

Textile Materials for Lightweight Constructions

Chokri Cherif
Editor

Textile Materials for Lightweight Constructions

Technologies - Methods - Materials -
Properties

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Preface

The supply of natural resources for economic development is limited. In order to prevent the destruction of humanity's own livelihood, this limited supply requires a gentle and efficient handling of the available energy sources and materials by all the branches of industry, aimed at reducing emission of pollutants and the efficient use of materials. This has become particularly clear against the backdrop of globalization with the abrupt increase in global transportation and the steady growth of individual mobility. Particularly in branches of industry relying on the accelerated transportation of large masses, passenger and goods traffic, as well as mechanical and plant engineering, innovative lightweight construction technologies based on plastics are more important than ever before. These aspects of material and energy efficiency also apply for wooden and concrete reinforcements. In the construction industry, the number of applications increases for fiber-reinforced slender and filigree concrete components, for fiber-reinforced plastics, as well as for the reinforcement and restoration of existing structures. Furthermore, textile membranes are highly efficient and extremely lightweight construction materials with adjustable functionalities, making them relevant for a wide range of applications.

Textile materials and semifinished products have a versatile property potential and often act as carriers and driving forces behind innovative developments. They are distinguished by the use of high-performance fiber materials and advanced technologies. In the past decades, a unique interdisciplinary spectrum of knowledge has been evolved worldwide in the field of textile technology. The focus is placed on polymeric, mineral, and metallic fiber-based materials for use in high-tech applications. These textile materials will remain a crucial group of high-performance materials and will be established as a significant research priority in twenty-first-century material science. The fiber and textile technology research institutions will become the centers of an indispensable multidisciplinary research of innovative technologies and products.

The combination of material science, nanotechnology, microsystems technology, bionics, physics, and chemistry results in a new product range with properties adjustable to the individual demands in a wide range. The gamut and depth of the

required processes and materials are immense and highly complex. Even products with unique characteristics and fundamental approaches toward intelligent and self-learning materials are realizable.

The aim of this first edition is to fully exploit the performance potential and the variety of textile materials and semifinished products. Experts of textile technology will share basic knowledge of textile and ready-made technology as well as future-oriented special knowledge for the manufacture and use of high-tech textiles. They show the possibilities for the application of textile structures in lightweight construction. Therefore, this book will concentrate on the detailed portrayal and description of the entire textile process chain from fiber material to the diverse yarn constructions and various textile semifinished products in two- and three-dimensional shapes, but will also touch upon preforming and interphase/interface design. Beyond those, tests according to valid norms and special, recently developed test methods for textile lightweight construction will be introduced. This reference book is rounded off by remarks concerning the modeling and simulation technology for the structure-mechanical calculations of highly anisotropic, flexible high-performance textiles, and exemplary applications from the fields of fiber-reinforced composites, textile concrete, and textile membranes. This aims to exemplify the potential of textile structures as innovative lightweight construction material by the specific selection and combination of textile processes for the realization of a nearly unlimited number of property profiles, and finding possibilities of functional integration as well as designing of near-net shape components. The aim is to create a conscious motivation for a wider use of textile high-performance materials in lightweight construction applications on a large scale, which will soon start their triumph in the field of fiber-reinforced composite materials.

The deliberations included in this book are based on long years of interdisciplinary research and development work, including special research areas and research clusters in the fields of fiber-reinforced composites, textile-reinforced concrete, and textile membranes. These research projects along the entire textile process chain are promoted at the Institute of Textile Machinery and High-Performance Material Technology of TU Dresden. Extensive teaching material could be gathered from engineering education and doctoral studies in textile and assembly technology as well as lightweight construction, all of which contributed to the successful creation of this textbook.

Dresden, Germany
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Chokri Cherif

Acknowledgment

This textbook is the result of a combined effort of scientists of the Institute of Textile Machinery and High-Performance Material Technology (ITM) at Dresden University of Technology and external experts from research and teaching. The majority of them are experienced researchers with extensive knowledge in the areas of textile and assembly technology as well as of textile-reinforced lightweight construction gathered from working and teaching in these fields. Other contributions were provided from junior researchers, whose graduate studies yielded specialized insights into their respective fields. The intense cooperation of the editor with the individual authors and the resulting coherence of the content and interlinking of the chapters have created a consistent work on the subject of “Textile Materials for Lightweight Construction” from fiber materials and semifinished products to preforms, along the textile supply chain.

This textbook was first published in a German-language edition in 2011, which laid the groundwork for this translated version.

First of all, all staff members of the ITM involved in the creation of this book have to be acknowledged. Apart from conducting their activities in research and teaching, their personal dedication and commitment were crucial for the success of this project. This book is based on years of experience of the scientists of the ITM designated as authors. My special thanks are due to all authors of individual chapters for their contributions and understanding collaboration in ensuring the success of this book.

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My gratitude is also due to all authors for their support in the translation of this book and for their invaluable advice. Many of them have left the ITM or the respective institutions since the original publication of the book to take over highly responsible managerial positions in the industry or in public institutions.

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