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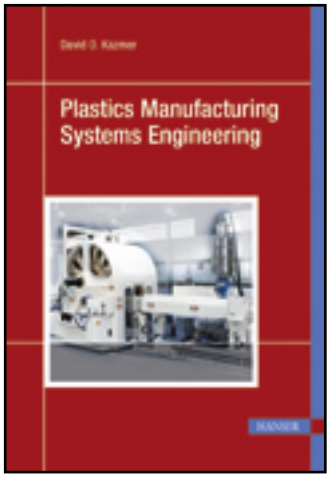

Preface

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Plastics Manufacturing Systems Engineering

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Preface

Plastics manufacturing is a highly interdisciplinary field integrating materials science, physics, engineering, and management. Because of this diversity, the plastics engineer interacts with many stakeholders: customers, designers, materials suppliers, machine builders, mold/die suppliers, systems integrators, operators, quality engineers, managers, and others. Yet, many plastics manufacturing systems are poorly engineered and require too much investment to achieve too little productivity.

This book was written to support plastics and manufacturing engineers as well as others who are performing process development, research, and design. The physics of these processes are not treated here at an advanced level given the availability of many more specific reference texts. Instead, a systems engineering approach was adopted to provide guidance about plastics manufacturing as an integrated system with broadly applicable analysis of the underlying subsystems.

The book begins with a high level review of plastics manufacturing strategy from a management perspective followed by a review of plastics manufacturing systems from a technical perspective. The remaining twelve chapters of the book are evenly divided into three parts related to 1) machine elements, 2) controls, and 3) operations. More specifically, the chapters of the book are outlined as follows:

- Chapter 1 opens with cost and productivity data of the plastics industry. Manufacturing planning and strategy are then discussed to provide a basis for plastics manufacturing systems engineering. To economically efficient engineering, a review of engineering economics is also provided.
- Chapter 2 provides a brief overview of the most common plastics manufacturing processes including extrusion, injection molding, thermoforming, and blow molding. The goal is not to provide detailed analysis of these processes, but indicate the common characteristics of their design and operation.
- Chapter 3 provides design and analysis of heating and cooling systems commonly integrated within plastics manufacturing processes. The chapter also provides a discussion of specifications applicable to all actuators.
- Chapter 4 covers hydraulics and pneumatics including not only cylinders and motors but also pumps and the supporting fluid conditioning systems. Design and operation of directional and metering valves is supported by dynamic analysis of the integrated fluid power system.
- Chapter 5 supports the increasing use of electric drives in plastics manufacturing. While the book focuses on the design of DC and AC motors, basic analysis of electromagnetism and electromotive forces are provided. A comparison of these and other motors is developed with respect to efficient, power output, and other performance measurements.
- Chapter 6 discusses sensors used for feedback control of the process states such as force, pressure, position, and temperature. Common transducer specifications are also discussed.

- Chapter 7 delves into signal conditioners used for signal conversion, amplification, filtering, and digital signal processing. The chapter also provides some very practical programs for implementing filtering in control software or post-processing.
- Chapter 8 deals with data acquisition: analog to digital, digital to analog, and digital input/output. Performance specifications related to resolution, response time, and bandwidth are analyzed to support the selection and use of commercial products.
- Chapter 9 discusses the integration of these subsystems with modern control system architectures including programmable logic controllers, virtualized PC controllers, and embedded controllers.
- Closed loop control and tuning are discussed in Chapter 10. The chapter has been written to be highly accessible without the use of Laplace transform yet still provide significant insight into PID control laws and tuning.
- Chapter 11 provides a process characterization methodology based on statistical modeling of variation, design of experiments, and regression methods.
- Chapter 12 uses the developed process models for process optimization, providing a treatment of both process window mapping and multiobjective optimization.
- Chapter 13 covers quality control with gage R&R, acceptance sampling, and statistical process control.
- Finally, Chapter 14 discusses various process and plant automation technologies that can be implemented after the plastics manufacturing processes are developed, optimized, and consistent.

It is my intention for the book to cover the essence of plastics manufacturing systems engineering. I hope you find it useful and are encouraged to advance your applications and improve our world's prosperity.

Sincerely,

David Kazmer
Lowell, Massachusetts
April, 2009