

Handbook of Elastomers

NEW DEVELOPMENTS AND TECHNOLOGY

edited by

Anil K. Bhowmick

Howard L. Stephens

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RUBBER TECHNOLOGY CENTRE
INDIAN INSTITUTE OF TECHNOLOGY
KHARAGPUR, INDIA

Howard L. Stephens

DEPARTMENT OF POLYMER SCIENCE
THE UNIVERSITY OF AKRON
AKRON, OHIO

MARCEL DEKKER, INC.

New York and Basel

Library of Congress Cataloging in Publication Data

Handbook of elastomers.

(Plastics engineering : 19)

Includes bibliographies and index.

I. Elastomers--Handbooks, manuals, etc. I. Bhowmick, Anil K. II. Stephens, Howard L. III. Series: Plastics engineering (Marcel Dekker, Inc.) ; 18.

TS1925.H35 1988 676 87-36395

ISBN 0-8247-7800-6

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MARCEL DEKKER, INC
270 Madison Avenue, New York, New York 10016

Current printing (last digit):

10 9 8 7 6 5 4 3 2 1

PRINTED IN THE UNITED STATES OF AMERICA

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Preface

During the last two decades, a wealth of materials, processes, and products have been developed in the field of rubber science and engineering. The object of this book is to present a unified treatment of these developments, with special emphasis placed on the materials. Also presented here are discussions of the physical and mechanical properties of new elastomeric materials with pertinent reference made to the properties of the old. The aim of this approach is to arrive at a comprehensive understanding of the materials while providing up-to-date coverage of the field.

Of the vast amount of recent developments in elastomeric technology, we have chosen to include here only those advances that are commercially important and in current use. Emphasis is placed on scientific and technological facts and applications of the various materials available.

The chapters in this volume cover the progress of both natural and synthetic elastomers. They are contributions written by a galaxy of experts who present detailed, stimulating accounts of their topics. As far as possible, the brand names for different rubbers and chemicals have been avoided.

The book is intended for materials scientists, engineers, graduate students, and persons involved in industrial research, sales, and marketing. It is hoped that the book will serve as a useful professional reference book and a graduate textbook.

We wish to thank all the authors for their fine contributions and ready willingness to give of their time and expertise to bring this work to fruition. We are also grateful to those at the Rubber Division of the American Chemical Society, especially Mrs. Ruth Murray and Mr. R. H. Gerster, and to Professor F. N. Kelley, Director of the Institute of Polymer Science, Dr. S. L. Aggarwal of GENCORP, Dr. A. I. Medalia of Cabot Corporation, and many others for valuable information and suggestions. Special thanks are offered to Professors D. McIntyre and A. N. Gent, Mr. R. Seeger of the University of Akron, to Professors K. L. Chopra, G. S. Sanyal, S. K. De, A. Paul, A. Mookherjee, D. Sen, and B. N. Avasthi of the Indian Institute

of Technology, Kharagpur, and to Dr. D. Banerjee and Mr. A. N. Bhattacharya of the Plastics and Rubber Institute—(Indian Section-Rubber), London, for their kind assistance and interest. The editors also thank Ashima, Anurekha, Anima Di, Mr. A. K. Naskar and their own students for their help. Last but not least, the editors wish to record their profound gratitude to Dr. Eileen Gardiner, Executive Editor, Engineering, at Marcel Dekker Inc., without whose help, guidance, and great interest this book would not have taken shape.

Anil K. Bhowmick
Howard L. Stephens

Contributors

Muhanad A. Alsamarraie Research Associate, Institute of Polymer Science, The University of Akron, Akron, Ohio

Crispin S. L. Baker Deputy Director, The Malaysian Rubber Producers' Research Association, Brickendonbury, Hertford, United Kingdom

Dominic A. Berta* Senior Research Chemist, Research and Development Department, Hercules, Inc., Wilmington, Delaware

Anil K. Bhowmick Assistant Professor, Rubber Technology Centre, Indian Institute of Technology, Kharagpur, India

Aubert Y. Coran Distinguished Science Fellow, Rubber Chemicals Research Laboratory, Monsanto Chemical Company, Akron, Ohio

Bharat Davé ECC Products/3M Laboratory, Burlington, Massachusetts

Adolf Dräxler Chemist, Rubber Technology Applications, Hüls AG, (Retired), Marl, Federal Republic of Germany

P. Dreyfuss Professor and Senior Research Scientist, Michigan Molecular Institute, Midland, Michigan

John R. Dunn Principal Scientist-Elastomers, Elastomers Research & Development Division, Polysar Limited, Sarnia, Ontario, Canada

***Current affiliation:** Senior Research Chemist, Research & Development Center, Himont USA, Inc., Marshallton, Delaware

Douglas C. Edwards Manager, Materials Research, Corporate Research and Development Division, Polysar Limited, Sarnia, Ontario, Canada

Colin W. Evans* Technical Director, Dunlop Hose Group, Gateshead, United Kingdom

Lloyd A. Goettler Fellow, Thermoplastic Elastomers Department, Monsanto Chemical Company, Akron, Ohio

Kinro Hashimoto Manager—Technical Sales of Elastomers, Nippon Zeon of America, Inc., Akron Office, Akron, Ohio

Alan C. Haynes Research Steward, London School of Polymer Technology, Polytechnic of North London, London, United Kingdom

Daniel L. Hertz, Jr. President and Technical Director, Seals Eastern, Inc., Red Bank, New Jersey

Gen Kojima Senior Researcher, Research and Development Division, Asahi Glass Company, Ltd., Yokohama, Japan

D. Frederick Lohr Research Associate, Central Research Laboratories, The Firestone Tire and Rubber Company, Akron, Ohio

D. McIntyre Professor of Chemistry and Polymer Science, Institute of Polymer Science, The University of Akron, Akron, Ohio

Harold R. Penton Assistant Director, Commercial Development, Research and Development Department, Ethyl Corporation, Baton Rouge, Louisiana

Keith E. Polmanteer Consultant, KEP Enterprises, Midland, Michigan. Formerly Dow Corning Corporation (Retired), Midland, Michigan

Roderick P. Quirk Professor of Polymer Science, Institute of Polymer Science, The University of Akron, Akron, Ohio

C. Michael Roland† Associate Scientist, Central Research Laboratories, The Firestone Tire and Rubber Company, Akron, Ohio

W. Schoenmaker Product Manager-Arnitel, KEA Department, Akzo Plastics bv, Arnhem, The Netherlands

Charles S. Schollenberger Polyurethane Specialist & Consultant, Hudson Ohio. Formerly The B. F. Goodrich Chemical Company (Retired), Akron, Ohio

*Current affiliation: Consultant, Gateshead, United Kingdom

†Current affiliation: Research Chemist, Polymeric Materials Branch, Naval Research Laboratory, Washington, D.C.

Donald N. Schulz* Group Head and Senior Research Associate, Corporate Research--Science Laboratories, Exxon Research and Engineering Company, Annandale, New Jersey

C. Stein General Manager, Societe Chimique des Charbonnages Tour Aurore, Cdf Chimie S.A., Paris, France

Howard L. Stephens Emeritus Professor of Chemistry and Polymer Science, Department of Polymer Science, The University of Akron, Akron, Ohio

Roger W. Strassburg Lecturer V, Center for Environmental Studies, The University of Akron, Akron, Ohio. Formerly The B. F. Goodrich Chemical Company (Retired), Akron, Ohio

Yoshihiro Todani Project Manager, Rubber Division, Nippon Zeon Co., Ltd., Tokyo, Japan

Edwin J. Vandenberg Adjunct Professor, Department of Chemistry, Arizona State University, Tempe, Arizona

C. R. Wilder Senior Research Chemist, Polymer & Materials Division, Research and Development Research Center, Phillips Petroleum Company, Bartlesville, Oklahoma

*Current affiliation: Section Head and Senior Research Associate, Polymers Group, Exxon Chemical Company, Linden, New Jersey

Contents

<i>Dedication</i>	
<i>Preface</i>	v
<i>Contributors</i>	xv
Chapter 1 Guayule Rubber	1
<i>D. McIntyre, Howard L. Stephens, and Anil K. Bhowmick</i>	
1. Introduction	1
2. Structure and Biogenesis of Guayule Rubber	2
3. Rubber Separation Processes	9
4. Compounding and Processing of Guayule Rubber for End Product Uses	11
5. Implications of Commercial Guayule Production References	27
Chapter 2 Modified Natural Rubber	31
<i>Crispin S. L. Baker</i>	
1. Introduction	31
2. Hydrogenated Natural Rubber	32
3. Chlorinated Natural Rubber	33
4. Hydrohalogenated Natural Rubber	34
5. Cyclized Natural Rubber	35
6. Resin Modified Natural Rubber	39
7. Poly(methyl methacrylate)-Grafted Natural Rubber	42
8. Superior Processing Rubber	46
9. ENPCAF-Modified Natural Rubber	49
10. Polystyrene-Grafted Natural Rubber	52
11. Epoxidized Natural Rubber	56
12. Depolymerized Natural Rubber	63
13. Thermoplastic Natural Rubber	66
14. Summary	71

Acknowledgments	71
References	71
Chapter 3 Chemical Modification of Synthetic Elastomers	75
<i>Donald M. Schulz</i>	
1. Introduction	75
2. Hydrogenation	75
3. Cyclization	83
4. Isomerization	86
5. Halogenation and Hydrohalogenation	86
6. Epoxidation	87
7. Ene Reactions	88
8. Ionomeric Modification	91
9. Carbene and Sulfenyl Chloride Addition	92
10. Hydrosilylation	93
11. Binding Antioxidants	94
12. Miscellaneous Modifications	95
13. Summary	96
References	96
Chapter 4 Liquid Rubber	101
<i>Douglas C. Edwards</i>	
1. Introduction	101
2. Classes of Commercially Established Liquid Elastomers	103
3. Model Studies Using Terminally Functional Polybutadiene	118
4. Practical Considerations Affecting the Development of Telechelic Polymers as General-Purpose Elastomers	125
5. Additional Themes in Telechelic Elastomer Research and Development	127
6. Concluding Remarks	136
Acknowledgment	136
References	136
Chapter 5 Powdered Rubber	141
<i>Colin W. Evans</i>	
1. Introduction	141
2. Conventional Mixing	142
3. Powdered Polymer Technology	146
4. Extrusion, Injection Molding, and Transfer Molding of Powdered Rubber Preblended Compounds	161
5. Effect of Powder Technology on Mixing Cycle Times, Power Consumption, and Plant Maintenance Costs	165
6. Continuous Production	171
7. Polymer Blends (NBR-SBR)	172
8. Adhesives and Doughs	172
9. Environmental Considerations	173
10. Economics of Powdered Rubber Systems	174

	11. Conclusion	179
	References	180
Chapter 6	Rubber-Rubber Blends	183
	<i>C. Michael Roland</i>	
	1. Introduction	183
	2. Morphology	183
	3. Analytical Methods for Blend Characterization	188
	4. Preparation of Rubber Blends	193
	5. Properties of Rubber Blends	198
	Acknowledgments	211
	References	211
Chapter 7	Short Fiber-Rubber Composites	215
	<i>Lloyd A. Goettler</i>	
	1. Introduction	215
	2. Literature Review	217
	3. Short-Fiber Composite Concepts	222
	4. Short-Fiber Reinforcing Materials	231
	5. Processing	232
	6. Properties and Performance	240
	7. Design and Applications	243
	8. Summary	244
	References	244
	Nomenclature	247
Chapter 8	Thermoplastic Rubber-Plastic Blends	249
	<i>Aubert Y. Coran</i>	
	1. Introduction	249
	2. Rubber and Plastics Used in Blends	251
	3. Preparation of Rubber-Plastic Blends	255
	4. Phase Morphology	258
	5. Properties of Unvulcanized Rubber-Plastic Blends	263
	6. Properties of Blends Prepared by Dynamic Vulcanization	276
	7. Technological Applications	304
	References	310
Chapter 9	Thermoplastic Styrene Block Copolymers	313
	<i>C. R. Wilder</i>	
	1. Introduction	313
	2. History	314
	3. Manufacture	315
	4. Availability of Polymers	317
	5. Physical Properties	317
	6. Compounding	325
	7. Mixing and Processing	327
	8. Applications	329
	9. Conclusions	339
	Acknowledgment	339
	References	339

Chapter 10	Polyester Thermoplastic Elastomers	341
	<i>Roderick P. Quirk, Muhanad A. Alsamarraie, and W. Schoenmaker</i>	
1.	Introduction	341
2.	Basic Structure	342
3.	Synthesis, Manufacture, and Chemistry	343
4.	Morphology	346
5.	Commercial Elastomer Grades	353
6.	Engineering Properties	354
7.	Applications	371
8.	Summary	372
	References	372
Chapter 11	Thermoplastic Polyurethane Elastomers	375
	<i>Charles S. Schollenberger</i>	
1.	Background	375
2.	Introduction	376
3.	Scope and Content of Chapter	376
4.	Chemistry	377
5.	Reaction Components and Structure Effects	379
6.	Polymerization Processes	382
7.	Chain Structure, Organization, and Behavior	385
8.	Morphology and Thermal Responses	386
9.	Molecular Weight Effects	388
10.	Chemical Crosslinking Effects	390
11.	Environmental Stability and Stabilization	392
12.	Compounding	396
13.	Processing	398
14.	Applications	401
15.	Commercial Polymers and Their Properties	401
	References	407
Chapter 12	Additional Types of Thermoplastic Elastomers	411
	<i>Anil K. Bhowmick and Howard L. Stephens</i>	
1.	Thermoplastic 1,2-Polybutadiene	411
2.	<i>Trans</i> -1,4-Polyisoprene	422
3.	Modified Polyethylene	423
4.	Ionic Thermoplastic Elastomers	432
5.	Silicon-Based Thermoplastic Elastomers	436
6.	Polyamide 12 Elastomers (Vestamid)	437
	Acknowledgment	441
	References	441
Chapter 13	Halogen-Containing Elastomers	443
	<i>Daniel L. Hertz, Jr.</i>	
1.	Introduction	443
2.	Halobutyl Elastomers	445
3.	Chlorinated Polyethylene Elastomers	451
4.	Chlorosulfonated Polyethylene (Chloro-Sulfonyl-Polyethylene) Elastomers	455
5.	Epichlorohydrin Elastomers Chemistry and Markets	459

6.	Polychloroprene Rubber	464
7.	Fluorosilicone Elastomers	470
8.	Fluorine-Containing Elastomers	475
	References	482
Chapter 14	Tetrafluoroethylene-Propylene Rubber	485
	<i>Gen Kojima</i>	
1.	Introduction	485
2.	Manufacturing	485
3.	Polymer Structure and Fundamental Properties	487
4.	Commercial Polymer Types and Grades	490
5.	Compounding and Vulcanization	490
6.	Vulcanizate Properties	494
	References	501
Chapter 15	Carboxylated Rubber	503
	<i>John R. Dunn</i>	
1.	Introduction	503
2.	Historical	503
3.	Preparation of Carboxylic Rubbers	504
4.	Composition of Carboxylated Emulsion Polymers	507
5.	Vulcanization of Carboxylated Rubbers	508
6.	Scorch and Bin Storage Stability of Carboxylic Elastomers	513
7.	Compounding Ingredients for Carboxylated Elastomers	516
8.	Physical Properties	518
9.	Blends of Carboxylated Elastomers with Other Polymers	522
10.	Applications for Carboxylated Elastomers	525
11.	Conclusion	529
	References	529
Chapter 16	Polyphosphazene Elastomers	535
	<i>D. Frederick Lohr and Harold R. Penton</i>	
1.	Introduction	535
2.	Polyphosphazene Chemistry	536
3.	Commercial Development of Polyphosphazene Elastomers	539
4.	Polyfluoroalkoxyphosphazene Elastomer Properties and Applications	539
5.	Polyaryloxyphosphazene Elastomer Properties and Applications	545
6.	Summary	549
	References	550
Chapter 17	Advances in Silicone Rubber Technology	551
	<i>Keith E. Polmanteer</i>	
1.	Introduction	551
2.	General Silicone Rubber Technology	552
3.	Advances in Silicone Rubber	578

	Acknowledgments	614
	References	614
Chapter 18	Acrylic-Based Elastomer	617
	<i>Roger W. Strassburg</i>	
	1. Introduction	617
	2. Basic Structure	618
	3. Methods of Production	619
	4. Commercial Polymer Types	622
	5. Compounding Techniques	624
	6. Processing Characteristics	626
	7. Vulcanization Methods	627
	8. Physical Properties	630
	9. Applications	633
	10. Summary	636
	References	636
Chapter 19	Poly(propylene oxide) Elastomer	643
	<i>Dominic A. Berta and Edwin J. Vandenberg</i>	
	1. Introduction	643
	2. Structure of GPO	644
	3. Methods of Production of GPO	645
	4. Molecular Weight and Solution Behavior of GPO	646
	5. Crosslink System for GPO	646
	6. Vulcanizate Properties of GPO	647
	7. Compounding of GPO	650
	8. Carbon Blacks and Plasticizers in GPO	650
	9. Dynamic Properties of GPO	655
	10. Applications for GPO	658
	11. Conclusion	658
	References	659
Chapter 20	Polyalkenylenes	661
	<i>Adolf Dräxler</i>	
	1. Introduction	661
	2. Basic Structures and Commercial Types of Polyalkenylenes	662
	3. Production of Polyalkenylenes	670
	4. Compounding and Processing Characteristics	671
	5. Vulcanization Methods and Physical Properties of Vulcanized Rubbers	677
	6. Applications	683
	7. Summary	692
	References	692
Chapter 21	Polytetrahydrofuran	695
	<i>P. Dreyfuss</i>	
	1. Introduction	695
	2. Polymer Preparation	696
	3. Physical Properties	702
	4. Uses	704
	References	706

Chapter 22	Crosslinked Polyethylene	709
	<i>Bharat Davé</i>	
	1. Introduction	709
	2. Basic Structure	711
	3. Compounding and Mixing of Polyethylene	714
	4. Processing	717
	5. Physical Properties of Crosslinked Polyethylene	723
	6. Applications of Crosslinked Polyethylene	723
	7. Summary	727
	References	728
Chapter 23	Polynorbornene Rubber	729
	<i>Anil K. Bhowmick, C. Stein, and Howard L. Stephens</i>	
	1. Introduction	729
	2. Standard Grades of Norsorex	729
	3. Processing of Norsorex	730
	4. Compounding of Norsorex and Properties of Vulcanized Compounds	732
	5. Applications of Norsorex	738
	References	740
Chapter 24	Highly Saturated Nitrile Elastomer	741
	<i>Kinro Hashimoto and Yoshihiro Todani</i>	
	1. Introduction	741
	2. Basic Structure	741
	3. Production Methods	742
	4. Commercial Polymer Types	742
	5. Compounding, Processing, and Vulcanization	744
	6. Basic Properties	745
	7. Applications	748
	References	757
Chapter 25	Nitroso and Triazine Elastomers	759
	<i>Anil K. Bhowmick and Howard L. Stephens</i>	
	1. Nitroso Elastomer	759
	2. Triazine Elastomer	759
	References	760
Chapter 26	Developments in Diene Based Rubbers	761
	<i>Alan C. Haynes</i>	
	1. Introduction	761
	2. Polybutadiene Rubbers	763
	3. Styrene-Butadiene Rubbers	765
	4. Other Diene-Based Rubbers	766
	References	769
Index		775

1

Guayule Rubber

D. MCINTYRE, HOWARD L. STEPHENS, and ANIL K. BHARGAVA*
The University of Akron, Akron, Ohio

1. INTRODUCTION

1.1 Commercial Natural Rubbers

Although thousands of plant species contain rubber in small amounts, only a few species generate enough rubber to make them commercially attractive. In fact, only *Hevea brasiliensis* and guayule, *Perthenium argentatum*, have been used commercially in modern times and are likely to be used in the immediate future. Therefore in this review these two natural rubbers will be called hevea rubber and guayule rubber. Other natural rubbers will be included in the discussion to give a better perspective on the nature of natural rubbers and their prospects for future development.

1.2 Previous Reviews and Present Perspectives

There have been several previous reviews of hevea and guayule rubber. The international scientific conferences on guayule rubber are particularly interesting and relevant but have frequently included overwhelming amounts of agronomic and economic material (McGinnies and Haase, 1975; Campos-Lopez, 1978; Gregg et al., 1983). The later conferences (Guayule Rubber Society, 1983, 1984, 1985) only have abstracts and are therefore less helpful for details of research. A recent conference (International Symposium on Natural Rubber, 1980) (on hevea, guayule, and other rubbers) has some interesting comparisons of the two rubbers in the discussions. Several early authoritative review articles on the whole subject of the viability and value of guayule rubber have been published (U.S. National Academy of Sciences, 1977; Campos-Lopez, 1978). A more easily accessible article on guayule rubber also recently appeared (Eagle, 1981), but it comprises an extensive literature review without either a critical evaluation of the underlying inconsistencies of different workers or an attempted synthesis of the science and technology of guayule rubber.

In this small chapter we hope to present a current critical, scientific, and technological point of view. The remarks on the agronomic and

*Current affiliation: Indian Institute of Technology, Kharagpur, India.