

## CONTENTS

|                                                     |           |
|-----------------------------------------------------|-----------|
| <b>1. POLYMERS</b>                                  | <b>1</b>  |
| Introduction                                        | 1         |
| Molecular Structure                                 | 2         |
| The Rheology of Polymer Melts                       | 8         |
| Crystallinity in Polymers                           | 13        |
| Chemical Structure                                  | 18        |
| Polymerization Processes                            | 22        |
| Summary                                             | 30        |
| Bibliography                                        | 30        |
| <br>                                                |           |
| <b>2. PROCESSES FOR MAKING PLASTIC FILMS</b>        | <b>31</b> |
| Introduction                                        | 31        |
| The Extrusion Sequence                              | 31        |
| Melt Film Formation                                 | 39        |
| Cast Film Process                                   | 43        |
| Blown Film Process                                  | 51        |
| Cast and Blown Film Comparison                      | 54        |
| Cast and Blown Films – Typical Systems              | 56        |
| Film Orientation                                    | 59        |
| Flat Film Orientation Process                       | 61        |
| Tubular Orientation Process                         | 65        |
| Flat and Tubular Orientation Comparison             | 69        |
| Flat and Tubular Orientated Films – Typical Systems | 69        |
| Economics                                           | 72        |
| Bibliography                                        | 74        |
| <br>                                                |           |
| <b>3. PROCESSES FOR MODIFYING PLASTIC FILMS</b>     | <b>75</b> |
| Introduction                                        | 75        |
| Surface Adhesion                                    | 75        |
| Film Treatment for Adhesion                         | 79        |
| Printing                                            | 83        |
| Film Coating                                        | 87        |
| Extrusion Coating                                   | 101       |
| Film Lamination                                     | 104       |
| Metallization                                       | 110       |
| Film Slitting                                       | 114       |

|                                                   |            |
|---------------------------------------------------|------------|
| Economics                                         | 117        |
| Coextrusion                                       | 118        |
| Bibliography                                      | 129        |
| <b>4. PACKAGE FUNCTIONS AND REQUIREMENTS</b>      | <b>131</b> |
| Introduction                                      | 131        |
| Package Functions                                 | 131        |
| Package Requirements                              | 136        |
| <b>5. PACKAGING MACHINERY</b>                     | <b>147</b> |
| Introduction                                      | 147        |
| Chapter Organization                              | 149        |
| Dry Powders and Particles                         | 149        |
| Liquid Products                                   | 157        |
| Individual Solid Products                         | 160        |
| Packaging Loose Items in a Container              | 170        |
| Heat Sealing Equipment                            | 173        |
| Summary                                           | 175        |
| Bibliography                                      | 177        |
| <b>6. PACKAGING APPLICATION FOR PLASTIC FILMS</b> | <b>179</b> |
| Introduction                                      | 179        |
| Food Packaging                                    | 182        |
| Conclusions                                       | 204        |
| Packaged Retail Products Other Than Food          | 205        |
| Health Care Packaging                             | 210        |
| Trash Bags, Merchandise Bags and Grocery Sacks    | 213        |
| Heavy-Duty Bag Packaging                          | 214        |
| Pallet Wrap and Stretch Wrap                      | 215        |
| Bibliography                                      | 216        |
| <b>7. FUTURE TRENDS AND POSSIBILITIES</b>         | <b>217</b> |
| Introduction                                      | 217        |
| Government Action                                 | 217        |
| Sociological Trends That Impact Packaging         | 220        |
| Economic Trends                                   | 220        |
| Trends and Possibilities in Technology            | 223        |
| Summary                                           | 227        |

|                                            |            |
|--------------------------------------------|------------|
| <b>APPENDIX</b>                            | <b>229</b> |
| The Packaging Industry                     | 229        |
| Properties of Plastic Films                | 232        |
| Market Prices for Plastic Resins and Films | 234        |
| <br>                                       |            |
| Glossary                                   | 237        |
| Index                                      | 251        |