

Regenerated Cellulosic Fiber

Cellulose, Viscose Rayon, and Bamboo

Federal Trade Commission—

Green Building and Textiles Workshop

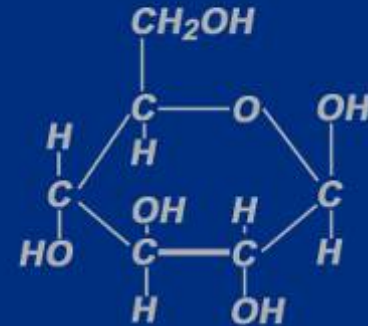
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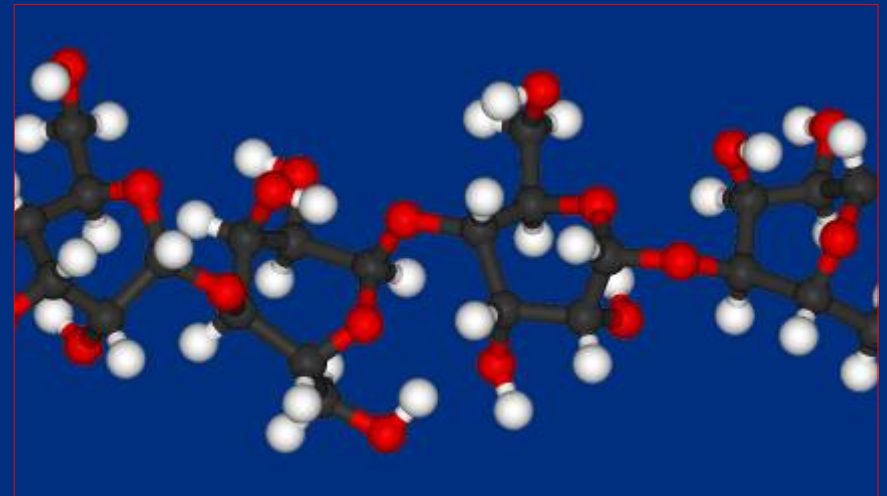
U.S. Customs and
Border Protection

Cellulose

- A polysaccharide $(C_6H_{10}O_5)_n$ of glucose units



- A high-molecular weight polymer composed of carbon, hydrogen, and oxygen atoms



Cellulose

- A major component of most plant cell walls
 - Occurs naturally in fibrous substances—
 - Cotton
 - Flax (linen)
 - Jute
 - Kapok
 - One of the most widely distributed organic materials
 - Accounts for more than half of total consumption of textile fibers
 - Can be obtained from seed hairs, plant stems, leaves, or bark
 - Raw material for manufactured goods—paper, cellophane, and **rayon**



Bamboo

- A group of woody perennial evergreen plants
 - “True grass” family *Poaceae* (*Gramineae*)
 - Subfamily *Bambusoideae*
 - Tribe *Bambuseae*
 - Subtribe : *Bambusinae*
- Fastest growing woody plant in the world
 - Accelerated growth rate (up to 3-4 feet/day)
 - Due to unique rhizome system
 - Dependent on local soil/climate conditions
- *Giant Bamboo*—largest member of the grass family



Bamboo

- 91 *genera*; approximately 1,000 *species* found in:
 - Diverse climates—cold, mountainous to hot, tropical
 - East Asia, (50°N) to N Australia, west to India/Himalayas
 - Sub-Saharan Africa
 - Americas from SE US to Argentina, Chile (47°S)
- Of economic, high cultural significance in E and SE Asia
 - Used extensively
 - In gardens
 - As building materials
 - For food source
- Increasing importance for commercial applications



Bamboo

- As a botanical grown commercially, bamboo is
 - Easy to propagate
 - Fast growing
 - Self-renewing
 - Needs little attention—grows in variety of soils/climates
 - Broad potential for marketable application
- Regarding “green” attributes—differentiate between the
 - Botanical entity
 - Unprocessed plant parts may convey beneficial attributes
 - Derived commercial product
 - Post-processing, products may not maintain attributes



Cellulose & Bamboo

- Not a new concept—research dates to early 1930s
 - With respect to cellulose, compared acetolysis products isolated from bamboo stalks with those from cotton: found them to be chemically identical.
 - Source: “Acetolysis of Bamboo Cellulose.” Oguri and Nara. *TRI Bulletin*. 1930
 - “. . . cotton and wood cellulose give the same X-ray diffraction lines as cellulose from bamboo.” Further, “since the cellulose from the stalk, leaves, and sheaths of bamboo give the same diffraction lines as cotton cellulose, it is concluded that bamboo cellulose has the same crystallographic properties as cotton.
 - Source: “X-ray Study of Bamboo Cellulose.” Oguri. *Cellulose Industry*. 1933



Rayon

- As defined by FTC:
 - **Rayon**—A manufactured fiber composed of regenerated cellulose, as well as manufactured fibers composed of regenerated cellulose in which substituents have replaced not more than 15 percent of the hydrogens of the hydroxyl groups.
 - Where the fiber is composed of cellulose precipitated from an organic solution in which no substitution of the hydroxyl groups takes place and no chemical intermediates are formed, the term **lyocell** may be used as a generic description of the fiber.

Source: *Rules and Regulations Under the Textile Fiber Products Identification Act* [16 CFR Part 303]



Rayon

- As defined by the *HTSUS*, Chapter 54, Note 1 (b)
 - Throughout the tariff schedule, the term "man-made fibers" means staple fibers and filaments of organic polymers produced by manufacturing processes, . . .
 - By dissolution or chemical treatment of natural organic polymers (for example, cellulose) to produce polymers such as cuprammonium rayon (cupro) or viscose rayon, or by chemical modification of natural organic polymers (for example, cellulose, casein, and other proteins, or alginic acid), to produce polymers such as cellulose acetate or alginates.

Source: *The Harmonized Tariff Schedule of the United States (HTSUS)*, 2008, Rev. 2



Rayon

- As defined by the *HTSUS*, Chapter 54, Note 1(b)
 - The terms "synthetic" and "artificial", used in relation to fibers, mean: synthetic: fibers as defined at (a); artificial: fibers as defined at (b).
- Tariff Chapters Providing for *Rayon*
 - 54—Man-Made Filaments
 - 55—Man-Made Staple Fibers
 - 56—Wadding, Felt, Nonwovens; Special Yarns, Twine, Cordage, Ropes, Cables; Articles Thereof
 - 59—Impregnated, Coated, Covered, Laminated Textile Fabrics; Textile Articles Suitable for Industrial Use



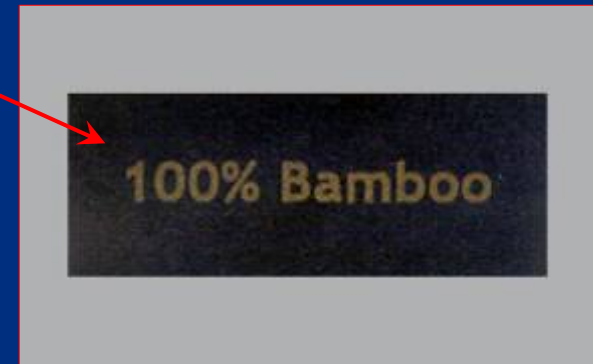
Rayon from Bamboo Cellulose

- At least one attempt at early commercialization—1947
 - Travancore Rayons, Ltd. Travancore, India
 - Swiss and UK machinery
 - Estimated production: five tons fiber per day
 - Impetus: Shortage of cotton Linters; restrictions on wood pulp—implied post-WWII economic circumstances

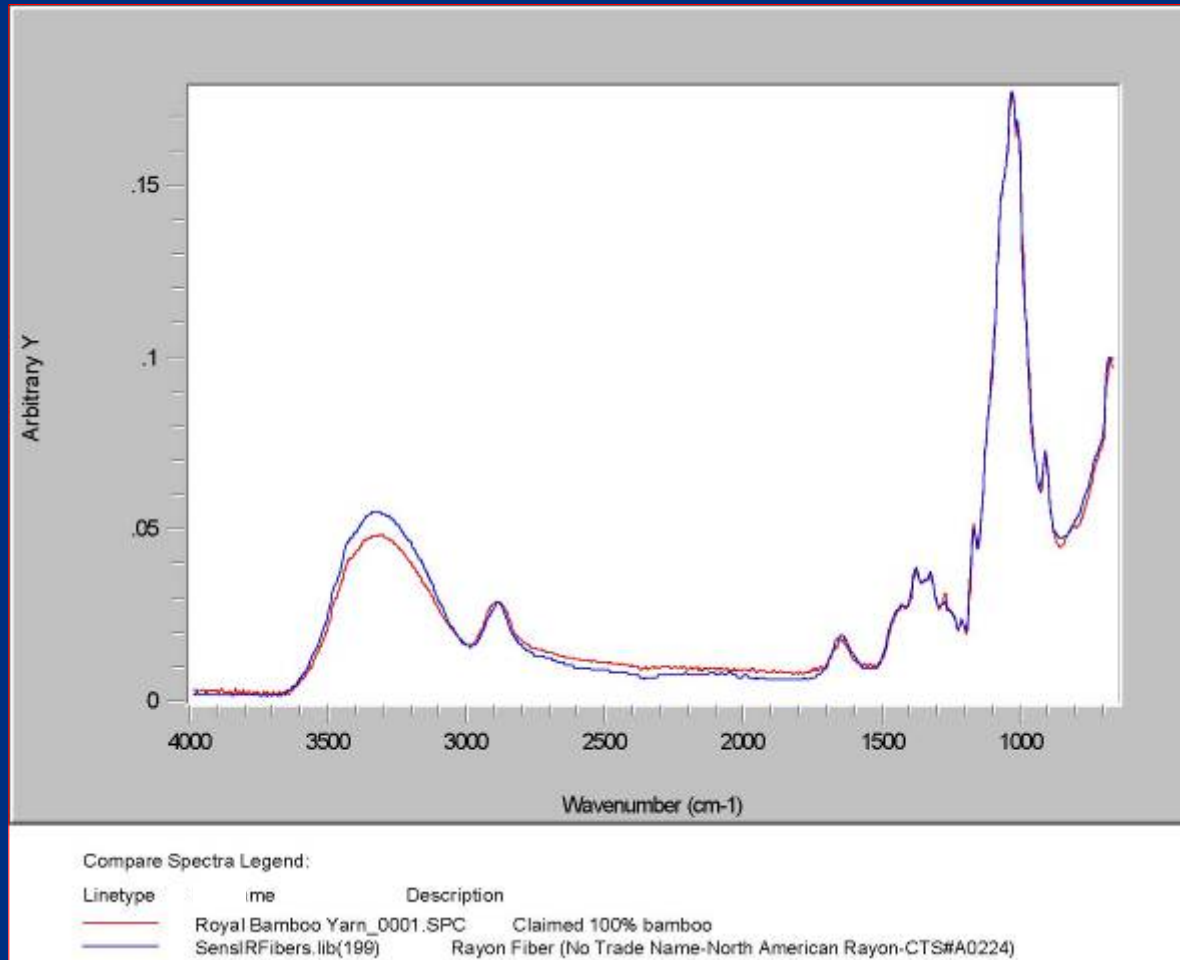
Source: “Bamboo Pulp: Its Possibilities for Rayon Manufacture,”
Anonymous. *Fiber*. March 1947 (Vol. VIII, No 3)



Rayon from Bamboo Cellulose



Rayon from Bamboo Cellulose



For Further Study . . .

- “Green” attributes: differentiation between
 - Botanical entity that may convey beneficial attributes
 - Derived commercial products that, post-processing, do not retain those attributes
- Development of methods to characterize those attributes
- Instrumental approaches



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DHS, CBP, & LSS on the Web

- www.dhs.gov/
 - The “Big Picture”
 - Links to all DHS Components, Subcomponents, and Agencies
- www.cbp.gov/
 - Agency Initiatives
 - Commissioner’s Highlights
 - Links to Trade and Enforcement Sites
- www.cbp.gov/xp/cgov/trade/automated/labs_scientific_svcs/org_and_operations.xml/
 - Under “Trade,” “Automated Systems & Operational Support”
 - Mission and Vision Statements
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