

## CHAPTER 3

### Textile Fibers and Their Properties

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### Textile Fibers and Their Properties

- ▣ **Natural fibers:** Fibers grown or developed in nature in recognizable forms.
- ▣ **Manufactured or man-made fibers:** Made from chemical compounds produced in manufacturing facilities, original form not recognizable as a fiber.

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### Fiber Properties

- ▣ Physical structure
  - Length of fiber
    - **Filament:** Long, continuous fiber
    - **Filament tow:** Filaments crimped, then cut
    - **Staple fibers:** Short
  - **Diameter:** Affects fabric performance and hand.
    - **Micrometer:** Unit of measurement for fineness of natural fibers
  - **Denier:** Weight, in grams, per 9,000 meters; manufactured fibers and yarns

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### Fiber Properties

- **Cross-section shape:** Fiber shape affects luster, bulk, body, texture, hand, etc.
- **Surface contour:** Describes outer surface of the fiber, i.e. smooth, rough, serrated, etc.
- **Crimp:** The three-dimensional shape of the fiber.
  - **Fiber crimp:** Waves and twists along the fiber.
  - **Fabric crimp:** Bend caused by distortion of yarns due to weaving and knitting.
- **Fiber parts:** Complex for natural fibers; simple for manufactured fibers.

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### Chemical Composition and Molecular Arrangement

- ▣ Classify and differentiate among generic fibers.
- ▣ **Polymerization:** Process of joining many small molecules (monomers) to form one large compound.
- ▣ **Degree of polymerization:** The number of monomers connected to form polymer.
- ▣ **Amorphous:** Polymer chains arranged in a random, disorganized way, not parallel; fibers are weak, flexible, absorbent; low elastic, but good elongation properties.

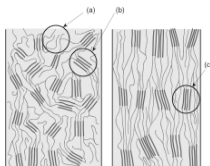
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### Chemical Composition and Molecular Arrangement

- ▣ **Crystalline:** Polymer chains are parallel.
- ▣ **Orientation:** Polymer chains parallel to each other and to the fiber's longitudinal axis; stiff, nonabsorbent; low elongation, good elasticity.
- ▣ **Stretching or drawing:** Increase fiber orientation and crystallinity.

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## Polymers



- ☐ (a) Amorphous
- ☐ (b) Oriented
- ☐ (c) Crystalline

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## Chemical Bonds

- ☐ **Hydrogen bonds:** Attraction between positive hydrogen and negative oxygen or nitrogen of adjacent chains.
- ☐ **Van der waals:** Weak bonds between atoms of adjacent chains.

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## Aesthetic Properties

- ☐ **Luster:** Sheen caused by light reflected from a fiber's surface.
- ☐ **Drape:** The manner in which a fabric hangs over a form.
- ☐ **Texture:** Nature of a textile's surface.
- ☐ **Hand:** How a textile feels to the touch.

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## Durability Properties

- ☐ **Abrasion resistance:** Ability to withstand rubbing and folding.
- ☐ **Flexibility:** Ability to bend repeatedly without breaking.
- ☐ **Tenacity:** Ability to withstand a heavy pulling force.
- ☐ **Elongation:** Ability to stretch without breaking.

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## Comfort Properties

- ☐ **Absorbency:** Ability to take up moisture.
  - **Hydrophilic:** very absorbent
  - **Hydrophobic:** not absorbent
  - **Hygroscopic:** Absorbs moisture without feeling wet.
- ☐ **Heat or thermal retention:** Ability to hold heat.
- ☐ **Heat sensitivity:** Fiber's reaction to heat.
- ☐ **Density or specific gravity:** Measure of fiber weight per unit volume.

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## Appearance-Retention Properties

- ☐ **Resiliency:** Ability to return to original shape after bending, twisting, or crushing.
- ☐ **Dimensional stability:** Ability to retain given size and shape through use and care.
- ☐ **Shrinkage resistance:** Ability of fabric to retain given size through care or cleaning.
- ☐ **Elasticity or elastic recovery:** Ability of extended fiber, yarn, or fabric to return immediately to its original length.

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### Other Characteristics

- ▣ **Chemical resistance:** Determines appropriateness of care procedures and end uses.
- ▣ **Light resistance:** Ability to withstand exposure to light without color fading or fiber weakening.
- ▣ **Environmental impact:** Effect of production, use, care, and disposal of textiles on environment.

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### Other Characteristics

- ▣ **Care properties:** Treatment required to maintain a textile’s new look.
- ▣ **Cost:** Affected by how a fiber is produced, the number and type of modifications present, and how the fiber is marketed.

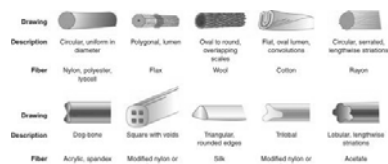
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### Fiber Identification

- ▣ **Visual inspection**
  - Fiber length
  - Luster
  - Body, texture, or hand
- ▣ **Burn test**
  - Reaction to heat
  - Manner of burning
  - Smoke color & odor
  - Type of residue
- ▣ **Microscopy**
  - Longitudinal appearance
  - Cross-sectional appearance
- ▣ **Solubility tests**

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### Fiber Cross-Sections and Contours



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