Dynamics of Fibre Formation and Processing

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Modelling and Application in Fibre and Textile Industry

With 171 Figures

Springer

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Dedicated to our wives

Ute Beyreuther

and

Dietlinde Brünig

with a warm thanks for many hours of appreciative patience

Preface

The special subject *"dynamics"* calls forth mostly mixed feelings to students and graduates of technical fields. The first foresee and the second know the problems to reach a good or very good mark before or after an appropriate leaving examination.
The reasons for this are well known and even partly understandable. Dynamics – the science of changes or motions which are caused by means of energetic impulses or forces – requires namely a certain amount of applicable knowledge of mathematics as well as logical abstraction and intellectual power to its understanding. These are not within reach by means of schematic memorising.

But basic knowledge and field specific applications of special branches of knowledge are absolutely necessary for engineers, physicists, chemists or mathematicians, if they in practice and research intend to treat determined tasks and operation fields successfully. Such knowledges and considerations are unconditional prerequisites specifically to the analysis of technological processes, to the suppression of disturbances and to the process stabilisation by means of qualitative high-class automatic control systems.

This is especially valid for many textile-technological processes. The mastery of their dynamics decisively influences the process economy as well as the product quality because these processes are often connected with a high manufacturing velocity and/or with a special disturbance sensitivity.

The manufacture of textile products is one of the oldest machine technologies of mankind because it satisfies one of the elementary basic necessities, namely clothing. Many additional technical applications of textile products came along in the nearest past. The processes of manufacturing, the treatment and the processing of fibre threads have a special importance in this context because the fibres (in their multiform kind) were and are the most important basic elements for textile fabrics.

Several ten-thousands of parallel single fibre formations and processing stages are realised simultaneously in a textile or man-made fibre plant. These

processes are to be organised with the lowest possible disturbance (e. g. fibre break) levels. Additionally, a strongly increased production velocity has been realised in the last decades for the natural as well as for the man made fibre manufacturing. Both – the multitude of single work positions and the high production and processing velocities – require an increasing knowledge and reliable mastery of the process dynamics from engineers.

This presented book collects the results of industry orientated research which the authors have been carrying out during their work at the Leibniz-Institute of Polymer Research Dresden, Germany (former Institute of Technology of Fibres, until 1990). It deals with dynamic-analytical investigations of different basic processes of the yarn formation and processing for natural as well as chemical (man made) and also glass fibres. The carding processes (roller top card and stationary flat card) and also the false twist texturing process are included (Chaps. 4 and 5, Beyreuther). The main point of these investigations is the dynamic transfer and step response functions and their methodical fundamentals will be fully explained before hand in the introductory Chaps. 1 and 2 (Beyreuther). Therefore the explanations should be understandable for experts who are not skilled in the process-dynamical thinking, too.

A large scale occupies the engineering modelling of the steady state man made fibre process (Chap. 3, Brünig). The presented results are based on the current knowledge of the theory of fibre formation but also on own developed description statements. They include the single filament and multifilament melt spinning processes as well as the fibre formation of the spunbonded nonwoven process.

Some representations about the importance of the tensile force time function for the process stability, its measurement and evaluation conclude the book (Chap. 6, Beyreuther).

All theoretical investigations and results are discussed and verified by means of numerous examples within the industrial practice. With the representation of these complex subjects the book should be qualified for natural and engineer scientists of research and education as well as of textile and man made fibre industry to extend their know-how and know-why knowledge about the processes of fibre formation and processing. The book is also recommendable for lecturers and students of appropriate technical and chemical special branches at technical universities and colleges. The authors also considered didactic experiences in the present subject representation which they have obtained during the last three decades at lectures and seminars at the Technische Universität Dresden/Germany to graduate students of textile

engineering and macromolecular chemistry.

We thank all collaborators from the Leibniz-Institute of Polymer Research Dresden/Germany, especially our fellow-workers of the former department *"Fibre Formation"*, for the given support and assistance with numerous experiments, for their evaluation and for many scientific discussions which were very helpful to the conception and planning of the presented book.

Furthermore we are very grateful to our longterm research partners from industry, research institutes and research organisations for the financial support and many fruitful discussions to application related projects which stimulated us to the shaping of general examples into single book chapters. This particularly concerns the companies EMS Inventa AG Domat/Switzerland, DSM Research Geleen/Netherlands, Barmag AG Remscheid/Germany, Saxon Textile Research Institute Chemnitz/Germany and the German Research Association (DFG) Bonn/Germany.

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Contents