FIBER QUALITY CHALLENGES FACING THE COTTON INDUSTRY
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Abstract
The cotton industry is in the midst of an exciting time with increased domestic consumption, but also facing pressure from other crops and the global marketplace. In order to ensure the U.S. cotton crop remains the fiber of choice for the world it is important to keep an eye on the challenges to fiber quality. High micronaire values, contamination with non-plant materials, increased bark and the ever-present threat of stickiness are very real challenges. The industry can rise to meet these challenges, but only if the industry is aware of them and the appropriate ways to manage, minimize or eliminate them.

Introduction
The last 20 years have seen a radical shift in the U.S. cotton industry. Mill consumption of cotton increased overseas while decreasing in the U.S. The domestic cotton industry has evolved from an importer of raw cotton to an exporter of raw cotton. In recent years that trend is starting to slowly change, U.S. fiber consumption has been increasing recently. In the last few months nearly $500 million in increased domestic cotton spinning capacity has been announced. This includes $70 million investment by ShriVallabh Pittie Group in a new cotton spinning plant near Sylvania, GA, in their first U.S. textile plant (Sylvania Telephone, 2013). Parkdale Mills has announced an $85 million expansion of cotton spinning in Rabun Gap, GA, and Gildan Activewear is investing $200 million in spinning facilities in three locations throughout North Carolina and Georgia (Textile World, 2013 and Elkins, 2013). A new textile group, Gulf Coast Spinning, has announced $130 million in spinning facilities to be constructed in Bunkie, LA (The Advocate, 2013). The reasons for increasing domestic consumption are varied but can be traced to several major factors. Domestic textile production allows for reduced shipping costs of the raw material while allowing faster responses to changes in the market. Shorter lead times provide greater flexibility to textile manufacturers. The domestic work force is well-educated and efficient. Energy costs in the U.S. are relatively low and the energy infrastructure is reliable. Energy and labor are two of the highest costs that textile mills incur.

While increasing domestic consumption is good news for the cotton industry, there are still many challenges to be faced. The domestic cotton textile industry is largely composed of open end rotor spinning as well as other high production rate spinning of cotton blends on vortex and air jet spinning systems. The foreign market for U.S. cotton largely consists of ring spinning. The fiber needs of these different systems vary, but the fiber quality challenges remain the same. Five major quality challenges are discussed here: 1) high micronaire values, 2) contamination, 3) bark, 4) visible foreign matter and 5) stickiness. The impact of these quality issues and possible remedies are discussed.

Discussion
Micronaire values have been steadily increasing in U.S. cotton for several years. Higher micronaire cottons are typically coarser fibers. Micronaire is one of the most important factors in open end rotor spinning, while length is generally the most important factor for ring spinning. Micronaire limits how fine a yarn can be spun. Coarser fibers provide for fewer fibers in a cross-section of a yarn. Equation 1 shows the formula for estimating the number of fibers in a cross-section of a yarn. (McCreight et al, 1997). It is obvious by examining the equation that fine count yarns (high cotton count) are impacted by higher micronaire values.

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\text{Fibers per cross section} = \frac{15,000}{(\text{Micronaire})(\text{Yarn Count, Ne})}
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Micronaire is largely a function of variety, but may be influenced by field conditions. Higher micronaire cottons tend to yield more pounds per acre due to the general rule that a 0.1 increase in micronaire translates to roughly 32 lbs/acre increase in yield. Variety selection and a properly timed harvest are the two most effective ways to control micronaire and produce cotton that is of optimal value to textile mills.
Contamination is a quality issue that the export market frequently complains about. Contamination is non-plant material in the bale. This material can originate from many sources and be made up of a variety of materials. Plastics are a common group of contaminant which may originate from bags, twine or plastic mulch, amongst other sources. Rags used in maintenance of equipment can find a way into the cotton material stream and lead to problems in mills as well. These foreign materials can lead to defects in both yarn and fabric. The contamination slows textile production by requiring more cleaning in the mill and also causing ends down (yarn breaks) during spinning. Contaminants that end up in the yarn may be removed by clearing during the winding process, however this process takes time and is not perfect and may miss some foreign materials. The solution to contamination is largely preventions. It is important to understand that biodegradable plastics take time to break down. Disking plastics in a field can often cause large pieces of plastics to become small pieces which are more difficult to remove at the gin and/or mill. It is good practice to walk fields looking for contamination sources before harvesting and to keep track of all rags used in cleaning and maintenance operations of field, ginning, and textile processing equipment.

Bark is a fiber quality issue that represents unique challenges. Bark is a class of extraneous matter that the USDA Agricultural Marketing Service (AMS) classing offices look for during classing of raw cotton. Bark is from the outer layer of the cotton plant and is a problem often associated with an early freeze during harvest and/or the use of stripper harvesters. In recent years, bark calls by AMS are increasing as are the number of bark complaints from textile mills. Bark issues are being found in areas that traditionally do not see any problems with bark, such as the Delta and Mid-South production areas. Bark causes similar problems in textile production as contamination, namely increased ends downs which slows production and the potential for undesirable material to make it into yarn and fabric. Unfortunately, there is no easy answer about dealing with bark issues. Proper settings on harvesters, well-timed defoliation and harvest and other established best-practices are the best ways to minimize the problem. The issue of bark increasing and showing up in new areas is an area of on-going research.

Visible foreign matter (VFM) is also an issue that the export market frequently brings up, however it is an issue for domestic textile mills, as well. VFM is the percent of material, by weight, of a bale that is not lint. This measurement includes previously discussed issues, such as bark and contamination, but also includes leaf, stem, seed coat and other materials. VFM is similar to leaf grade, but the two measurements do not correlate, as one is weight based and the other is a visual observation. Cotton leaf grade is assigned during classing and is part of the marketing system. Determination of true VFM is a slow process generally performed using the Uster AFIS or the Shirley Analyzer, although there are other instruments available to separate lint and non-lint content to determine non-lint content. VFM directly correlates with turnout in the mill, more foreign matter in a bale results in less fiber being converted into yarn per bale. Increased foreign matter not only reduces the yield that textile mills get from raw cotton, it also increases ends down during spinning and defects in resultant textile products.

Stickiness is an intermittent problem that usually occurs in specific geographical locations, and is a relatively rare problem. Stickiness is excessive sugars on the surface of cotton fiber caused by insects, specifically the Sweetpotato Whitefly (Silverleaf Whitefly) and Aphids. It is most common in the western United States, but when there is an outbreak it is generally very localized. Excessive seed coat fragments, containing particles of seed meat on the seed coat can imitate the stickiness due to insect sugars, but it is a different problem. There is no high speed detection method, so the problem is generally known until the bales reach the textile mill, although excessively sticky cottons may cause problems during ginning as well. Sticky cotton causes buildup of sugars and fiber on rolls and prevents fiber from doffing properly. As little as one or two bales in a 50 bale laydown can shut down a mill from processing effectively. The only solution to processing sticky cotton is to dilute the sticky cotton with large quantities of unaffected cotton. The solution to stickiness is one of prevention. Proper pest management by the producer and nearby farms can prevent the problem. Research is on-going to develop high-speed accurate methods to detect the presence of sugars, measure the amounts of sugars present and to determine the types of sugars present to better understand the source of stickiness.

**Summary**

It is an exciting time for the U.S. cotton industry. Domestic consumption is on the rise and U.S. cotton has a reputation as a premium fiber that is desirable for the production of high quality textile goods. In order to maintain the reputation as a premium fiber it is important that the entire cotton supply chain, from breeders and seed companies to textile mills, keep an eye on quality. Domestic cotton has good length, strength and maturity but there
are other quality traits that are important to the efficient conversion from fiber to quality textile products. Micronaire values must be within an acceptable range for mills to be able to produce quality yarn and fabric. The cotton bales must be clean and free from as many issues as possible to allow for efficient processing. Some of these issues, such as contamination, bark and visible foreign matter can be seen relatively easily by the producers and ginters, while other issues such as high micronaire and stickiness are invisible to the eye and only make their presence known when it is too late to address. Although it is an exciting time for the U.S. cotton industry, it is important that all members of the supply chain keep their eyes on quality and try to stay in-front of any issues which may harm U.S. cotton and its reputation as a premium fiber.

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Disclaimer

Names of companies or commercial products are given solely for the purpose of providing specific information; their mention does not imply recommendation or endorsement by the U.S. Department of Agriculture over others not mentioned.

References


Sylvania Telephone Staff Reports. Textile plant to create 250 jobs in Screven County. Sylvania Telephone, Oct. 15, 2013. Sylvania, GA.