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Polymer Processing

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Modeling and Simulation

ISBN 3-446-40381-7

Vorwort

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PREFACE

The groundwork for the fundamentals of polymer processing was laid out by Professor R. B. Bird, here at the University of Wisconsin-Madison, over 50 years ago. Almost half a century has past since the publication of Bird, Steward and Lightfoot's transport phenomena book. *Transport Phenomena* (1960) was followed by several books that specifically concentrate on polymer processing, such as the books by McKelvey (1962), Middleman (1977), Tadmor and Gogos (1979), and Agassant, Avenas, Sergent and Carreau (1991). These books have influenced generations of mechanical and chemical engineering students and practicing engineers. Much has changed in the plastics industry since the publication of McKelvey's 1962 *Polymer Processing* book. However, today as in 1962, the set-up and solution of processing problems is done using the fundamentals of transport phenomena.

What has changed in the last 50 years, is the complexity of the problems and how they are solved. While we still use traditional analytical, back-of-the-envelope solutions to model, understand and optimize polymer processes, we are increasingly using computers to numerically solve a growing number of realistic models. In 1990, Professor C.L. Tucker III, at the University of Illinois at Urbana-Champaign edited the book *Computer Simulation for Polymer Processes*. While this book has been out of print for many years, it is still the standard work for the graduate student learning computer modeling in polymer processing.

Since the publication of Tucker's book and the textbook by Agassant *et al.*, advances in the plastics industry have brought new challenges to the person modeling polymer processes. For example, parts have become increasingly thinner, requiring much higher injection pressures and shorter cooling times. Some plastic parts such as lenses and parts with microfeatures require much higher precision and are often dominated by three-dimensional flows.

The book we present here addresses traditional polymer processing as well as the emerging technologies associated with the 21st Century plastics industry, and combines the modeling aspects in *Transport Phenomena* and traditional polymer processing textbooks of the last few decades, with the simulation approach in *Computer Modeling for Polymer Processing*. This textbook is designed to provide a polymer processing background to engineering students and practicing engineers. This three-part textbook is written for a two-semester polymer processing series in mechanical and chemical engineering. The first and second part of the book are designed for the senior- to grad-level course, introducing polymer processing, and the third part is for a graduate course on simulation in polymer processing. Throughout the book, many applications are presented in form of examples and illustrations. These will also serve the practicing engineer as a guide when determining important parameters and factors during the design process or when optimizing a process.

Polymer Processing – Modeling and Simulation is based on lecture notes from intermediate and advanced polymer processing courses taught at the Department of Mechanical Engineering at the University of Wisconsin-Madison and a modeling and simulation in polymer processing course taught once a year to mechanical engineering students specializing in plastics technology at the University of Erlangen-Nuremberg, Germany. We are deeply indebted to the hundreds of students on both sides of the Atlantic who in the past few years endured our experimenting and trying out of new ideas and who contributed with questions, suggestions and criticisms.

The authors cannot acknowledge everyone who helped in one way or another in the preparation of this manuscript. We are grateful to the engineering faculty at the University of Wisconsin-Madison, and the University of Erlangen-Nuremberg for their support while developing the courses which gave the base for this book. In the Department of Mechanical Engineering at Wisconsin we are indebted to Professor Jeffrey Giacomini, for his suggestions and advise, and Professor Lih-Sheng Tzeng for letting us use his 3D mold filling results in Chapter 9. In the Department of Chemical and Biological Engineering in Madison we are grateful to Professors Juan dePablo and Michael Graham for JPH's financial support, and for allowing him to work on this project. We would like to thank Professor G.W. Ehrenstein, of the LKT-Erlangen, for extending the yearly invitation to teach the "Blockvorlesung" on *Modeling and Simulation in Polymer Processing*. The notes for that class, and the same class taught at the University of Wisconsin-Madison, presented the starting point for this textbook. We thank the following students who proofread, solved problems and gave suggestions: Javier Cruz, Mike Dattner, Erik Foltz, Yongho Jeon, Fritz Klaiber, Andrew Kotloski, Adam Kramschuster, Alejandro Londoño, Ivan López, Petar Ostojic, Sean Petzold, Brian Ralston, Alejandro Roldán and Himanshu Tiwari. We are grateful to Luz Mayed (Lumy) D. Nouguez for the superb job of drawing some of the figures. Maria del Pilar Noriega from the ICIPC and Whady F. Florez from the UPB, in Medellín, Colombia, are acknowledged for their contributions to Chapter 11. We are grateful to Dr. Christine Strohm and Oswald Immel of Hanser Publishers for their support throughout the development of this book. TAO thanks his wife, Diane Osswald, for as always serving as a sounding board from the beginning to the end of this project. JPH thanks his family for their continuing support.

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