Polymer Processing

Modeling and Simulation

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Vorwort

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 a 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 pats 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-Nurenburg, 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.

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