

1  **Chapter 8**

Synthetic Fibers

2  **Synthetic Fibers**

- Production: Synthesize polymer from raw materials by addition or condensation polymerization.

3  **Common Properties**

- Heat sensitive: Softens or melts with sufficient heat.
- Pilling: Formation of tiny balls of fiber on fabric.
- Static electricity: Soil and lint cling; problems in production & processing; discomfort during use.
- Oleophilic: Affinity for oil and grease.
- Chemically resistant
- Hydrophobic: Low absorbency.

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5  **Common Properties**

- Slick and abrasion resistant
- Strong and resilient
- Resistant to most common fiber degradants: sunlight (except for nylon)
- Flame resistance varies widely
- Low density
- Non-biodegradable

6  **Common Manufacturing Processes**

- Melt spun: Used for most synthetics.
- Drawn: To develop strength, pliability, toughness, and elasticity properties.
- Heat set: To stabilize yarns or fabrics.

7  **Identification of Synthetic Fibers**

- Only reliable test is solubility. (According to the book. But in reality, there are others – dye tests and spectroscopic analysis.)

8  **Common Fiber Modifications**

- Fiber shape and size: Melt spun fibers easy to alter.
- Low-pilling fibers: Reduce flex life by reducing molecular weight slightly.
- High-tenacity fibers: By drawing, chemical modifications, or combination
- Low-elongation fibers: Used in blends.

9  **Nylon (Polyamide)**

- Production: Melt spun from condensation polymer made from diamine & acid; cold drawn.
- Physical structure: Wide variety of types.
- Chemical structure: Manufactured fiber in which the fiber-forming substance is a long chain synthetic polyamide in which less than 85% of the amide linkages are attached directly to two aromatic rings.
  - Common types: Nylon 6 & 6,6

10  **Properties**

- Aesthetics: Sheer and durable fabrics; poor cover; hand, texture, luster, etc. can be controlled for end use.
- Durability: High tenacity, good breaking elongation, excellent abrasion resistance.
- Comfort: Smooth & silky feel; low density; low absorbency; static prone.
- Appearance retention: Excellent resiliency & elasticity; retains appearance well; pills readily.

11  **Properties**

- Care: easy care

- Resistant to chemicals, insects, and mildew;
  - Color scavenger (Picks up color from other textiles and soil.)
  - Low melting point
  - Quick drying
  - Oleophilic
  - Degraded quickly by sunlight
  - Environmental impact: Processed from petrochemicals with inherent concerns regarding the environment; little processing after fiber production needed; can be recycled.
- 12  **Nylon**
- Identification: Nylon dissolves in phenol and formic acid.
  - Fiber modifications: Cross section, size, solution dyed, textured, antistatic, anti-soil, bicomponent, antimicrobial, sunlight resistant, flame retardant, delustered, high tenacity, cross linked, dye affinity.
  - End uses: Furnishings (carpeting, upholstery); apparel; industrial (tire cord, car interiors, ropes, performance apparel, sporting goods).
- 13  **Polyester**
- Production: Melt spun of condensation polymer from di-acid and di-alcohol, hot drawn.
  - Physical structure: Variety of types.
  - Chemical structure: Manufactured fiber in which the fiber-forming substance is a long chain synthetic polymer composed of at least 85% by weight of an ester of a dihydric alcohol and terephthalic acid.
  - Straight molecular chains with high degree of orientation.
  - Several polymer types.
- 14  **Polyester Properties**
- Aesthetics: Can resemble most natural fibers; many types.
  - Durability: Excellent strength & abrasion resistance; good breaking elongation.
  - Comfort: Low density; low absorbency; static prone; soil release finishes improve wicking; performance and stretch polyester available.
- 15  **Polyester**
- Appearance retention: Excellent elasticity; excellent resiliency; does not shrink if properly heat set; resists wrinkling.
  - Care: Easy care, quick drying; resists most common fiber degradants; thermoplastic; heavier than nylon & acrylic; oleophilic.
  - Environmental impact: Extensive recycling programs.
  - Identification: Resistant to most solvents.
- 16  **Polyester**
- Fiber modifications: Cross section; size; dyeability; solution dyed, textured, tenacity; shrinkage; pill resistant; copolymer; bigeneric; luster; binder staple; flame retardant; antistatic; anti-soil; antimicrobial; delustered; nonpilling.
  - End uses: Apparel; furnishings; industrial (fiberfill, nonwoven fabrics, tire cord, sporting goods, rope, cordage, filters, geotextiles, medical applications).
- 17  **Olefin**
- Production:
    - High-pressure system
    - Low-pressure system
    - Addition polymer: melt spun; cold drawn
    - May be gel spun
- 18  **Olefin**
- Physical structure: Available in many forms.
  - Chemical structure: Manufactured fiber in which the fiber-forming substance is a long chain synthetic polymer composed of at least 85% by weight of ethylene, propylene, or other olefin units except amorphous (noncrystalline) polyolefins qualifying as rubber,

- polypropylene or polyethylene.
- 19  **Olefin Properties**
- Aesthetics: Can be modified for end use.
  - Durability: Good tenacity, elongation, and abrasion resistance.
  - Comfort: Low regain, good wicking, non-static; light weight; waxy hand, but can be modified; performance fibers.
  - Moisture vapor transport rate (MVRT): Measures the rate moisture vapor moves from the fabric side next to the body to the fabric's exterior side.
- 20  **Olefin**
- Appearance retention: Excellent resiliency; good dimensional stability.
  - Care: Unaffected by water borne stains; excellent resistant to most chemicals; low melting point; oleophilic.
  - Environmental impact: Few processing chemicals used; easily recycled; used for environmental applications.
  - Identification: Melt spinnable.
- 21  **Olefin**
- Fiber modifications: Heat stabilized; light stabilized; modified cross section and size; solution dyed, dye-ability; fibrillated; high tenacity.
  - End uses: Apparel; furnishings; industrial (carpet backing; dye nets, diaper cover stock, filter fabrics, bags, wall panel fabrics, envelopes, banners, geotextiles, ground cover fabrics, protective clothing, substrates for coated fabrics, ropes, twines).
- 22  **Acrylic**
- Production: Addition polymer or copolymer; dry spun & hot drawn or wet spun & drawn.
  - Physical structure: Cross-sectional shape & size varies; usually staple.
  - Chemical structure: Manufactured fiber in which the fiber-forming substance is a long chain synthetic polymer composed of at least 85% by weight of acrylonitrile units; copolymer or graft copolymer; bicomponent.
- 23  **Polymer Types**
- 24  **Acrylic Properties**
- Aesthetics: Various types; often textured or crimped.
  - Durability: Moderate tenacity, abrasion resistance, & breaking elongation.
  - Comfort: Not as synthetic feeling; low density; low regain.
- 25  **Acrylic**
- Appearance retention: Good resiliency & elasticity; moderate dimensional stability; poor heat settability; pills readily.
  - Care: Follow care instructions; resistant to chemicals, insects, & sunlight.
  - Environmental impact: Chemicals used to produce raw materials, spin fibers, & wash fibers; dyes.
  - Identification: Solubility test.
- 26  **Acrylic**
- Fiber modifications: Self crimping, solution dyed, bicomponent or copolymer, modified cross section, size, dyeability.
  - End uses: Furnishings; apparel; industrial (craft yarn, tarps, awnings, luggage, vehicle covers, tents, sandbags, precursor of carbon fiber).
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- 27  **Modacrylic**
- Production: Addition copolymer, dry spun, hot drawn.
  - Physical structure: Staple fiber, variable cross section.
  - Chemical structure: Manufactured fiber in which the fiber-forming substance is any long chain synthetic polyamide comprised of less than 85% but at least 35% by weight of acrylonitrile.
- 28  **Modacrylic Properties**

- Aesthetics: Latent crimp for realistic fake furs; other modifications based on end use.
- Durability: Low abrasion resistance & tenacity, good elongation.
- Comfort: warm, soft, pills; low regain; moderate density.
- Appearance retention: Moderate resiliency & dimensional stability; high elastic recovery.
- Care: Resists most common fiber degradants; flame retardant; heat sensitive; washable or dry cleanable.

29  **Modacrylic**

- Environmental impact: Fewer problems; minor fiber.
- Identification: Self extinguishes, solubility test.
- Fiber modifications: Heat sensitivity, solution dyed, dyeability, crimped.
- End uses: Furnishings; apparel; industrial (protective clothing, filters, wigs, blankets & upholstery in airplanes).