22741	3.70
15	17.12	904802	5329	26660	4.63
16	17.20	816280	6148	30803	5.72
17	17.28	737251	6967	34938	6.95
18	17.37	666616	7815	39107	8.32

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
19	17.45	603414	8581	43028	9.83
20	17.53	546794	9353	46904	11.48
21	17.62	496018	10172	50628	13.26
22	17.70	450431	10800	54191	15.17
23	17.78	409457	11438	57323	17.18
24	17.87	372591	11975	60341	19.30
25	17.95	339386	12480	63033	21.52
26	18.03	309446	13118	65519	23.82
27	18.12	282421	13507	67566	26.19
28	18.20	258005	13850	69249	28.63
29	18.28	235921	14115	70525	31.11
30	18.37	215927	14281	71375	33.62
31	18.45	197809	14385	71922	36.14
32	18.53	181372	14384	72040	38.68
33	18.62	166448	14325	71684	41.20
34	18.70	152883	14157	71012	43.69
35	18.78	140544	14113	70187	46.16
36	18.87	129307	13802	69024	48.58
37	18.95	119067	13515	67710	50.96
38	19.03	109724	13247	66175	53.29
39	19.12	101195	12950	64452	55.56
40	19.20	93400	12591	62695	57.76
41	19.28	86271	12161	60739	59.89
42	19.37	79744	11683	58639	61.96
43	19.45	73765	11338	56740	63.95
44	19.53	68282	10908	54470	65.86
45	19.62	63250	10473	52423	67.71
46	19.70	58629	10009	50221	69.47
47	19.78	54381	9622	48100	71.16
48	19.87	50473	9172	46075	72.78
49	19.95	46876	8771	43985	74.33
50	20.03	43561	8383	41806	75.80

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
51	20.12	40505	7929	39791	77.20
52	20.20	37685	7570	37869	78.53
53	20.28	35082	7202	36081	79.80
54	20.37	32676	6886	34347	81.00
55	20.45	30451	6527	32497	82.15
56	20.53	28393	6126	30868	83.23
57	20.62	26487	5857	29190	84.26
58	20.70	24720	5499	27592	85.23
59	20.78	23083	5230	26226	86.15
60	20.87	21564	4962	24824	87.02
61	20.95	20153	4708	23462	87.84
62	21.03	18843	4440	22186	88.62
63	21.12	17625	4153	20860	89.36
64	21.20	16492	4004	19829	90.05
65	21.28	15438	3750	18731	90.71
66	21.37	14457	3544	17750	91.34
67	21.45	13542	3409	16769	91.93
68	21.53	12690	3065	15718	92.48
69	21.62	11894	3021	14872	93.00
70	21.70	11152	2838	14068	93.50
71	21.78	10460	2675	13319	93.96
72	21.87	9812	2540	12533	94.40
73	21.95	9208	2334	11814	94.82
74	22.03	8642	2228	11010	95.21
75	22.12	8113	2093	10305	95.57
76	22.20	7618	1973	9750	95.91
77	22.28	7154	1852	9170	96.23
78	22.37	6720	1718	8523	96.53
79	22.45	6313	1569	7948	96.81
80	22.53	5932	1510	7459	97.08
81	22.62	5574	1376	6845	97.32
82	22.70	5239	1313	6293	97.54

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
83	22.78	4924	1164	5793	97.74
84	22.87	4628	1091	5406	97.93
85	22.95	4351	985	5090	98.11
86	23.03	4090	955	4673	98.27
87	23.12	3845	892	4277	98.42
88	23.20	3614	819	3834	98.56
89	23.28	3398	742	3682	98.69
90	23.37	3194	698	3367	98.81
91	23.45	3003	682	3216	98.92
92	23.53	2823	624	3001	99.03
93	23.62	2653	546	2796	99.12
94	23.70	2493	564	2582	99.21
95	23.78	2343	458	2136	99.29
96	23.87	2202	428	2096	99.36
97	23.95	2069	456	2027	99.43
98	24.03	1943	264	1735	99.50
99	24.12	1825	320	1700	99.55
100	24.20	1714	352	1703	99.61
101	24.28	1609	265	1381	99.66
102	24.37	1511	274	1203	99.71
103	24.45	1418	277	1250	99.75
104	24.53	1330	276	1188	99.79
105	24.62	1248	218	911	99.82
106	24.70	1170	188	896	99.85
107	24.78	1097	168	793	99.88
108	24.87	1028	167	674	99.91
109	24.95	963	84	625	99.93
110	25.03	902	93	509	99.95
111	25.12	845	63	437	99.96
112	25.20	791	81	338	99.97
113	25.28	740	51	446	99.99
114	25.37	692	78	307	100.00

APPENDIX B

Rheological Characterization

Table B1 The storage modulus (G') of PS as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 160°C (Figure 4.1)

Frequency (rad/s)	G' (Pa)					$\overline{X}$	σ
100	1.47E+05	1.60E+05	1.40E+05	1.76E+05	1.70E+05	1.59E+05	1.51E+04
63.096	1.56E+05	1.43E+05	1.26E+05	1.57E+05	1.52E+05	1.47E+05	1.29E+04
39.811	1.38E+05	1.27E+05	1.12E+05	1.40E+05	1.36E+05	1.31E+05	1.15E+04
25.119	1.23E+05	1.13E+05	9.98E+04	1.25E+05	1.20E+05	1.16E+05	1.02E+04
15.849	1.08E+05	9.85E+04	8.70E+04	1.10E+05	1.05E+05	1.02E+05	9.30E+03
10	9.39E+04	8.59E+04	7.64E+04	9.64E+04	9.14E+04	8.88E+04	7.95E+03
6.3096	8.09E+04	7.37E+04	6.55E+04	8.33E+04	7.86E+04	7.64E+04	7.05E+03
3.9811	6.85E+04	6.25E+04	5.62E+04	7.12E+04	6.68E+04	6.50E+04	5.87E+03
2.5119	5.73e+04	5.21E+04	4.66E+04	5.99E+04	5.57E+04	5.43E+04	5.16E+03
1.5849	4.77E+04	4.34E+04	3.86E+04	4.98E+04	4.63E+04	4.52E+04	4.34E+03
1	3.85e+04	3.47E+04	3.26E+04	4.08E+04	3.73E+04	3.68E+04	3.21E+03
0.63096	3.30E+04	2.81E+04	2.49E+04	3.25E+04	2.97E+04	2.96E+04	3.33E+03
0.39811	2.35E+04	2.17E+04	2.06E+04	2.53E+04	2.31E+04	2.28E+04	1.79E+03
0.25119	1.80E+04	1.64E+04	1.51E+04	1.93E+04	1.77E+04	1.73E+04	1.60E+03
0.15849	1.33E+04	1.22E+04	1.17E+04	1.42E+04	1.30E+04	1.29E+04	9.73E+02
0.1	9.43E+03	8.85E+03	8.59E+03	9.88E+03	9.12E+03	9.17E+03	5.03E+02
0.0631	6.59E+03	6.17E+03	5.91E+03	7.12E+03	6.05E+03	6.37E+03	4.91E+02
0.039811	4.16E+03	4.02E+03	4.43E+03			4.20E+03	2.08E+02

Frequency (rad/s)	G' (Pa)					$\overline{X}$	σ
0.031623	3.20E+03	3.32E+03	3.42E+03			3.31E+03	1.10E+02
0.025119	2.67E+03	2.72E+03	2.74E+03			2.71E+03	3.61E+01
0.019953	1.99E+03	2.07E+03	2.02E+03			2.03E+03	4.04E+01
0.015849	1.90E+03	1.58E+03	1.46E+03			1.65E+03	2.27E+02
0.012589	1.25E+03	1.28E+03	1.28E+03			1.27E+03	1.73E+01
0.01	9.24E+02	1.01E+03	7.10E+02			8.81E+02	1.54E+02

Table B2 The loss modulus (G") of PS as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 160°C (Figure 4.1)

Frequency (rad/s)	G" (Pa)					$\overline{X}$	σ
100	7.60E+04	6.84E+04	5.87E+04	7.56E+04	7.26E+04	7.03E+04	7.14E+03
63.096	6.49E+04	5.84E+04	5.06E+04	6.51E+04	6.20E+04	6.02E+04	6.02E+03
39.811	5.72E+04	5.17E+04	4.46E+04	5.75E+04	5.48E+04	5.32E+04	5.32E+03
25.119	5.18E+04	4.67E+04	4.04E+04	5.23E+04	4.91E+04	4.81E+04	4.84E+03
15.849	4.71E+04	4.22E+04	3.69E+04	4.75E+04	4.51E+04	4.38E+04	4.37E+03
10	4.35E+04	3.94E+04	3.41E+04	4.39E+04	4.16E+04	4.05E+04	4.00E+03
6.3096	4.06E+04	3.63E+04	3.16E+04	4.09E+04	3.85E+04	3.76E+04	3.82E+03
3.9811	3.72E+04	3.38E+04	2.94E+04	3.79E+04	3.56E+04	3.48E+04	3.40E+03
2.5119	3.41E+04	3.07E+04	2.73E+04	3.50E+04	3.32E+04	3.21E+04	3.11E+03
1.5849	3.12E+04	2.83E+04	2.52E+04	3.18E+04	3.00E+04	2.93E+04	2.65E+03
1	2.80E+04	2.57E+04	2.23E+04	2.88E+04	2.67E+04	2.63E+04	2.53E+03
0.63096	2.46E+04	2.23E+04	1.97E+04	2.56E+04	2.38E+04	2.32E+04	2.30E+03
0.39811	2.16E+04	1.95E+04	1.77E+04	2.20E+04	2.10E+04	2.04E+04	1.76E+03

Frequency (rad/s)	G" (Pa)					$\bar{X}$	σ
0.25119	1.83E+04	1.67E+04	1.49E+04	1.90E+04	1.76E+04	1.73E+04	1.59E+03
0.15849	1.50E+04	1.37E+04	1.25E+04	1.59E+04	1.48E+04	1.44E+04	1.31E+03
0.1	1.27E+04	1.15E+04	1.05E+04	1.29E+04	1.19E+04	1.19E+04	9.70E+02
0.0631	9.91E+03	9.11E+03	8.29E+03	1.01E+04	9.15E+03	9.31E+03	7.23E+02
0.039811	7.75E+03	7.65E+03	7.45E+03			7.62E+03	1.53E+02
0.031623	6.75E+03	6.67E+03	6.63E+03			6.68E+03	6.11E+01
0.025119	5.74E+03	5.82E+03	5.77E+03			5.78E+03	4.04E+01
0.019953	5.10E+03	4.85E+03	5.07E+03			5.01E+03	1.37E+02
0.015849	4.24E+03	4.14E+03	3.99E+03			4.12E+03	1.26E+02
0.012589	3.42E+03	3.40E+03	3.33E+03			3.38E+03	4.73E+01
0.01	2.98E+03	3.01E+03	2.65E+03			2.88E+03	2.00E+02

Table B3 The storage modulus (G') of H5604F as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.2)

Frequency (rad/s)	G' (Pa)				$\overline{X}$	σ
100	2.07E+05	2.12E+05	1.82E+05	2.03E+05	2.01E+05	1.32E+04
63.096	1.77E+05	1.83E+05	1.57E+05	1.74E+05	1.73E+05	1.11E+04
39.811	1.49E+05	1.56E+05	1.33E+05	1.47E+05	1.46E+05	9.64E+03
25.119	1.24E+05	1.32E+05	1.15E+05	1.23E+05	1.24E+05	6.95E+03
15.849	1.02E+05	1.10E+05	9.71E+04	1.01E+05	1.03E+05	5.41E+03
10	8.29E+04	9.10E+04	8.00E+04	8.11E+04	8.38E+04	4.98E+03
6.3096	6.65E+04	7.47E+04	6.46E+04	6.49E+04	6.77E+04	4.76E+03
3.9811	5.29E+04	6.04E+04	5.13E+04	5.15E+04	5.40E+04	4.31E+03
2.5119	4.13E+04	4.81E+04	4.11E+04	4.02E+04	4.27E+04	3.65E+03
1.5849	3.25E+04	3.88E+04	3.29E+04	3.13E+04	3.39E+04	3.35E+03
1	2.51E+04	3.06E+04	2.63E+04	2.43E+04	2.66E+04	2.81E+03
0.631	1.94E+04	2.43E+04	2.12E+04	1.85E+04	2.09E+04	2.56E+03
0.3981	1.49E+04	1.98E+04	1.69E+04	1.39E+04	1.64E+04	2.60E+03
0.2512	1.12E+04	1.56E+04	1.31E+04	1.07E+04	1.27E+04	2.22E+03
0.1585	8.63E+03	1.22E+04	1.09E+04	7.84E+03	9.89E+03	2.01E+03
0.1	6.59E+03	9.64E+03	8.39E+03	5.77E+03	7.60E+03	1.75E+03
0.0631	4.99E+03	8.01E+03	6.49E+03	4.61E+03	6.03E+03	1.55E+03
0.0398	3.70E+03	6.35E+03	4.95E+03	3.27E+03	4.57E+03	1.39E+03
0.0251	3.04E+03	5.32E+03	4.60E+03	2.41E+03	3.84E+03	1.35E+03
0.0158	2.27E+03	4.50E+03	3.63E+03	1.96E+03	3.09E+03	1.19E+03
0.01	1.92E+03	4.08E+03	3.32E+03		3.11E+03	1.10E+03

Table B4 The loss modulus (G") of H5604F as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.2)

Frequency (rad/s)	G" (Pa)				$\bar{X}$	σ
100	9.59E+04	9.20E+04	7.87E+04	9.04E+04	8.93E+04	7.40E+03
63.096	8.88E+04	8.64E+04	7.20E+04	8.35E+04	8.27E+04	7.44E+03
39.811	8.11E+04	8.02E+04	6.57E+04	7.70E+04	7.60E+04	7.09E+03
25.119	7.32E+04	7.25E+04	6.19E+04	7.02E+04	6.95E+04	5.19E+03
15.849	6.51E+04	6.57E+04	5.61E+04	6.28E+04	6.24E+04	4.40E+03
10	5.77E+04	5.79E+04	5.00E+04	5.54E+04	5.53E+04	3.68E+03
6.3096	5.05E+04	5.05E+04	4.33E+04	4.83E+04	4.82E+04	3.40E+03
3.9811	4.31E+04	4.33E+04	3.71E+04	4.13E+04	4.12E+04	2.88E+03
2.5119	3.65E+04	3.62E+04	3.11E+04	3.50E+04	3.47E+04	2.49E+03
1.5849	3.02E+04	3.10E+04	2.64E+04	2.94E+04	2.93E+04	2.01E+03
1	2.48E+04	2.59E+04	2.22E+04	2.43E+04	2.43E+04	1.55E+03
0.63096	1.99E+04	2.08E+04	1.80E+04	1.95E+04	1.96E+04	1.17E+03
0.39811	1.62E+04	1.73E+04	1.49E+04	1.56E+04	1.60E+04	1.02E+03
0.25119	1.29E+04	1.40E+04	1.19E+04	1.24E+04	1.28E+04	8.98E+02
0.15849	1.01E+04	1.12E+04	9.49E+03	9.56E+03	1.01E+04	7.90E+02
0.1	7.92E+03	9.08E+03	7.88E+03	7.46E+03	8.09E+03	6.95E+02
0.063096	6.11E+03	7.23E+03	6.03E+03	5.76E+03	6.28E+03	6.49E+02
0.039811	4.74E+03	5.96E+03	4.83E+03	4.62E+03	5.04E+03	6.21E+02
0.025119	3.65E+03	4.77E+03	4.22E+03	3.47E+03	4.03E+03	5.89E+02
0.015849	2.75E+03	4.00E+03	3.29E+03	2.49E+03	3.13E+03	6.67E+02
0.01	2.24E+03	3.58E+03	2.99E+03		2.94E+03	6.72E+02

Table B5 The storage modulus (G') of H5840B as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.3)

Frequency (rad/s)	G' (Pa)				$\bar{X}$	σ
100	1.39E+05	1.28E+05	1.22E+05	1.05E+05	1.24E+05	1.42E+04
63.096	1.12E+05	1.03E+05	9.72E+04	8.34E+04	9.89E+04	1.20E+04
39.811	8.82E+04	8.12E+04	7.68E+04	6.55E+04	7.79E+04	9.52E+03
25.119	6.88E+04	6.37E+04	5.97E+04	5.08E+04	6.08E+04	7.61E+03
15.849	5.25E+04	4.88E+04	4.57E+04	3.84E+04	4.64E+04	5.98E+03
10	3.94E+04	3.71E+04	3.45E+04	2.90E+04	3.50E+04	4.47E+03
6.3096	2.92E+04	2.80E+04	2.57E+04	2.16E+04	2.61E+04	3.35E+03
3.9811	2.13E+04	2.06E+04	1.89E+04	1.56E+04	1.91E+04	2.54E+03
2.5119	1.54E+04	1.49E+04	1.35E+04	1.14E+04	1.38E+04	1.79E+03
1.5849	1.10E+04	1.06E+04	9.75E+03	8.22E+03	9.89E+03	1.23E+03
1	7.61E+03	7.53E+03	6.66E+03	5.67E+03	6.87E+03	9.07E+02
0.63096	5.30E+03	5.33E+03	4.84E+03	4.11E+03	4.90E+03	5.69E+02
0.39811	3.69E+03	3.56E+03	3.42E+03	2.85E+03	3.38E+03	3.70E+02
0.25119	2.35E+03	2.46E+03	2.41E+03	1.97E+03	2.30E+03	2.23E+02
0.15849	1.67E+03	1.77E+03	1.74E+03	1.57E+03	1.69E+03	8.88E+01
0.1	1.06E+03	1.22E+03	1.15E+03		1.14E+03	8.02E+01

Table B6 The loss modulus (G") of H5840B as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.3)

Frequency (rad/s)	G" (Pa)				$\overline{X}$	σ
100	9.72E+04	9.16E+04	8.87E+04	7.85E+04	8.90E+04	7.84E+03
63.096	8.40E+04	7.84E+04	7.61E+04	6.66E+04	7.63E+04	7.25E+03
39.811	7.21E+04	6.72E+04	6.48E+04	5.64E+04	6.51E+04	6.56E+03
25.119	6.08E+04	5.68E+04	5.46E+04	4.69E+04	5.48E+04	5.84E+03
15.849	5.05E+04	4.73E+04	4.51E+04	3.88E+04	4.54E+04	4.94E+03
10	4.14E+04	3.90E+04	3.70E+04	3.16E+04	3.73E+04	4.17E+03
6.3096	3.38E+04	3.19E+04	3.01E+04	2.55E+04	3.03E+04	3.55E+03
3.9811	2.69E+04	2.57E+04	2.41E+04	2.02E+04	2.42E+04	2.92E+03
2.5119	2.12E+04	2.01E+04	1.88E+04	1.59E+04	1.90E+04	2.29E+03
1.5849	1.66E+04	1.56E+04	1.46E+04	1.21E+04	1.47E+04	1.93E+03
1	1.25E+04	1.19E+04	1.12E+04	9.33E+03	1.12E+04	1.38E+03
0.63096	9.49E+03	9.04E+03	8.45E+03	6.96E+03	8.49E+03	1.10E+03
0.39811	6.88E+03	6.69E+03	6.28E+03	5.19E+03	6.26E+03	7.56E+02
0.25119	5.13E+03	4.93E+03	4.57E+03	3.80E+03	4.61E+03	5.86E+02
0.15849	3.64E+03	3.52E+03	3.18E+03	2.67E+03	3.25E+03	4.34E+02
0.1	2.85E+03	2.29E+03	2.17E+03		2.44E+03	3.63E+02

Table B7 The storage modulus (G') of H5690S as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.4)

Frequency (rad/s)	G' (Pa)				$\overline{X}$	σ
100	1.35E+05	1.34E+05	1.40E+05	1.41E+05	1.38E+05	3.51E+03
63.096	9.85E+04	9.75E+04	1.01E+05	1.03E+05	1.00E+05	2.48E+03
39.811	6.99E+04	6.90E+04	7.16E+04	7.26E+04	7.08E+04	1.63E+03
25.119	4.82E+04	4.75E+04	4.94E+04	5.04E+04	4.89E+04	1.28E+03
15.849	3.21E+04	3.17E+04	3.31E+04	3.37E+04	3.27E+04	9.15E+02
10	2.11E+04	2.07E+04	2.18E+04	2.22E+04	2.15E+04	6.76E+02
6.3096	1.35E+04	1.33E+04	1.41E+04	1.42E+04	1.38E+04	4.43E+02
3.9811	8.43E+03	8.30E+03	8.92E+03	8.99E+03	8.66E+03	3.46E+02
2.5119	5.34E+03	5.06E+03	5.47E+03	5.55E+03	5.36E+03	2.15E+02
1.5849	3.22E+03	3.17E+03	3.32E+03	3.48E+03	3.30E+03	1.37E+02
1	1.96E+03	1.94E+03	2.01E+03	2.08E+03	2.00E+03	6.24E+01
0.63096	1.19E+03	1.11E+03	1.14E+03	1.26E+03	1.18E+03	6.56E+01
0.39811	6.68E+02	7.69E+02	7.27E+02	8.48E+02	7.53E+02	7.57E+01

Table B8 The loss modulus (G") of H5690S as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.4)

Frequency (rad/s)	G" (Pa)				$\overline{X}$	σ
100	1.40E+05	1.36E+05	1.42E+05	1.44E+05	1.41E+05	3.42E+03
63.096	1.14E+05	1.11E+05	1.16E+05	1.17E+05	1.15E+05	2.65E+03
39.811	9.12E+04	8.87E+04	9.26E+04	9.44E+04	9.17E+04	2.40E+03
25.119	7.15E+04	6.94E+04	7.27E+04	7.39E+04	7.19E+04	1.92E+03
15.849	5.43E+04	5.28E+04	5.54E+04	5.64E+04	5.47E+04	1.54E+03
10	4.07E+04	3.95E+04	4.16E+04	4.23E+04	4.10E+04	1.21E+03
6.3096	2.98E+04	2.90E+04	3.04E+04	3.11E+04	3.01E+04	8.92E+02
3.9811	2.15E+04	2.10E+04	2.21E+04	2.25E+04	2.18E+04	6.60E+02
2.5119	1.52E+04	1.49E+04	1.56E+04	1.59E+04	1.54E+04	4.40E+02
1.5849	1.05E+04	1.03E+04	1.10E+04	1.10E+04	1.07E+04	3.56E+02
1	7.28E+03	7.15E+03	7.42E+03	7.67E+03	7.38E+03	2.23E+02
0.63096	4.98E+03	4.76E+03	5.03E+03	5.12E+03	4.97E+03	1.53E+02
0.39811	3.24E+03	3.19E+03	3.34E+03	3.59E+03	3.34E+03	1.78E+02

Table B9 The storage modulus (G') of S1018 as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.5)

Frequency (rad/s)	G' (Pa)		$\bar{X}$	σ
100	4.62E+03	4.61E+03	4.62E+03	7.07E+00
79.433	4.00E+03	3.99E+03	4.00E+03	7.07E+00
63.096	3.46E+03	3.45E+03	3.46E+03	7.07E+00
50.119	2.97E+03	2.97E+03	2.97E+03	0.00E+00
39.811	2.55E+03	2.54E+03	2.55E+03	7.07E+00
31.623	2.17E+03	2.18E+03	2.18E+03	7.07E+00
25.119	1.85E+03	1.85E+03	1.85E+03	0.00E+00
19.953	1.56E+03	1.56E+03	1.56E+03	0.00E+00
15.849	1.32E+03	1.32E+03	1.32E+03	0.00E+00
12.589	1.10E+03	1.10E+03	1.10E+03	0.00E+00
10	9.22E+02	9.15E+02	9.19E+02	4.95E+00
7.9433	7.61E+02	7.65E+02	7.63E+02	2.83E+00
6.3096	6.26E+02	6.24E+02	6.25E+02	1.41E+00
5.0119	5.00E+02	5.07E+02	5.04E+02	4.95E+00
3.9811	4.10E+02	4.16E+02	4.13E+02	4.24E+00
3.1623	3.40E+02	3.26E+02	3.33E+02	9.90E+00
2.5119	2.57E+02	2.72E+02	2.65E+02	1.06E+01
1.9953	2.12E+02	2.04E+02	2.08E+02	5.66E+00
1.5849	1.57E+02	1.70E+02	1.64E+02	9.19E+00
1.2589	1.41E+02	1.29E+02	1.35E+02	8.49E+00
1	1.11E+02	1.14E+02	1.13E+02	2.12E+00

Table B10 The loss modulus (G") of S1018 as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.5)

Frequency (rad/s)	G" (Pa)		$\bar{X}$	σ
100	5.51E+03	5.48E+03	5.50E+03	2.12E+01
79.433	4.88E+03	4.85E+03	4.87E+03	2.12E+01
63.096	4.33E+03	4.30E+03	4.32E+03	2.12E+01
50.119	3.83E+03	3.82E+03	3.83E+03	7.07E+00
39.811	3.39E+03	3.38E+03	3.39E+03	7.07E+00
31.623	2.98E+03	2.97E+03	2.98E+03	7.07E+00
25.119	2.63E+03	2.62E+03	2.63E+03	7.07E+00
19.953	2.32E+03	2.30E+03	2.31E+03	1.41E+01
15.849	2.03E+03	2.02E+03	2.03E+03	7.07E+00
12.589	1.78E+03	1.77E+03	1.78E+03	7.07E+00
10	1.54E+03	1.55E+03	1.55E+03	7.07E+00
7.9433	1.34E+03	1.33E+03	1.34E+03	7.07E+00
6.3096	1.16E+03	1.16E+03	1.16E+03	0.00E+00
5.0119	9.95E+02	1.00E+03	9.98E+02	3.54E+00
3.9811	8.58E+02	8.49E+02	8.54E+02	6.36E+00
3.1623	7.30E+02	7.36E+02	7.33E+02	4.24E+00
2.5119	6.22E+02	6.13E+02	6.18E+02	6.36E+00
1.9953	5.24E+02	5.23E+02	5.24E+02	7.07E-01
1.5849	4.37E+02	4.42E+02	4.40E+02	3.54E+00
1.2589	3.70E+02	3.76E+02	3.73E+02	4.24E+00
1	3.09E+02	3.07E+02	3.08E+02	1.41E+00

Table B11 The storage modulus (G') of LD2130FA as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.6)

Frequency (rad/s)	G' (Pa)			$\overline{X}$	σ
100	3.27E+04	2.93E+04	2.87E+04	3.02E+04	2.16E+03
46.416	2.67E+04	2.20E+04	2.15E+04	2.34E+04	2.87E+03
21.544	2.02E+04	1.62E+04	1.58E+04	1.74E+04	2.43E+03
10	1.53E+04	1.17E+04	1.14E+04	1.28E+04	2.17E+03
4.6416	1.11E+04	8.26E+03	8.10E+03	9.15E+03	1.69E+03
2.1544	6.97E+03	5.69E+03	5.66E+03	6.11E+03	7.48E+02
1	3.88E+03	3.86E+03	3.89E+03	3.88E+03	1.53E+01
0.46416	2.72E+03	2.60E+03	2.62E+03	2.65E+03	6.43E+01
0.21544	1.63E+03	1.75E+03	1.76E+03	1.71E+03	7.23E+01
0.1	1.06E+03	1.14E+03	1.14E+03	1.11E+03	4.62E+01
0.046416	6.85E+02	8.29E+02	7.36E+02	7.50E+02	7.30E+01
0.021544	4.59E+02	5.06E+02	5.04E+02	4.90E+02	2.66E+01
0.01	3.45E+02	4.03E+02	3.47E+02	3.65E+02	3.29E+01

Table B12 The loss modulus (G") of LD2130FA as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.6)

Frequency (rad/s)	G" (Pa)			$\bar{X}$	σ
100	1.70E+04	1.61E+04	1.61E+04	1.64E+04	5.20E+02
46.416	1.42E+04	1.27E+04	1.27E+04	1.32E+04	8.66E+02
21.544	1.11E+04	1.00E+04	9.97E+03	1.04E+04	6.44E+02
10	9.15E+03	7.67E+03	7.65E+03	8.16E+03	8.60E+02
4.6416	6.98E+03	5.88E+03	5.89E+03	6.25E+03	6.32E+02
2.1544	4.92E+03	4.34E+03	4.42E+03	4.56E+03	3.14E+02
1	3.19E+03	3.19E+03	3.27E+03	3.22E+03	4.62E+01
0.46416	2.35E+03	2.29E+03	2.39E+03	2.34E+03	5.03E+01
0.21544	1.62E+03	1.66E+03	1.69E+03	1.66E+03	3.51E+01
0.1	1.11E+03	1.17E+03	1.20E+03	1.16E+03	4.58E+01
0.046416	7.69E+02	8.45E+02	8.28E+02	8.14E+02	3.99E+01
0.021544	5.35E+02	5.99E+02	5.79E+02	5.71E+02	3.27E+01
0.01	3.93E+02	4.31E+02	4.53E+02	4.26E+02	3.04E+01

Table B13 The storage modulus (G') of D2022 as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.7)

Frequency (rad/s)	G' (Pa)			$\overline{X}$	σ
100	2.80E+04	2.73E+04	2.90E+04	2.81E+04	8.54E+02
46.416	2.13E+04	2.06E+04	2.20E+04	2.13E+04	7.00E+02
21.544	1.60E+04	1.56E+04	1.66E+04	1.61E+04	5.03E+02
10	1.18E+04	1.15E+04	1.22E+04	1.18E+04	3.51E+02
4.6416	8.56E+03	8.40E+03	8.91E+03	8.62E+03	2.61E+02
2.1544	6.16E+03	6.06E+03	6.41E+03	6.21E+03	1.80E+02
1	4.36E+03	4.13E+03	4.44E+03	4.31E+03	1.61E+02
0.46416	2.94E+03	2.91E+03	3.09E+03	2.98E+03	9.64E+01
0.21544	2.00E+03	2.03E+03	2.10E+03	2.04E+03	5.13E+01
0.1	1.29E+03	1.33E+03	1.32E+03	1.31E+03	2.08E+01
0.046416	8.70E+02	9.17E+02	9.08E+02	8.98E+02	2.49E+01

Table B14 The loss modulus (G") of D2022 as a function of frequency (transducer no.1 and 25-mm.cone and plate diameter) at strain amplitude equal to 0.2% at T = 190°C (Figure 4.7)

Frequency (rad/s)	G" (Pa)			$\bar{X}$	σ
100	1.63E+04	1.53E+04	1.68E+04	1.61E+04	7.64E+02
46.416	1.27E+04	1.20E+04	1.32E+04	1.26E+04	6.03E+02
21.544	1.00E+04	9.49E+03	1.04E+04	9.96E+03	4.56E+02
10	7.79E+03	7.43E+03	8.11E+03	7.78E+03	3.40E+02
4.6416	6.11E+03	5.75E+03	6.33E+03	6.06E+03	2.93E+02
2.1544	4.65E+03	4.42E+03	4.90E+03	4.66E+03	2.40E+02
1	3.50E+03	3.33E+03	3.74E+03	3.52E+03	2.06E+02
0.46416	2.61E+03	2.44E+03	2.77E+03	2.61E+03	1.65E+02
0.21544	1.87E+03	1.77E+03	2.00E+03	1.88E+03	1.15E+02
0.1	1.36E+03	1.31E+03	1.54E+03	1.40E+03	1.21E+02
0.046416	9.59E+02	9.07E+02	1.03E+03	9.65E+02	6.17E+01

APPENDIX C

FORTRAN program for discretized data from gel permeation chromatography

```
c  This is a program to establish a coarse discrete MWD for the
c  double reptation input.
c  ===============================================
c                    VARIABLE DICTIONARY
c     N        - weight average molecular weight from GPC data
c     v        - volume fraction
c     mw       - molecular weight after discrete
c     nv       - volume fraction after discrete
c     ndiv     - number of discrete molecular weight component
c     mwmax - maximum weight average molecular weight
c     mwmin  - minimum weight average molecular weight
c  ===============================================

      implicit doubleprecision(a-h,m-z)
      dimension N(1000),v(1000),mw(1000),nv(1000)
      real N,v,mw,nv
      integer ndiv

            open(10,file='mwd')
            open(12,file='species')

            i=0
1           continue
            read(10,*,end=2) a,b

                  i=i+1
                  N(i)=a
                  v(i)=b

            go to 1

2           k=i

c           this part is used to change N(i) in to log form (log(mw(i))

            do 80 i = 1,k
                  N(i) = log10(N(i))

80          continue

            write(6,*)'How many discrete molecular weight components'
            read(5,*)ndiv

c           calculate delta(log(mw))
            mwmax = N(k)
```

```
      mwmin = N(1)
      deltamw=(mwmax-mwmin)/(ndiv+1)
c     calculate new mw data

      mw(1) = mwmin
      do 20 i = 1, ndiv+1
            mw(i+1) = mwmin + (i*deltamw)

20    continue

c     calculate new nv

      do 30 i = 1, (ndiv+2)

            do 40 j = 1,k
              if ((mw(i).gt.N(j)).and.(mw(i).lt.N(j+1))) then
              nv(i) = v(j)+((mw(i)-N(j))/(N(j+1)-N(j))*(v(j+1)-v(j)))
            end if

40          continue

30    continue

c  This section is used to calculate mw(i) in log form to mw(i) in normal form

      do 50 i = 1,(ndiv+2)
            mw(i) = 10**(mw(i))
50  continue

c     this section is used to normalize nv

      sumnv = 0.0
      do 60 i = 1, (ndiv+2)
            sumnv = sumnv+nv(i)
60    continue
      sumnv2 = 0.0
      do 70 i = 1+1, (ndiv+1)
            nv(i) = nv(i)/sumnv
            sumnv2=sumnv2+nv(i)
            write(12,*) mw(i),nv(i)
70    continue

      stop
      close(10)
      close(12)
      end
```

APPENDIX D

FORTRAN program for calculate storage modulus (G') and loss modulus (G") by using double reptation theory

```
c    This program is to calculate storage modulus(G") and loss modulus (G")
c    by using double reptation theory
c    ================================================
c                      VARIABLE DICTIONARY
c       mw      - molecular weight after discrete
c       nv      - volume fraction after discrete
c       M       - number of discrete time
c       tact    - the actual characteristic relaxation time
c       tau     - the longest relaxation time
c       p       - the tube survival proability
c       md      - fractionof unrelaxaed stress at time t
c       wi      - initial frequency
c       wf      - final frequency
c       Gtotal  - stress relaxation modulus
c       Gp      - storage modulus
c       Gdp     - loss modulus
c  ================================================

       implicit real*4(a-h,n-z)
       dimension  mw(32),nv(32),w(24)
       dimension  tau(32),Gtotal(1000000)
       real*4  mw,nv,tau,deltat,Gn,K,w,p
       real*4  sum,sum1,sum2,sine,cosine
       integer*4  M

       open(10,file='species')
       open(12,file='doublereptation')

       write(6,*)'Input Plateau modulus (GNo)'
       read(5,*)Gn

       w(1)=0.01
       w(2)=0.0126
       w(3)=0.0158
       w(4)=0.02
       w(5)=0.0251
```

```
      w(6)=0.0316
      w(7)=0.0398
      w(8)=0.0631
      w(9)=0.1
      w(10)=0.158
      w(11)=0.251
      w(12)=0.398
      w(13)=0.631
      w(14)=1.0
      w(15)=1.58
      w(16)=2.51
      w(17)=3.98
      w(18)=6.31
      w(19)=10.0
      w(20)=15.8
      w(21)=25.1
      w(22)=39.8
      w(23)=63.1
      w(24)=100.0

      i=0
20    continue
      read(10,*,end=30)a,b
            i=i+1
            mw(i)=a
            nv(i)=b
      goto 20

30    L=i

c     This part is used to find the longest relaxation time of chain i

      K=1e-18
      deltat=1e-3
      tact=K*9e19
      M=tact/deltat


c     This part is to calculate md(fraction of unrelaxed stress at time t)
c     and the stress relaxation modulus(Gtotal)

      do 60 i=1,L
```

```
            tau(i)=K*(mw(i)**3.4)

60      continue

        do 70 j=1,M
            sum=0.0
            do 65 i=1,L

                p=exp(((-1)*j*deltat)/tau(i))
                sum=sum+(nv(i)*p)
65          continue

c       md(j)=sum**2
        Gtotal(j)=Gn*(sum**2)

70      continue
c       This part is to calculate storage modulus(G') and loss modulus(G")

        do 90 i=1,24
            sum1=0.0
            sum2=0.0

            do 80 j=1,M

                sine=sin(w(i)*j*deltat)
                cosine=cos(w(i)*j*deltat)
                sum1=sum1+(Gtotal(j)*sine*deltat)
                sum2=sum2+(Gtotal(j)*cosine*deltat)

80          continue

            Gp=w(i)*sum1
            Gdp=w(i)*sum2
            write(12,*)w(i),Gp,Gdp

90      continue
        stop
        End
```

APPENDIX E

Calibration Data for Gel Permeation Chromatography at high temperature

RI(32*4) Calibration Report
Method Name : MWD Test Method of GPC-150C
Calibration Type : Narrow Standards using Universal Parameters
Curve Type : 5th Order
Equation of Curve : $\log([n]MW) = +7.53E+02 - 1.18E+02*R + 7.41E+00*R^2 - 2.33E-01*R^3 + 3.62E-03*R^4 - 2.24E-05*R^5$
Correlation Coefficient : $r^2 = 0.9975379$
Standard Error of Estimate : 0.05176955
Universal Parameters :
Source for Standards 'Mark-Houwink constants is "Specified"

Table E1 Calibration point of standard polystyrene with known molecular weight

Retention time	Specified Molecular	Calculated Molecular
22.63	20600000	366156873
23.43	8420000	82163550
24.13	4480000	29394928
26.59	1090000	2452089
29.14	335000	308155
30.13	190000	131467
31.21	96400	49758
33.22	37900	7773
34.69	18100	2096
35.81	9100	823
38.64	2630	90
41.23	500	5

APPENDIX F

The molecular weight Calibration Data for Gel Permeation Chromatography at high temperature of HDPE grade H5604F

Molecular Weight Distribution Averages (Area Normalization [W(t)])

Number average : 640 Polydispersity : 77.255947

Weight average : 49444 Instrinsic viscosity : 0.754057

Viscosity average : 34137 Z avg / Wt avg : 9.081067

Z average : 449009 Z+1 avg / Wt avg : 48.923125

Z+1 average : 2418978

Peak maximum : Slice# : 124

Molecular Wt : 22497

Table F1 The slice detail of HDPE grade H5604F from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
1	22.35	14681553	37	278	Rejected
2	22.43	12951184	53	313	Rejected
3	22.51	11472673	78	351	Rejected
4	22.60	10204075	74	364	Rejected
5	22.68	9111247	63	348	Rejected
6	22.76	8166186	81	366	Rejected
7	22.85	7345786	79	357	Rejected
8	22.93	6331008	12	135	Rejected
9	23.01	6006049	73	319	Rejected
10	23.10	5457707	96	485	Rejected
11	23.18	4974986	134	681	0.02
12	23.26	4548654	169	761	0.04
13	23.35	4170914	79	462	Rejected
14	23.43	3835203	93	494	Rejected

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
15	23.51	3535955	102	444	0.05
16	23.60	3268420	90	452	Rejected
17	23.68	3028562	75	416	Rejected
18	23.76	2812927	40	237	Rejected
19	23.85	2618535	59	310	Rejected
20	23.93	2442837	75	350	Rejected
21	24.01	2283630	64	310	Rejected
22	24.10	2138997	98	462	Rejected
23	24.18	2007284	92	450	Rejected
24	24.26	1887051	100	519	0.06
25	24.35	1777036	131	713	0.08
26	24.43	1676141	130	687	0.1
27	24.51	1583403	127	603	0.11
28	24.60	1497971	132	631	0.13
29	24.68	1419101	141	643	0.15
30	24.76	1346137	133	594	0.16
31	24.85	1278493	152	730	0.18
32	24.93	1215655	126	595	0.2
33	25.01	1157167	102	501	0.21
34	25.10	1102619	88	403	Rejected
35	25.18	1051649	48	260	Rejected
36	25.26	1003936	83	411	Rejected
37	25.35	959177	125	613	0.22
38	25.43	917146	128	604	0.24
39	25.51	877587	109	494	0.25
40	25.6	840280	90	454	Rejected
41	25.68	805058	107	495	0.27
42	25.76	771748	71	407	Rejected
43	25.85	740195	113	531	0.28
44	25.93	710263	128	637	0.3
45	26.01	681809	131	716	0.31
46	26.10	654780	197	913	0.34
47	26.18	629015	177	922	0.36
48	26.26	604443	217	1071	0.39
49	26.35	580979	221	1097	0.42
50	26.43	558550	218	1166	0.45

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
51	26.51	537086	360	1747	0.49
52	26.60	516525	367	1906	0.54
53	26.68	496811	453	2322	0.6
54	26.76	477892	565	2863	0.67
55	26.85	459721	706	3495	0.76
56	26.93	442255	780	3918	0.87
57	27.01	425457	991	4911	0.99
58	27.10	409289	1098	5437	1.13
59	27.18	393720	1250	6134	1.29
60	27.26	378720	1352	6695	1.46
61	27.35	364261	1493	7421	1.65
62	27.43	350318	1666	8302	1.87
63	27.51	336870	1825	9069	2.10
64	27.60	323894	1940	9685	2.35
65	27.68	311371	2060	10312	2.62
66	27.76	299283	2164	10825	2.89
67	27.85	287613	2224	11126	3.18
68	27.93	276346	2336	11630	3.48
69	28.01	265468	2374	11839	3.79
70	28.10	254966	2430	12172	4.10
71	28.18	244825	2512	12582	4.42
72	28.26	235036	2598	12948	4.76
73	28.35	225586	2595	12992	5.09
74	28.43	216465	2650	13166	5.43
75	28.51	207664	2673	13375	4.77
76	28.60	199173	2727	13659	6.13
77	28.68	190982	2814	14094	6.49
78	28.76	183083	2940	14688	6.87
79	28.85	175468	3027	15173	7.26
80	28.93	168126	3110	15605	7.66
81	29.01	161056	3334	16580	8.09
82	29.10	154244	3429	17174	8.53
83	29.18	147685	3535	17734	8.99
84	29.26	141372	3658	18338	9.46
85	29.35	135298	3829	19133	9.95
86	29.43	129455	3987	19842	10.46
87	29.51	123837	4067	20371	10.99

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
88	29.60	118437	4243	21169	11.53
89	29.68	113250	4313	21595	12.09
90	29.76	108268	4440	22225	12.66
91	29.85	103485	4542	22676	13.24
92	29.93	98896	4635	23131	13.48
93	30.01	94493	4758	23751	14.45
94	30.10	90272	4834	24214	15.08
95	30.18	86226	4937	24679	15.71
96	30.26	82349	5021	25114	16.36
97	30.35	78636	5193	25889	17.02
98	30.43	75081	5274	26411	17.70
99	30.51	71679	5393	26946	18.40
100	30.60	68426	5426	27086	19.10
101	30.68	65311	5523	27537	19.80
102	30.76	62335	5583	27932	20.52
103	30.85	59491	5633	28242	21.25
104	30.93	56774	5765	28748	21.99
105	31.01	54179	5849	29161	22.74
106	31.10	51707	5938	29586	23.50
107	31.18	49339	5959	29786	24.27
108	31.26	47079	5956	29861	25.04
109	31.35	44926	6080	30408	25.82
110	31.43	42872	6161	30785	26.62
111	31.51	40914	6287	31308	27.42
112	31.60	39048	6220	31222	28.23
113	31.68	37269	6343	31682	29.04
114	31.76	35574	6384	31865	29.86
115	31.85	33960	6409	31998	30.69
116	31.93	32422	6436	32247	31.52
117	32.01	30957	6509	32641	32.36
118	32.10	29563	6557	32878	33.21
119	32.18	28235	6649	33149	34.06
120	32.26	26971	6630	33185	34.91
121	32.35	25768	6649	33308	35.77
122	32.43	24623	6733	33630	36.64
123	32.51	23533	6807	33915	37.51
124	32.60	22497	6808	33977	38.39

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
125	32.68	21510	6763	33812	39.26
126	32.76	20571	6805	33928	40.13
127	32.85	19678	6725	33593	41.00
128	32.93	18828	6704	33380	41.86
129	33.01	18019	6595	32886	42.70
130	33.10	17249	6542	32649	43.54
131	33.18	16517	6464	32306	44.37
132	33.26	15820	6430	32075	45.20
133	33.35	15157	6313	31601	46.01
134	33.43	14525	6283	31463	46.82
135	33.51	13924	6266	31329	47.63
136	33.60	13352	6206	31038	48.43
137	33.68	12807	6157	30893	49.23
138	33.76	12288	6226	31009	50.03
139	33.85	11793	6188	30973	50.82
140	33.93	11322	6181	30968	51.62
141	34.01	10874	6179	30907	52.42
142	34.10	10446	6171	30813	43.21
143	34.18	10038	6053	30384	53.99
144	34.26	9648	6142	30690	54.78
145	34.35	9277	6068	30373	55.56
146	34.43	8923	6006	30059	56.34
147	34.51	8584	5995	29969	57.11
148	34.60	8261	5981	29938	57.88
149	34.68	7952	5997	30013	58.65
150	34.76	7657	5989	29932	59.43
151	34.85	7375	6026	30043	60.20
152	34.93	7105	5963	29777	60.97
153	35.01	6847	5911	29581	61.73
154	35.10	6599	5911	29541	62.49
155	35.18	6362	5897	29451	63.25
156	35.26	6134	5934	29524	64.01
157	35.35	5916	5903	29507	64.77
158	35.43	5707	5879	29420	65.52
159	35.51	5505	5836	29228	66.28
160	35.60	5312	5861	29202	67.03
161	35.68	5126	5843	29130	67.78

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
162	35.76	4947	5754	28819	68.52
163	35.85	4774	5735	28635	69.26
164	35.93	4608	5707	28534	69.99
165	36.01	4447	5738	28608	70.73
166	36.10	4292	5720	28510	71.46
167	36.18	4142	5624	28211	72.19
168	36.26	3997	5563	27868	72.91
169	36.35	3857	5529	27598	73.62
170	36.43	3721	5486	27413	74.33
171	36.51	3589	5463	27321	75.03
172	36.60	3462	5441	27216	75.73
173	36.68	3338	5357	26786	76.42
174	36.76	3217	5271	26266	77.10
175	36.85	3100	5168	25806	77.76
176	36.93	2985	5126	25650	78.42
177	37.01	2874	5137	25673	79.08
178	37.10	2766	5127	25555	79.74
179	37.18	2660	5075	25238	80.39
180	37.26	2557	5033	25036	81.04
181	37.35	2456	4979	24855	81.68
182	37.43	2357	4851	24349	82.30
183	37.51	2261	4854	24154	82.92
184	37.60	2167	4770	23745	83.54
185	37.68	2075	4641	23246	87.13
186	37.76	1986	4609	23115	84.73
187	38.85	1898	4591	22917	85.32
188	37.93	1812	4470	22383	85.90
189	38.01	1728	4417	22059	86.46
190	38.10	1646	4305	21572	87.02
191	38.18	1565	4248	21283	87.57
192	38.26	1484	4216	21060	88.11
193	38.35	1411	4086	20527	88.64
194	38.43	1336	4092	20515	89.17
195	38.51	1263	4017	20259	89.69
196	38.60	1196	3949	19799	90.20
197	38.68	1124	3832	19113	90.69
198	38.76	1057	3704	18517	91.17

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
199	38.85	992	3597	17992	91.63
200	38.93	930	3425	17186	92.07
201	39.01	869	3305	16512	92.50
202	39.10	811	3209	15999	92.91
203	39.18	754	3049	15265	93.30
204	39.26	700	2912	14594	93.68
205	38.35	648	2810	14035	94.04
206	39.43	599	2726	13560	94.39
207	39.51	551	2566	12877	94.72
208	39.60	506	2450	12312	95.04
209	39.68	463	2367	11799	95.34
210	39.76	423	2259	11313	95.63
211	39.85	385	2149	10755	95.91
212	39,93	349	2037	10220	96.18
213	40.01	315	1962	9746	96.43
214	40.10	283	1826	9058	96.66
215	40.18	254	1760	8707	96.88
216	40.26	227	1635	8239	97.10
217	40.35	202	1589	8078	97.30
218	40.43	179	1589	7874	97.51
219	40.51	158	1482	7412	97.70
220	40.60	138	1464	7273	97.88
221	40.68	121	1372	6895	98.06
222	40.76	105	1298	6579	98.23
223	40.85	91	1210	6085	98.39
224	40.93	78	1171	5760	98.54
225	41.01	67	1039	5170	98.67
226	41.10	57	958	4804	98.79
227	41.18	48	878	4424	98.91
228	41.26	41	892	4364	99.02
229	41.35	34	758	3784	99.12
230	41.43	28	722	3588	99.21
231	41.51	23	727	3568	99.30
232	41.60	19	695	3483	99.39
233	41.68	16	701	3519	99.48
234	41.76	13	729	3626	99.58
235	41.85	10	672	3357	99.66

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
236	41.93	8	632	3138	99.74
237	42.01	6	600	2940	99.82
238	42.10	5	537	2554	99.88
239	42.18	4	375	1843	99.93
240	42.26	3	229	1226	99.96
241	42.35	2	175	904	99.99
242	42.43	2	104	525	100.00
243	42.51	1	43	212	Rejected
244	42.60	1	70	226	Rejected

APPENDIX G

The molecular weight Calibration Data for Gel Permeation Chromatography at high temperature of HDPE grade H5840B

Molecular Weight Distribution Averages (Area Normalization [W(t)])

Number average : 1155 Polydispersity : 40.489958

Weight average : 46782 Instrinsic viscosity : 0.746371

Viscosity average : 33641 Z avg / Wt avg : 5.327753

Z average : 249244 Z+1 avg / Wt avg : 13.435867

Z+1 average : 628558

Peak maximum : Slice# : 126

Molecular Wt : 20571

Table G1 The slice detail of HDPE grade H5840B from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
1	22.35	14681553	-2	-22	Rejected
2	22.43	12951184	36	97	Rejected
3	22.51	11472673	-23	-49	Rejected
4	22.60	10204075	-10	-14	Rejected
5	22.68	9111247	-4	-64	Rejected
6	22.76	8166186	-19	-145	Rejected
7	22.85	7345786	-14	-131	Rejected
8	22.93	6631008	-49	-153	Rejected
9	23.01	6006049	-35	-127	Rejected
10	23.10	5457707	-1	-40	Rejected
11	23.18	4974986	7	-11	Rejected
12	23.26	4548654	9	43	Rejected
13	23.35	4170914	17	69	Rejected
14	23.43	3835203	2	-44	Rejected
15	23.51	3535955	-2	-49	Rejected

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
16	23.60	3267420	21	66	Rejected
17	23.68	3028562	18	135	Rejected
18	23.76	2812927	5	174	Rejected
19	23.85	2618535	121	545	0.02
20	23.93	2442837	89	397	Rejected
21	24.01	2283630	63	338	Rejected
22	24.10	2138997	84	462	Rejected
23	24.18	2007284	41	216	Rejected
24	24.26	1887051	27	190	Rejected
25	24.35	1777036	42	260	Rejected
26	24.43	1676141	31	206	Rejected
27	24.51	1583403	56	293	Rejected
28	24.60	1497971	88	419	Rejected
29	24.68	1419101	104	456	0.03
30	24.76	1346137	87	339	Rejected
31	24.85	1278493	9	86	Rejected
32	24.93	1215655	32	178	Rejected
33	25.01	1157167	56	297	Rejected
34	25.10	1102619	96	415	Rejected
35	25.18	1051649	117	580	0.04
36	25.26	1003936	100	520	Rejected
37	25.35	959188	87	436	Rejected
38	25.43	917146	136	602	0.06
39	25.51	877581	117	624	0.08
40	25.60	840280	122	631	0.10
41	25.68	805058	167	819	0.12
42	25.76	771748	164	837	0.14
43	25.85	740195	233	1130	0.17
44	25.93	710263	289	1374	0.21
45	26.01	681829	293	1496	0.25
46	26.10	654780	305	1643	0.30
47	26.18	629015	404	1963	0.35
48	26.26	604443	502	2375	0.42
49	26.35	580979	532	2619	0.49
50	26.43	558550	550	2807	0.57
51	26.51	537086	639	3180	0.66
52	26.60	516525	710	3602	0.76

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
53	26.68	496811	963	4709	0.89
54	26.76	477892	997	5069	1.03
55	26.85	459721	1098	5475	1.18
56	26.93	442255	1188	5874	1.34
57	27.01	425457	1249	6172	1.52
58	27.10	409289	1283	6439	1.70
59	27.18	393720	1341	6750	1.88
60	27.26	378720	1412	7037	20.80
61	27.35	364261	1438	7182	2.28
62	27.43	350318	1481	7379	2.48
63	27.51	336870	1541	7648	2.70
64	27.60	323894	1534	7701	2.91
65	27.68	311371	1591	7903	3.13
66	27.76	299283	1587	7905	3.35
67	27.85	287613	1637	8111	3.57
68	27.93	276346	1668	8237	3.80
69	28.01	265468	1640	8186	4.03
70	28.10	254966	1715	8534	4.27
71	28.18	244825	1758	8805	4.51
72	28.26	235036	1798	9062	4.76
73	28.35	225586	1832	9228	5.02
74	28.43	216465	1912	9548	5.28
75	28.51	207664	1984	9956	5.56
76	28.60	199173	2059	10343	5.85
77	28.68	190982	2142	10728	6.15
78	28.76	183083	2265	11312	6.46
79	28.85	175468	2344	11721	6.79
80	28.93	168128	2435	12164	7.12
81	29.01	161056	2525	12627	7.48
82	29.10	154244	2615	13121	7.84
83	29.18	147685	2754	13749	8.22
84	29.26	141372	2846	14240	8.62
85	29.35	135298	2976	14860	9.03
86	29.43	129455	3120	15647	9.46
87	29.51	123837	3230	16496	9.91
88	29.60	117437	3364	16797	10.38
89	29.68	113250	3476	17368	10.86

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
90	29.76	108268	3576	17904	11.36
91	29.85	103485	3680	18427	11.87
92	29.93	98896	3789	18971	12.40
93	30.01	94493	3970	19737	12.95
94	30.10	90272	4045	20205	13.51
95	30.18	86226	4152	20782	14.09
96	30.26	82349	4285	21415	14.68
97	30.35	78636	4388	21914	15.29
98	30.43	75081	4534	22508	15.92
99	30.51	71679	4564	22869	16.55
100	30.60	68424	4715	23566	17.21
101	30.68	65311	4842	24202	17.88
102	30.76	62335	4993	24893	18.57
103	30.85	59491	5081	25401	19.28
104	30.93	56774	5210	26022	20.00
105	31.01	54179	5318	26597	20.74
106	31.10	51701	5451	27288	21.50
107	31.18	49336	5650	28142	22.28
108	31.26	47079	5761	28796	23.08
109	31.35	44926	5859	29375	23.89
110	31.43	42872	6035	30149	24.73
111	31.51	40914	6187	30970	25.59
112	31.60	39048	6359	31813	26.47
113	31.68	37269	6509	32578	27.38
114	31.76	35574	6689	33393	28.31
115	31.85	33960	6759	33859	29.25
116	31.93	32422	6923	34660	30.21
117	32.01	30957	7078	35403	31.19
118	32.10	29563	7087	35920	32.19
119	32.18	28235	7283	36425	33.20
120	32.26	26971	7395	36971	34.23
121	32.35	25768	7500	37482	35.27
122	32.43	24623	7554	37702	36.32
123	32.51	23533	7530	37653	37.37
124	32.60	22497	7537	37761	38.41
125	32.68	21510	7595	37967	39.47
126	32.76	20571	7596	37936	40.52

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
127	32.85	19678	7529	37696	41.57
128	32.93	18828	7542	37722	42.62
129	33.01	18019	7572	37849	43.67
130	33.10	17249	7477	37497	44.71
131	33.18	16517	7518	37589	45.76
132	33.26	15820	7523	37660	46.80
133	33.35	15157	7561	37778	47.85
134	33.43	14525	7542	37679	48.90
135	33.51	13924	7555	37694	49.94
136	33.60	13352	7542	37708	50.99
137	33.68	12807	7565	37806	52.04
138	33.76	12288	7544	37669	53.09
139	33.85	11793	7438	37222	54.12
140	33.93	11322	7405	37041	55.15
141	34.01	10874	7367	36902	56.18
142	34.10	10446	7316	36587	57.19
143	34.18	10038	7280	36342	58.20
144	34.26	9648	7229	36047	59.20
145	34.35	9277	7108	35514	60.19
146	34.43	8923	7039	35227	61.17
147	34.51	8584	6959	34787	62.14
148	34.60	8261	6872	34297	63.09
149	34.68	7952	6873	33889	64.03
150	34.76	7657	6749	33679	64.97
151	34.85	7375	6606	33063	65.88
152	34.93	7105	6518	32636	66.79
153	35.01	6847	6429	32126	67.68
154	35.10	6599	6349	31689	68.56
155	35.18	6362	6270	31349	69.43
156	35.26	6134	6168	30947	70.29
157	35.35	5916	6131	30657	71.15
158	35.43	5707	6035	30163	71.98
159	35.51	5505	5885	29532	72.80
160	35.60	5312	5784	28940	73.61
161	35.68	5126	5689	28484	74.40
162	35.76	4947	5651	28208	75.18
163	35.85	4774	5485	27474	75.95

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
164	35.93	4608	5410	27064	76.70
165	36.01	4447	5331	26612	77.44
166	36.10	4292	5256	26274	78.17
167	36.18	4142	5149	25808	78.88
168	36.26	3997	5085	25461	79.59
169	36.35	3857	4996	24988	80.29
170	36.43	3721	4888	24486	80.97
171	36.51	3589	4835	24097	81.64
172	36.60	3462	4726	23557	82.29
173	36.68	3338	4618	23160	82.93
174	36.76	3217	4536	22666	83.56
175	36.85	3100	4459	22246	84.18
176	36.93	2985	4397	21913	84.79
177	37.01	2874	4240	21256	85.38
178	37.10	2766	4122	20660	85.95
179	37.18	2660	4063	20267	86.52
180	37.26	2557	3984	19989	87.07
181	37.35	2456	3938	19681	87.62
182	37.43	2357	3814	19098	88.15
183	37.51	2261	3749	18742	88.67
184	37.60	2167	3687	18349	89.18
185	37.68	2075	3528	17638	89.67
186	37.76	1986	3506	17451	90.15
187	38.85	1898	3378	16960	90.63
188	37.93	1812	3290	16475	91.08
189	38.01	1728	3218	16023	91.53
190	38.10	1646	3109	15601	91.96
191	38.18	1565	3031	15162	92.38
192	38.26	1487	2958	14699	92.79
193	38.35	1411	2836	14125	93.18
194	38.43	1336	2717	13555	93.56
195	38.51	1263	2567	12911	93.92
196	38.60	1193	2508	12526	94.27
197	38.68	1124	2382	11934	94.60
198	38.76	1057	2254	11305	94.91
199	38.85	992	2164	10738	95.21
200	38.93	930	2037	10173	95.49

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
201	39.01	869	1905	9613	95.76
202	39.10	811	1805	9067	96.01
203	39.18	754	1697	8467	96.25
204	39.26	700	1584	7923	96.47
205	38.35	648	1453	7319	96.67
206	39.43	599	1316	6627	96.86
207	39.51	551	1255	6210	97.03
208	39.60	506	1177	5824	97.19
209	39.68	463	1080	5410	97.34
210	39.76	423	1028	5197	97.48
211	39.85	385	1041	5183	97.63
212	39.93	349	997	5003	97.77
213	40.01	315	1000	5005	97.91
214	40.10	283	989	4978	98.04
215	40.18	254	922	4641	98.17
216	40.26	227	858	4322	98.29
217	40.35	202	855	4175	98.41
218	40.43	179	781	3986	98.52
219	40.51	158	800	4061	98.63
220	40.60	138	767	3935	98.74
221	40.68	121	798	3992	98.85
222	40.76	105	730	3699	98.96
223	40.85	91	730	3571	99.06
224	40.93	78	634	3212	99.14
225	41.01	67	604	2991	99.23
226	41.10	57	538	2654	99.30
227	41.18	48	466	2322	99.37
228	41.26	41	409	2073	99.42
229	41.35	34	444	2252	99.49
230	41.43	28	397	2067	99.54
231	41.51	23	433	2181	99.60
232	41.60	19	444	2213	99.67
233	41.68	16	405	2051	99.72
234	41.76	13	387	1890	99.77
235	41.85	10	358	1724	99.82
236	41.93	8	328	1590	99.87
237	42.01	6	354	1697	99.91

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
238	42.10	5	281	1430	99.95
239	42.18	4	235	1097	99.98
240	42.26	3	108	564	100.00
241	42.35	2	72	315	Rejected
242	42.43	2	-1	-69	Rejected
243	42.51	1	-122	-489	Rejected
244	42.60	1	-94	-368	Rejected

APPENDIX H

The molecular weight Calibration Data for Gel Permeation Chromatography at high temperature of HDPE grade H5690S

Molecular Weight Distribution Averages (Area Normalization [W(t)])

Number average : 2024 Polydispersity : 22.011906

Weight average : 44562 Instrinsic viscosity : 0.803183

Viscosity average : 37357 Z avg / Wt avg : 2.813181

Z average : 125361 Z+1 avg / Wt avg : 5.705954

Z+1 average : 254269

Peak maximum : Slice # : 116

Molecular Wt : 32422

Table H1 The slice detail of HDPE grade H5690S from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
1	22.35	14681553	-21	-43	Rejected
2	22.43	12951184	66	201	Rejected
3	22.51	11472673	-64	-313	Rejected
4	22,60	10204075	-9	-150	Rejected
5	22.68	9111247	-8	-8	Rejected
6	22.76	8166186	38	214	Rejected
7	22.85	7345786	73	355	Rejected
8	22.93	6631008	24	173	Rejected
9	23.01	6006049	28	123	Rejected
10	23.10	5457707	-2	23	Rejected
11	23.18	4974986	88	412	Rejected
12	23.26	4548654	72	434	Rejected
13	23.35	4170914	87	411	Rejected
14	23.43	3835203	80	340	Rejected
15	23.51	3535955	-20	-63	Rejected

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
16	23.60	3268420	25	43	Rejected
17	23.68	3028562	-16	-90	Rejected
18	23.76	2812927	-3	-63	Rejected
19	23.85	2618535	28	118	Rejected
20	23.93	2442837	33	183	Rejected
21	24.01	2283630	22	97	Rejected
22	24.10	2138997	18	33	Rejected
23	24.18	2007284	39	98	Rejected
24	24.26	1887051	37	132	Rejected
25	24.35	1777036	12	116	Rejected
26	24.43	1676141	69	315	Rejected
27	24.51	1583403	24	175	Rejected
28	24.60	1497971	25	158	Rejected
29	24.68	1419101	44	250	Rejected
30	24.76	1346137	55	330	Rejected
31	24.85	1278493	15	125	Rejected
32	24.93	1215655	39	192	Rejected
33	25.01	1157167	74	282	Rejected
34	25.10	1102519	25	141	Rejected
35	25.18	1051649	66	216	Rejected
36	25.26	1003936	56	163	Rejected
37	25.35	959188	-14	-30	Rejected
38	25.43	917146	12	107	Rejected
39	25.51	877581	61	242	Rejected
40	25.60	840280	78	354	Rejected
41	25.68	205058	92	474	Rejected
42	25.76	771748	86	399	Rejected
43	25.85	740195	60	306	Rejected
44	25.93	710263	108	533	0.01
45	26.01	681629	68	424	Rejected
46	26.10	654780	104	547	0.03
47	26,18	629015	178	836	0.05
48	26.26	604443	136	778	0.08
49	26.35	580979	210	1068	0.10
50	26.43	558550	208	1057	0.13
51	26.51	537086	262	1261	0.17
52	26.60	516525	213	1109	0.20

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
53	26.68	496811	262	1264	0.24
54	26.76	477892	228	1188	0.27
55	26.85	459721	344	1542	0.31
56	26.93	442255	296	1435	0.35
57	27.01	425457	370	1787	0.40
58	27.10	409289	366	1855	0.45
59	27.18	393720	382	1978	0.51
60	27.26	378720	497	2418	0.58
61	27.35	364261	533	2669	0.65
62	27.43	350318	613	3007	0.73
63	27.51	336870	601	3015	0.82
64	27.60	323894	620	3129	0.91
65	27.68	311371	739	3642	1.01
66	27.76	299283	787	3952	1.12
67	27.85	287613	856	4305	1.24
68	27.93	276346	947	4783	1.37
69	28.01	265468	1019	5051	1.51
70	28.10	254966	1050	5299	1.66
71	28.18	244825	1181	5960	1.82
72	28.26	235036	1260	6442	2.00
73	28.35	225586	1405	7119	2.20
74	28.43	216465	1559	7807	2.42
75	28.51	207664	1720	8672	2.66
76	28.60	199173	1850	9325	2.92
77	28.68	190982	2038	10182	3.21
78	28.76	183083	2182	10894	3.51
79	28.85	175468	2304	11516	3.83
80	28.93	168128	2486	12371	4.17
81	29.01	161056	2669	13354	4.55
82	29.10	154244	2875	14390	4.95
83	29.18	147685	3087	15388	5.38
84	29.26	141372	3302	16475	5.84
85	29.35	135298	3499	17577	6.33
86	29.43	129455	3712	18602	6.84
87	29.51	123837	3924	19631	7.39
88	29.60	118437	4198	21011	7.98
89	29.68	113250	4465	22431	8.60

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
90	29.76	108268	4816	24047	9.27
91	29.85	103485	5076	25337	9.98
92	29.93	98896	5338	26741	10.72
93	30.01	94493	5696	28450	11.52
94	30.10	90272	5963	29856	12.35
95	30.18	86226	6304	31581	13.23
96	30.26	82349	6726	33604	14.17
97	30.35	78636	7084	35368	15.15
98	30.43	75081	7407	37021	16.18
99	30.51	71679	7726	38649	17.26
100	30.60	68424	8035	40199	18.38
101	30.68	65311	8381	41887	19.55
102	30.76	62335	8811	44007	20.77
103	30.85	59491	9150	45790	22.05
104	30.93	56774	9501	47552	23.38
105	31.01	54179	9877	49389	24.75
106	31.10	51701	10278	51353	26.18
107	31.18	49336	10578	52916	27.66
108	31.26	47079	10896	54552	29.18
109	31.35	44926	11222	56118	30.74
110	31.43	42872	11501	57529	32.35
111	31.51	40914	11806	59008	33.99
112	31.60	39048	12043	60275	35.67
113	31.68	37269	12271	61304	37.38
114	31.76	35574	12388	61909	39.10
115	31.85	33960	12528	62537	40.85
116	31.93	32422	12591	62893	42.60
117	32.01	30957	12559	62807	44.35
118	32.10	29563	12503	62494	46.09
119	32.18	28235	12383	61885	47.82
120	32.26	26971	12263	61229	49.52
121	32.35	25768	12082	60408	51.21
122	32.43	24623	11861	59343	52.86
123	32.51	23533	11597	57997	54.48
124	32.60	22497	11363	56814	56.06
125	32.68	21510	11140	55760	57.61
126	32.76	20571	10945	54768	59.14

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
127	32.85	19678	10709	53552	60.63
128	32.93	18828	10475	52325	62.09
129	33.01	18019	10182	50921	63.51
130	33.10	17249	9891	49563	64.89
131	33.18	16517	9672	48353	66.24
132	33.26	15820	9401	46956	67.55
133	33.35	15157	9130	45636	68.82
134	33.43	14525	8828	44186	70.05
135	33.51	13924	8560	42741	71.24
136	33.60	13352	8230	41113	72.39
137	33.68	12807	7918	39573	73.49
138	33.76	12288	7645	38118	74.55
139	33.85	11793	7354	36686	75.58
140	33.93	11322	7014	35181	76.56
141	34.01	10874	6775	33892	77.50
142	34.10	10446	6463	32366	78.40
143	34.18	10038	6252	31219	79.27
144	34.26	9648	5922	29648	80.10
145	34.35	9277	5657	28272	81.89
146	34.43	8923	5415	27072	81.64
147	34.51	8584	5182	25838	82.36
148	34.60	8261	4924	24626	83.05
149	34.68	7952	4710	23596	83.71
150	34.76	7657	4539	22705	84.34
151	34.85	7375	4351	21623	84.94
152	34.93	7105	4128	20547	85.51
153	35.01	6847	3997	19909	86.07
154	35.10	6599	3752	18870	86.60
155	35.18	6362	3597	17995	87.10
156	35.26	6134	3453	17259	87.58
157	35.35	5916	3290	16452	88.04
158	35.43	5707	3159	15832	88.48
159	35.51	5505	3094	15417	88.91
160	35.60	5312	2912	14635	89.31
161	35.68	5126	2856	14286	89.71
162	35.76	4947	2698	13538	90.09
163	35.85	4774	2612	12992	90.45

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
164	35.93	4608	2465	12332	90.80
165	36.01	4447	2370	11769	91.12
166	36.10	4292	2244	11196	91.44
167	36.18	4142	2137	10714	91.73
168	36.26	3997	2097	10447	92.03
169	36.35	3857	1966	9920	92.30
170	36.43	3721	1893	9559	92.57
171	36.51	3589	1799	90889	92.82
172	36.60	3462	1721	8761	93.07
173	36.68	3338	1726	8649	93.31
174	36.76	3217	1584	7932	93.53
175	36.85	3100	1508	7537	93.74
176	36.93	2985	1429	7268	93.94
177	37.01	2874	1479	7287	94.14
178	37.10	2766	1387	6912	94.34
179	37.18	2660	1346	6684	94.52
180	37.26	2557	1323	6586	94.71
181	37.35	2456	1280	6438	94.89
182	37.43	2357	1258	6302	95.06
183	37.51	2261	1200	6003	95.23
184	37.60	2167	1111	5614	95.39
185	37.68	2075	1090	5409	95.54
186	37.76	1986	1074	5322	95.68
187	38.85	1898	1046	5202	95.83
188	37.93	1812	991	4940	95.97
189	38.01	1728	978	4872	96.10
190	38.10	1646	921	4689	96.23
191	38.18	1565	918	4603	96.36
192	38.26	1487	879	4405	96.48
193	38.35	1411	832	4218	96.60
194	38.43	1336	832	4173	96.72
195	38.51	1263	802	4033	96.83
196	38.60	1193	753	3749	96.94
197	38.68	1124	705	3494	97.03
198	38.76	1057	716	3481	97.13
199	38.85	992	643	3266	97.22
200	38.93	930	598	3081	97.31

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
201	39.01	869	618	3067	97.39
202	39.10	811	661	3195	97.48
203	39.18	754	635	3157	97.57
204	39.26	700	626	3148	97.66
205	38.35	648	624	3187	97.75
206	39.43	599	679	3321	97.84
207	39.51	551	607	3033	97.92
208	39.60	506	570	2932	98.00
209	39.68	463	592	2955	98.09
210	39.76	423	631	3066	98.17
211	39.85	385	601	2979	98.26
212	39.93	349	596	3006	98.34
213	40.01	315	603	3989	98.42
214	40.10	283	577	3948	98.50
215	40.18	254	607	3049	98.59
216	40.26	227	622	3069	98.67
217	40.35	202	689	3378	98.77
218	40.43	179	632	3213	98.86
219	40.51	158	706	3487	98.96
220	40.60	138	727	3576	99.06
221	40.68	121	723	3575	99.16
222	40.76	105	644	3319	99.25
223	40.85	91	596	3011	99.33
224	40.93	78	518	2586	99.40
225	41.01	67	447	2242	99.47
226	41.10	57	340	1775	99.52
227	41.18	48	394	1951	99.57
228	41.26	41	357	1819	99.62
229	41.35	34	327	1625	99.67
230	41.43	28	299	1526	99.71
231	41.51	23	338	1702	99.76
232	41.60	19	288	1559	99.80
233	41.68	16	299	1472	99.84
234	41.76	13	273	1346	99.88
235	41.85	10	257	1336	99.92
236	41.93	8	269	1376	99.95
237	42.01	6	180	969	99.98

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
238	42.10	5	137	701	100.00
239	42.18	4	53	283	Rejected
240	42.26	3	7	15	Rejected
241	42.35	2	-108	-451	Rejected
242	42.43	2	-94	-491	Rejected
243	42.51	1	-101	-490	Rejected
244	42.60	1	-59	-266	Rejected

APPENDIX I

The molecular weight Calibration Data for Gel Permeation Chromatography at high temperature of LDPE grade S1018

Molecular Weight Distribution Averages (Area Normalization [W(t)])

Number average : 643 Polydispersity : 111.258450

Weight average : 71565 Instrinsic viscosity : 0.968737

Viscosity average : 48826 Z avg / Wt avg : 15.981003

Z average : 1143677 Z+1 avg / Wt avg : 70.688260

Z+1 average : 5058791

Peak maximum : Slice # : 107

Molecular Wt : 49336

Table I1 The slice detail of LDPE grade S1018 from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
1	22.35	14681553	60	319	Rejected
2	22.43	12951184	111	531	Rejected
3	22.51	11472673	122	639	Rejected
4	22.60	10204075	115	625	Rejected
5	22.68	9111247	131	613	0.02
6	22.76	8166186	118	583	0.03
7	22.85	7345786	114	591	0.05
8	22.93	6631008	75	440	Rejected
9	23.01	6006049	105	531	0.06
10	23.10	5457707	103	492	0.08
11	23.18	4974986	93	429	Rejected
12	23.26	4548654	99	505	Rejected
13	23.35	4170914	133	674	0.10
14	23.43	3835203	137	629	0.11
15	23.51	3535955	121	569	0.13

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
16	23.60	3268420	121	568	0.15
17	23.68	3028562	129	674	0.16
18	23.76	2812927	146	728	0.18
19	23.85	2618535	201	935	0.21
20	23.93	2442837	162	846	0.23
21	24.01	2283630	161	847	0.26
22	24.10	2138997	191	1009	0.29
23	24.18	2007284	182	954	0.31
24	24.26	1887051	199	1024	0.34
25	24.35	1777036	248	1225	0.37
26	24.43	1676141	184	907	0.40
27	24.51	1583403	193	944	0.43
28	24.60	1497971	208	1,092	0.46
29	24.68	1419101	218	1086	0.49
30	24.76	1346137	242	1122	0.52
31	24.85	1278493	229	1152	0.55
32	24.93	1215655	258	1322	0.59
33	25.01	1157167	292	1482	0.63
34	25.10	1102619	276	1405	0.67
35	25.18	1051649	284	1420	0.71
36	25.26	1003936	268	1377	0.74
37	25.35	959188	288	1415	0.78
38	25.43	917146	334	1630	0.83
39	25.51	877581	367	1843	0.88
40	25.60	840280	344	1776	0.93
41	25.68	805058	307	1672	0.98
42	25.76	771748	355	1736	1.02
43	25.85	740195	382	1825	1.07
44	25.93	710263	375	1837	1.13
45	26.01	681829	311	1645	1.17
46	26.10	654780	340	1779	1.22
47	26.18	629015	413	2031	1.28
48	26.26	604443	383	1952	1.33
49	26.35	580979	402	2000	1.39
50	26.43	558550	389	1920	1.44
51	26.51	537086	394	1948	1.49
52	26.60	516525	447	2140	1.55

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
53	26.68	496811	386	1970	1.61
54	26.76	477892	442	2246	1.67
55	26.85	459721	490	2451	1.74
56	26.93	442255	594	2874	1.82
57	27.01	425457	625	3087	1.90
58	27.10	409289	638	3226	1.99
59	27.18	393720	711	3530	2.09
60	27.26	378720	786	3900	2.20
61	27.35	364261	820	4148	2.32
62	27.43	350318	919	4597	2.44
63	27.51	336870	980	4948	2.58
64	27.60	323894	1107	5511	2.73
65	27.68	311371	1252	6162	2.90
66	27.76	299283	1315	6616	3.09
67	27.85	287613	1538	7607	3.30
68	27.93	276346	1640	8170	3.53
69	28.01	265468	1724	8701	3.77
70	28.10	254966	1925	9549	4.03
71	28.18	244825	2028	10211	4.32
72	28.26	235036	2190	10977	4.62
73	28.35	225586	2377	11791	4.95
74	28.43	216465	2513	12526	5.30
75	28.51	207664	2741	13602	5.67
76	28.60	199173	2880	14396	6.07
77	28.68	190982	3072	15385	6.50
78	28.76	183083	3304	16525	6.96
79	28.85	175468	3499	17514	7.45
80	28.93	168128	3729	18604	7.96
81	29.01	161056	3873	19375	8.50
82	29.10	154244	4060	20304	9.06
83	29.18	147685	4279	21313	9.66
84	29.26	141372	4513	22433	10.28
85	29.35	135298	4707	23465	10.93
86	29.43	129455	4844	24296	11.60
87	29.51	123837	5104	25499	12.31
88	29.60	118437	5268	26264	13.04
89	29.68	113250	5468	27309	13.80

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
90	29.76	108268	5697	28498	14.59
91	29.85	103485	5871	29345	15.41
92	29.93	98896	6052	30267	16.25
93	30.01	94493	6285	31342	17.12
94	30.10	90272	6433	32184	18.01
95	30.18	86226	6604	33078	18.93
96	30.26	82349	6816	34149	19.88
97	30.35	78636	7024	35119	20.85
98	30.43	75081	7203	36032	21.85
99	30.51	71679	7411	37109	22.88
100	30.60	68424	7678	38360	23.95
101	30.68	65311	7778	39001	25.03
102	30.76	62335	8005	39967	26.14
103	30.85	59491	8162	40786	27.27
104	30.93	56774	8218	41255	28.42
105	31.01	54179	8413	42031	29.58
106	31.10	51701	8481	42331	30.76
107	31.18	49336	8544	42668	31.94
108	31.26	47079	8530	42703	33.13
109	31.35	44926	8487	42461	34.31
110	31.43	42872	8460	42270	35.48
111	31.51	40914	8397	41965	36.65
112	31.60	39048	8364	41776	37.81
113	31.68	37269	8215	41134	38.95
114	31.76	35574	8120	40624	40.08
115	31.85	33960	8039	40176	41.19
116	31.93	32422	7980	39872	42.30
117	32.01	30957	7936	39670	43.40
118	32.10	29563	7944	39658	44.50
119	32.18	28235	7876	39379	45.59
120	32.26	26971	7922	39501	46.69
121	32.35	25768	7912	39525	47.79
122	32.43	24623	7929	39584	48.89
123	32.51	23533	7887	39418	49.98
124	32.60	22497	7902	39386	51.07
125	32.68	21510	7847	39158	52.16
126	32.76	20571	7785	38950	53.24

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
127	32.85	19678	7698	38532	54.31
128	32.93	18828	7642	38182	55.37
129	33.01	18019	7535	37699	56.42
130	33.10	17249	7463	37300	57.46
131	33.18	16517	7369	36887	58.48
132	33.26	15820	7306	36501	59.49
133	33.35	15157	7189	35926	60.49
134	33.43	14525	7054	35254	61.47
135	33.51	13924	6920	34614	62.43
136	33.60	13352	6848	34209	63.38
137	33.68	12807	6673	33419	64.31
138	33.76	12288	6613	33088	65.23
139	33.85	11793	6477	32406	66.13
140	33.93	11322	6397	31955	67.01
141	34.01	10874	6295	31515	67.89
142	34.10	10446	6197	30967	68.75
143	34.18	10038	6053	30260	69.59
144	34.26	9648	5964	29754	70.41
145	34.35	9277	5838	29233	71.23
146	34.43	8923	5697	28566	72.02
147	34.51	8584	5647	28163	72.80
148	34.60	8261	5572	27775	73.57
149	34.68	7952	5386	27008	74.32
150	34.76	7657	5230	26196	75.05
151	34.85	7375	5160	25765	75.76
152	34.93	7105	5065	25274	76.47
153	35.01	6847	4995	24901	77.16
154	35.10	6599	4844	24289	77.83
155	35.18	6362	4771	23889	78.49
156	35.26	6134	4669	23304	79.14
157	35.35	5916	4567	22829	79.78
158	35.43	5707	4485	22450	80.40
159	35.51	5505	4416	22049	81.01
160	35.60	5312	4339	21623	81.61
161	35.68	5126	4189	20924	82.19
162	35.76	4947	4116	20567	82.76
163	35.85	4774	4037	20184	83.32

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
164	35.93	4608	3936	19739	83.87
165	36.01	4447	3862	19324	84.41
166	36.10	4292	3752	18774	84.93
167	36.18	4142	3706	18471	85.44
168	36.26	3997	3542	17816	85.94
169	36.35	3857	3501	17537	86.42
170	36.43	3721	3395	16972	86.89
171	36.51	3589	3288	16387	87.35
172	36.60	3462	3154	15760	87.79
173	36.68	3338	3019	15129	88.21
174	36.76	3217	2930	14675	88.61
175	36.85	3100	2851	14252	89.01
176	36.93	2985	2739	13722	89.39
177	37.01	2874	2671	13365	89.76
178	37.10	2766	2618	13081	90.13
179	37.18	2660	2493	12533	90.47
180	37.26	2557	2443	12175	90.81
181	37.35	2456	2296	11518	91.13
182	37.43	2357	2208	11064	91.44
183	37.51	2261	2126	10692	91.73
184	37.60	2167	2100	10445	92.02
185	37.68	2075	2007	10008	92.30
186	37.76	1986	1933	9687	92.57
187	38.85	1898	1867	9372	92.83
188	37.93	1812	1785	8942	93.08
189	38.01	1728	1737	8694	93.32
190	38.10	1646	1737	8644	93.56
191	38.18	1565	1632	8197	93.79
192	38.26	1487	1596	7958	94.01
193	38.35	1411	1579	7879	94.23
194	38.43	1336	1493	7445	94.44
195	38.51	1263	1495	7480	94.64
196	38.60	1193	1446	7302	94.85
197	38.68	1124	1473	7293	95.05
198	38.76	1057	1390	6903	95.24
199	38.85	992	1345	6678	95.43
200	38.93	930	1291	6499	95.61

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
201	39.01	869	1270	6367	95.78
202	39.10	811	1235	6234	95.96
203	39.18	754	1235	6193	96.13
204	39.26	700	1209	6087	96.30
205	38.35	648	1223	6084	96.47
206	39.43	599	1101	5648	96.62
207	39.51	551	1146	5715	96.78
208	39.60	506	1127	5621	96.94
209	39.68	463	1096	5541	97.09
210	39.76	423	1164	5784	97.25
211	39.85	385	1094	5581	97.41
212	39.93	349	1160	5793	97.57
213	40.01	315	1145	5731	97.73
214	40.10	283	1071	5446	97.88
215	40.18	254	1033	5241	98.02
216	40.26	227	986	4920	98.16
217	40.35	202	894	4488	98.28
218	40.43	179	881	4453	98.41
219	40.51	158	880	4355	98.53
220	40.60	138	786	3900	98.64
221	40.68	121	731	3652	98.74
222	40.76	105	628	3266	98.83
223	40.85	91	617	3158	98.92
224	40.93	78	610	3067	99.00
225	41.01	67	596	3058	99.09
226	41.10	57	650	3183	99.18
227	41.18	48	572	2868	99.25
228	41.26	41	555	2809	99.33
229	41.35	34	523	2673	99.41
230	41.43	28	577	2724	99.48
231	41.51	23	478	2352	99.55
232	41.60	19	399	2016	99.60
233	41.68	16	360	1850	99.66
234	41.76	13	357	1837	99.71
235	41.85	10	366	1769	99.76
236	41.93	8	278	1451	99.80
237	42.01	6	198	1062	99.83

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
238	42.10	5	160	825	99.85
239	42.18	4	153	747	99.87
240	42.26	3	158	737	99.89
241	42.35	2	162	757	99.91
242	42.43	2	170	856	99.93
243	42.51	1	238	1204	99.97
244	42.60	1	310	1173	100.00

APPENDIX J

The molecular weight Calibration Data for Gel Permeation Chromatography at high temperature of LDPE grade LD2130FA

Molecular Weight Distribution Averages (Area Normalization [W(t)])

Number average : 1450 Polydispersity : 37.187620

Weight average : 53920 Instrinsic viscosity : 0.874645

Viscosity average : 42195 Z avg / Wt avg : 5.352021

Z average : 288580 Z+1 avg / Wt avg : 21.537907

Z+1 average : 1161321

Peak maximum : Slice # : 110

Molecular Wt : 42872

Table J1 The slice detail of LDPE grade LD2130FA from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
1	22.35	14681553	-1	-17	Rejected
2	22.43	12951184	10	68	Rejected
3	22.51	11472673	-24	-67	Rejected
4	22.60	10204075	36	165	Rejected
5	22.68	9111247	14	115	Rejected
6	22.76	8166186	38	131	Rejected
7	22.85	7345786	37	154	Rejected
8	22.93	6631008	42	221	Rejected
9	23.01	6006049	3	89	Rejected
10	23.10	5457707	52	263	Rejected
11	23.18	4974986	45	255	Rejected
12	23.26	4548654	24	193	Rejected
13	23.35	4170914	8	97	Rejected
14	23.43	3835203	21	153	Rejected
15	23.51	3535955	35	223	Rejected

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
16	23.60	3268420	117	483	0.01
17	23.68	3028562	56	307	Rejected
18	23.76	2812927	4	118	Rejected
19	23.85	2618535	91	418	Rejected
20	23.93	2442837	46	318	Rejected
21	24.01	2283630	110	478	0.03
22	24.10	2138997	47	306	Rejected
23	24.18	2007284	112	539	0.05
24	24.26	1887051	112	571	0.06
25	24.35	1777036	141	651	0.08
26	24.43	1676141	140	637	0.10
27	24.51	1583403	168	776.00	0.13
28	24.60	1497971	158	790	0.15
29	24.68	1419101	112	525	0.17
30	24.76	1346137	161	692	0.19
31	24.85	1278493	150	700	0.21
32	24.93	1215655	163	682	0.23
33	25.01	1157167	100	510	0.25
34	25.10	1102619	159	690	0.27
35	25.18	1051649	106	555	0.28
36	25.26	1003936	81	484	Rejected
37	25.35	959188	88	477	Rejected
38	25.43	917146	102	469	0.30
39	25.51	877581	101	456	0.31
40	25.60	840280	72	385	Rejected
41	25.68	805058	109	522	0.33
42	25.76	771748	108	461	0.34
43	25.85	740195	82	380	Rejected
44	25.93	710263	104	515	0.36
45	26.01	681829	130	663	0.38
46	26.10	654780	138	707	0.40
47	26.18	629015	211	1009	0.43
48	26.26	604443	209	1066	0.46
49	26.35	580979	241	1196	0.50
50	26.43	558550	245	1249	0.54
51	26.51	537086	294	1448	0.58
52	26.60	516525	282	1461	0.63

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
53	26.68	496811	391	1869	0.68
54	26.76	477892	407	2014	0.75
55	26.85	459721	441	2215	0.81
56	26.93	442255	497	2462	0.89
57	27.01	425457	532	2616	0.97
58	27.10	409289	547	2720	1.05
59	27.18	393720	535	2771	1.14
60	27.26	378720	669	3258	1.24
61	27.35	364261	669	3304	1.34
62	27.43	350318	735	3611	1.45
63	27.51	336870	816	4030	1.57
64	27.60	323894	878	4404	1.70
65	27.68	311371	964	4843	1.85
66	27.76	299283	1073	5322	2.02
67	27.85	287613	1111	5556	2.19
68	27.93	276346	1237	6141	2.37
69	28.01	265468	1368	6764	2.58
70	28.10	254966	1402	7011	2.79
71	28.18	244825	1512	7505	3.02
72	28.26	235036	1596	8001	3.27
73	28.35	225586	1724	8627	3.53
74	28.43	216465	1835	9259	3.81
75	28.51	207664	2006	9992	4.12
76	28.60	199173	2151	10683	4.45
77	28.68	190982	2219	11126	4.79
78	28.76	183083	2335	11638	5.14
79	28.85	175468	2508	12525	5.52
80	28.93	168128	2655	13339	5.93
81	29.01	161056	2847	14266	6.37
82	29.10	154244	3004	15138	6.83
83	29.18	147685	3236	16170	7.32
84	29.26	141372	3417	17009	7.84
85	29.35	135298	3635	18107	8.40
86	29.43	129455	3834	19165	8.98
87	29.51	123837	4029	20180	9.60
88	29.60	118437	4302	21536	10.26
89	29.68	113250	4581	22895	10.96

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
90	29.76	108668	4800	24117	11.70
91	29.85	103485	5129	25739	12.48
92	29.93	98896	5452	27251	13.31
93	30.01	94493	5762	28796	14.19
94	30.10	90272	6156	30693	15.13
95	30.18	86226	6525	32589	16.13
96	30.26	82349	6809	34119	17.17
97	30.35	78636	7177	35851	18.27
98	30.43	75081	7508	37507	19.41
99	30.51	71679	7869	39324	20.61
100	30.60	68424	8184	40943	21.87
101	30.68	65311	8554	42720	23.17
102	30.76	62335	8899	44393	24.53
103	30.85	59491	9171	45813	25.93
104	30.93	56774	9439	47189	27.37
105	31.01	54179	9697	48432	28.85
106	31.10	51701	9842	49278	30.36
107	31.18	49336	10022	50141	31.89
108	31.26	47079	10181	50792	33.44
109	31.35	44926	10206	51041	35.00
110	31.43	42872	10270	51273	36.57
111	31.51	40914	10129	50693	38.12
112	31.60	39048	10086	50383	39.66
113	31.68	37269	9931	49660	41.17
114	31.76	35574	9722	48641	42.66
115	31.85	33960	9484	47440	44.11
116	31.93	32422	9227	46130	45.52
117	32.01	30957	8921	44607	46.88
118	32.10	29563	8696	43390	48.21
119	32.18	28235	8397	42002	49.49
120	32.26	26971	8163	40816	50.74
121	32.35	25768	7911	39561	51.95
122	32.43	24623	7805	38972	53.14
123	32.51	23533	7653	38221	54.31
124	32.60	22497	7461	37309	55.45
125	32.68	21510	7323	36645	56.57
126	32.76	20571	7178	35936	57.67

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
127	32.85	19678	7069	35331	58.75
128	32.93	18828	6908	34596	59.8
129	33.01	18019	6815	34020	60.84
130	33.10	17249	6663	33315	61.86
131	33.18	16517	6564	32776	62.86
132	33.26	15860	6373	31985	63.84
133	33.35	15157	6255	31371	64.80
134	33.43	14525	6169	30872	65.74
135	33.51	13924	6036	30178	66.66
136	33.60	13352	5896	29428	67.56
137	33.68	12807	5749	28805	68.44
138	33.76	12288	5631	28203	69.31
139	33.85	11793	5509	27500	70.15
140	33.93	11322	5382	26869	70.97
141	34,01	10874	5296	26490	71.78
142	34.10	10446	5235	26100	72.57
143	34.18	10038	5084	25372	73.35
144	34.26	9648	4925	24645	74.10
145	34.35	9277	4910	24394	74.85
146	34.43	8923	4756	23789	75.58
147	34.51	8584	4721	23571	76.30
148	34.60	8261	4607	23078	77.00
149	34.68	7952	4491	22523	77.69
150	34.76	7,657	4469	22313	78.37
151	34.85	7375	4328	21696	79.03
152	34.93	7105	4234	21242	79.68
153	35.01	6847	4187	20900	80.32
154	35.10	6599	4119	20548	80.95
155	35.18	6362	4013	20124	81.56
156	35.26	6134	3909	19613	82.16
157	35.35	5916	3847	19244	82.75
158	35.43	5707	3755	18812	83.33
159	35.51	5505	3624	18188	83.88
160	35.60	5312	3589	17910	84.43
161	35.68	5126	3501	17540	84.97
162	35.76	4947	3388	16983	85.49
163	35.85	4774	3245	16256	85.98

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
164	35.93	4608	3179	15919	86.47
165	36.01	4447	3107	15536	86.94
166	36.10	4292	3018	15126	87.41
167	36.18	4142	2962	14792	87.86
168	36.26	3,997	2886	14428	88.30
169	36.35	3857	2815	14064	88.73
170	36:43	3721	2683	13463	89.14
171	36.51	3589	2580	12935	89.54
172	36.60	3462	2572	12840	89.93
173	36.68	3338	2434	12263	90.30
174	36.76	3217	2374	11829	90.66
175	36.85	3110	2274	11398	91.01
176	36.93	2985	2170	10886	91.34
177	37.01	2874	2089	10498	91.67
178	37.10	2766	2040	10244	91.98
179	37.18	2660	1933	9766	92.28
180	37.26	2557	1957	9723	92.57
181	37.35	2456	1850	9268	92.86
182	37.43	2357	1747	8815	93.13
183	37.51	2161	1707	8545	93.39
184	37.60	2167	1633	8205	93.64
185	37.68	2075	1584	7962	93.88
186	37.76	1986	1556	7725	94.12
187	38.85	1898	1465	7354	94.34
188	37.93	1812	1429	7150	94.56
189	38.01	1728	1378	6797	94.77
190	38.10	1646	1313	6507	94.97
191	38.18	1565	1260	6318	95.16
192	38.26	1,487	1213	6065	95.35
193	38.35	1411	1149	5755	95.52
194	38.43	1336	1117	5537	95.69
195	38.51	1263	999	5030	95.85
196	38.60	1193	1088	5296	96.01
197	38.68	1124	939	4801	96.15
198	38.76	1057	969	4808	96.30
199	38.85	992	923	4577	96.44
200	38.93	930	885	4389	96.57

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
201	39.01	869	907	4456	96.71
202	39.10	811	851	4263	96.84
203	39.18	754	854	4233	96.97
204	39.26	700	830	4155	97.10
205	38.35	648	818	4127	97.22
206	39.43	599	811	4060	97.35
207	39.51	511	753	3841	97.47
208	39.60	506	784	3878	97.58
209	39.68	463	740	3701	97.70
210	39.76	423	730	3651	97.81
211	39.85	385	695	3471	97.91
212	39.93	349	634	3259	98.01
213	40.01	315	656	3264	98.11
214	40.10	283	670	3328	98.22
215	40.18	254	690	3420	98.32
216	40.26	227	727	3575	98.43
217	40.35	202	688	3461	98.53
218	40.43	179	693	3445	98.64
219	40.51	158	646	3281	98.74
220	40.60	138	661	3292	98.84
221	40.68	121	636	3245	98.94
222	40.76	105	553	2851	99.03
223	40.85	91	570	2781	99.11
224	40.93	78	479	2499	99.19
225	41.01	67	516	2574	99.27
226	41.10	57	500	2470	99.34
227	41.18	48	439	2230	99.41
228	41.26	41	383	2004	99.47
229	41.35	34	393	1993	99.53
230	41.43	28	345	1740	99.59
231	41.51	23	375	1798	99.64
232	41.60	19	386	1868	99.70
233	41.68	16	339	1785	99.75
234	41.76	13	385	1901	99.81
235	41.85	10	323	1611	99.86
236	41.93	8	341	1661	99.91
237	42.01	6	262	1369	99.95

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
238	42.10	5	179	887	99.98
239	42.18	4	142	655	100.00
240	42.26	3	76	367	Rejected
241	42.35	2	16	60	Rejected
242	42.43	2	28	96	Rejected
243	42.51	1	-43	-87	Rejected
244	42.60	1	53	170	Rejected

APPENDIX K

The molecular weight Calibration Data for Gel Permeation Chromatography at high temperature of LDPE grade D2022

Molecular Weight Distribution Averages (Area Normalization [W(t)])

Number average : 5694 Polydispersity : 18.452776

Weight average : 105079 Instrinsic viscosity : 1.399794

Viscosity average : 82607 Z avg / Wt avg : 3.313059

Z average : 348133 Z+1 avg / Wt avg : 6.029365

Z+1 average : 633560

Peak maximum : Slice # : 107

Molecular Wt : 49336

Table K1 The slice detail of LDPE grade D2022 from gel permeation chromatography

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
1	22.35	14681553	-27	-131	Rejected
2	22.43	12951184	-26	-135	Rejected
3	22.51	11472673	-61	-309	Rejected
4	22.60	10204075	-57	-270	Rejected
5	22.68	9111247	-57	-218	Rejected
6	22.76	8166186	14	2	Rejected
7	22.85	7345786	-24	-132	Rejected
8	22.93	6631008	-21	-137	Rejected
9	23.01	6006049	-30	-122	Rejected
10	23.10	5457707	3	-17	Rejected
11	23.18	4974986	19	81	Rejected
12	23.26	4548654	8	59	Rejected
13	23.35	4170914	41	153	Rejected
14	23.43	3835203	-22	-98	Rejected
15	23.51	3535955	-8	-59	Rejected

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
16	23.60	3268420	-19	-89	Rejected
17	23.68	3028562	12	86	Rejected
18	23.76	2812927	30	150	Rejected
19	23.85	2618535	-37	-134	Rejected
20	23.93	2442837	-48	-172	11.00
21	24.01	2283630	19	92	Rejected
22	24.10	2138997	20	107	Rejected
23	24.18	2007284	-29	-49	Rejected
24	24.26	1887051	61	263	Rejected
25	24.35	1777036	89	418	Rejected
26	24.43	1676141	80	482	Rejected
27	24.51	1583403	160	796	0.02
28	24.60	1497971	192	1020	0.06
29	24.68	1419101	224	1227	0.09
30	24.76	1346137	278	1369	0.14
31	24.85	1278493	313	1563	0.18
32	24.93	1215655	336	1769	0.24
33	25.01	1157167	452	2162	0.30
34	25.10	1102619	432	2168	0.37
35	25.18	1051649	508	2481	0.45
36	25.26	1003936	502	2563	0.53
37	25.35	959188	535	2742	0.61
38	25.43	917146	622	3023	0.70
39	25.51	877581	696	3319	0.80
40	25.60	840280	697	3466	0.91
41	25.68	805058	780	3951	1.03
42	25.76	771748	850	4311	1.16
43	25.85	740195	939	4644	1.31
44	25.93	710263	951	4746	1.45
45	26.01	681829	977	4936	1.60
46	26.10	654780	1097	5453	1.77
47	26.18	629015	1147	5800	1.95
48	26.26	604443	1254	6200	2.14
49	26.35	580979	1287	6442	2.34
50	26.43	558550	1381	6971	2.55
51	26.51	537086	1544	7707	2.79
52	26.60	516525	1717	8514	3.05

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
53	26.68	496811	1801	8995	3.33
54	26.76	477892	1930	9698	3.62
55	26.85	459721	2036	10258	3.94
56	26.93	442255	2212	11097	4.28
57	27.01	425457	2421	12055	4.65
58	27.10	409289	2564	12794	5.04
59	27.18	393720	2750	13821	5.47
60	27.26	378720	2970	14824	5.92
61	27.35	364261	3121	15609	6.40
62	27.43	350318	3298	16434	6.91
63	27.51	336870	3463	17280	7.44
64	27.60	323894	3632	18096	7.99
65	27.68	311371	3821	19060	8.58
66	27.76	299283	3989	19937	9.19
67	27.85	287613	4138	20710	9.83
68	27.93	276346	4310	21529	10.49
69	28.01	265468	4415	22060	11.17
70	28.10	254966	4513	22624	11.86
71	28.18	244825	4660	23306	12.58
72	28.26	235036	4787	23879	13.31
73	28.35	225586	4870	24323	14.06
74	28.43	216465	4875	24493	14.81
75	28.51	207664	5031	25092	15.58
76	28.60	199173	5115	25585	16.36
77	28.68	190982	5305	26463	17.18
78	28.76	183083	5387	26928	18.00
79	28.85	175468	5460	27291	18.84
80	28.93	168128	5542	27700	19.69
81	29.01	161056	5673	28252	20.56
82	29.10	154244	5733	28625	21.44
83	29.18	147685	5770	28885	22.33
84	29.26	141372	5828	29184	23.22
85	29.35	135298	5960	29745	24.14
86	29.43	129455	6077	30312	25.07
87	29.51	123837	6093	30544	26.01
88	29.60	118437	6217	31054	26.96
89	29.68	113250	6298	31479	27.93

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
90	29.76	108268	6424	32072	28.91
91	29.85	103485	6514	32588	29.91
92	29.93	98896	6669	33297	30.93
93	30.01	94493	6752	33801	31.97
94	30.10	90272	6887	34381	33.03
95	30.18	86226	6911	34574	34.09
96	30.26	82349	7068	35284	35.17
97	30.35	78636	7138	35775	36.27
98	30.43	75081	7333	36606	37.40
99	30.51	71679	7395	37023	38.53
100	30.60	68424	7539	37654	39.69
101	30.68	65311	7596	38007	40.86
102	30.76	62335	7665	38342	42.03
103	30.85	59491	7752	38802	43.22
104	30.93	56774	7847	39228	44.43
105	31.01	54179	7867	39356	45.64
106	31.10	51701	7833	39232	46.84
107	31.18	49336	7891	39466	48.05
108	31.26	47079	7873	39357	49.2600
109	31.35	44926	7770	38883	50.46
110	31.43	42872	7640	38293	51.63
111	31.51	40914	7559	37775	52.79
112	31.60	39048	7395	36989	53.93
113	31.68	37269	7280	36353	55.05
114	31.76	35574	7186	35937	56.15
115	31.85	33960	7051	35355	57.23
116	31.93	32422	6981	34961	58.31
117	32.01	30957	6959	34670	59.37
118	32.10	29563	6847	34123	60.42
119	32.18	28235	6776	33808	61.46
120	32.26	26971	6739	33627	62.49
121	32.35	25768	6668	33348	63.52
122	32.43	24623	6570	32843	54.52
123	32.51	23533	6478	32443	65.52
124	32.60	22497	6513	32451	66.52
125	32.68	21510	6333	31716	67.49
126	32.76	20571	6284	31439	68.46

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
127	32.85	19678	6182	30970	69.41
128	32.93	18828	6063	30322	70.34
129	33.01	18019	5977	29839	71.26
130	33.10	17249	5815	29080	72.15
131	33.18	16517	5683	28341	73.02
132	33.26	15820	5569	27820	73.87
133	33.35	15157	5462	27364	74.71
134	33.43	14525	5291	26582	75.53
135	33.51	13924	5206	26004	76.33
136	33.60	13352	5111	25476	77.11
137	33.68	12807	5003	24968	77.88
138	33.76	12288	4868	24336	78.62
139	33.85	11793	4755	23771	79.35
140	33.93	11322	4584	22986	80.06
141	34.01	10874	4526	22617	80.75
142	34.10	10446	4377	21932	81.43
143	34.18	10038	4297	21441	82.09
144	34.26	9648	4,177	20910	82.73
145	34.35	9277	4089	20460	83.36
146	34.43	8923	3955	19815	83.97
147	34.51	8584	3846	19214	84.56
148	34.60	8261	3720	18619	85.13
149	34.68	7952	3610	18064	85.68
150	34.76	7657	3504	17512	86.22
151	34.85	7375	3368	16836	86.74
152	34.93	7105	3277	16317	87.24
153	35.01	6847	3164	15833	87.72
154	35.10	6599	3030	15238	88.19
155	35.18	6362	2937	14662	88.64
156	35.26	6134	2841	14183	89.08
157	35.35	5916	2770	13843	89.50
158	35.43	5707	2651	13282	89.91
159	35.51	5505	2581	12898	90.31
160	35.60	5312	2479	12396	90.69
161	35.68	5126	2364	11819	91.05
162	35.76	4947	2324	11616	91.41
163	35,85	4774	2241	11153	91.75

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
164	35.93	4608	2177	10808	92.08
165	36.01	4447	2077	10446	92.40
166	36.10	4292	2011	10068	92.71
167	36.18	4142	1943	9737	93.01
168	36.26	3997	1856	9390	93.30
169	36.35	3857	1833	9179	93.58
170	36.43	3721	1743	8733	93.85
171	36.51	3589	1652	8292	94.10
172	36.60	3462	1590	7997	94.35
173	36.68	3338	1519	7623	94.58
174	36.76	3217	1,402	7042	94.8
175	36.85	3100	1347	6753	95.01
176	36.93	2,985	1335	6706	95.21
177	37.01	2874	1262	6437	95.41
178	37.10	2766	1226	6133	95.60
179	37.18	2660	1103	5651	95.77
180	37.26	2557	1112	5657	95.95
181	37.35	2456	1117	5555	96.12
182	37.43	2357	1037	5157	96.28
183	37.51	2261	951	4878	96.42
184	37.60	2167	973	4875	96.57
185	37.68	2075	950	4691	96.72
186	37.76	1986	888	4398	96.85
187	38.85	1898	808	4081	96.98
188	37.93	1812	839	4097	97.10
189	38.01	1728	749	3766	97.22
190	38.10	1646	778	3835	97.34
191	38.18	1565	701	3496	97.45
192	38.26	1487	673	3306	97.55
193	38.35	1411	678	3271	97.65
194	38.43	1336	617	3164	97.74
195	38.51	1263	630	3142	97.84
196	38.60	1193	611	3056	97.94
197	38.68	1124	605	3007	98.03
198	38.76	1057	604	3016	98.12
199	38.85	992	567	2847	98.21
200	38.93	930	562	2721	98.29

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
201	39.01	869	530	2620	98.37
202	39.10	811	580	2777	98.46
203	39.18	754	511	2623	98.54
204	39.26	700	564	2834	98.62
205	38.35	648	496	2476	98.70
206	39.43	599	498	2458	98.78
207	39.51	551	498	2492	98.85
208	39.60	506	494	2395	98.93
209	39.68	463	483	2408	99.00
210	39.76	423	477	2417	99.07
211	39.85	385	477	2365	99.15
212	39.93	349	454	2278	99.22
213	40.01	315	464	2381	99.29
214	40.10	283	500	2542	99.37
215	40.18	254	457	2341	99.44
216	40.26	227	483	2397	99.51
217	40.35	202	464	2279	99.58
218	40.43	179	416	2037	99.65
219	40.51	158	338	1710	99.70
220	40.60	138	306	1491	99.74
221	40.68	121	277	1307	99.78
222	40.76	105	230	1071	99.82
223	40.85	91	152	781	99.84
224	40.93	78	102	594	99.86
225	41.01	67	151	733	99.88
226	41.10	57	93	534	Rejected
227	41.18	48	116	571	99.90
228	41.26	41	76	449	Rejected
229	41.35	34	113	536	99.92
230	41.43	28	102	538	99.93
231	41.51	23	129	634	99.95
232	41.60	19	114	576	99.97
233	41.68	16	100	564	Rejected
234	41.76	13	122	574	99.99
235	41.85	10	103	416	100.00
236	41.93	8	54	193	Rejected
237	42.01	6	6	-18	Rejected

Slice #	Retention Time (minutes)	Molecular Weight	Slice Height (Microvolts)	Slice Area (microvolts-sec)	Cumulation Area point
238	42.10	5	-72	-391	Rejected
239	42.18	4	-145	-764	Rejected
240	42.26	3	-218	-1075	Rejected
241	42.35	2	-194	-977	Rejected
242	42.43	2	-209	-970	Rejected
243	42.51	1	-192	-895	Rejected
244	42.60	1	-139	-579	Rejected

CURRICULUM VITAE

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