

Textiles

NINTH EDITION



Sara J. Radolph
Anna L. Langford



Ninth Edition

TEXTILES

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PREFACE

Philosophy of this Book

Textiles provides students with a basic knowledge of textiles so that they understand how textiles are produced and how appropriate performance characteristics are incorporated into materials and products. With this knowledge, they have the foundation they need to make informed decisions regarding textile materials and products and to communicate effectively with buyers, suppliers, customers, and others. A solid understanding of textile components (fibers, yarns, fabrics, and finishes), the interrelationships among these components, and their impact on product performance is necessary to fulfill day-to-day responsibilities in many careers in the textile, apparel, and furnishings industry.

Serviceability of textiles and textile products is the fundamental principle emphasized throughout the book. I discuss the contributions of each component as it is incorporated in or combined with other components in a textile product. I stress interrelationships among the components. Basic information regarding how each component is processed or handled helps in understanding product performance and cost. Production of textiles is a complex process dealing with a wide variety of materials and techniques. To understand textiles, students need a basic understanding of the choices and technology involved.

This book will help students:

- use textile terminology correctly.
- know laws and labeling requirements regulating textile distribution.
- understand the impact of production processes and selection of components on product performance, cost, and consumer satisfaction.
- recognize the forces that drive industry developments.

- identify fiber type, yarn type, and fabrication method.
- predict fabric or product performance based on a knowledge of fibers, yarns, fabrication methods, and finishes in conjunction with informative labeling.
- select textile components or products based on specified end uses and target market expectations for performance and serviceability.
- select appropriate care for textile products.
- develop an interest in and appreciation of textiles.

Understanding textiles cannot be achieved only by studying this book; it also requires working with fabrics. Kits are available from several sources. In addition, many workbooks for lab use and self-study have been designed to help students learn this information.

Organization of this Book

Each section of the book focuses on a basic component or aspect of fabrics and textile products or on general issues important to the use of, production of, or satisfaction with textile products. These sections are complete and can be used in any order desired. The four main sections follow the normal sequence used in the production of textiles: fiber, yarn, fabrication, and finishing.

The first section of the book introduces the study of textiles and approaches product development from a textile perspective. Section Two focuses on fibers, their production, serviceability, effect on product performance, and use. Several new fibers or new generic classifications have been added to this section. Section Three focuses on yarn production, yarn types, the relationship of yarn type to product performance and serviceability, and sewing thread. Section Four examines fabrication methods. These chap-

ters are organized by basic fabrication method, standard or classic fabric names and types, and the relationships between fabrication and product performance. Flow charts to aid in identifying fabrics have been added. (More extensive flow charts are available in the instructor's manual.) Section Five deals with finishes, grouped by type or effect. Dyeing and printing are also included, as well as problems that consumers and producers experience with dyed or printed fabrics. The discussion of ink-jet printing has been updated to reflect the tremendous changes occurring in this area. Several new finishes have been added to this section. The final section deals with other issues related to textiles. One chapter focuses on care of textile products, new cleaning products and processes, and associated environmental issues. Another chapter investigates legal and environmental issues. The discussion on environmental issues illustrates current environmental efforts and explores recycling of textiles. The final chapter discusses career opportunities requiring knowledge of textiles.

Features of the Book

Instructors and students have always liked this book's summary and reference tables and charts, the presentation of information in a clear and consistent fashion, the emphasis on serviceability, and the numerous illustrations, graphics, and photographs. I tried to strengthen these things in this revision. I developed new flow charts to facilitate fabric identification. I revised, reorganized, or updated tables where necessary or where students or colleagues suggested improvements.

Although the basic content and flavor of *Textiles* remain intact, the changes help students recognize and focus on the most important material. Objectives and key terms for each chapter are revised so that students will be able to identify and understand the major concepts. After reading and studying each chapter, students should be able to define each term in the key terms list and describe how terms relate to each other and to the chapter content. Study questions provide students with an opportunity to test their level of understanding, focus on key concepts or applications, and integrate the information. I updated the list of readings for students who would like to investigate topics beyond the scope of the book. Many of these readings are technical in nature. There are a few articles on textiles in the popular press, but these often include little substantive information. Hence, the most valuable articles and books tend to be those written from a technical perspective.

Major Changes and Additions

The emphasis in this revision has been on updating and adding material where new processes or concerns have

developed in the professional workplace, in the textile industry, or among consumers. I added explanations, expanded discussions, and clarified concepts in areas where students had indicated the need or where colleagues expressed or suggested improvements. Terminology incorporates an industry perspective so that professionals can understand and communicate with other professionals. The pronunciation guide included with some words in the glossary will help professionals pronounce and use terms correctly. I expanded the index to facilitate the book's use as a resource by professionals who need to locate information quickly regarding a specific term, process, or product. I omitted some photos and diagrams of marginal usefulness and modified others to make them current or easier to understand.

Technological advances and new industry and societal concerns that have arisen or have increased in importance since the last edition are included. The discussion of environmental impact for each major component is important to the industry and consumers. The book continues to focus on the three major end uses of textiles: apparel, furnishings, and industrial or technical products.

The discussion of dyeing and printing provides more information on the basic processes of adding color to fabric. The discussion of finishing addresses aesthetic finishes that add a softer or stressed look to goods and products. Professional wet cleaning as an alternative to dry cleaning is included in the chapter on care. In addition, recent changes in detergents and other laundry additives are described. New fiber developments are included.

The chapter on career opportunities includes updated information on starting salaries. This discussion is intended to help students understand how they will apply their knowledge of textiles and textile products in their professional work. It should help students gain a better understanding of careers and how professionals interact with each other. Although this chapter may not be assigned in a beginning textile course, students might read the chapter to explore career possibilities on their own and use the information when considering career options other than those that are most obvious to the consumer.

Ancillaries and Supplements

This book assumes that the student requires basic information regarding textiles in order to perform professional responsibilities and communicate with other professionals in an intelligent and informed manner. Hence, the book is designed to be of use as a textbook and as a part of a professional's reference library. Key terms are defined in both the text and the glossary. The expanded

glossary includes more than basic or classic fabric names as well as a pronunciation guide. Fiber modifications, finishes, and terminology related to performance have been incorporated. The expanded index will help individuals locate information needed for class or on the job. Appendix A lists fiber names in several languages that may be encountered in the international textile industry. Appendix C lists selected trade names for fibers, yarns, fabrics, finishes, and cleaning procedures.

The instructor's manual includes an updated outline of the material for each chapter, a revised list of suggested activities, a bank of test questions in various formats, and transparency masters for use in class.

Several basic textile swatch kits are available for use in conjunction with this edition of *Textiles*. The swatch kits usually consist of fabric swatches, mounting sheets, and a master list with fabric name/description/fiber content. Some also include a three-ring binder. One such swatch kit is available from Textile Fabric Consultants, 5499 Murfreesboro Rd, Suite D, LaVergne, TN 37086, 800-210-9394 e-mail: textilefc@aol.com.

Acknowledgments

I used the comments and contributions of many students and colleagues in preparing this revision. I find students' comments help the most in evaluating the approach, wording, and style of presentation, and therefore I appreciate hearing from any student or faculty

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Revising this book is always an exciting challenge. I enjoy the opportunity to explore the textiles literature in more depth than our university responsibilities usually allow. I enjoy sharing the exciting area of textiles with so many others. I hope that this book hooks you on textiles as the third edition of this book did for me when I was a sophomore student just beginning to learn about textiles.

Sara J. Kadolph

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INTRODUCTION TO TEXTILES

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Product Development from a Textile
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INTRODUCTION

OBJECTIVES

- To recognize the diversity in textiles and textile products.
- To understand the importance of developing a professional knowledge of textiles.
- To recognize how textiles, as apparel, furnishings, and industrial products, contribute to contemporary life.

This section is divided into two chapters. Chapter 1 introduces the study of textiles by defining terms, providing examples of textile products, surveying the diversity of textiles, and describing the importance of the industry to the U.S. economy. Chapter 2 discusses the relationships among textiles, product development, and use of and satisfaction with textile products.

This book was written to aid students in learning and understanding what to expect in fabric performance and why fabrics perform as they do. Textiles change in response to changes in fashion, consumers' needs, production processes, government standards for safety and environmental quality, and international trade. These factors are discussed briefly, but the bulk of the book is devoted to basic information about textile materials, with an emphasis on fibers, yarns, fabric construction, and finishes. These interdependent elements contribute to the beauty, durability, care, and comfort of textile products.

Much of the terminology used in this book may be new to students, and many facts must be memorized. To apply a knowledge of textiles, an understanding of the

basics is essential. Historical development, basic concepts, and innovations are discussed. Production processes are described in general terms to help the student develop a better understanding of, and appreciation for, the textile industry.

An ideal starting place for understanding textiles is to define several basic terms. (See Figure 1-1.)

Fabric A flexible planar substance constructed from solutions, fibers, yarns, or fabrics, in any combination.

Fiber Any substance, natural or manufactured, with a high length-to-width ratio and with suitable characteristics for being processed into fabric; the smallest component, hairlike in nature, that can be separated from a fabric.

Finish Any process used to add color and augment performance of gray goods (unfinished fabric).

Gray goods (grey or greige goods) Any fabric that has not been finished.

Textile A term originally applied only to woven fabrics, now generally applied to fibers, yarns, or fabrics or products made of fibers, yarns, or fabrics.

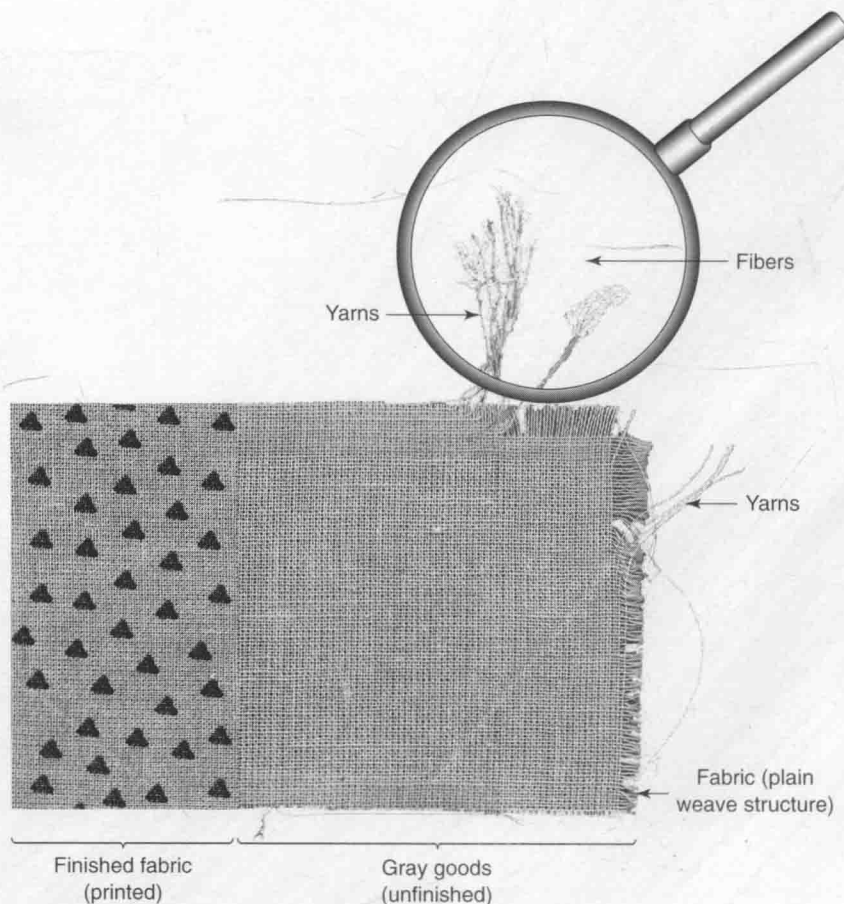


FIGURE 1-1

The components of a fabric: fiber, yarn, structure, and finish.

Yarn An assemblage of fibers that is twisted or laid together so as to form a continuous strand that can be made into a textile fabric.

Food, shelter, and clothing are basic human needs. Most clothing is made from textiles, and shelters are made more comfortable and attractive with textiles. Textiles are used in the production or processing of many items used in day-to-day living, such as food and manufactured goods.

We are surrounded by textiles from birth to death. We walk on and wear textile products; we sit on fabric-covered chairs and sofas; we sleep on and under fabrics; textiles dry us and keep us dry; they keep us warm and protect us from the sun, fire, and infection. Clothing and furnishing textiles that vary in color, design, texture, and cost are aesthetically pleasing. Table 1-1 lists examples of textiles used in industrial products that contribute to work and pleasure. Industrial and technical textiles

contribute to our current standard of living. For example, the automotive industry uses textiles to make tire cords, upholstery, carpeting, head liners, window runners, seat belts, shoulder harnesses, fan belts, gaskets, and seals; textiles are also used as reinforcement fibers in molded plastic parts.

Astronauts traveled to the moon in 20-layer, \$100,000 space suits with nylon water-cooled underwear. Life is prolonged by replacing worn-out body parts with textiles such as polyester arteries and velour heart valves. Bullet-resistant vests protect police and soldiers, and shoulder and seat belts make automobile travel safer. Three-dimensional, inflatable structures protect us from desert heat and arctic cold.

Industrial textiles surround us. We brush our teeth, hair, and clothes with bristles made of synthetic or natural fibers. Buildings are warmer with fiberglass insulation and polyethylene film barriers against wind and moisture. Roads last longer with synthetic fiberweb un-

TABLE 1-1 Examples of industrial and technical textiles.

Personal Hygiene	Transportation	Environment	Medical
Tooth & hair brushes	Tire cords	Erosion barriers	Support wraps
Medicated pads	Road bed underlays	Weed-control fabrics	Casts
Makeup brushes	Bicycle helmets	Pond liners	Surgical masks
Nail buffers	Interiors for planes, buses, cars, & trucks	Snow & silt fences	Sutures
Incontinence pads	Seat belts & air bags	Drainage screens	Arteries
Feminine hygiene products	Brake linings	Shore protectors	Examination gowns
Cotton balls	Gaskets & seals	Oil-spill-control barriers	Bandages
Dental floss	Convertible tops	Air & water filters	Dialysis filters
			Gloves
Food	Animal Care	Agriculture	Protective Gear
Bags & sacks	Leashes	Bags & sacks	Bullet-resistant vests
Bakery filters	Blankets	Ropes	Heat/fire-resistant suits
Coffee filters	Saddles	Hoses & belts	Impact-resistant helmets
Packaging materials	Stall liners	Bale coverings	Chemical-resistant gloves
Tea bags	Restraints	Tractor interiors	Abrasion-resistant gloves
	Pet bed liners	Plant covers & tree wraps	Hazmat suits
Sports & Recreation	Manufactured Goods	Miscellaneous Products	Building Materials
Helmet liners	Hoses	Artificial flowers/plants	Insulation
Protective pads	Belts	Banners & flags	Covers for wiring
Balls	Loading dock covers	Book bindings	Drop cloths
String for rackets	Tarpaulins	Candle wicks	Pool liners & covers
Tents	Paint rollers	Casket linings	Wall coverings
Backpacks	Wipes	Communication lines	Venetian blinds
Life jackets	Carpet backing	Felt-tip pens	Window screens
Rafts & boat hulls	Mailing envelopes	Lampshades	Gaskets & seals
Sails	Duct tape backing	Mops & dusting cloths	Duct tape
Fishing line & nets	Conveyor belts	Sandbags	Awnings
Artificial playing surfaces	Silk-screening mesh	Personal computer boards	Moisture barriers

delays that minimize shifting of the road base. Soil is conserved with fiber erosion-control barriers. Computer disks are protected with an olefin fiberweb. Wiring is insulated with fiberglass woven braids. Athletic performance is enhanced with carbon reinforcement fibers in golf clubs and tennis rackets. Body parts are protected with support wraps of woven or knit fabrics. Fruits and vegetables are packaged in net bags. Outdoor activities take place under tents and awnings to protect us from sun and rain. Manufactured goods are transported on conveyor belts made of textiles coated with a thin plastic film. At the gas station, gas is pumped through a fibrous filter and a fabric-supported hose. It is hard to imagine how different our lives would be if all industrial textiles were to disappear.

In the United States, the textile industry is tremendous. It includes the natural and manufactured fiber producers, spinners, weavers, knitters, throwsters, yarn converters, tufters, fiberweb producers, finishers, equipment producers, and many others. In 1999, the textile industry employed more than 562,000 people. Textile products, valued at over \$61 billion in 1999, are produced by computerized systems in the United States. The textile industry has developed from an arts-and-crafts industry perpetuated by guilds in the early centuries, through the Industrial Revolution in the 18th and 19th centuries (when the emphasis was on mechanization and mass production), to the 21st century, with its emphasis on science, technology, quality, and cost efficiency.

In the 20th century, manufactured fibers were developed and modified textured yarns were created. New fabrications were created, the production of knits in-

creased, and many finishes and sophisticated textile production and marketing systems were developed. Manufactured fibers and soil-resistant and durable-press finishes help keep textiles neat and clean.

New developments in textiles have created some problems, particularly in the selection of apparel and furnishing textiles. Many items look alike but their performance and care may differ significantly. Knitted fabrics look like woven fabrics, vinyl and polyurethane films look like leather, and acrylic and polyester fabrics look like wool. Traditional cotton fabrics may be polyester or polyester/cotton blends.

To make textile selection easier for consumers, the textile industry has set standards and established quality-control programs for many textile products. Federal laws inform consumers of fiber content and care requirements and protect them from improperly labeled merchandise and other unfair trade practices.

Energy conservation, environmental quality, noise abatement, health, and safety issues affect the textile and many other industries. The efforts of the textile industry to meet standards set by the federal government affect the consumer by raising prices for merchandise, by limiting the choices available, and by improving product and environmental quality.

Textile fabrics can be beautiful, durable, comfortable, and easy care. Knowing the components used in textile products and how these components were made will provide a better basis for their selection and a better understanding of their limitations. Knowledge of textiles and their production will result in a more appropriate and better product for a specific use and, therefore, a more satisfied user.

Key Terms

Fabric	Gray, grey, or greige goods
Fiber	Textile
Finish	Yarn

Questions

1. Define the key terms, explain the differences among them, and describe how these terms relate to textiles.
2. How do textiles contribute to contemporary life?
3. Make a list of all textile products you use in an average day. Be sure to consider furnishing, industrial, and apparel products. What would your life be like without these products?

4. Select a fabric and dismantle it so that you have a fiber and a yarn. What are the differences and similarities between these components?

Suggested Readings

Examine several of these trade publications to determine each one's focus and depth of information: *America's Textiles International*, *Industrial Products Review*, *Interiors*, *Interior Design*, *Technical Textiles International*, *Textile Horizons*, *Textile Month*, *Textile Progress*, *Textile Research Journal*, and *Textile World*.

Bryne, C. (1995). Technical textiles, *Textiles Magazine*, pp. 12-16.