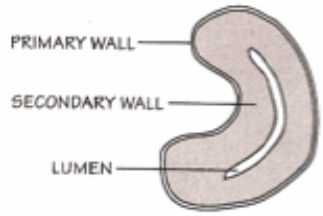
Cotton Classroom

Physical Structure of Cotton Fiber

Cotton is "the fabric of our lives." We use it every day, whether it is the clothes we wear or the furniture in our homes, we use some form of it. Cotton is comfortable to wear, easy to care for, and durable. It is the most important cash crop for many countries such as China, India, and the United States (Wikipedia, 2008, para. 31).

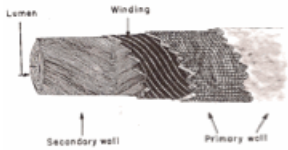
In the beginning, cotton fiber starts out as a single cell in the epidermis of the seed coat in the cotton plant (Andres, Buchanan, Civardi, and Kottes, 1984, p. 100). The fiber grows about 1,000 times its width as the cotton boll matures (Parker, 1998, p. 9). A cotton fiber consists of a cuticle, primary wall, secondary wall, and a lumen. The cuticle is a few molecules thick and covers the primary wall with a waxy film. The wax is a mixture of fats, waxes, and resins (Textiles Home, 2002, para. 8). The primary wall consists of numerous fibrils spiraling around the fiber axis. Fibrils are simply packs of cellulose chains (Parker, 1998, p. 10). The secondary wall has several layers of spiraling fibers, which make up most of the weight of the cotton fiber. The lumen, located within the secondary wall, is a hollow canal that carries nutrients of the cotton during growth (Parker, 1998, p. 9). It also contains the dried out remains of the protoplasm and nucleus when the cotton boll development is complete (Textiles Home, 2002, para. 11). Cotton fiber is about 95% cellulose (Andres et al., 1984, p. 105). The rest of the materials are waxes, pertinacious substances, and nitrogenous matter, which are primarily located in the primary wall and some in the lumen (Andres et al., 1984, p. 105). Finally, when the growing period is finished, the boll bursts open with dried, twisted, and shriveled tubes of fiber.



CROSS-SECTION OF MATURE COTTON FIBER


REVERSE SPIRALS OF COTTON FIBER

Cotton fiber has natural twists along the entire length of the fiber called convolutions. The convolutions help the fibers interlock when it is spun into yarn. Long fibers have about 300 convolutions per inch and short fibers have 200 or less (Parker, 1998, p. 10). Layers of the secondary wall also contain fibrils that are arranged spirally and reverse in direction at regular intervals. The reverse spirals help the cotton fiber have better elasticity and twist but are 15 to 30% weaker (Parker, 1998, p. 10). Also, beneath the primary wall is the winding layer that has a single layer of fibrillar bundles of micro fibrils that are at about a 70-degree angle around the fiber axis (Textiles Home, 2002, para. 9). The winding layer is also a layer of the secondary wall.



The length of the cotton fiber contributes to the fiber fineness and strength. Cotton fibers differ in lengths from 1/2 inch to 2 inches (Parker, 1998, p. 9). Staple fibers are short fibers and are coarse. Natural fibers such as cotton and wool are staple fibers. Filaments are long, continuous strands of fiber and are much finer and stronger. Most manufactured fibers such as silk are filaments. The diameter of cotton fibers can be from 15 to 20 microns (Parker, 1998, p. 9). One micron is equal to 1/1000th of a millimeter (Parker, 1998, p. 9). Depending on the maturity of the cotton fiber, the younger fiber will be u-shaped and the older fiber will be more circular. Raw cotton is a natural creamy white and turns yellow as it ages (Parker, 1998, p. 9). Cotton can also turn gray after it rains. Differences in fiber length, fineness, and color all depend on factors such as weather, fertilizers, and harvesting techniques.

From yard hoses to coffee filters, cotton is a very important and useful fiber. It can even be blended with other fibers such as rayon, polyester, or spandex to improve comfort and strength. No matter what it is being used for, cotton will always be functional in our daily lives.

Works Cited

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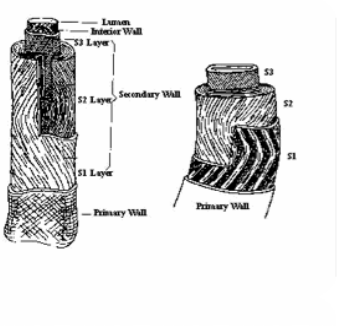
By Angelica Chuon

The Physical Structure of Cotton

There are five main parts of the physical structure of cotton: length, distinctive parts, convolutions, fineness and color.



Length is the main factor to define cotton quality, the longer length the stronger yarn cotton will create. Length is determined by removing a sample from a bale of cotton, sorting the fibers by length, and calculating the average staple length and the variation of length or uniformity ratio. There are 3 groups of cotton are commercially important: upland cotton, long-staple cotton, short-staple cotton. Long-staple cotton has the best quality and is used to produce softer, smoother and stronger products. About 97% of the US cotton is upland cotton. According to Cotton Incorporated's information, cotton length uniformity is "is the ratio between the mean length and the upper half mean length of the fibers and is expressed as a percentage. If all of the fibers in the bale were of the same length, the mean length and the upper half mean length would be the same, and the uniformity index would be 100." Over 80% of uniformity will be considered very high in uniformity, which is good quality.

Distinctive parts, the cotton fiber is made from a cuticle, primary wall, secondary wall and lumen. The cuticle is the outset layer of cotton fiber and the lumen is the core.

Convolutions are ribbon-like twists that characterize cotton. When cotton fiber matures, lumen will dry out and collapses which makes secondary wall start to twist. Long-staple cotton has about 300 convolutions per inch; short-staple has less than 200.

Fineness: The cross-sectional shape varies with the maturity of the fiber. Every cotton boll contains some immature fiber that can create problems in spinning and dyeing. Micronaire is a measure of fiber fineness and maturity. An airflow instrument is used to measure the air permeability of a constant mass of cotton fibers compressed to a fixed volume. The chart below can be used as a guide in interpreting micronaire measurements.

Color: Most raw cotton is creamy white in color and it is highly desirable because it can be dyed or printed to meet fashion and consumer needs. Cotton color will change if it ages, or being moistened by rain just before harvest. Cotton breeders can color the cotton to blue, lavender and yellow to natural cotton.

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