

1. Record Nr.	UNINA9911006723703321
Titolo	Plastics compounding and polymer processing : fundamentals, machines, equipment, application technology / / Klemens Kohlgrüber, Michael Bierdel, Harald Rust [eds.]
Pubbl/distr/stampa	München : , : Hanser, , 2022 ©2022
ISBN	1-5231-4507-2 1-56990-838-9
Edizione	[1st ed.]
Descrizione fisica	1 online resource (881 pages)
Disciplina	668.41
Soggetti	Plastics - Mixing Polymerization Handbooks and manuals.
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Intro -- The Authors -- In Memoriam -- Preface -- Contents -- PART A: Introduction to the Processing of Polymers -- 1 Introduction -- Klemens Kohlgrüber, Michael Bierdel -- 1.1 Plastics and Their Importance -- 1.2 Processing and Compounding -- 1.3 Recycling of Plastics -- 1.4 Guide to the Individual Chapters of this Book -- 2 Polymer Processing - Process Technology of Polymer Production -- Klemens Kohlgrüber -- 2.1 Introduction -- 2.2 Polymer Processing during the Polymer Synthesis in the Primary Production -- 2.3 Polymer Processing after the Polymer Production - Compounding -- 2.3.1 Main Temperature Window when Compounding for Finish Mixture -- 2.3.2 Mixing in the Extruder -- 2.3.3 Temperature and Time Limits for Compounding -- 2.3.4 Challenges when Compounding -- 2.3.5 Energy Requirement when Compounding -- 2.3.6 Range of Performance of Extruder -- 2.3.7 Throughput and Performance Density -- 2.3.8 Performance Density in the Melt Area -- 2.3.9 Energy Balance and Product Discharge Temperature -- 2.3.10 Static Mixers -- 2.3.11 Mixing Performance, Mixing Quality, Cross Mixing, Longitudinal Mixing -- 2.3.11.1 Mixing Performance -- 2.3.11.2 Mixing

Performance and Mixing Quality -- 2.3.11.3 Cross and Longitudinal Mixing -- 2.3.11.4 Residence Time Distribution -- 2.3.11.5 Mean Residence Time -- PART B: Processing in Polymer Production -- 3 Devolatilizing Devices -- 3.1 Fundamentals of Devolatilization -- Heino Thiele -- 3.1.1 Phase Equilibrium -- 3.1.2 Macroscopic Mass and Energy Balance -- 3.1.3 Quantities Influencing the Change in Concentration -- 3.1.4 General Conclusions -- 3.2 Polymer Production and Degassing Tasks -- Klemens Kohlgrüber -- 3.2.1 General Challenges at the Degassing of Volatiles from Polymers -- 3.2.2 Special Features at the Degassing of Polymers with High Content of Volatiles and Limitation of Finish Degassing.

3.3 Overview of Devices and Machines for Compounding with Polymer Degassing -- Klemens Kohlgrüber -- 3.3.1 Introduction -- 3.3.2 Devices with Rotating Components and Machines -- 3.4 Apparatus-Based Polymer Evaporation -- Klemens Kohlgrüber -- 3.4.1 Tube Evaporator -- 3.4.2 Process and Devices for Finish Degassing for Very Low Residual Contents in the Polymer -- 3.4.3 General Scheme of an Apparatus-Based Evaporation Stage -- 3.4.4 Product Quality -- 3.5 Degassing of Polymers in Purge Bins -- Harald Wilms, Hans Schneider -- 3.5.1 Introduction -- 3.5.2 Process Requirements for Degassing of Solids -- 3.5.3 Basics of Particle Degassing -- 3.5.4 Determination of Degassing Process Parameters -- 3.5.4.1 Oven Tests -- 3.5.4.2 Batch Trials -- 3.5.4.3 Pilot Plant Tests -- 3.5.4.4 Criteria for the Gas Flow Rate for Degassing -- 3.5.5 Design Requirements for the Degassing Silo -- 3.5.6 Heating of Bulk Solids -- 3.5.7 Energy-Efficient Plant Concepts -- 3.5.8 Comparable Applications -- 3.5.9 Summary -- PART C: Processing after Polymer Production - Compounding -- 4 Requirements, Product Development, Additives, Sources of Faults -- 4.1 Compounding Requirements from the Compounder's Perspective -- Thomas Schuldt -- 4.1.1 Introduction -- 4.1.2 Economics -- 4.1.3 Technical Requirements along the Process Chain -- 4.1.3.1 Material Handling -- 4.1.3.2 Raw Material Pre-Treatment -- 4.1.3.3 Premixing -- 4.1.3.4 Extruder and Wear -- 4.1.3.5 Cooling and Pelletizing -- 4.1.3.6 Packaging -- 4.1.4 Quality Control -- 4.1.5 Environmental Aspects -- 4.1.6 Conclusions -- 4.2 Product Development -- Thomas Schuldt -- 4.2.1 Introduction -- 4.2.2 Types of Product Development -- 4.2.3 Building Blocks of Product Development -- 4.2.3.1 Equipment Technology -- 4.2.3.2 Process Technology -- 4.2.3.3 Formulation -- 4.2.4 Ingredients -- 4.2.4.1 Additives -- 4.2.4.2 Fillers -- 4.2.4.3 Pigments. -- 4.2.5 Innovation -- 4.2.6 Quality Control -- 4.2.7 Scale-up -- 4.3 Additives for Polymers - From Polymer to Plastic -- Hermann Diem -- 4.3.1 Blends -- 4.3.1.1 Definition of Blends -- 4.3.1.2 Classification of Multi-Phase Systems -- 4.3.1.2.1 Polymer Blends -- 4.3.1.2.2 Dry Blends -- 4.3.2 Additives -- 4.3.2.1 Definition of Additives -- 4.3.2.2 Effects and Mode of Operation of the Additives -- 4.3.2.2.1 Plasticizers -- 4.3.2.2.2 Stabilizers -- 4.3.2.3 Incorporation of Additives into Polymers -- 4.3.3 Fillers -- 4.3.3.1 Definition of Fillers -- 4.3.3.2 Classification and Properties of Fillers -- 4.3.3.3 Aspect Ratio -- 4.4 Practical Examples Regarding Sources of Fault/Avoidance of Faults during Compounding -- Klemens Kohlgrüber -- 4.4.1 Black Specks -- 4.4.2 Sources at Dosing and Mixing -- 4.4.2.1 Demixing -- 4.4.2.2 Dosing System -- 4.4.2.3 Mixing of Polymer with Additives -- 4.4.3 Drive-Measurement Technique -- 4.4.4 Faults in Tests with Small Extruders for Scale-up Purposes -- 5 Compounding with Co-Rotating Twin-Screw Extruders -- 5.1 Introduction -- Klemens Kohlgrüber -- 5.1.1 Advantages of the Co-Rotating Twin-Screw Extruder -- 5.1.2 Disadvantages of the Co-

Rotating Twin-Screw Extruder -- 5.1.3 Range of Services and Power Density of Co-Rotating Twin-Screw Extruders -- 5.1.4 Parameters in Dependence on the Diameter Ratio D_a/D_i -- 5.1.4.1 Strength and Throughput as a Function of D_a/D_i -- 5.1.4.2 Pressure and Power Characteristic as a Function of D_a/D_i -- 5.1.4.3 Maximum Product Volume -- 5.1.4.4 Inner Surface of the Housing to Maximum Product Space -- 5.1.4.5 Outlook -- 5.1.5 Special Types of Construction of the Co-Rotating Extruder -- 5.2 Tasks and Design of the Processing Zones of a Compounding Extruder -- Reiner Rudolf, Michael Bierdel -- 5.2.1 Melt Conveying Zone -- 5.2.2 Solids Conveying Zone -- 5.2.3 Plastification Zone. 5.2.4 Distributive and Dispersive Mixing Zone -- 5.2.5 Devolatilization Zone -- 5.2.6 Pressure Build-up Zone -- 5.2.7 Complete Screw Configuration -- 5.2.8 Specific Energy Input -- 5.2.9 Residence Time Characteristics -- 5.3 Process and Screw Concepts for Machines with High Throughputs -- Frank Lechner -- 5.3.1 Development to High Torques, Volumes, and Rotations -- 5.3.2 Parameters and Process Limits of Co-Rotating Twin-Screw Kneaders -- 5.3.3 Process Length and Screw Development -- 5.3.4 Maximum Possible Screw Speed -- 5.3.5 Torque-Limited Processes -- 5.3.6 Volume-Limited Processes -- 5.3.7 Quality-Limited Processes -- 5.3.8 Process Concept for Economical Compounding -- 5.3.9 Outlook -- 5.4 Screw Designs for Highly Filled Polymers (and Dosing Strategies) -- Sebastian Fraas -- 5.4.1 Why Filler Compounds? -- 5.4.2 Typical Applications -- 5.4.3 Material-Specific Influencing Factors -- 5.4.3.1 Influence of Filler -- 5.4.3.1.1 Origin/Mining -- 5.4.3.1.2 Particle Size and Particle Size Distribution -- 5.4.3.1.3 Coating -- 5.4.3.1.4 Moisture Content -- 5.4.3.2 Polymer and Additives -- 5.4.4 Process Technology -- 5.4.4.1 Conveying Technology -- 5.4.4.2 Dosing Equipment -- 5.4.4.3 Downstream Equipment -- 5.4.4.4 Barrel Setup of an Extruder for Highly Filled Compounds -- 5.4.4.5 Screw Design -- 5.4.4.5.1 Melting Zone -- 5.4.4.5.2 Filler Addition and Wetting -- 5.4.4.5.3 Dispersion Zone -- 5.4.4.5.4 Vacuum and Discharge Zone -- 5.4.4.6 Entire System -- 5.5 Compounding of Natural Fiber Reinforced Plastics -- Dijan Iliew, Stephen Kroll, Andrea Siebert-Raths -- 5.5.1 Pre-Knowledge for the Processing of Natural Fibers -- 5.5.2 Design and Parameterization of the Process Unit of a Co-Rotating Twin-Screw Extruder -- 5.6 Fundamentals of Thermoplastic Foam Extrusion by Means of Parallel Twin-Screw Extruders -- Lukas Vogel. 5.6.1 Definition and Characterization of Foams -- 5.6.2 Process Steps for Foam Extrusion -- 5.6.2.1 Provision of Thermoplastic Melts -- 5.6.2.2 Addition and Admixing of the Propellant (Blowing Agent) -- 5.6.2.3 Injecting the Blowing Agent and Conditioning of the Melt -- 5.6.2.4 Discharge of the Melt through the Die -- 5.6.2.5 Growth of Cells and Stabilization of the Foam Structure -- 5.6.3 System Components for Foam Extrusion -- 5.7 Screw Configurations -- Michael Bierdel -- 5.8 Materials, Coatings, Wear Technology -- Oliver Kayser -- 5.8.1 Requirements to the Components for Compounding -- 5.8.2 Materials and Heat Treatment -- 5.8.2.1 Tempering Steels and Nitriding Steels -- 5.8.2.2 Hot-Work Steels -- 5.8.2.3 Alloyed Cold-Work Steels -- 5.8.2.4 High-Speed Steels -- 5.8.3 Execution of Components of Twin-Screw Extruders -- 5.8.4 Process of Surface Layer Hardening -- 5.8.4.1 Wear Protection by Nitriding -- 5.8.4.2 Avoidance of Adhesive Wear due to Nitriding -- 5.8.4.3 Avoidance of Pitting Corrosion by Nitriding -- 5.8.4.4 Special Process for Maintaining Corrosion Protection -- 5.8.5 Wear Protection by Coatings -- 5.8.5.1 Hard Chromium -- 5.8.5.2 Chemical Nickel -- 5.8.5.3 Thin Layers of Hard Material -- 5.8.5.3.1 Physical Vapor Deposition --

5.8.5.3.2 Chemical Vapor Deposition -- 5.8.6 Recommendations for Application -- 5.8.7 Summary and Outlook -- 6 Compounding and Polymer Processing with Different Extruder Types -- 6.1 Extruder Types - Introduction -- Klemens Kohlgrüber -- 6.1.1 Compounding and Processing with Different Extruder Types -- 6.1.2 Single-Screw Extruders -- 6.1.3 Gear Pumps -- 6.1.4 Co-Rotating Twin-Screw Extruders -- 6.1.5 Counter-Rotating Twin-Screw Extruders -- 6.1.6 Multi-Screw Extruders: Ring Extruders and Planetary Roller Extruders -- 6.1.7 Non-Screw Extruders -- 6.1.8 High-Viscosity Reactors -- 6.2 Single-Screw Extruder.
Gregor Karrenberg.

Sommario/riassunto

Plastics production comprises the main process steps "synthesis (reaction)", "preparation/compounding" at the raw material manufacturer and compounder, and "processing" (shaping into semi-finished or finished products). In this handbook, the central middle step, preparation and compounding, is discussed. The preparation tasks include the removal of components, the incorporation of additives, and the change of particle size. Compounding is the incorporation of additives into a polymer or plastic. The process engineering fundamentals and the specific equipment and machines used are described. The specialist authors impart their knowledge from the fields of research, polymer production, and equipment/machine production with applications in plastics technology.
