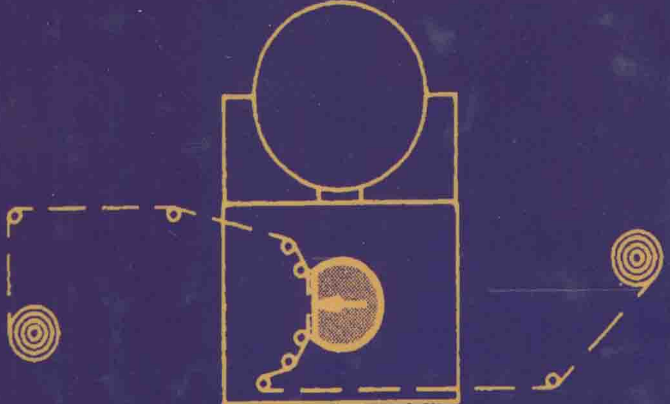
SECOND EDITION

Radiation Technology for Polymers



Jiri George Drobny

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Radiation Technology for Polymers

To Betty Anne

Preface to the First Edition

The industrial use of ultraviolet (UV) and electron beam (EB) radiation is growing at a fast pace and is penetrating many areas, such as electronics, automotive, printing, adhesives and coatings, packaging, etc., which traditionally have had their own well-established processes. Information on this topic useful to a professional can be found in many places, such as encyclopedias (*Encyclopedia of Polymer Science and Engineering, Ullmann's Encyclopedia of Industrial Chemistry*), professional publications (*PCI, Paint and Coating Industry, Paint & Powder, FLEXO, Converting, Modern Plastics, Rubber Chemistry and Technology, Modern Plastics, Wire and Cable, Radiation Physics and Chemistry, Journal of Applied Polymer Science*), and others. RadTech News, a publication of RadTech North America, covers applications, new technology, and industry news. During the past few years, several very informative books have been published by SITA Technology Ltd. in the UK that cover different aspects of UV/EB radiation technology in great detail. However, seeking specific information may be prohibitively time-consuming and a need for a quick reference book is obvious.

Radiation Technology for Polymers is designed to meet this need by providing systematic fundamental information about practical aspects of UV/EB radiation to professionals in many different fields. The intended audiences are mainly chemists or chemical engineers new to UV/EB radiation technology. Another reader of this book may be a product or process designer looking for specifics about the effects of UV/EB on a specific polymeric material or for a potential technological tool. This book may also be a useful resource for recent college and university graduates or for graduate or undergraduate students in polymer science and engineering and for corporate training. Because of the breadth of the field and the multitude of applications, the book does not go into details; this is left to publications of a much larger size and scope and to professional periodicals. Rather, it covers the essentials and points the reader toward sources of more specific and/or detailed information. *Radiation Technology for Polymers* is not a competition to other books on the subject, it merely complements them. With this in mind, this book is divided into eleven separate chapters, covering the principles of generating UV and EB energy, equipment, processes, applications, dosimetry, safety, and hygiene. The last chapter covers the newest developments and trends.

This book began as lectures and seminars at the Plastics Engineering Department of the University of Massachusetts at Lowell and to varied professional groups and companies in the United States and abroad. It draws from the author's more than 40 years of experience as an R&D and manufacturing professional in the polymer processing industry and more recently as an independent international consultant.

My thanks are due to the team from the CRC Press, Susan Farmer, Helena Redshaw, and Sylvia Wood, for helping to bring this work to fruition; to my family for continuing support; and Dr. Ewa Andrzejewska, John Chrusciel, Dr. Joseph Koleske, and Richard W. Stowe for valuable comments and recommendations.

Merrimack, New Hampshire
April 2002

Preface to Second Edition

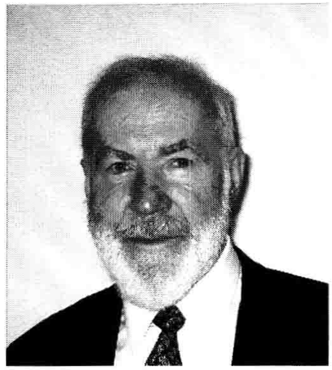
The first edition of *Radiation Technology for Polymers* had the main goal of providing systematic fundamental information to professionals entering the industrial practice of radiation technology as it applies to processing of polymers or already working in this field. Since its publication in 2003 the industry has changed markedly. Many technological developments have taken place, new applications and products have been developed and commercialized, and some already established ones were discontinued. Companies were sold and bought, reorganized, or renamed. UV/EB technology is becoming increasingly more important in a variety of issues, such as its continuing quest for further reduction of volatile organic compounds and toxic substances in the environment, development of alternative sources of energy, and more. Thus, it was time to update the publication to include these changes, developments, and issues. As the first edition, the second edition still stresses the practical aspects of UV/EB technology and its industrial applications. Few illustrations were added, and one of the major features is the addition of processing and engineering data of some commercial products. In addition, the feedback from colleagues, students, clients, and attendants of various seminars and training sessions was helpful in preparing the manuscript of this updated and expanded edition.

Special thanks go to Anthony J. Berejka, Dr. Marshall R. Cleland, and Richard W. Stowe for editing parts of the manuscript and providing helpful comments and recommendations.

Allison Shatkin, who was very helpful and encouraging from the beginning until the end of the preparation of the manuscript, deserves many thanks. A special credit is due to the team from CRC Press, particularly to Andrea Dale, Jennifer Ahringer, and Amy Rodriguez, for bringing this work to fruition.

Jiri George Drobny
Merrimack, New Hampshire, and Prague, Czech Republic
June 2009

About the Author



Jiri George Drobny was educated at the Technical University in Prague in chemical engineering, specializing in processing of plastics and elastomers, and at the Institute of Polymer Science of the University of Akron (Ohio) in physics and engineering of polymers. He also earned an MBA in finance and management at Shippensburg State University in Shippensburg, Pennsylvania. His career spans over 40 years in the rubber and plastics processing industries in Europe, the United States, and Canada, mainly in R&D with senior and executive responsibilities. Currently, he is president of Drobny Polymer Associates, an international consulting firm specializing in fluoropolymer science and technology, radiation processing, and elastomer technology. Drobny is also active as an educator, author, and technical and scientific translator. He is a member of the Society of Plastic Engineers, American Chemical Society, and RadTech International North America, and is listed in *Who's Who in America, Who's Who in Science and Engineering, Who's Who in Plastics and Engineering,* and *Who's Who in the East.* He resides in New Hampshire.

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