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EVALUATION OF THE LEWIS COTTON MOISTURE RESTORATION SYSTEM

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Abstract

The research question in this work is to document the effect of restored moisture on fiber and yarn quality parameters through textile processing. To answer this question, four target moisture conditions were undertaken in this experiment. There being a normal moisture, 8% moisture, 10 % moisture, and a variable moisture condition. The normal moisture condition represented cotton ginned under normal conditions at a gin not equipped with a moisture restoration/monitoring system. The total sample size was 16 bales. The test-bale cottons were then processed into yarns using common conventional textile equipment representative of equipment found in today's American textile industry.

Introduction

Cotton is a cellulose fiber with a moisture regain in a standard atmosphere for textile testing of nearly eight percent. Previous research has shown that the moisture content of a cotton fiber directly affects its strength. The moisture content effect on cotton fiber strength is well documented and has reached a point among every aspect of the cotton industry to be considered common knowledge. However, with moisture restoration comes many additional considerations for the overall effect on cotton fibers. Some of these concerns are color degradation and microbial growth. There are few well documented cases of the overall effect cotton moisture content has on fiber quality, processability, and what level of moisture content would be optimum among the advantages and disadvantages of moisture restoration.

The Cotton Moisture System of Lewis Electric is one of several available moisture systems in the cotton-ginning arena prior to baling. The difference claimed by the Lewis system is accuracy in moisture application despite changes in the module moisture or the ginning environment. Some of the differentiating features of the system are: (1) the use of infra-red and radio frequency technology to quantify moisture content continuously; (2) the system reads ginning production information every half second and can respond accordingly to ensure uniform moisture application percentage; (3) the additional moisture added to the cotton is computer controlled and divides each pound of water into 91 pulses with a control tolerance of plus or minus one pulse; and (4) the system has an entirely unique five-nozzle arrangement for moisture application that is fed constantly with 40 PSI of water where changes in moisture quantity delivered are controlled by activating or deactivating nozzles.

Most textile spinning operations in the United States realize the importance of moisture when processing cotton fibers; hence, the reason these same spinning operations stage cotton laydowns prior to processing and operate the opening room areas with increased moisture content in the atmosphere. Researchers have proven that cotton fibers are brittle and sustain damage when processed in a dryer state when compared to a more hydrated cotton condition (Maughon, 1995). Specifically, moisture was seen to increase processed fiber quality characteristics from bale to finisher sliver in the areas of mean length, mean length %CV, short fiber content, and upper quartile length, all measured by the Uster AFIS.

Experimental

The four bales from each experimental condition were arranged in laydowns for the carding portion of the trial. The cotton was processed at the American Truetzschler pilot carding facility in Charlotte, North Carolina, on December 11-12, 2001. The opening and carding equipment used were a BDT – 019 Topfeeder, a MPM 4 Cell Multiphase Mixer, a CVT1 1600 Cleanomat, a Dustex 1600, a DFK 549 Card Chute, a DK 903 Carding Machine.

The fiber from each condition was carded utilizing identical machine settings with the exception of production speeds. Because the fibers would eventually be spun into both ring and open-end yarns for all moisture conditions, typical United States textile industry carding speeds were employed for each spinning scenario. The fiber destined for ring spinning was carded at 150 pounds per hour, and the fiber to be open-end spun was carded at 180 pounds per hour. The reasoning here was to mimic the most widely practical set-up in actual textile plants processing comparable cotton. All card sliver samples were tested using a Zellweger Uster Tester III for mass evenness, and tested for fiber quality characteristics via a Uster AFIS. Samples of card sliver from each condition were tested for moisture content.

Once carded, the cotton for each condition was subjected to two processes of drawing and one process of roving for the ring spinning trials, and one process of drawing for the open-end trails. The number of drawing passes also represents the standard practice of most United States yarn producers. All drawing slivers were tested for mass uniformity on a Uster Tester III, and fiber quality attributes on a Uster AFIS. The primary purpose of the AFIS testing on drawn sliver was to ensure the machine configuration did not adversely affect the fiber length.

Ring and open-end spun yarns were made from each experimental moisture condition. The ring yarns produced were 28/1 Ne. For open-end spinning, two yarns counts were made: 18/1 Ne and 26/1 Ne. The logic behind producing two counts of open-end spun yarns was that, in many cases, the inherent structure of the open-end yarns would often subdue cotton fiber attributes. However, as open-end yarns become finer differences in the fiber can be more readily seen. All yarns spun for the trials were spun utilizing standard textile industry set-ups for both the ring and open-end yarns. Each yarn was tested for quality characteristics such as mass evenness, strength, and defects.

Results, Discussion, and Conclusions

The research question posed by this work was to quantify the effect restored moisture has on fiber quality parameters through the carding process. Conventional reasoning says that moisture enhances the strength of cotton fiber mainly because of the reduction of the fiber's brittleness. Table 1 displays the carding process effect on the cotton fiber moisture content. Two key points of interest in these data are, with respect to carding, the higher the initial moisture content the higher the moisture content of the sliver. The second point is that carding speed affects the amount of moisture lost during carding. As previously stated, the ring slivers were carded at 150 pounds per hour and the open-end slivers were carded at 180 pounds per hour. For any given initial moisture content, the ring slivers had more moisture after carding than did the open-end slivers.

When fiber quality characteristics are concerned, there were no statistically significant differences in the ring card slivers from the slower carding speed. However, in the case of the open-end card slivers, the 10% moisture condition resulted in greater fiber mean length, greater fiber upper quartile length, and lower short fiber content when compared to all other samples. This can be seen in Figures 1 through 3.

For both yarns types and all counts made into yarn from the moisture conditions, no statistically significant difference existed between any of the yarn quality parameters. In the case of the ring yarns, a difference was not expected because the fibers from each condition destined for ring spinning displayed no real difference in quality parameters such as length and short fiber content.

However, in the case of the open-end yarns, it may have been possible for a difference in some quality parameters due to the difference that existed in the fiber length and short fiber content prior to spinning. Past textile research has shown the benefits of longer fibers and reduced short fiber on yarn quality. Two explanations for the lack of a difference in the open-end yarns spun for this work are: (1) the effect of the opening roller on the open-end spinning machine damaged the fibers from each condition sufficiently to void any preservation of length seen in the card slivers; and (2) spinning sample size was too small, and/or the true benefits of fiber length and short fiber content would require a large-scale, long-term plant trial to quantify its effect on yarn quality and spinning plant productivity.

The Cotton Moisture System can restore moisture to cotton fibers after ginning to a pre-set level, and do it accurately and consistently throughout the bale. With standard polyethylene bagging, the restored moisture remained in the bale for 3 months prior to processing with no loss to the atmosphere while in the warehouse environment. Moreover, when the bales were opened, no negative, visible signs related to moisture were present in any of the moisture-restored bales. Also, the restored moisture could not be felt by touch, giving an indication that the moisture had penetrated the fiber.

Some evidence that the restored moisture penetrated the fibers was in the fiber quality characteristics after the AFIS device and the carding process. Specifically, the restored moisture can result in the preservation of fiber length and reduction of short fiber generation when subjected to various mechanical devices, which are a direct effect of the increase fiber strength related to the moisture content. The additional fiber moisture improved the tenacity of the cotton fibers, which were more able to withstand the opening roller of an AFIS Tester. The improved tenacity of the fibers allowed for more fiber length preservation as carding production rates increased.

Researchers have shown that better fiber makes better yarn. Better fiber meaning optimum micronaire, fiber strength, longer length, less short fiber, and better length uniformity. However, this study did not see any statistical difference in the yarns made from any of the trial moisture conditions. Since previous research in many arenas of the cotton and textile fields have proven the benefits of moisture to cotton fibers and the fibers impact on yarn quality and performance, the reason for the lack of findings in the yarn results could be related to the size of the spinning trials. It maybe necessary to conduct more, long-term spinning trials to completely document the effect restored moisture has on cotton yarn quality and performance.

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References

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Table 1. Results of moisture content via the "bone" dry method for test conditions from bale laydown to card sliver.

	Moisture Content Percent - "Bone" Dry Method		
Condition	Bale Laydown	Ring Card Sliver	Open-End Card Sliver
Variable	5.88	4.48	4.46
Normal	5.30	4.72	4.48
8 %	7.34	4.84	4.54
10 %	9.15	4.90	4.67

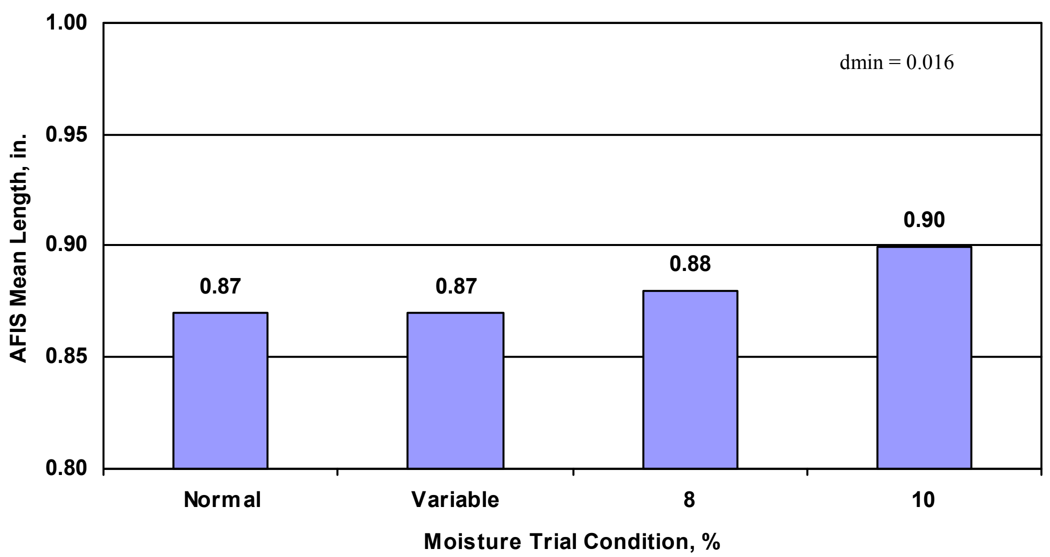

Figure 1. AFIS mean length for open-end card slivers.

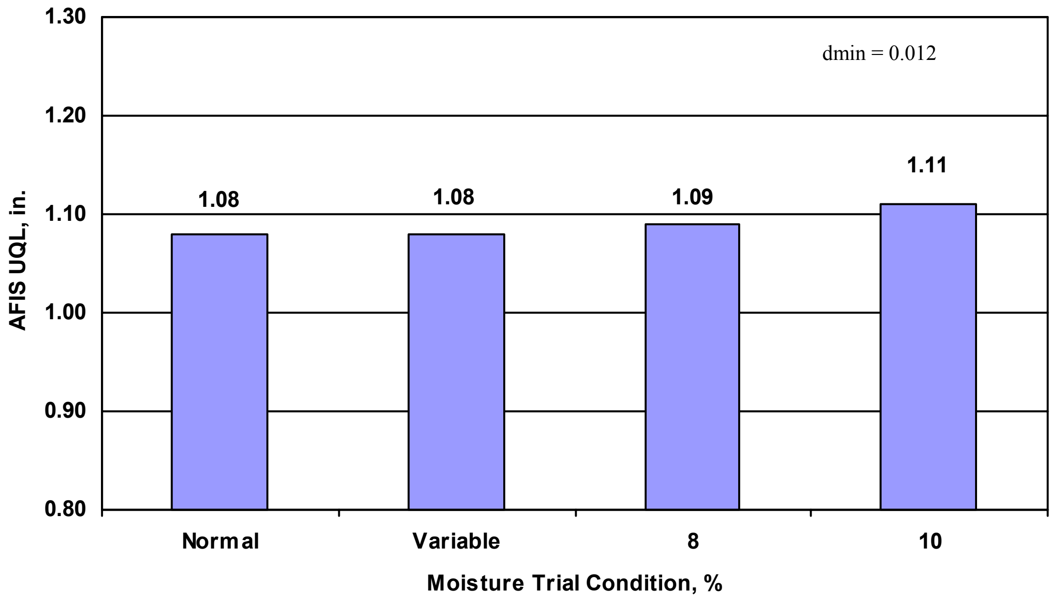

Figure 2. AFIS upper quartile length for open-end card slivers.

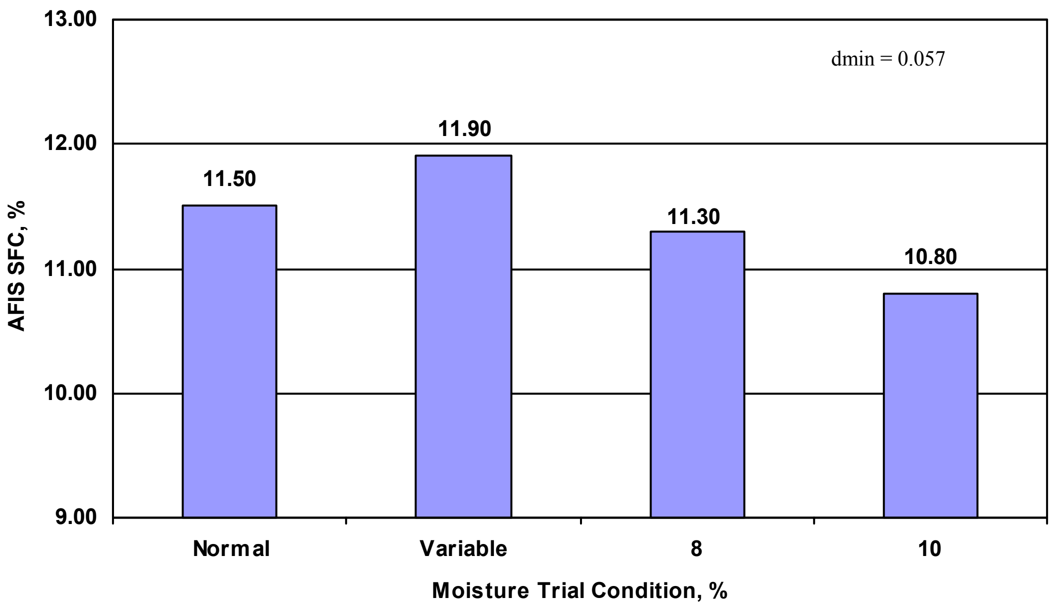

Figure 3. AFIS short fiber content percent for open-end card slivers.