Regenerated fibers

- Produced from cellulosic materials such as wood chips, bamboo, and cotton linters

- Raw materials for rayon (viscose and cupro) and modal are converted to cellulose derivative pulp, which is extruded to make fibers

- Raw materials for lyocell are converted directly to cellulose pulp with no alteration of the cellulose
Tencel® Lyocell – Wood chips (raw material), pulp, and fibers

Samples courtesy Lenzing Fibers
Rayon, Modal, and Lyocell

- Rayon - first manufactured fiber

- Manufacturing viscose rayon originally required strong chemicals, energy, and water

- U.S. companies discontinued production due to cost and environmental concerns

- Manufacturing rayon has changed considerably

- Producers meet certification requirements for ÖKO-TEX Standard 100 and the European Commission’s Eco-label
Federal Trade Commission Labeling

- Does not differentiate between regular **viscose rayon**, high wet modulus rayon (including polynosic rayon and **modal**), high tenacity rayon, or cuprammonium (**cupro**) rayon

- Requires that rayon fibers made from bamboo cellulose be labeled "rayon from bamboo" or "bamboo rayon"

- **Lyocell** is a specific generic class distinct from viscose rayon and a sub-class of rayon

- Permits the use of ISO approved names **viscose**, **cupro**, and **modal** as generic names on garment labels
Fiber Structure

- **Surface Contour (longitudinal view)**
  - Viscose rayon - striations along length
  - Modal and lyocell - smooth surfaces

- **Shape (cross-section)**
  - Viscose rayon - irregular cross-section
  - Modal and lyocell - circular cross-sections

- **Luster**
  - Inherently lustrous
  - Delusterant is added to produce semi-dull and dull fibers

- **Size**
  - Varying size based on intended end use
Photomicrographs of Rayon that was Labeled as Bamboo

Note: The fiber images show that the fiber was labeled incorrectly. The striations clearly show that the fiber is incorrectly labeled as bamboo. The raw material for the fiber may have been bamboo.
Performance Highlights

- **Viscose** rayon - Low strength, weak and weaker when wet
- **Modal** and **lyocell** - higher strength than viscose
- Low abrasion resistance, especially when wet
- High flexibility, excellent drape
- Poor wrinkle resistance
- Poor elastic recovery and resilience
- **Viscose** rayon- poor dimensional stability
- **Modal** and **lyocell** - good dimensional stability
Performance Highlights

- **Excellent moisture absorbance**, hydrophilic
- **Does not irritate skin**
- **Biodegradable**
- **Damaged** by prolonged exposure to light
- **Burns**
Examples of End Uses

- **Apparel**
  - Women's dresses, blouses, jackets, and suits
  - Men's casual shirts, pants, and suits
  - Lyocell lingerie, children's clothing, and women's blouses and dresses
  - Modal lingerie, sleepwear, knitwear, and socks

- **Textiles for Interiors**
  - Bedspreads, draperies, upholstery, throw cushions
Examples of End Uses

- **Household and Institutional Textiles**
  - Table linen
  - Bed linen
  - Modal and modal/cotton blends - towels and bath mats

- **Technical Textiles**
  - Viscose - disposable and limited-use items (e.g., hospital gowns, tea bags)
  - Fire retardant rayon - protection against radiant heat, electric arcs, and molten metals
  - Cordenka® yarns (high tenacity rayon) - reinforcement of tires and firehoses
Care

- Care varies considerably
- Easily stained by water-soluble fluids
- Viscose rayon - **dry clean**
- Modal and lyocell - **machine wash**
- **Iron** using the appropriate setting
- **Damaged by acidic materials**
- **Susceptible to mildew and silverfish**
Acetate and Triacetate

- Acetate - second manufactured fiber

- **Modified cellulosic fibers**, derivatives of cellulose
  - Formed from wood pulp and other sources of cellulose
  - Raw materials are changed by chemical reaction
  - Derivative is dissolved, extruded, solvent evaporated

- **Triacetate**-
  - No longer produced in the U.S.
  - Solvent banned by the Environmental Protection Agency (EPA)
Fiber Structure

- **Surface Contour (longitudinal view)**
  - Striations along the fiber length

- **Shape (cross-section)**
  - Irregular cross-section
  - Varied by changing the shape of the spinneret holes

- **Luster**
  - Inherently lustrous
  - Delusterant added to produce semi-dull and dull fibers

- **Size**
  - Variable size based on intended end use
Cross-section of Acetate Fiber Used for Cigarette Filters

acetate fiber with “Y” cross-section
spinneret hole shape used to produce “Y” cross-section fiber

Note: The fiber cross-section can be varied by changing the shape of the hole. The “Y” cross-section, used to achieve maximum surface area, is the standard shape for acetate filaments used in cigarette filters.

Courtesy Celanese Acetate Products
Fiber Size Modification – Comparison of human hair and ~40 microns acetate filament fiber

human hair size ~ 80 microns

acetate fiber used for cigarette filters -40 microns

Note: 40 microns = 40/1000 of a millimeter (1 micron is .001 mm).

Courtesy Celanese Acetate Products
Solution Dyed Acetate Filament Yarns

Note: Eastman Chromspun™ is the trademark for solution dyed (dope dyed) acetate yarns manufactured by Eastman Chemical Company. These yarns are used for end use applications such as apparel, linings, draperies, bedspreads, and ribbons.

Samples and information courtesy Eastman Chemical Company
Performance Highlights

- Very low strength, weak
- Poor flat and flex abrasion resistance
- High flexibility
- Poor wrinkle resistance
- Poor elastic recovery and resilience
- **Acetate** - moderate dimensional stability
- Heat set **triacetate** - excellent dimensional stability
Performance Highlights

- Low moisture absorption
- Average resistance to sunlight
- Melts on exposure to heat, thermoplastic
Examples of End Uses

● **Apparel**
  o Blouses, skirts, dresses, and formal gowns
  o Graduation and choir robes
  o Linings for suits, jackets, and dresses
  o Triacetate - permanent pleats

● **Textiles for Interiors**
  o Draperies and upholstered furniture

● **Technical Textiles**
  o Cigarette filters
  o Decorative ribbons and casket linings
Cigarette Filter – Cigarette filters are typically manufactured with acetate fibers.

Solubility test for acetate fibers – A few drops of acetone were applied to the partially opened filter. Acetate fibers immediately dissolved in acetone.
Care

- **Cleaning**
  - Usually **dry cleaned**
  - If hand washed, fabrics should not be wrung or twisted to remove water as creases are difficult to remove
  - **Not damaged by dry cleaning solvent**
  - **Dissolve in acetone and stain removal solvent** used to remove ink and glue
    - Special care should be taken when spot cleaning these fabrics. Check for acetate fibers in linings before spot cleaning.

- **Ironing**
  - Fabrics should be ironed with care at low temperatures

- **Storage**
  - No special care is required for storing acetates and triacetates
Women’s Silk Dress with Acetate Lining - Damaged during stain removal

Note: The acetate lining dissolved from the use of an ink and glue removal product containing isopropyl alcohol.
<table>
<thead>
<tr>
<th></th>
<th>Viscose Rayon</th>
<th>Modal</th>
<th>Lyocell</th>
<th>Acetate</th>
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