REFERENCES

Anastasiadis, S. H., and Hatzikiriakos, S. G. (1998) The work of adhesion of polymer/wall interfaces and its association with the onset of wall slip. J. Rheol, 42(4), 795-812.

Black, W. B., and Graham, M. D. (1996) Wall slip and polymer-melt flow instability, Physical Review Letters, 77(5), 956-959.

Black, W. B., and Graham, M. D. (1999) Effect of wall slip on the stability of viscoelastic plane shear flow. Physics of Fluids, 11, 1749-1756.

Brochard, F., and de Gennes, P. G. (1992) Shear-dependent slippage at a polymer/solid interface. Langmuir, 8, 3033-3037.

Brochard-Wyart, F. B., Gay, C., and Gennes, P. G. (1996) Slippage of polymer melts on grafted surfaces. Macromolecules, 29, 377-382.

Dealy, J. M., and Wissbrun, K. F. (1990) Melt rheology and its role in plastics processing, New York, Van Nostrand Reinhold.

Hatzikiriakos, S. G. (1994) The onset of wall slip and sharkskin melt fracture in capillary flow. Polymer Engineering and Science, 34(19), 1441-1449.

Hatzikiriakos, S. G., Hong, P., Ho, W., and Stewart, C. W. (1995) The effect of Teflon™ coating in polyethylene capillary extrusion. Journal of Applied Polymer Science, 55, 595-603.

Haupt, B. J., Ennis, J., and Sevick, E.M. (1999) The detachment of a polymer chain from a weakly adsorbing surface using an AFM tip. Langmuir, 15, 3886-3892.

Kumar, K. A., and Graham, M. D. (1998) Effect of pressure-dependent slip on flow curve multiplicity. Rheol Acta, 37, 245-255.

Leger, L., Hervet, H., and Massey, G. (1997) The role of attached polymer molecules in wall slip. TRIP, 5(2), 40-45.

Larson, R. G. (1999) The structure and rheology of complex fluid. New York, Oxford university press.

Mhetar, V., and Archer, L. A. (1998) Slip in entangled polymer solutions. Macromolecules, 31, 6636-6649.

Mhetar, V., and Archer, L. A. (1998) Slip in entangled polymer melts. 1. General Features. Macromolecules, 31, 8607-8616.

Mhetar, V., and Archer, L. A. (1998) Slip in entangled polymer melts. 2. Effect of Surface Treatment. Macromolecules, 31, 8617-8622.

Moynihan, R. H., Baird, D. G., and Ramanathan, R. (1990) Additional observations on the surface melt fracture behavior of linear low-density polyethylene. Journal of Non-Newtonion Fluid Mechanics, 36, 255-263.

Muller-Mohnssen, H., Weiss, D., and Tippe, A. (1990) Using of laser dropper velocity in flowing of polyacrylamide solution . J. Rheol., 34, 233-246.

Petrie, J. S., and Denn, M. M. (1976) Instabilities in polymer processing. AIChE Journal, 22(2), 209-236.

Rosenbaum, E. E., and Hatzikiriakos, S. G. (1997) Wall slip in the capillary flow of molten polymers subject to viscous heating. AIChE Journal, 43(3), 598-608.

Shore, J. D., Ronis, D., Piche, L., and Grant, M. (1997) Sharkskin texturing instabilities in the flow of polymer melts. Physica A, 239, 350-357.

Wang, S. Q., Drda, P. A., and Inn, Y. W. (1996) Exploring molecular origins of sharkskin, partial slip, and slope change in the flow curves of linear low density polyethylene. J. Rheol., 40(5), 875-898.

Weill, A. (1980) About The origin of sharkskin. Rheol Acta, 19, 623-632.

Yarin, A. L., and Graham, M. D. (1998) A model for slip at polymer/solid interfaces. J. Rheol., 42(6), 1491-1504.

APPENDICES

APPENDIX A

A.1 Apparent Flow Curve with Slip Correction

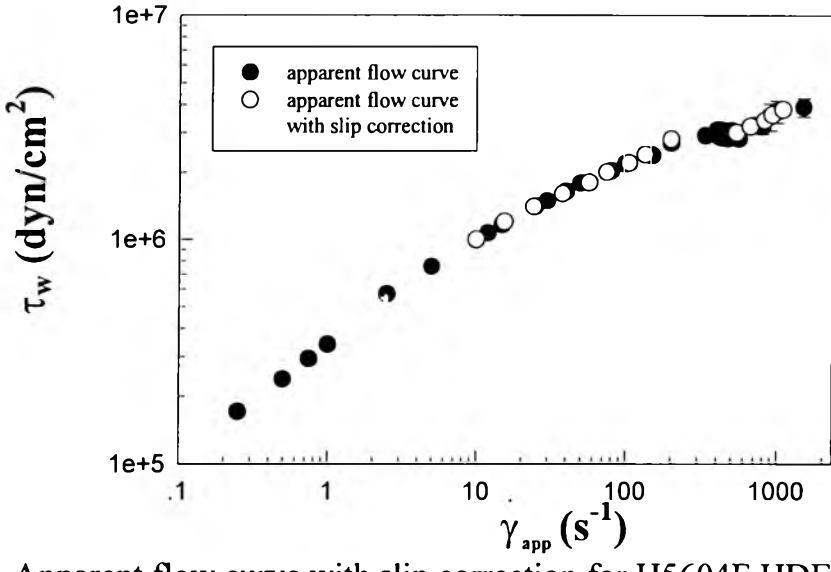

Figure A1 Apparent flow curve with slip correction for H5604F HDEP at the temperature of 180 ^{0}C.

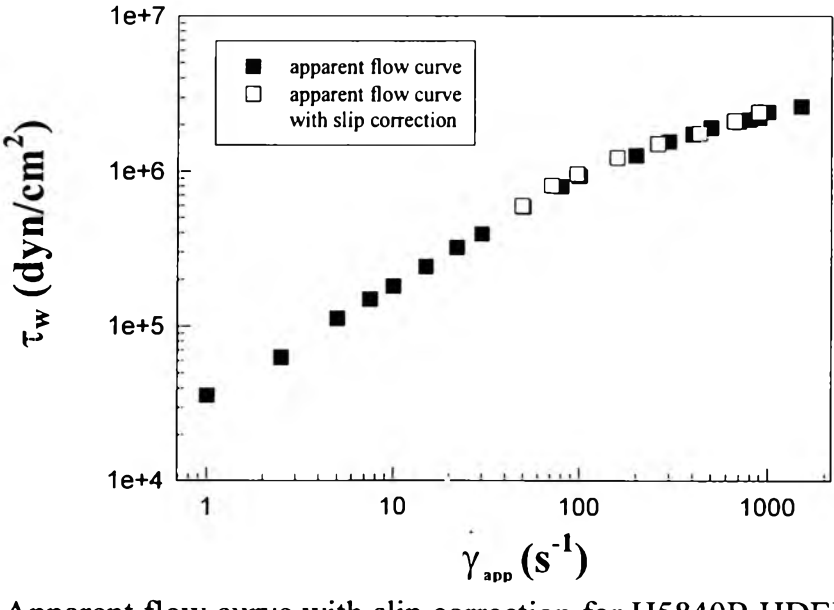

Figure A2 Apparent flow curve with slip correction for H5840B HDEP at the temperature of 180 ^{0}C.

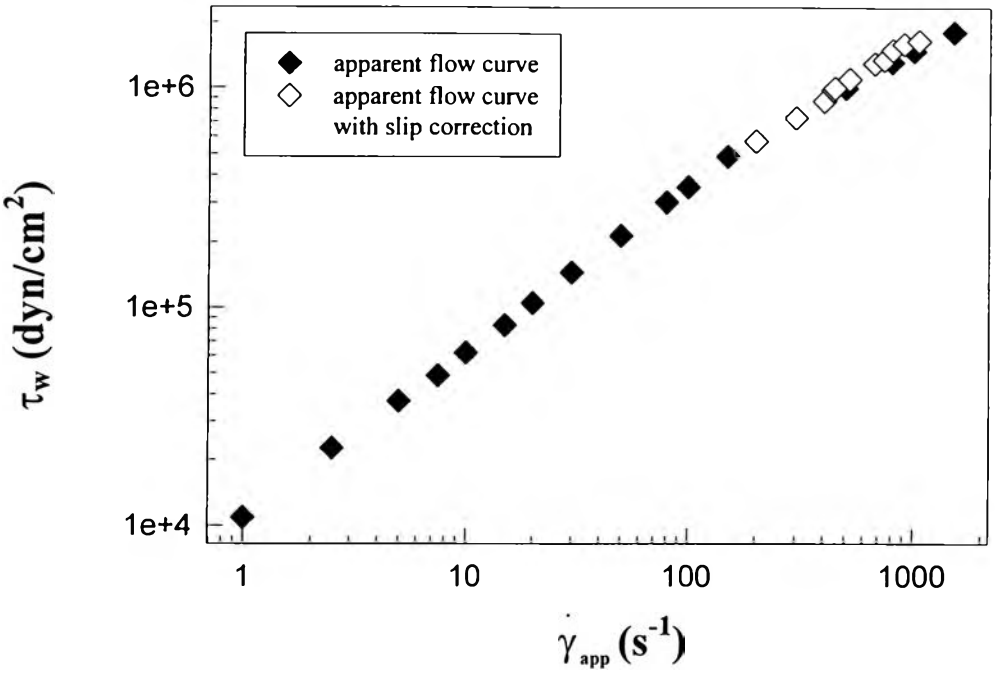

Figure A3 Apparent flow curve with slip correction for H5818J HDPE at the temperature of 180 ^{0}C.

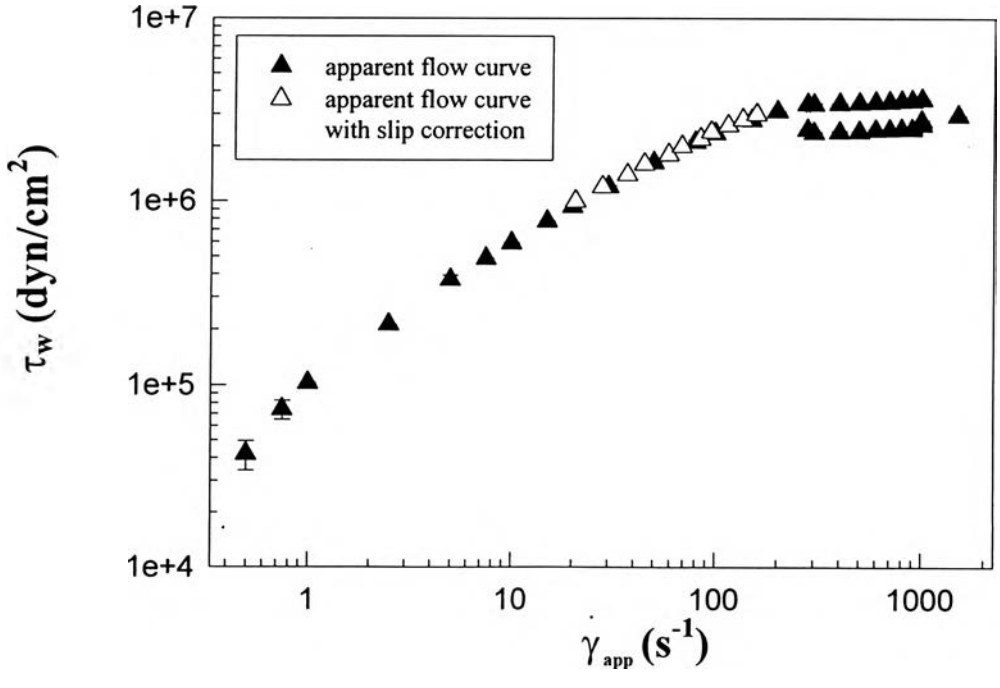

Figure A4 Apparent flow curve with slip correction for H5690S HDPE at the temperature of 180 ^{0}C.

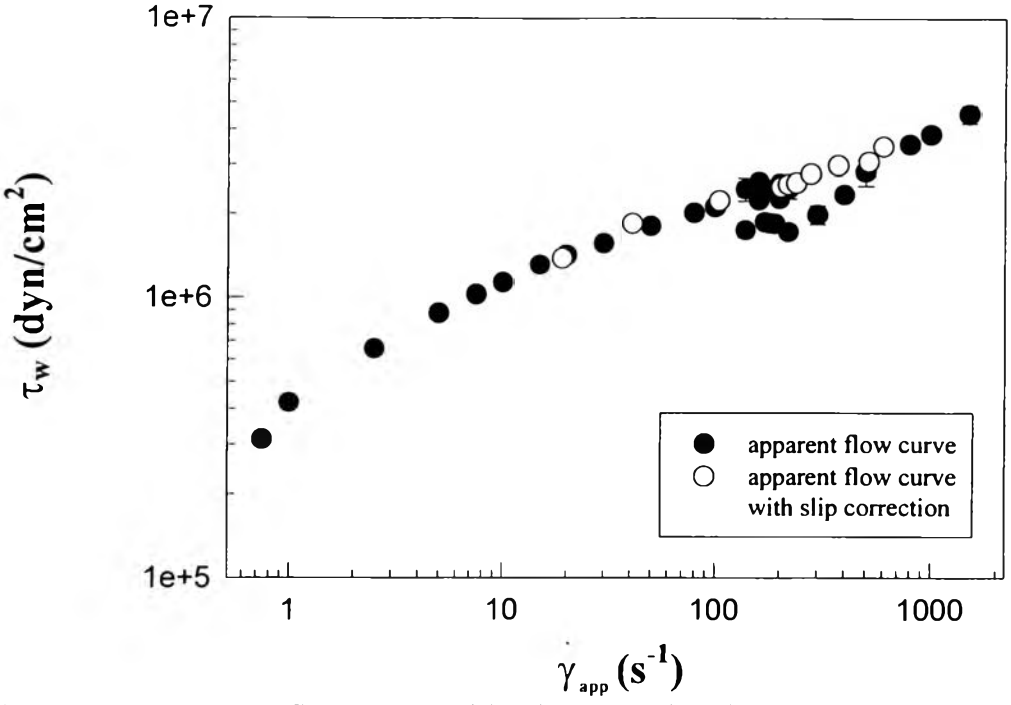

Figure A5 Apparent flow curve with slip correction for H5604F HDPE at the temperature of 160 ^{0}C.

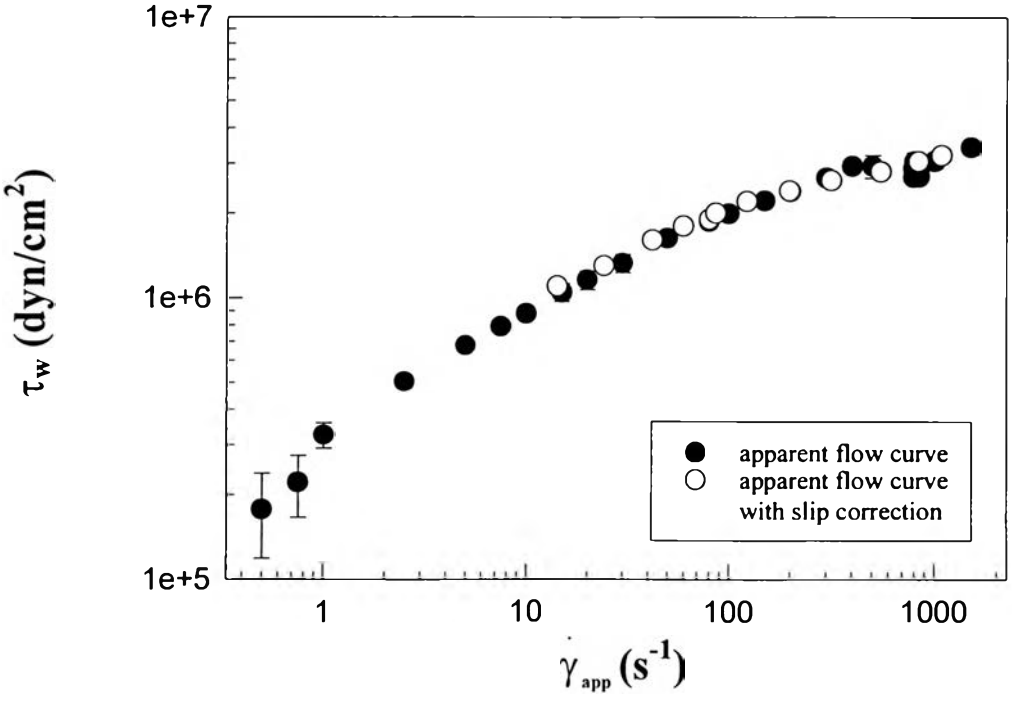

Figure A6 Apparent flow curve with slip correction for H5604F HDPE at the temperature of 200 ^{0}C.

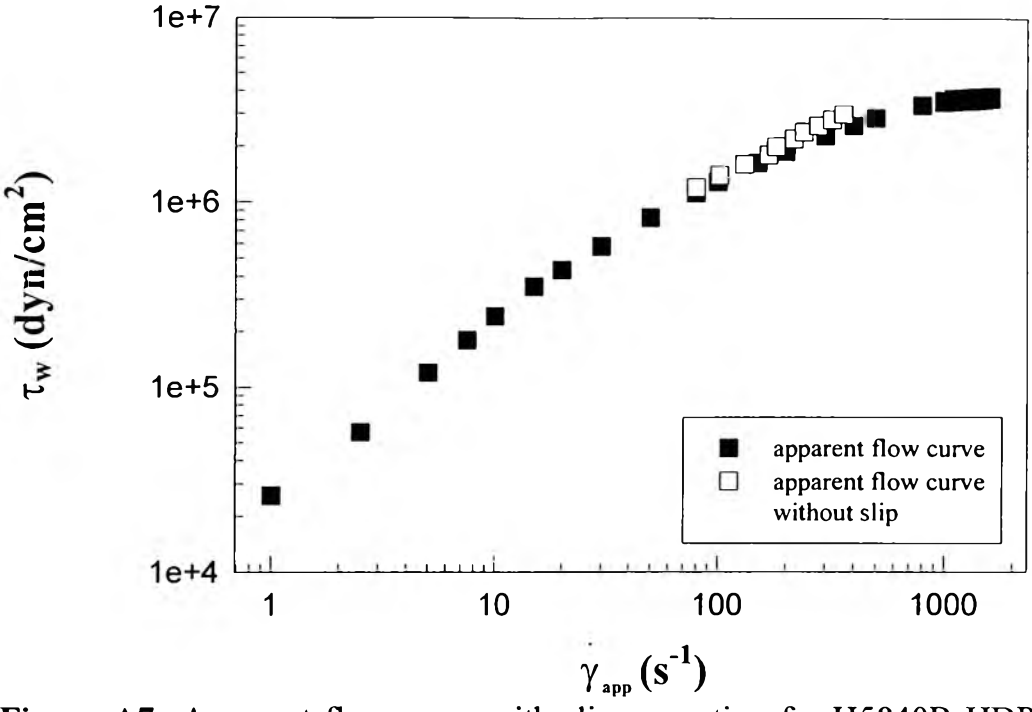

Figure A7 Apparent flow curve with slip correction for H5840B HDPE at the temperature of 160 ^{0}C.

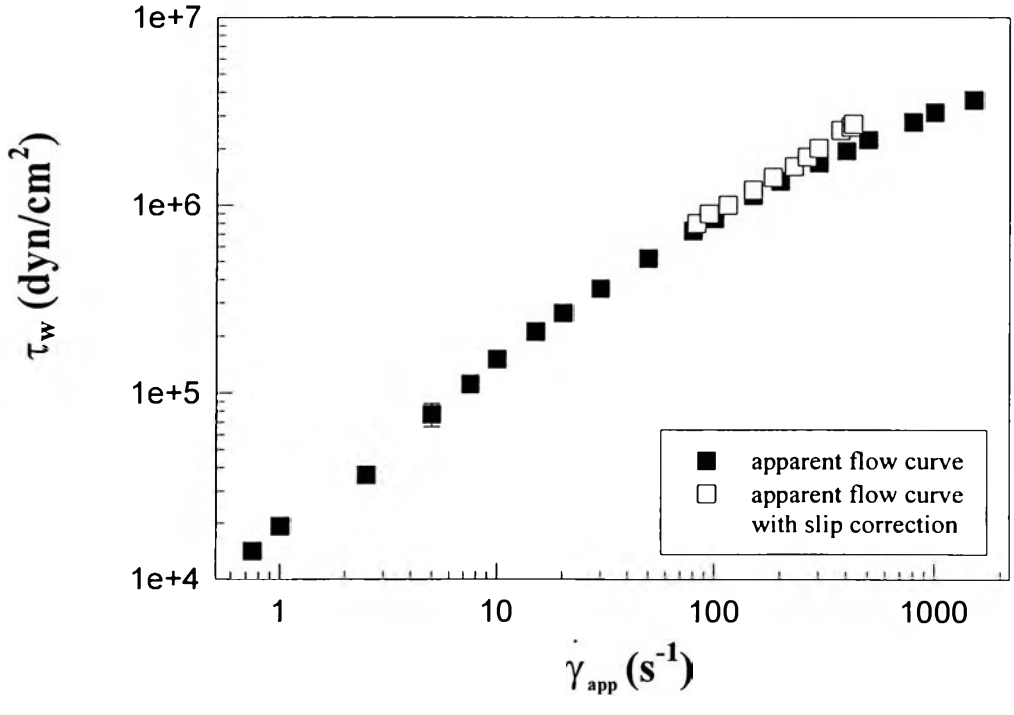

Figure A8 Apparent flow curve with slip correction for H5840B HDPE at the temperature of 200 ^{0}C.

APPENDIX B

B.1 Rheological Characterization

1) The storage modulus of H5604F HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.1)

Frequency (rad/s)	G' (dyn/cm^2)			
	160 °C	180 °C	190 °C	200 °C
1.00E-01	6.14E+04	5.43E+04	5.35E+04	3.32E+04
1.58E-01	7.71E+04	7.93E+04	7.12E+04	4.98E+04
2.51E-01	1.21E+05	1.06E+05	9.67E+04	6.99E+04
3.98E-01	1.26E+05	1.41E+05	1.24E+05	9.83E+04
6.31E-01	1.92E+05	1.82E+05	1.60E+05	1.33E+05
1.00E+00	2.30E+05	2.34E+05	2.03E+05	1.77E+05
1.58E+00	2.95E+05	2.97E+05	2.57E+05	2.31E+05
2.51E+00	3.76E+05	3.77E+05	3.21E+05	3.02E+05
3.98E+00	4.80E+05	4.71E+05	3.99E+05	3.93E+05
6.31E+00	6.05E+05	5.86E+05	4.93E+05	5.03E+05
1.00E+01	7.53E+05	7.23E+05	6.04E+05	6.36E+05
1.58E+01	9.28E+05	8.83E+05	7.33E+05	7.95E+05
2.51E+01	1.13E+05	1.07E+05	8.80E+05	9.81E+05
3.98E+01	1.36E+05	1.28E+05	1.05E+05	1.20E+05
6.31E+01	1.61E+05	1.52E+05	1.24E+05	1.45E+05
1.00E+02	1.91E+05	1.79E+05	1.46E+05	1.74E+05

2) The loss modulus of H5604F HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.2)

Frequency (rad/s)	G" (dyn/cm^2)			
	160 ^{0}C	180 ^{0}C	190 ^{0}C	200 ^{0}C
1.00E-01	7.36E+04	6.67E+04	5.68E+04	5.24E+04
1.58E-01	9.95E+04	8.63E+04	7.40E+04	7.13E+04
2.51E-01	1.25E+05	1.12E+05	9.33E+04	9.44E+04
3.98E-01	1.05E+05	1.39E+05	1.16E+05	1.22E+05
6.31E-01	1.59E+05	1.72E+05	1.44E+05	1.55E+05
1.00E+00	2.00E+05	2.12E+05	1.77E+05	1.95E+05
1.58E+00	2.43E+05	2.58E+05	2.14E+05	2.41E+05
2.51E+00	2.91E+05	3.13E+05	2.56E+05	2.97E+05
3.98E+00	3.47E+05	3.72E+05	3.05E+05	3.60E+05
6.31E+00	4.11E+05	4.37E+05	3.58E+05	4.31E+05
1.00E+01	4.83E+05	5.06E+05	4.13E+05	5.07E+05
1.58E+01	5.57E+05	5.78E+05	4.73E+05	5.87E+05
2.51E+01	6.35E+05	6.55E+05	5.35E+05	6.71E+05
3.98E+01	7.15E+05	7.35E+05	6.00E+05	7.61E+05
6.31E+01	7.93E+05	8.16E+05	6.66E+05	8.54E+05
1.00E+02	8.75E+05	8.97E+05	7.33E+05	9.48E+05

3) The storage modulus of H5690S HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.3)

Frequency (rad/s)	G' (dyn/cm^2)				
	140 ^{0}C	160 ^{0}C	180 ^{0}C	190 ^{0}C	200 ^{0}C
1.00E-01	6.19E+03	4.31E+03	1.15E+04	8.46E+03	6.89E+03
1.58E-01	9.67E+03	6.94E+03	1.79E+04	1.35E+04	9.82E+03
2.51E-01	1.61E+04	1.10E+04	2.65E+04	1.97E+04	1.41E+04
3.98E-01	2.56E+04	1.75E+04	3.81E+04	2.79E+04	2.06E+04
6.31E-01	4.11E+04	2.80E+04	5.42E+04	4.00E+04	2.98E+04
1.00E+00	6.53E+04	4.46E+04	7.65E+04	5.64E+04	4.27E+04
1.58E+00	1.03E+05	7.11E+04	1.08E+05	8.01E+04	6.19E+04
2.51E+00	1.62E+05	1.12E+05	1.51E+05	1.14E+05	9.11E+04
3.98E+00	2.49E+05	1.79E+05	2.12E+05	1.62E+05	1.34E+05
6.31E+00	3.83E+05	2.78E+05	2.93E+05	2.31E+05	1.97E+05
1.00E+01	5.71E+05	4.15E+05	4.01E+05	3.26E+05	2.85E+05
1.58E+01	8.22E+05	6.05E+05	5.41E+05	4.48E+05	4.07E+05
2.51E+01	1.15E+05	8.59E+05	7.22E+05	6.08E+05	5.73E+05
3.98E+01	1.57E+05	1.19E+05	9.56E+05	8.13E+05	7.96E+05
6.31E+01	2.10E+05	1.62E+05	1.25E+05	1.08E+05	1.09E+05
1.00E+02	2.76E+05	2.17E+05	1.64E+05	1.41E+05	1.48E+05

4) The loss modulus of H5690S HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.4)

Frequency (rad/s)	G' (dyn/cm^2)				
	140 ^{0}C	160 ^{0}C	180 ^{0}C	190 ^{0}C	200 ^{0}C
1.00E-01	2.56E+04	1.80E+04	2.46E+04	1.90E+04	1.56E+04
1.58E-01	3.74E+04	2.66E+04	3.45E+04	2.68E+04	2.17E+04
2.51E-01	5.51E+04	3.90E+04	4.77E+04	3.64E+04	3.02E+04
3.98E-01	7.95E+04	5.70E+04	6.46E+04	5.00E+04	4.31E+04
6.31E-01	1.14E+05	8.30E+04	8.66E+04	6.79E+04	6.11E+04
1.00E+00	1.63E+05	1.19E+05	1.16E+05	9.20E+04	8.52E+04
1.58E+00	2.30E+05	1.70E+05	1.55E+05	1.24E+05	1.19E+05
2.51E+00	3.20E+05	2.40E+05	2.07E+05	1.67E+05	1.66E+05
3.98E+00	4.41E+05	3.38E+05	2.74E+05	2.24E+05	2.29E+05
6.31E+00	5.96E+05	4.67E+05	3.60E+05	2.99E+05	3.15E+05
1.00E+01	7.88E+05	6.26E+05	4.67E+05	3.95E+05	4.27E+05
1.58E+01	1.01E+06	8.15E+05	5.95E+05	5.12E+05	5.66E+05
2.51E+01	1.27E+06	1.04E+06	7.54E+05	6.52E+05	7.37E+05
3.98E+01	1.55E+06	1.29E+06	9.45E+05	8.17E+05	9.38E+05
6.31E+01	1.84E+06	1.56E+06	1.16E+06	1.01E+06	1.17E+06
1.00E+02	2.13E+06	1.85E+06	1.41E+06	1.23E+06	1.44E+06

5) The storage modulus of H5840B HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.5)

Frequency	G' (dyn/cm^2)				
(rad/s)	128 ^{0}C	160 ^{0}C	180 ^{0}C	190 ^{0}C	200 ^{0}C
1.00E-01	6.94E+02	4.20E+02	6.43E+02	5.01E+02	3.02E+02
1.58E-01	2.36E+03	6.21E+02	1.26E+03	1.38E+03	6.14E+02
2.51E-01	4.53E+03	1.28E+03	1.55E+03	1.58E+03	1.15E+03
3.98E-01	7.11E+03	2.27E+03	2.43E+03	2.75E+03	1.96E+03
6.31E-01	1.28E+04	4.08E+03	4.09E+03	4.14E+03	3.26E+03
1.00E+00	2.12E+04	7.21E+03	6.55E+03	6.60E+03	5.37E+03
1.58E+00	3.82E+04	1.25E+04	1.04E+04	1.03E+04	8.83E+03
2.51E+00	6.32E+04	2.15E+04	1.65E+04	1.60E+04	1.43E+04
3.98E+00	1.03E+05	3.67E+04	2.63E+04	2.55E+04	2.30E+04
6.31E+00	1.67E+05	6.26E+04	4.13E+04	3.97E+04	3.69E+04
1.00E+01	2.65E+05	1.08E+05	6.43E+04	6.16E+04	5.95E+04
1.58E+01	4.16E+05	1.73E+05	9.98E+04	9.52E+04	9.45E+04
2.51E+01	6.60E+05	2.66E+05	1.53E+05	1.46E+05	1.44E+05
3.98E+01	9.84E+05	4.00E+05	2.30E+05	2.21E+05	2.14E+05
6.31E+01	1.41E+06	5.87E+05	3.52E+05	3.40E+05	3.14E+05
1.00E+02	1.97E+06	8.46E+05	5.33E+05	5.25E+05	4.54E+05

6) The loss modulus of HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.6)

Frequency (rad/s)	G" (dyn/cm^2)				
	128 °C	160 °C	180 °C	190 °C	200 °C
1.00E-01	1.21E+04	4.40E+03	3.36E+03	3.33E+03	2.71E+03
1.58E-01	1.72E+04	6.70E+03	4.66E+03	4.91E+03	4.19E+03
2.51E-01	2.66E+04	1.02E+04	6.98E+03	7.32E+03	6.30E+03
3.98E-01	4.06E+04	1.56E+04	1.11E+04	1.08E+04	9.51E+03
6.31E-01	6.00E+04	2.35E+04	1.65E+04	1.59E+04	1.42E+04
1.00E+00	8.94E+04	3.53E+04	2.41E+04	2.36E+04	2.09E+04
1.58E+00	1.31E+05	5.29E+04	3.54E+04	3.45E+04	3.07E+04
2.51E+00	1.89E+05	7.83E+04	5.14E+04	5.00E+04	4.46E+04
3.98E+00	2.69E+05	1.15E+05	7.36E+04	7.16E+04	6.45E+04
6.31E+00	3.77E+05	1.68E+05	1.05E+05	1.02E+05	9.28E+04
1.00E+01	5.22E+05	2.45E+05	1.47E+05	1.44E+05	1.33E+05
1.58E+01	7.12E+05	3.45E+05	2.04E+05	2.00E+05	1.90E+05
2.51E+01	9.63E+05	4.73E+05	2.78E+05	2.76E+05	2.64E+05
3.98E+01	1.26E+05	6.30E+05	3.76E+05	3.74E+05	3.60E+05
6.31E+01	1.60E+05	8.23E+05	5.05E+05	5.06E+05	4.83E+05
1.00E+02	1.99E+05	1.05E+05	6.69E+05	6.78E+05	6.37E+05

7) The storage modulus of H5818J HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.7)

Frequency (rad/s)	G' (dyn/cm^2)				
	140 ^{0}C	150 ^{0}C	160 ^{0}C	180 ^{0}C	200 ^{0}C
1.00E-01	1.51E+02	1.12E+02	8.74E+01	1.48E+02	7.87E+01
1.58E-01	2.46E+02	1.89E+02	2.36E+02	1.03E+02	8.37E+01
2.51E-01	3.67E+02	3.28E+02	3.23E+02	2.21E+02	1.90E+02
3.98E-01	6.24E+02	5.86E+02	5.03E+02	3.84E+02	3.08E+02
6.31E-01	1.04E+03	9.21E+02	9.00E+02	6.57E+02	5.33E+02
1.00E+00	1.74E+03	1.60E+03	1.58E+03	1.09E+03	8.90E+02
1.58E+00	2.97E+03	2.69E+03	2.61E+03	1.88E+03	1.51E+03
2.51E+00	4.97E+03	4.51E+03	4.40E+03	3.15E+03	2.50E+03
3.98E+00	8.24E+03	7.52E+03	7.35E+03	5.29E+03	4.17E+03
6.31E+00	1.37E+04	1.25E+04	1.24E+04	8.86E+03	6.97E+03
1.00E+01	2.37E+04	2.09E+04	2.18E+04	1.51E+04	1.19E+04
1.58E+01	4.38E+04	3.76E+04	3.99E+04	2.76E+04	2.12E+04
2.51E+01	7.49E+04	6.84E+04	6.58E+04	4.91E+04	3.75E+04
3.98E+01	1.16E+05	1.07E+05	1.03E+05	7.82E+04	6.07E+04
6.31E+01	1.74E+05	1.63E+05	1.57E+05	1.21E+05	9.42E+04
1.00E+02	2.59E+05	2.43E+05	2.37E+05	1.85E+05	1.44E+05

8) The loss modulus of H5818J HDPE as a function of frequency (transducer 2 and 25-mm cone diameter) at strain amplitude equal to 10 and at various temperatures (Figure 4.8)

Frequency	G" (dyn/cm^2)				
(rad/s)	140 °C	150 °C	160 °C	180 °C	200 °C
1.00E-01	1.09E+03	1.04E+03	1.06E+03	8.36E+02	6.30E+02
1.58E-01	1.66E+03	1.57E+03	1.60E+03	1.25E+03	9.82E+02
2.51E-01	2.56E+03	2.43E+03	2.44E+03	1.88E+03	1.50E+03
3.98E-01	3.87E+03	3.69E+03	3.80E+03	2.92E+03	2.29E+03
6.31E-01	5.89E+03	5.57E+03	5.71E+03	4.40E+03	3.51E+03
1.00E+00	8.83E+03	8.41E+03	8.67E+03	6.66E+03	5.29E+03
1.58E+00	1.32E+04	1.26E+04	1.30E+04	1.01E+04	8.03E+03
2.51E+00	1.97E+04	1.88E+04	1.95E+04	1.51E+04	1.21E+04
3.98E+00	2.92E+04	2.80E+04	2.90E+04	2.26E+04	1.80E+04
6.31E+00	4.33E+04	4.15E+04	4.33E+04	3.37E+04	2.68E+04
1.00E+01	6.49E+04	6.15E+04	6.54E+04	5.04E+04	4.03E+04
1.58E+01	9.94E+04	9.33E+04	9.98E+04	7.68E+04	6.12E+04
2.51E+01	1.48E+05	1.42E+05	1.47E+05	1.16E+05	9.24E+04
3.98E+01	2.08E+05	2.02E+05	2.10E+05	1.68E+05	1.34E+05
6.31E+01	2.86E+05	2.80E+05	2.92E+05	2.38E+05	1.90E+05
1.00E+02	3.88E+05	3.81E+05	4.01E+05	3.31E+05	2.66E+05

9) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5604F HDPE at the reference temperature of 160 ^{0}C

Temperature (^{0}C)	a_T	b_T
160	1.00	1.00
180	0.57	0.87
190	0.53	0.68
200	0.31	0.66

10) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5604F HDPE at the reference temperature of 180 ^{0}C

Temperature (^{0}C)	a_T	b_T
160	1.76	1.15
180	1.00	1.00
190	0.94	0.78
200	0.55	0.75

11) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5604F HDPE at the reference temperature of 200 ^{0}C

Temperature (^{0}C)	a_T	b_T
160	3.22	1.52
180	1.83	1.33
190	1.71	1.04
200	1.00	1.00

12) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5690S HDPE at the reference temperature of 180 ^{0}C

Temperature (^{0}C)	a_T	b_T
140	4.84	1.93
160	3.88	2.20
180	1.00	1.00
190	0.29	0.17
200	0.19	0.19

13) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5840B HDPE at the reference temperature of 160 ^{0}C

Temperature (^{0}C)	a_T	b_T
140	1.44	0.41
160	1.00	1.00
180	0.96	0.44
190	0.94	0.77
200	0.88	0.77

14) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5840B HDPE at the reference temperature of 180 ^{0}C

Temperature (^{0}C)	a_T	b_T
140	1.53	0.53
160	1.02	0.57
180	1.00	1.00
190	0.93	1.00
200	1.07	1.30

15) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5840B HDPE at the reference temperature of 200 ^{0}C

Temperature (^{0}C)	a_T	b_T
140	1.44	0.41
160	0.96	0.44
180	0.94	0.77
190	0.88	0.77
200	1.00	1.00

16) Horizontal shift factor, a_T, and vertical shift factor, b_T, as a function of temperature of H5818J HDPE at the reference temperature of 180 ^{0}C

Temperature (^{0}C)	a_T	b_T
140	2.35	1.46
150	1.81	1.25
160	1.40	0.99
180	1.00	1.00
200	0.96	1.26

17)Master curve of H5604F HDPE at the reference temperature of 160 ^{0}C (Figure 4.9)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.00E-01	3.32E+04	5.24E+04
1.58E-01	4.98E+04	7.13E+04
1.82E-01	6.34E+04	7.79E+04
1.95E-01	7.82E+04	8.30E+04
2.51E-01	6.99E+04	9.44E+04
2.89E-01	9.27E+04	1.01E+05
3.09E-01	1.04E+05	1.08E+05
3.98E-01	9.83E+04	1.22E+05
4.58E-01	1.24E+05	1.31E+05
4.89E-01	1.42E+05	1.36E+05
6.31E-01	1.33E+05	1.55E+05
7.26E-01	1.64E+05	1.63E+05
7.76E-01	1.81E+05	1.70E+05
1.00E+00	1.77E+05	1.95E+05
1.15E+00	2.13E+05	2.01E+05
1.23E+00	2.34E+05	2.11E+05
1.58E+00	2.31E+05	2.41E+05
1.82E+00	2.73E+05	2.48E+05
1.95E+00	2.97E+05	2.58E+05
2.51E+00	3.02E+05	2.97E+05
2.89E+00	3.47E+05	3.01E+05
3.09E+00	3.76E+05	3.13E+05
3.98E+00	3.93E+05	3.60E+05

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.00E+01	6.36E+05	5.07E+05
1.15E+01	6.85E+05	5.10E+05
1.23E+01	7.21E+05	5.23E+05
1.58E+01	7.95E+05	5.87E+05
1.82E+01	8.44E+05	5.91E+05
1.95E+01	8.83E+05	6.05E+05
2.51E+01	9.81E+05	6.71E+05
2.89E+01	1.03E+06	6.75E+05
3.09E+01	1.07E+06	6.91E+05
3.98E+01	1.20E+06	7.61E+05
4.58E+01	1.25E+06	7.65E+05
4.89E+01	1.29E+06	7.83E+05
6.31E+01	1.45E+06	8.54E+05
7.26E+01	1.49E+06	8.58E+05
7.76E+01	1.53E+06	8.77E+05
1.00E+02	1.74E+06	9.48E+05
1.15E+02	1.77E+06	9.52E+05
1.23E+02	1.82E+06	9.74E+05
1.82E+02	2.09E+06	1.05E+06
1.95E+02	2.14E+06	1.07E+06

18) Master curve of H5604F HDPE at the reference temperature of 180 ^{0}C (Figure 4.10)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
3.11E-02	2.13E+04	3.37E+04
4.93E-02	3.20E+04	4.58E+04
5.32E-02	3.78E+04	4.65E+04
5.68E-02	4.67E+04	4.96E+04
7.81E-02	4.49E+04	6.07E+04
8.43E-02	5.53E+04	6.02E+04
9.00E-02	6.22E+04	6.46E+04
1.00E-01	6.14E+04	7.36E+04
1.24E-01	6.32E+04	7.81E+04
1.34E-01	7.41E+04	7.80E+04
1.43E-01	8.45E+04	8.15E+04
1.59E-01	7.71E+04	9.95E+04
1.96E-01	8.52E+04	9.98E+04
2.12E-01	9.81E+04	9.72E+04
2.26E-01	1.08E+05	1.01E+05
2.51E-01	1.21E+05	1.25E+05
3.11E-01	1.14E+05	1.26E+05
3.36E-01	1.27E+05	1.20E+05
3.58E-01	1.40E+05	1.26E+05
3.98E-01	1.26E+05	1.05E+05
4.93E-01	1.49E+05	1.55E+05
5.32E-01	1.63E+05	1.48E+05
5.68E-01	1.77E+05	1.54E+05

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
6.31E-01	1.92E+05	1.59E+05
7.81E-01	1.94E+05	1.91E+05
8.43E-01	2.07E+05	1.80E+05
9.00E-01	2.24E+05	1.87E+05
1.00E+00	2.30E+05	2.00E+05
1.24E+00	2.53E+05	2.32E+05
2.51E+00	3.76E+05	2.91E+05
3.11E+00	4.09E+05	3.26E+05
3.36E+00	4.09E+05	3.05E+05
3.58E+00	4.30E+05	3.12E+05
3.98E+00	4.80E+05	3.47E+05
4.93E+00	5.11E+05	3.78E+05
5.32E+00	5.04E+05	3.53E+05
5.68E+00	5.27E+05	3.61E+05
6.31E+00	6.05E+05	4.11E+05
7.81E+00	6.31E+05	4.32E+05
8.43E+00	6.15E+05	4.03E+05
9.00E+00	6.40E+05	4.13E+05
1.00E+01	7.53E+05	4.83E+05
1.24E+01	7.69E+05	4.89E+05
1.34E+01	7.43E+05	4.57E+05
1.43E+01	7.69E+05	4.67E+05
1.58E+01	9.28E+05	5.57E+05

19) Master curve of H5604F HDPE at the reference temperature of 200 ^{0}C (Figure 4.11)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.00E-01	2.13E+04	3.37E+04
1.59E-01	3.20E+04	4.58E+04
1.71E-01	3.78E+04	4.65E+04
1.83E-01	4.67E+04	4.96E+04
2.51E-01	4.49E+04	6.07E+04
2.71E-01	5.53E+04	6.02E+04
2.89E-01	6.22E+04	6.46E+04
3.22E-01	6.14E+04	7.36E+04
3.98E-01	6.32E+04	7.81E+04
4.30E-01	7.41E+04	7.80E+04
4.59E-01	8.45E+04	8.15E+04
5.10E-01	7.71E+04	9.95E+04
6.31E-01	8.52E+04	9.98E+04
6.81E-01	9.81E+04	9.72E+04
7.27E-01	1.08E+05	1.01E+05
8.08E-01	1.21E+05	1.25E+05
1.00E+00	1.14E+05	1.26E+05
1.08E+00	1.27E+05	1.20E+05
1.15E+00	1.40E+05	1.26E+05
1.28E+00	1.26E+05	1.05E+05
1.58E+00	1.49E+05	1.55E+05
1.71E+00	1.63E+05	1.48E+05
1.83E+00	1.77E+05	1.54E+05
2.03E+00	1.92E+05	1.59E+05

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
2.51E+00	1.94E+05	1.91E+05
2.71E+00	2.07E+05	1.80E+05
2.89E+00	2.24E+05	1.87E+05
3.22E+00	2.30E+05	2.00E+05
3.98E+00	2.53E+05	2.32E+05
7.27E+00	3.49E+05	2.66E+05
8.08E+00	3.76E+05	2.91E+05
1.00E+01	4.09E+05	3.26E+05
1.08E+01	4.09E+05	3.05E+05
1.15E+01	4.30E+05	3.12E+05
1.28E+01	4.80E+05	3.47E+05
1.58E+01	5.11E+05	3.78E+05
1.71E+01	5.04E+05	3.53E+05
1.83E+01	5.27E+05	3.61E+05
2.03E+01	6.05E+05	4.11E+05
7.81E+00	6.31E+05	4.32E+05
8.43E+00	6.15E+05	4.03E+05
9.00E+00	6.40E+05	4.13E+05
1.00E+01	7.53E+05	4.83E+05
1.24E+01	7.69E+05	4.89E+05
1.34E+01	7.43E+05	4.57E+05
1.43E+01	7.69E+05	4.67E+05
1.58E+01	9.28E+05	5.57E+05
1.96E+01	9.31E+05	5.49E+05

20) Master curve of H5690S HDPE at the reference temperature of 180 ^{0}C (Figure 4.12)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.95E-02	8.77E+02	3.37E+04
2.86E-02	1.23E+03	4.58E+04
3.08E-02	1.41E+03	4.65E+04
4.53E-02	1.93E+03	4.96E+04
4.89E-02	2.23E+03	6.07E+04
7.18E-02	3.21E+03	6.02E+04
7.75E-02	3.55E+03	6.46E+04
1.00E-01	6.89E+03	7.36E+04
1.14E-01	5.11E+03	7.81E+04
1.23E-01	5.69E+03	7.80E+04
1.59E-01	9.82E+03	8.15E+04
1.80E-01	8.21E+03	9.95E+04
1.95E-01	9.07E+03	9.98E+04
2.51E-01	1.41E+04	9.72E+04
2.86E-01	1.30E+04	1.01E+05
3.08E-01	1.45E+04	1.25E+05
3.88E-01	1.91E+04	1.26E+05
3.98E-01	2.06E+04	1.20E+05
4.53E-01	2.06E+04	1.26E+05
4.84E-01	2.32E+04	1.05E+05
4.89E-01	2.29E+04	1.55E+05
6.15E-01	3.04E+04	1.48E+05
6.31E-01	2.98E+04	1.54E+05
7.18E-01	3.23E+04	1.59E+05

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
7.67E-01	3.60E+04	1.91E+05
7.75E-01	3.64E+04	1.80E+05
9.75E-01	4.43E+04	1.87E+05
1.00E+00	4.27E+04	2.00E+05
1.14E+00	4.98E+04	2.32E+05
1.93E+00	7.67E+04	1.30E+05
1.95E+00	8.45E+04	1.27E+05
2.45E+00	9.01E+04	1.53E+05
2.51E+00	9.11E+04	1.66E+05
2.86E+00	1.14E+05	1.57E+05
3.05E+00	1.09E+05	1.75E+05
3.08E+00	1.23E+05	1.66E+05
3.88E+00	1.27E+05	2.07E+05
3.98E+00	1.34E+05	2.29E+05
4.53E+00	1.64E+05	2.03E+05
4.84E+00	1.54E+05	2.34E+05
4.89E+00	1.75E+05	2.11E+05
6.15E+00	1.80E+05	2.80E+05
6.31E+00	1.97E+05	3.15E+05
7.18E+00	2.29E+05	2.53E+05
7.67E+00	2.17E+05	3.13E+05
7.75E+00	2.42E+05	2.62E+05
9.75E+00	2.56E+05	3.77E+05
1.00E+01	2.85E+05	4.27E+05

21) Master curve of H5840B HDPE at the reference temperature of 160 ^{0}C (Figure 4.13)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
8.75E-02	3.93E+02	2.61E+03
9.39E-02	5.17E+02	2.70E+03
9.58E-02	2.01E+02	2.11E+03
1.00E-01	3.02E+02	2.71E+03
1.39E-01	1.08E+03	3.85E+03
1.49E-01	1.01E+03	3.74E+03
1.52E-01	2.97E+02	3.21E+03
1.55E-01	1.98E+02	3.46E+03
1.59E-01	6.14E+02	4.19E+03
2.20E-01	1.24E+03	5.74E+03
2.36E-01	1.25E+03	5.61E+03
2.41E-01	6.13E+02	4.87E+03
2.46E-01	6.72E+02	4.90E+03
2.51E-01	1.15E+03	6.30E+03
3.48E-01	2.16E+03	8.45E+03
3.74E-01	1.96E+03	8.96E+03
3.81E-01	1.09E+03	7.47E+03
3.89E-01	1.29E+03	7.60E+03
3.98E-01	1.96E+03	9.51E+03
5.52E-01	3.25E+03	1.25E+04
5.92E-01	3.28E+03	1.33E+04
6.05E-01	1.95E+03	1.13E+04
6.17E-01	2.03E+03	1.16E+04
6.31E-01	3.26E+03	1.42E+04

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.39E+00	8.04E+03	2.70E+04
1.49E+00	8.33E+03	2.84E+04
1.52E+00	5.99E+03	2.53E+04
1.55E+00	6.05E+03	2.55E+04
1.58E+00	8.83E+03	3.07E+04
2.20E+00	1.25E+04	3.92E+04
2.36E+00	1.33E+04	4.13E+04
2.41E+00	1.03E+04	3.75E+04
2.46E+00	1.09E+04	3.73E+04
2.51E+00	1.43E+04	4.46E+04
3.48E+00	2.00E+04	5.61E+04
3.74E+00	2.11E+04	5.91E+04
3.81E+00	1.76E+04	5.51E+04
3.89E+00	1.81E+04	5.40E+04
3.98E+00	2.30E+04	6.45E+04
5.52E+00	3.11E+04	7.99E+04
5.92E+00	3.32E+04	8.43E+04
6.04E+00	3.00E+04	8.05E+04
6.17E+00	2.95E+04	7.67E+04
6.31E+00	3.69E+04	9.28E+04
8.75E+00	4.82E+04	1.13E+05
9.39E+00	5.17E+04	1.18E+05
9.58E+00	5.16E+04	1.17E+05
9.78E+00	4.75E+04	1.08E+05

22) Master curve of H5840B HDPE at the reference temperature of 180 ^{0}C (Figure 4.14)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
9.32E-02	3.93E+02	2.61E+03
1.00E-01	5.17E+02	2.70E+03
1.02E-01	2.01E+02	2.11E+03
1.07E-01	3.02E+02	2.71E+03
1.48E-01	1.08E+03	3.85E+03
1.59E-01	1.01E+03	3.74E+03
1.62E-01	2.97E+02	3.21E+03
1.65E-01	1.98E+02	3.46E+03
1.69E-01	6.14E+02	4.19E+03
2.34E-01	1.24E+03	5.74E+03
2.51E-01	1.25E+03	5.61E+03
2.56E-01	6.13E+02	4.87E+03
2.62E-01	6.72E+02	4.90E+03
2.68E-01	1.15E+03	6.30E+03
3.71E-01	2.16E+03	8.45E+03
3.98E-01	1.96E+03	8.96E+03
4.06E-01	1.09E+03	7.47E+03
4.15E-01	1.29E+03	7.60E+03
4.24E-01	1.96E+03	9.51E+03

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.48E+00	8.04E+03	2.70E+04
1.58E+00	8.33E+03	2.84E+04
1.62E+00	5.99E+03	2.53E+04
1.65E+00	6.05E+03	2.55E+04
1.69E+00	8.83E+03	3.07E+04
2.34E+00	1.25E+04	3.92E+04
2.51E+00	1.33E+04	4.13E+04
2.56E+00	1.03E+04	3.75E+04
2.62E+00	1.09E+04	3.73E+04
2.68E+00	1.43E+04	4.46E+04
3.71E+00	2.00E+04	5.61E+04
3.98E+00	2.11E+04	5.91E+04
4.06E+00	1.76E+04	5.51E+04
4.15E+00	1.81E+04	5.40E+04
4.24E+00	2.30E+04	6.45E+04
5.88E+00	3.11E+04	7.99E+04
6.31E+00	3.32E+04	8.43E+04
6.44E+00	3.00E+04	8.05E+04
6.58E+00	2.95E+04	7.67E+04

23) Master curve of H5840B HDPE at the reference temperature of 200 ^{0}C (Figure 4.15)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
8.75E-02	3.93E+02	2.61E+03
9.39E-02	5.17E+02	2.70E+03
9.58E-02	2.01E+02	2.11E+03
1.00E-01	3.02E+02	2.71E+03
1.39E-01	1.08E+03	3.85E+03
1.49E-01	1.01E+03	3.74E+03
1.52E-01	2.97E+02	3.21E+03
1.55E-01	1.98E+02	3.46E+03
1.59E-01	6.14E+02	4.19E+03
2.20E-01	1.24E+03	5.74E+03
2.36E-01	1.25E+03	5.61E+03
2.41E-01	6.13E+02	4.87E+03
2.46E-01	6.72E+02	4.90E+03
2.51E-01	1.15E+03	6.30E+03
3.48E-01	2.16E+03	8.45E+03
3.74E-01	1.96E+03	8.96E+03
3.81E-01	1.09E+03	7.47E+03
3.89E-01	1.29E+03	7.60E+03
3.98E-01	1.96E+03	9.51E+03
5.52E-01	3.25E+03	1.25E+04
5.92E-01	3.28E+03	1.33E+04
6.05E-01	1.95E+03	1.13E+04
6.17E-01	2.03E+03	1.16E+04
6.31E-01	3.26E+03	1.42E+04

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.39E+00	8.04E+03	2.70E+04
1.49E+00	8.33E+03	2.84E+04
1.52E+00	5.99E+03	2.53E+04
1.55E+00	6.05E+03	2.55E+04
1.58E+00	8.83E+03	3.07E+04
2.20E+00	1.25E+04	3.92E+04
2.36E+00	1.33E+04	4.13E+04
2.41E+00	1.03E+04	3.75E+04
2.46E+00	1.09E+04	3.73E+04
2.51E+00	1.43E+04	4.46E+04
3.48E+00	2.00E+04	5.61E+04
3.74E+00	2.11E+04	5.91E+04
3.81E+00	1.76E+04	5.51E+04
3.89E+00	1.81E+04	5.40E+04
3.98E+00	2.30E+04	6.45E+04
5.52E+00	3.11E+04	7.99E+04
5.92E+00	3.32E+04	8.43E+04
6.04E+00	3.00E+04	8.05E+04
6.17E+00	2.95E+04	7.67E+04
6.31E+00	3.69E+04	9.28E+04
8.75E+00	4.82E+04	1.13E+05
9.39E+00	5.17E+04	1.18E+05
9.58E+00	5.16E+04	1.17E+05
9.78E+00	4.75E+04	1.08E+05

24) Master curve of H5818J HDPE at the reference temperature of 180 ^{0}C (Figure 4.16)

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.00E-01	7.87E+01	6.30E+02
1.05E-01	1.22E+02	6.93E+02
1.46E-01	7.53E+01	9.16E+02
1.59E-01	8.37E+01	9.82E+02
1.66E-01	8.55E+01	1.03E+03
1.90E-01	1.25E+02	1.16E+03
2.31E-01	2.03E+02	1.38E+03
2.46E-01	2.01E+02	1.45E+03
2.51E-01	1.90E+02	1.50E+03
2.63E-01	1.83E+02	1.56E+03
3.00E-01	2.11E+02	1.75E+03
3.67E-01	2.78E+02	2.10E+03
3.91E-01	3.27E+02	2.21E+03
3.98E-01	3.08E+02	2.29E+03
4.17E-01	3.18E+02	2.42E+03
4.76E-01	3.64E+02	2.70E+03
5.81E-01	4.33E+02	3.27E+03
6.19E-01	4.88E+02	3.40E+03
6.31E-01	5.33E+02	3.51E+03
6.60E-01	5.44E+02	3.64E+03
7.54E-01	6.52E+02	4.11E+03
9.21E-01	7.76E+02	4.91E+03
9.81E-01	8.29E+02	5.14E+03
1.00E+00	8.90E+02	5.29E+03

Frequency (rad/s)	G' (dyn/cm^2)	G" (dyn/cm^2)
1.66E+00	1.56E+03	8.35E+03
1.89E+00	1.78E+03	9.36E+03
2.31E+00	2.25E+03	1.12E+04
2.46E+00	2.31E+03	1.17E+04
2.51E+00	2.50E+03	1.21E+04
2.63E+00	2.61E+03	1.25E+04
3.00E+00	2.99E+03	1.40E+04
3.67E+00	3.79E+03	1.68E+04
3.90E+00	3.94E+03	1.76E+04
3.98E+00	4.17E+03	1.80E+04
4.17E+00	4.38E+03	1.87E+04
4.76E+00	5.02E+03	2.10E+04
5.81E+00	6.33E+03	2.50E+04
6.19E+00	6.60E+03	2.62E+04
6.31E+00	6.97E+03	2.68E+04
6.60E+00	7.34E+03	2.79E+04
7.54E+00	8.37E+03	3.11E+04
9.21E+00	1.07E+04	3.73E+04
9.81E+00	1.10E+04	3.89E+04
1.00E+01	1.19E+04	4.03E+04
1.05E+01	1.25E+04	4.17E+04
1.20E+01	1.39E+04	4.61E+04
1.46E+01	1.87E+04	5.63E+04
1.55E+01	1.82E+04	5.76E+04

B.2 Apparent Flow Curve

Capillary die no.1860: diameter 1.25 mm, length 50.19 mm, l_c/d_c 40.15

25) The apparent flow curve of four different HDPE (H5604F, H5840B, H5818J and H5690S) melts at the temperature of 180 ^{0}C (Figure 4.21)

H5604F HDPE :

γ_{ap} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
0.25	1.65E+05	1.77E+05	1.71E+05	8.78E+03
0.5	2.36E+05	2.41E+05	2.38E+05	3.51E+03
0.75	3.05E+05	2.82E+05	2.93E+05	1.63E+04
1	3.51E+05	3.28E+05	3.39E+05	1.62E+04
2.5	5.77E+05	5.65E+05	5.71E+05	8.78E+03
5	7.71E+05	7.40E+05	7.56E+05	2.21E+04
10	1.01E+06	9.77E+05	9.92E+05	2.19E+04
12	1.06E+06	1.08E+06	1.07E+06	1.41E+04
15	1.16E+06	1.17E+06	1.17E+06	7.07E+03
20	1.34E+06	1.37E+06	1.36E+06	2.12E+04
25	1.42E+06	1.40E+06	1.41E+06	1.53E+04
30	1.49E+06	1.48E+06	1.49E+06	7.07E+03
40	1.65E+06	1.63E+06	1.64E+06	1.41E+04
50	1.80E+06	1.77E+06	1.79E+06	2.12E+04
80	2.03E+06	2.03E+06	2.03E+06	0.00E+00
100	2.17E+06	2.20E+06	2.19E+06	2.12E+04
150	2.37E+06	2.39E+06	2.38E+06	1.41E+04
200	2.65E+06	2.71E+06	2.68E+06	4.24E+04
340	2.93E+06	2.89E+06	2.91E+06	2.83E+04
560	2.75E+06	2.86E+06	2.81E+06	7.78E+04
700	3.17E+06	3.30E+06	3.24E+06	9.19E+04
800	3.37E+06	3.03E+06	3.20E+06	2.40E+05
1000	4.02E+06	3.43E+06	3.73E+06	4.17E+05
1500	3.63E+06	4.15E+06	3.89E+06	3.68E+05

H5840B HDPE :

γ_{ap} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
1	3.54E+04	3.64E+04	3.59E+04	7.07E+02
2.5	6.30E+04	6.27E+04	6.29E+04	2.12E+02
5	1.13E+05	1.11E+05	1.12E+05	1.41E+03
7.5	1.48E+05	1.51E+05	1.49E+05	2.12E+03
10	1.82E+05	1.80E+05	1.81E+05	1.41E+03
15	2.43E+05	2.40E+05	2.42E+05	2.12E+03
22	3.19E+05	3.21E+05	3.20E+05	1.41E+03
30	3.92E+05	3.93E+05	3.93E+05	7.07E+02
50	5.97E+05	5.80E+05	5.88E+05	1.24E+04
80	7.69E+05	8.25E+05	7.97E+05	4.01E+04
100	9.06E+05	9.64E+05	9.35E+05	4.12E+04
200	1.28E+06	1.26E+06	1.27E+06	1.24E+04
300	1.55E+00	1.58E+06	7.90E+05	1.12E+06
400	1.75E+06	1.76E+06	1.75E+06	5.49E+03
500	1.93E+06	1.92E+06	1.93E+06	8.72E+03
700	2.03E+06	2.18E+06	2.10E+06	1.11E+05
800	2.18E+06	2.17E+06	2.17E+06	2.95E+03
900	2.18E+06	2.28E+06	2.23E+06	6.85E+04
1000	2.37E+06	2.49E+06	2.43E+06	9.09E+04
1500	2.59E+06	2.68E+06	2.64E+06	5.78E+04

H5818J HDPE :

$\dot{\gamma}_{ap}$ (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
1	1.11E+04	1.07E+04	1.09E+04	3.03E+02
2.5	2.20E+04	2.33E+04	2.27E+04	9.08E+02
5	3.74E+04	3.71E+04	3.73E+04	2.42E+02
7.5	4.92E+04	4.83E+04	4.88E+04	6.66E+02
10	6.43E+04	5.95E+04	6.19E+04	3.39E+03
15	8.20E+04	8.36E+04	8.28E+04	1.09E+03
20	1.06E+05	1.03E+05	1.05E+05	1.82E+03
30	1.43E+05	1.46E+05	1.44E+05	1.82E+03
50	2.12E+05	2.13E+05	2.12E+05	4.85E+02
80	3.01E+05	3.03E+05	3.02E+05	1.21E+03
100	3.53E+05	3.53E+05	3.53E+05	0.00E+00
150	4.81E+05	4.90E+05	4.86E+05	6.24E+03
200	5.54E+05	5.91E+05	5.73E+05	2.62E+04
300	7.34E+05	7.30E+05	7.32E+05	2.91E+03
400	8.71E+05	8.73E+05	8.72E+05	1.57E+03
500	1.00E+06	9.99E+05	1.00E+06	1.76E+03
800	1.32E+06	1.31E+06	1.32E+06	9.87E+03
1000	1.48E+06	1.49E+06	1.48E+06	4.72E+03
1500	1.81E+06	1.82E+06	1.81E+06	8.48E+03

H5690S HDPE :

γ_{app} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
0.5	3.65E+04	4.74E+04	4.20E+04	7.75E+03
0.75	6.76E+04	7.98E+04	7.37E+04	8.66E+03
1	1.03E+05	1.02E+05	1.03E+05	7.87E+02
2.5	2.12E+05	2.12E+05	2.12E+05	4.84E+02
5	3.58E+05	3.88E+05	3.73E+05	2.16E+04
7.5	4.84E+05	4.88E+05	4.86E+05	2.73E+03
10	5.87E+05	5.94E+05	5.91E+05	4.91E+03
15	7.71E+05	7.79E+05	7.75E+05	5.33E+03
20	9.22E+05	9.42E+05	9.32E+05	1.37E+04
30	1.19E+06	1.21E+06	1.20E+06	1.85E+04
50	1.61E+06	1.65E+06	1.63E+06	2.88E+04
80	2.06E+06	2.15E+06	2.10E+06	6.21E+04
100	2.30E+06	2.41E+06	2.36E+06	8.39E+04
150	2.77E+06	2.79E+06	2.78E+06	1.04E+04
200	3.10E+06	3.12E+06	3.11E+06	1.13E+04
1000	2.73E+06	2.78E+06	2.75E+06	3.46E+04
1500	2.94E+06	2.95E+06	2.94E+06	6.30E+03

26) The apparent flow curve of H5604F HDPE at the different temperatures (Figure 4.22)

At 160 ^{0}C

γ_{app} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
0.75	3.01E+05	3.24E+05	3.13E+05	1.68E+04
1	4.33E+05	4.08E+05	4.21E+05	1.74E+04
2.5	6.48E+05	6.59E+05	6.54E+05	8.11E+03
5	8.65E+05	8.98E+05	8.82E+05	2.33E+04
7.5	1.02E+06	1.03E+06	1.03E+06	6.00E+03
10	1.14E+06	1.13E+06	1.13E+06	7.63E+03
15	1.36E+06	1.27E+06	1.31E+06	6.04E+04
20	1.46E+06	1.39E+06	1.42E+06	4.86E+04
30	1.67E+06	1.67E+06	1.67E+06	1.21E+03
50	1.94E+06	1.92E+06	1.93E+06	1.42E+04
80	2.15E+06	2.12E+06	2.14E+06	2.14E+04
100	2.36E+06	2.32E+06	2.34E+06	2.34E+04
300	1.90E+06	2.12E+06	2.01E+06	1.53E+05
400	2.43E+06	2.31E+06	2.37E+06	8.46E+04
500	2.64E+06	3.07E+06	2.86E+06	3.04E+05
800	3.49E+06	3.65E+06	3.57E+06	1.15E+05
1000	3.80E+06	3.97E+06	3.88E+06	1.18E+05
1500	4.81E+06	4.34E+06	4.58E+06	3.33E+05

At 200 ^{0}C

γ_{ap} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
0.5	1.96E+05	2.19E+05	2.07E+05	1.64E+04
0.75	2.22E+05	2.58E+05	2.40E+05	2.51E+04
1	3.46E+05	2.99E+05	3.23E+05	3.35E+04
2.5	5.23E+05	4.86E+05	5.04E+05	2.61E+04
5	6.92E+05	6.66E+05	6.79E+05	1.81E+04
7.5	8.07E+05	7.78E+05	7.92E+05	2.07E+04
10	8.97E+05	8.63E+05	8.80E+05	2.41E+04
15	9.92E+05	1.10E+06	1.05E+06	7.61E+04
20	1.09E+06	1.22E+06	1.16E+06	8.88E+04
30	1.26E+06	1.40E+06	1.33E+06	1.00E+05
50	1.63E+06	1.63E+06	1.63E+06	3.63E+02
80	1.86E+06	1.88E+06	1.87E+06	1.44E+04
100	1.98E+06	2.00E+06	1.99E+06	1.47E+04
150	2.22E+06	2.20E+06	2.21E+06	1.55E+04
200	2.42E+06	2.35E+06	2.39E+06	4.63E+04
300	2.68E+06	2.66E+06	2.67E+06	1.06E+04
400	2.92E+06	2.96E+06	2.94E+06	2.17E+04
500	2.74E+06	3.13E+06	2.93E+06	2.73E+05
800	2.89E+06	3.21E+06	3.05E+06	2.21E+05
1000	2.93E+06	3.18E+06	3.05E+06	1.73E+05
1500	3.28E+06	3.57E+06	3.42E+06	2.02E+05

27) The apparent flow curve of H5840B HDPE at the different temperatures (Figure 4.23)

At 160 ^{0}C

γ_{ap} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
1	2.36E+04	2.12E+04	2.24E+04	1.64E+03
2.5	4.79E+04	4.57E+04	4.68E+04	1.51E+03
5	1.07E+05	9.88E+04	1.03E+05	5.57E+03
7.5	1.65E+05	1.55E+05	1.60E+05	7.09E+03
10	2.15E+05	2.07E+05	2.11E+05	6.24E+03
15	3.52E+05	3.50E+05	3.51E+05	1.39E+03
20	4.32E+05	4.32E+05	4.32E+05	4.84E+02
30	5.81E+05	5.77E+05	5.79E+05	3.09E+03
50	8.26E+05	8.27E+05	8.26E+05	7.27E+02
80	1.12E+06	1.12E+06	1.12E+06	7.88E+02
100	1.29E+06	1.28E+06	1.29E+06	8.24E+03
150	1.62E+06	1.64E+06	1.63E+06	1.15E+04
200	1.87E+06	1.88E+06	1.88E+06	3.94E+03
300	2.27E+06	2.28E+06	2.28E+06	4.60E+03
400	2.61E+06	2.59E+06	2.60E+06	1.39E+04
500	2.84E+06	2.86E+06	2.85E+06	1.29E+04
800	3.33E+06	3.36E+06	3.35E+06	2.55E+04

At 200 ^{0}C

γ_{app} (s^{-1})	1st τ_w (dyn/cm^2)	2nd τ_w (dyn/cm^2)	Avg.	Std.
0.75	1.34E+04	1.50E+04	1.42E+04	1.15E+03
1	1.87E+04	1.98E+04	1.92E+04	7.87E+02
2.5	3.61E+04	3.72E+04	3.66E+04	7.87E+02
5	6.95E+04	8.48E+04	7.72E+04	1.08E+04
7.5	1.04E+05	1.19E+05	1.12E+05	1.02E+04
10	1.49E+05	1.53E+05	1.51E+05	2.48E+03
15	2.12E+05	2.11E+05	2.11E+05	4.84E+02
20	2.70E+05	2.60E+05	2.65E+05	6.84E+03
30	3.65E+05	3.55E+05	3.60E+05	6.96E+03
50	5.32E+05	5.10E+05	5.21E+05	1.55E+04
80	7.38E+05	7.22E+05	7.30E+05	1.17E+04
100	8.58E+05	8.37E+05	8.47E+05	1.49E+04
150	1.14E+06	1.10E+06	1.12E+06	3.07E+04
200	1.36E+06	1.32E+06	1.34E+06	2.77E+04
300	1.70E+06	1.63E+06	1.66E+06	5.51E+04
400	1.91E+06	1.96E+06	1.94E+06	3.48E+04
500	2.17E+06	2.27E+06	2.22E+06	7.09E+04
800	2.74E+06	2.79E+06	2.77E+06	3.72E+04
1000	3.03E+06	2.99E+06	3.01E+06	3.20E+04
1500	3.28E+06	3.14E+06	3.21E+06	1.02E+05

28) Step up experiment and step down experiment of H5604F HDPE at the temperature of 180 ^{0}C (Figure 4.24)

Step up :

$\dot{\gamma}_{app}$ (s^{-1})	1st $\tau_{w,min}$ (dyn/cm^2)	2nd $\tau_{w,min}$ (dyn/cm^2)	1st $\tau_{w,max}$ (dyn/cm^2)	2nd $\tau_{w,max}$ (dyn/cm^2)
420	2.85E+06	2.89E+06	3.07E+06	3.08E+06
440	2.83E+06	2.87E+06	3.03E+06	3.08E+06
460	2.81E+06	2.85E+06	3.06E+06	3.03E+06
480	2.82E+06	2.87E+06	3.04E+06	3.09E+06

The shear strain rate at the onset

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
400	2.95E+06	3.12E+06
410	2.91E+06	3.07E+06
405	2.89E+06	3.09E+06
400	2.89E+06	3.10E+06
Avg.	2.91E+06	3.09E+06
Std.	2.73E+04	1.68E+04

The shear strain rate at the terminal

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
490	2.89E+06	3.06E+06
510	2.94E+06	3.12E+06
500	2.92E+06	3.10E+06
495	2.88E+06	3.05E+06
Avg.	2.91E+06	3.08E+06
Std.	2.65E+04	3.12E+04

Step down :

$\dot{\gamma}_{app}$ (s^{-1})	1^{st} $\tau_{w,min}$ (dyn/cm^2)	2^{nd} $\tau_{w,min}$ (dyn/cm^2)	1^{st} $\tau_{w,max}$ (dyn/cm^2)	2^{nd} $\tau_{w,max}$ (dyn/cm^2)
420	2.90E+06	2.84E+06	3.07E+06	3.11E+06
440	2.86E+06	2.81E+06	3.02E+06	3.07E+06
460	2.86E+06	2.80E+06	3.08E+06	3.03E+06
480	2.81E+06	2.85E+06	3.02E+06	3.05E+06

The shear strain rate at the onset

$\dot{\gamma}_{ap}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
400	2.93E+06	3.05E+06
410	2.89E+06	3.11E+06
400	2.85E+06	3.10E+06
400	2.88E+06	3.02E+06
Avg.	2.89E+06	3.07E+06
Std.	3.33E+04	4.22E+04

The shear strain rate at the terminal

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
490	2.91E+06	3.09E+06
510	2.85E+06	3.04E+06
500	2.90E+06	3.05E+06
505	2.89E+06	3.14E+06
Avg.	2.89E+06	3.08E+06
Std.	2.74E+04	4.32E+04

29) The oscillating stress regime of H5604F HDPE at the temperature of 180 ^{0}C (Figure 4.25)

H5690S HDPE :

$\dot{\gamma}_{app}$ (s^{-1})	1st $\tau_{w,min}$ (dyn/cm^2)	2nd $\tau_{w,min}$ (dyn/cm^2)	1st $\tau_{w,max}$ (dyn/cm^2)	2nd $\tau_{w,max}$ (dyn/cm^2)
300	2.38E+06	2.36E+06	3.35E+06	3.43E+06
400	2.36E+06	2.42E+06	3.40E+06	3.44E+06
500	2.39E+06	2.41E+06	3.43E+06	3.46E+06
600	2.47E+06	2.42E+06	3.50E+06	3.46E+06
700	2.43E+06	2.49E+06	3.51E+06	3.46E+06
800	2.44E+06	2.50E+06	3.53E+06	3.51E+06
900	2.47E+06	2.48E+06	3.54E+06	3.55E+06

The shear strain rate at the onset

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
285	2.37E+06	3.42E+06
275	2.39E+06	3.41E+06
280	2.39E+06	3.38E+06
Avg.	2.38E+06	3.41E+06
Std.	1.26E+04	2.24E+04

The shear strain rate at the terminal

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
1005	2.58E+06	3.62E+06
1005	2.62E+06	3.60E+06
995	2.64E+06	3.61E+06
Avg.	2.61E+06	3.61E+06
Std.	3.03E+04	1.24E+04

30) The oscillating stress regime of H5604F HDPE at the different temperatures (Figure 4.26)

At 160 ^{0}C :

$\dot{\gamma}_{app}$ (s^{-1})	1st $\tau_{w,min}$ (dyn/cm^2)	2nd $\tau_{w,min}$ (dyn/cm^2)	1st $\tau_{w,max}$ (dyn/cm^2)	2nd $\tau_{w,max}$ (dyn/cm^2)
160	1.81E+06	1.92E+06	2.48E+06	2.56E+06
170	1.86E+06	1.91E+06	2.48E+06	2.41E+06
180	1.85E+06	1.90E+06	2.50E+06	2.46E+06
190	1.83E+06	1.90E+06	2.45E+06	2.51E+06
200	1.86E+06	1.92E+06	2.55E+06	2.42E+06

The shear strain rate at the onset

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
135	1.79E+06	2.46E+06
150	1.78E+06	2.65E+06
130	1.93E+06	2.52E+06
Avg.	1.83E+06	2.54E+06
Std.	8.31E+04	9.77E+04

The shear strain rate at the terminal

$\dot{\gamma}_{app}$ (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
220	1.99E+06	2.63E+06
215	1.79E+06	2.40E+06
225	1.82E+06	2.43E+06
Avg.	1.87E+06	2.48E+06
Std.	1.11E+05	1.25E+05

At 200 ^{0}C :

γ_{app} (s^{-1})	1st $\tau_{w,min}$ (dyn/cm^2)	2nd $\tau_{w,min}$ (dyn/cm^2)	1st $\tau_{w,max}$ (dyn/cm^2)	2nd $\tau_{w,max}$ (dyn/cm^2)
800	3.00E+06	3.02E+06	3.13E+06	3.12E+06
810	2.97E+06	3.00E+06	3.11E+06	3.12E+06
820	2.96E+06	3.00E+06	3.10E+06	3.13E+06
830	2.96E+06	3.00E+06	3.10E+06	3.10E+06
840	2.98E+06	2.99E+06	3.12E+06	3.11E+06

The shear strain rate at the onset

γ_{app} (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
795	2.96E+06	3.17E+06
785	3.03E+06	3.14E+06
790	3.01E+06	3.10E+06
Avg.	3.00E+06	3.13E+06
Std.	3.68E+04	3.65E+04

The shear strain rate at the terminal

γ_{app} (s^{-1})	$\tau_{w,min}$ (dyn/cm^2)	$\tau_{w,max}$ (dyn/cm^2)
840	3.02E+06	3.18E+06
845	2.99E+06	3.12E+06
855	3.00E+06	3.10E+06
Avg.	3.01E+06	3.14E+06
Std.	1.37E+04	4.16E+04

B.3 Wall Slip Determination

31) Slip velocity as a function of shear stress of four different HDPE (H5604F, H5840B, H5818J and H5690S) melts at the temperature of 180 ^{0}C (Figure 4.27a-d)

H5604F HDPE		**H5840B HDPE**		**H5818J HDPE**		**H5690S HDPE**	
τ_w (dyn/cm^2)	V_s (mm/s)	τ_w (dyn/cm^2)	V_s (mm/s)	τ_w (dyn/cm^2)	V_s (mm/s)	τ_w (dyn/cm^2)	V_s (mm/s)
1.6E+06	2.7E-01	6.0E+05	5.6E-01	9.8E+05	7.9E+00	1.0E+06	1.6E-01
1.9E+06	5.8E-01	8.0E+05	8.9E-01	1.1E+06	1.1E+01	1.2E+06	2.2E-01
2.4E+06	1.7E+00	1.0E+06	1.4E+00	1.3E+06	1.3E+01	1.4E+06	2.9E-01
2.8E+06	8.9E+00	1.2E+06	2.2E+00	1.3E+06	1.7E+01	1.6E+06	4.1E-01
2.9E+06	1.1E+01	1.5E+06	5.0E+00	1.5E+06	2.6E+01	1.8E+06	7.2E-01
2.9E+06	1.4E+01	2.0E+06	1.4E+01	1.7E+06	7.0E+01	2.0E+06	1.0E+00
3.0E+06	1.7E+01	3.0E+06	3.4E+01	1.9E+06	8.4E+01	2.2E+06	1.5E+00
3.1E+06	2.5E+01	4.0E+06	7.8E+01			2.4E+06	2.1E+00
3.5E+06	3.3E+01	5.0E+06	1.3E+02			2.6E+06	2.5E+00
4.0E+06	4.0E+01					2.8E+06	3.0E+00
						3.0E+06	3.5E+00

32) Slip velocity as a function of shear stress of H5604F HDPE and H5840B HDPE at the temperatures of 160 ^{0}C and 200 ^{0}C (Figure 4.31-4.32)

H5604F HDPE :

160 ^{0}C		200 ^{0}C	
τ_w (dyn/cm^2)	V_s (mm/s)	τ_w (dyn/cm^2)	V_s (mm/s)
1.2E+06	2.0E-01	1.0E+06	2.0E-01
1.4E+06	3.5E-01	1.2E+06	3.2E-01
1.6E+06	6.3E-01	1.4E+06	6.1E-01
1.8E+06	7.9E-01	1.8E+06	1.1E+00
2.0E+06	1.1E+00	1.9E+06	1.8E+00
2.2E+06	2.0E+00	2.1E+06	3.4E+00
2.4E+06	4.1E+00	2.2E+06	5.1E+00
2.8E+06	9.9E+00	2.4E+06	9.1E+00
3.0E+06	3.2E+01	2.6E+06	1.3E+01
3.2E+06	3.9E+01	2.8E+06	2.3E+01
3.4E+06	4.9E+01	3.1E+06	3.3E+01
3.6E+06	6.1E+01	3.2E+06	4.3E+01
3.8E+06	6.6E+01		

H5840B HDPE :

160 ^{0}C		200 ^{0}C	
τ_w (dyn/cm^2)	V_s (mm/s)	τ_w (dyn/cm^2)	V_s (mm/s)
1.2E+06	1.6E+00	8.0E+05	1.7E+00
1.4E+06	2.1E+00	9.0E+05	2.2E+00
1.6E+06	3.1E+00	1.0E+06	2.4E+00
1.8E+06	3.6E+00	1.2E+06	4.8E+00
2.0E+06	6.2E+00	1.4E+06	7.2E+00
2.2E+06	8.9E+00	1.6E+06	9.1E+00
2.4E+06	1.5E+01	1.8E+06	1.4E+01
2.6E+06	1.8E+01	2.0E+06	1.7E+01
2.8E+06	2.3E+01	2.5E+06	4.2E+01
3.0E+06	2.8E+01	3.0E+06	7.9E+01
		3.5E+06	1.5E+02

33) The extrapolation length as a function of slip velocity of four different HDPE (H5604F, H5840B, H5818J and H5690S) melts at the temperature of 180 ^{0}C (Figure 4.30-31)

H5604F HDPE:

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
3.54E-01	1.46E-02	-	-	-
6.28E-01	1.58E-02	-	-	-
7.85E-01	1.40E-02	1.55E-02	1.48E-02	1.03E-03
1.15E+00	1.54E-02	-	-	-
2.02E+00	1.93E-02	-	-	-
4.10E+00	3.06E-02	-	-	-
9.91E+00	5.02E-02	5.01E-02	5.02E-02	5.66E-05
3.16E+01	6.29E-02	-	-	-
3.90E+01	6.17E-02	5.77E-02	5.97E-02	2.86E-03
4.91E+01	5.85E-02	-	-	-
6.13E+01	6.28E-02	-	-	-
6.55E+01	5.72E-02	-	-	-

H5840B HDPE :

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
5.61E-01	2.39E-02	2.84E-02	2.62E-02	3.21E-03
8.88E-01	2.21E-02	-	-	-
1.44E+00	2.44E-02	-	-	-
2.18E+00	2.51E-02	-	-	-
5.02E+00	2.87E-02	-	-	-
1.44E+01	5.29E-02	-	-	-
3.45E+01	7.10E-02	8.62E-02	7.86E-02	1.08E-02
7.80E+01	1.19E-01	-	-	-
1.30E+02	1.46E-01	-	-	-

H5818J:

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Std.	Std.
5.88E+00	2.25E-02	-	-	-
9.68E+00	2.50E-02	2.32E-02	2.41E-03	1.25E-03
1.27E+01	2.40E-02	-	-	-
1.71E+01	2.60E-02	-	-	-
2.64E+01	3.65E-02	3.43E-02	3.54E-03	1.53E-03
6.96E+01	7.97E-02	-	-	-
8.40E+01	9.31E-02	-	-	-

H5690S HDPE :

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
1.63E-01	7.90E-03	-	-	-
2.21E-01	7.90E-03	8.20E-03	8.15E-03	2.12E-04
2.93E-01	7.90E-03	-	-	-
4.06E-01	9.03E-03	-	-	-
7.17E-01	1.21E-02	-	-	-
1.00E+00	1.46E-02	1.49E-02	1.47E-02	9.26E-03
1.48E+00	1.75E-02	-	-	-
2.11E+00	2.20E-02	-	-	-
2.54E+00	2.20E-02	-	-	-
2.99E+00	2.20E-02	-	-	-
3.53E+00	2.23E-02	-	-	-

34) The extrapolation length as a function of slip velocity for H5604F HDPE at the different temperatures (Figure 4.39)

At 160 ^{0}C

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
2.65E-01	1.39E-02	1.35E-02	1.37E-02	2.62E-04
5.76E-01	1.40E-02	-	-	-
1.66E+00	1.59E-02	-	-	-
8.91E+00	4.40E-02	4.42E-02	4.41E-02	1.34E-04
1.25E+01	5.72E-02	-	-	-
1.38E+01	5.79E-02	-	-	-
1.70E+01	6.39E-02	6.34E-02	6.37E-02	2.97E-04
2.55E+01	6.80E-02	-	-	-
3.34E+01	6.46E-02	-	-	-
3.84E+01	6.56E-02	-	-	-

At 200 ^{0}C

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
2.01E-01	1.41E-02	-	-	-
3.17E-01	1.31E-02	1.37E-02	1.34E-02	4.24E-04
6.07E-01	1.45E-02	-	-	-
1.11E+00	1.59E-02	-	-	-
1.77E+00	1.99E-02	-	-	-
3.41E+00	3.21E-02	3.22E-02	3.21E-02	9.19E-05
5.12E+00	3.87E-02	-	-	-
9.12E+00	4.60E-02	-	-	-
1.23E+01	5.68E-02	-	-	-
2.41E+01	5.36E-02	-	-	-
4.18E+01	5.68E-02	5.60E-02	5.64E-02	5.66E-04
5.67E+01	5.59E-02	-	-	-

35) The extrapolation length as a function of slip velocity for H5840B HDPE at the different temperatures (Figure 4.40)

At 160 ^{0}C

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
1.56E+00	1.96E-02	-	-	-
2.05E+00	2.02E-02	2.01E-01	1.11E-01	1.28E-01
3.11E+00	2.39E-02	-	-	-
3.59E+00	2.14E-02	-	-	-
6.24E+00	3.45E-02	-	-	-
8.90E+00	4.10E-02	-	-	-
1.48E+01	6.15E-02	-	-	-
1.80E+01	6.47E-02	-	-	-
2.32E+01	7.24E-02	7.24E-02	7.24E-02	5.66E-05
2.80E+01	7.76E-02	-	-	-

At 200 ^{0}C

V_s (mm/s)	b_1 (mm)	b_2 (mm)	Avg.	Std.
1.71E+00	2.07E-02	-	-	-
2.16E+00	2.29E-02	-	-	-
2.40E+00	2.09E-02	2.08E-02	2.08E-02	7.78E-05
4.80E+00	3.20E-02	-	-	-
7.20E+00	3.90E-02	-	-	-
9.05E+00	3.92E-02	-	-	-
1.35E+01	5.12E-02	-	-	-
1.71E+01	5.72E-02	5.72E-02	5.72E-02	4.24E-05
4.22E+01	1.12E-01	-	-	-
7.91E+01	1.89E-01	-	-	-
1.48E+02	3.90E-01	-	-	-

B.4 Normalized Flow Curve

36) Master curve of four HDPE melts of different molecular weight and polydispersity at the temperature of 180 ^{0}C (Figure 4.46-4.47)

H5604F HDPE :

Wi	τ_w/G_c
4.09E+00	1.23E+00
8.18E+00	1.76E+00
1.23E+01	2.28E+00
1.64E+01	2.62E+00
4.09E+01	4.31E+00
8.18E+01	5.76E+00
2.13E+02	7.40E+00
2.56E+02	7.97E+00
3.20E+02	8.70E+00
4.26E+02	1.01E+01
5.33E+02	1.05E+01
6.39E+02	1.11E+01
8.52E+02	1.22E+01
1.07E+03	1.33E+01
2.13E+03	1.63E+01
3.20E+03	1.77E+01
4.26E+03	2.00E+01
7.24E+03	2.17E+01
1.03E+04	2.09E+01
1.47E+04	2.39E+01
1.66E+04	2.64E+01
1.84E+04	2.78E+01
2.76E+04	2.90E+01

H5840B HDPE :

Wi	τ_w/G_c
2.91E-02	3.86E-02
7.28E-02	6.87E-02
1.46E-01	1.23E-01
2.19E-01	1.61E-01
2.91E-01	1.99E-01
4.37E-01	2.65E-01
6.41E-01	3.48E-01
8.74E-01	4.27E-01
1.43E+00	6.11E-01
2.40E+00	6.87E-01
3.28E+00	8.59E-01
5.38E+00	1.15E+00
8.85E+00	1.46E+00
1.47E+01	1.73E+00
3.03E+01	2.45E+00

H5818J HDPE :

Wi	τ_w/G_c
1.10E-02	1.02E-02
2.75E-02	2.02E-02
5.50E-02	3.43E-02
8.25E-02	4.52E-02
1.10E-01	5.90E-02
1.65E-01	7.53E-02
2.20E-01	9.71E-02
3.30E-01	1.31E-01
5.50E-01	1.95E-01
8.80E-01	2.76E-01
1.10E+00	3.24E-01
1.65E+00	4.41E-01
2.20E+00	5.25E-01
3.63E+00	6.71E-01
4.84E+00	8.00E-01
6.06E+00	9.17E-01
9.69E+00	1.21E+00
1.21E+01	1.36E+00
1.82E+01	1.66E+00

H5690S HDPE :

Wi	τ_w/G_c
2.69E-01	1.13E-01
4.03E-01	2.10E-01
5.38E-01	3.20E-01
1.53E+00	6.59E-01
3.06E+00	1.11E+00
4.59E+00	1.50E+00
6.12E+00	1.82E+00
9.18E+00	2.40E+00
1.22E+01	2.86E+00
1.26E+01	3.11E+00
1.71E+01	3.73E+00
2.52E+01	4.35E+00
3.07E+01	4.97E+00
4.03E+01	5.59E+00
4.67E+01	6.21E+00
5.77E+01	6.83E+00
6.52E+01	7.45E+00
7.86E+01	8.07E+00
9.26E+01	8.70E+00
1.08E+02	9.32E+00

37) Master curve of H5604F HDPE at the different temperatures (Figure 4.54)

At 160 ^{0}C

Wi	τ_w/G_c
4.17E+01	2.03E+00
5.57E+01	2.93E+00
1.39E+02	4.38E+00
4.12E+02	5.85E+00
6.18E+02	6.91E+00
8.24E+02	7.70E+00
1.24E+03	9.16E+00
1.58E+03	9.37E+00
3.38E+03	1.26E+01
1.04E+04	1.52E+01
2.02E+04	1.71E+01
2.18E+04	1.74E+01
2.38E+04	1.76E+01
2.78E+04	1.90E+01
3.73E+04	2.03E+01
5.16E+04	2.09E+01
6.01E+04	2.37E+01

At 200 ^{0}C

Wi	τ_w/G_c
7.58E+00	1.70E+00
1.14E+01	2.27E+00
1.52E+01	4.32E+00
5.52E+01	6.53E+00
1.10E+02	8.63E+00
1.66E+02	1.01E+01
2.21E+02	1.12E+01
3.14E+02	1.38E+01
5.35E+02	1.62E+01
9.27E+02	2.01E+01
1.32E+03	2.25E+01
2.38E+03	2.38E+01
2.57E+03	2.50E+01
3.64E+03	2.75E+01
5.90E+03	3.00E+01
9.43E+03	3.26E+01
1.63E+04	3.50E+01
2.49E+04	3.81E+01
3.21E+04	4.00E+01

38) Master curve of H5818J HDPE at the different temperatures (Figure 4.55)

At 160 ^{0}C

Wi	τ_w/G_c
3.13E-02	2.66E-02
7.84E-02	5.74E-02
1.57E-01	1.27E-01
2.35E-01	1.76E-01
3.13E-01	2.51E-01
4.70E-01	3.59E-01
6.27E-01	4.40E-01
1.14E+00	5.92E-01
1.90E+00	8.41E-01
3.04E+00	1.22E+00
3.86E+00	1.43E+00
4.96E+00	1.63E+00
6.36E+00	1.83E+00
6.87E+00	2.04E+00
8.26E+00	2.24E+00
9.14E+00	2.44E+00
1.06E+01	2.65E+00
1.22E+01	2.85E+00
1.37E+01	3.05E+00

At 200 ^{0}C

Wi	τ_w/G_c
2.03E-02	1.51E-02
2.70E-02	2.11E-02
6.75E-02	4.07E-02
1.35E-01	7.84E-02
2.03E-01	1.18E-01
2.70E-01	1.68E-01
4.05E-01	2.38E-01
5.40E-01	3.04E-01
9.24E-01	4.11E-01
1.54E+00	6.00E-01
2.46E+00	8.32E-01
2.55E+00	9.02E-01
2.91E+00	1.01E+00
3.54E+00	1.13E+00
4.62E+00	1.35E+00
5.69E+00	1.58E+00
7.11E+00	1.80E+00
8.14E+00	2.03E+00
9.19E+00	2.25E+00
1.16E+01	2.82E+00
1.29E+01	2.93E+00
1.32E+01	3.04E+00

CIRRICULUM VITAE

Name : Narin Sarapirom

Date of Birth : June 13,1976

Nationality : Thai

University Education :

1993-1997 Bachelor Degree of Science in Industrial Chemistry, King Mongkut Institute Technology of Ladkrabang.