

## CONTENTS

<b>Chapter 1 Flow Properties – An Introduction</b>	<b>1</b>
1.1 Introduction	1
1.2 Rheological Equations of State	2
1.3 Non-Newtonian Fluids	7
<b>Chapter 2 Flow Trough Channels of Simple Cross Section</b>	<b>21</b>
2.1 Introduction	21
2.2 Flow through a Pipe (capillary flow)	21
2.3 Flow Between Parallel Plates	30
2.3 Flow through an Annulus	31
2.5 Summary	31
Appendix	32
References	34
<b>Chapter 3 Measurement of Flow Properties</b>	<b>35</b>
3.1 Introduction	35
3.2 Types of Capillary Viscometers	35
3.3 Review of Assumptions	36
3.4 Corrections to Data obtained from Capillary Rheometers	39
3.5 Summary	45
References	46
<b>Chapter 4 Factors Affecting Viscous Flow</b>	<b>47</b>
4.1 Introduction	47
4.2 Effect of Temperature	47
4.3 Effect of Pressure	50
4.4 Effect of Shear History	55
4.5 Viscosity Changes during Extrusion	57
4.6 Effect of Molecular Structure on Viscous Flow	59
References	62
<b>Chapter 5 Elastic Effect in Polymer Melt Flow</b>	<b>63</b>
5.1 Introduction	63
5.2 Die Swell	63
5.3 Elastic Turbulence or Melt Fracture	69
5.4 Sharkskin	78

5.5 Frozen-In Orientation	81
5.6 Draw-down	84
5.7 Measurement of Elastic Effects	87
References	88
<b>Chapter 6 The Application of Rheological Studies to Polymer Processing</b>	<b>89</b>
6.1 Introduction	89
6.2 Extrusion	90
6.3 Injection Moulding	94
6.4 Bottle Blowing and Related Blow Moulding Operations	104
6.5 Compression and Transfer Moulding of Thermosetting Materials	109
6.6 Transfer Moulding of Thermosetting Materials	113
6.7 Calendering	115
6.8 Vacuum Forming and Related Shaping Applications	116
6.9 Flow Properties of Individual Thermoplastics	116
<b>Chapter 7 More Complex Rheological Problems</b>	<b>126</b>
7.1 Introduction	126
7.2 Components of Stress	128
7.3 Time Derivatives	134
7.4 The Equation of Continuity	136
7.5 The Equation of Momentum	138
7.6 Examples of Applications of Continuum Mechanics in Rheology	142
7.7 Measurement of Elastic Effects in Polymer Flow	153
References	158
<b>Chapter 8 Tensile Deformation in Molten Polymers</b>	<b>159</b>
8.1 Introduction	159
8.2 Measurement of Tensile Deformation	160
8.3 Traction Viscosity of Polymer Melts	162
8.4 Significance of Traction Viscosity in Polymer Processes	164
8.5 Elastic Strains in Tension	165
8.6 Melt Strength	166
References	166
Index	185