

WOODHEAD PUBLISHING IN TEXTILES



Physical properties of textile fibres

Fourth edition

W. E. Morton and J. W. S. Hearle



The Textile Institute

WP

Physical properties of textile fibres

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Preface to the first edition

Physics plays a large part in textile technology. But, while there are many applications to textile processing, these are diverse and cannot usefully be studied except as part of the technology of the processes themselves; however, the study of the structure and physical properties of fibres, yarns, and fabrics forms the unified subject that is legitimately called textile physics, and which is an essential part of the education of any textile technologist. The present book deals only with the fibre properties, augmented by an introductory chapter on fibre structure. While it was conceived as the first part of a trilogy, it remains to be seen whether it will be possible to write the companion volumes on yarns and fabrics.

This book is primarily a text book, based on our teaching experience, and intended for textile students in universities and colleges. While a full understanding of the whole of the text demands a wide knowledge of physics and mathematics, much of it is suitable for those who have not studied physics far beyond Ordinary G.C.E. level*. With this point in mind, the subject matter has been subdivided and arranged so that the more advanced theoretical treatments may be omitted without detriment to an understanding of the rest of the book.

We also hope that the book will prove useful to those preparing for the Associateship examinations of the Textile Institute; to graduates in science entering direct into the industry; and to the large body of technologists, already following a career in the industry, who wish to have available a survey of this particular part of textile technology.

We would like to emphasize that this book is not intended to be a comprehensive treatise, including a reference to every relevant research publication; on the contrary, our aim has been to provide a background of knowledge and understanding of the subject, much of which is unlikely to change radically with the passage of time, and which will therefore serve as a basis for more detailed study by reference to current literature.

We wish to take this opportunity of gratefully acknowledging the invaluable help that we have received from Miss Shirley Smith in the preparation of the illustrations; and from Professor R. Meredith, Mr. G. E. Cusick, and Dr. D. W. Saunders in reading and criticizing sections of the manuscript.

Manchester College of Science and Technology

W. E. M.

J. W. S. H.

* Now GCSE, a British school examination taken at age 15–16.

Preface to the fourth edition

It is 50 years since I started writing my contribution to the first edition of this book. By then, the ancient craft of manufacturing textiles from wool, cotton, flax and other natural fibres had been supplemented by 50 years of scientific research into their physical properties. Rayon had been around for 50 years and new synthetic fibres were entering the market. Nylon and polyester were expensive 'miracle fibres'. Now polyester has replaced cotton as the cheap, general-purpose fibre. The high-performance fibres were not to come for another 20 years.

The 1960s saw the high-water mark of fibre research. Changes were rapid and a revised edition was needed in the 1970s. The third edition in 1993 was a reprint of the second edition with two extra chapters on 'High Performance Fibres' and 'Flex Fatigue and other Forms of Failure'. A full revision was overdue. In this fourth edition, I have followed the approach described in the preface to the second edition.

We need to add little to our previous preface: the general character and aims of the book are unchanged, and the continuing demand shows that our approach has, as we hoped, stood the test of time. There is, indeed, a body of knowledge of fibre physical properties which is basic in the education of a textile technologist, and this is what we aim to present.

The changes in this edition result, in part, from a closer adherence to the essential character of the book: some of the details of theories and experimental techniques, which seemed important at the time, have been omitted [since then, developments in electronics and digital processing have transformed experimental methods]. The book is now more concentrated on the fundamentals of the subject; some digressions on topics less directly concerned with physical properties have been dropped.

The other source of change is new knowledge. When the first edition was published, ideas of fibre structure were in a state of disturbance and controversy, partly reflected in what we wrote. Now, it is possible to take a more stable view of the subject, and the first chapter contains substantial changes. Theories of mechanical properties, as related to structure, have also developed considerably in recent years. In experimental work, much has been published on time-dependent properties, though this has not radically changed the picture, and some valiant studies of the anisotropy of fibre mechanical properties have been made. However, the topic which has been most advanced is the study of thermal properties: this has

made it possible to write a much more useful and coherent account of experimental results, their interpretation, and their relation to the technology of heat-setting.

The general pattern of the book in this fourth edition is as it has been, but there has been some reorganisation. Partly this results from the increasing dominance of manufactured fibres. Fibre fineness is now a more important quality than fibre length. Thermomechanical responses and fibre failure now have their own chapters. High-performance fibres take their place through the book, instead of being Band-Aid at the end.

In the preface to the third edition, I wrote the following:

Since the second edition was published, my co-author, W.E. Morton, has died. During over forty years as a Professor of Textile Technology in Manchester, he did a great deal to advance the scientific study of fibres and textiles. He also gave great encouragement and help to those of us who joined him as young men on the staff or as research students. I remember with great affection his many kindnesses, not least by inviting me to join him in writing the first edition of this book 35 years ago.

After 60 years of research in fibres and textiles, I owe a debt to too many people to name. My introduction to textile fibres started in 1946 with the distinguished scientists at the Shirley Institute. Since then I have interacted with researchers in many universities, research institutes and industrial companies. Without them this book could not have been written. Finally, the writing and publication of this edition has been made much easier by the generous professional help of the staff of Woodhead Publishing and Macfarlane Book Production Services.

Mellor, Greater Manchester
John W. S. Hearle

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