THE VALUE OF FIBER TESTING IN THE GINNING INDUSTRY

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Abstract

Traditional fiber testing methods have focused on the bales of cotton as they are used in the spinning process. Basic fiber properties such as length, strength, micronaire, and color have been analyzed in great detail for the affect on yarn strength. A tremendous amount of data has been generated showing excellent correlations between the HVI measured fiber properties and yarn quality. These prediction formulas and correlations show that HVI properties measured on each bale of cotton can predict certain yarn quality parameters from 50% to 75% of the time. This has lead mills to further investigate the process in an attempt to improve the predicted yarn quality and overall spinning performance in the textile mill.

Over the past few years mills have begun to focus on process improvement using the AFIS instrument. The AFIS was designed to measure individual fibers in raw and process cotton. The measurement is much slower than the HVI with each test taking about three (3) minutes, but the results are very detailed distributions. Information from the AFIS provides averages and complete distribution histograms of all measured properties. The focus of the AFIS measurement has been on neps, short fiber content, and trash.

We have now taken this instrument with its detailed results into the ginning process. This was done because both the ginning and spinning processes have a large impact on neps, short fiber content, and trash. We also discovered that controlling the process in both the spinning mill and gin have a great impact on the final quality of yarn and fabric. Our investigation focused on the changes in neps and short fiber content in saw-ginned U.S. upland cottons. The results show that there is a wide difference within and between gins on these two fiber properties.

Yarn and Fabric Quality

Zellweger Uster has done many studies to show the correlation between neps and trash in cotton and yarn imperfections. Several studies have shown that there is a direct correlation between the number of neps (including seed coat fragments) and trash particles and the number of yarn neps. The imperfections in the yarn translate to imperfections in the fabric. This is highly visible in fabrics that are produced using the knitting process. These imperfections also have a negative affect on woven fabric but the visual affect is not as pronounced. A cotton yarn with a high number of neps, seed coat fragments, and trash is not only weaker, but it also produces a fabric that is visually unacceptable. Optimizing the process of opening, cleaning, and carding can greatly reduce the imperfections that result in poor quality yarn and fabric. The AFIS instrument is being used throughout the spinning industry as a tool for process control. The information from the AFIS on the neps and trash in cotton allows for precise scheduling of equipment maintenance and repair. Identifying machines that are producing off-quality material can now be done easily and effectively. Zero defects in fabric is quickly becoming the standard as worldwide competition pushes quality requirements higher.

Many US spinning mills have recently noticed changes in nep and trash levels that, until now, were difficult to explain. When a mill practices process control procedures, it is much easier to identify and isolate where a problem begins. During a recent AFIS User's Group seminar, the single largest interest was the identification of neps, seed coat neps, and trash in raw material. This is beyond the normal HVI information that all these mills now use on a routine basis. Many AFIS users are currently monitoring groups or lots of bales received from growth areas and gins that are supplying cotton. Spinning mills have discovered that yarn quality and spinning efficiency drop during the end of the crop year (especially when inventory stocks are low) and crop change. This information has led us to analyze bales based on growth areas and gin locations.

There is also a direct monetary reason for analyzing more closely the cotton bales. Figure 1 shows the breakdown of cost percentages in the manufacturing of rotor spun yarn. Raw material, by far, has the greatest impact on the cost and profitability of a spinning mill.

Ginning Effects on Neps, Short Fiber Content and Trash

The effects of multiple saw-type stages of lint cleaners can be analyzed using the AFIS instrument. Figures 2 and 3 show the AFIS results of multiple lint cleaners. The analysis highlights the rise in neps, reduction in trash particle count, and size as the number of lint cleaners increase. Knowing this information, some spinning mills are now buying gin direct cotton with the specification of using only one lint cleaner.

Recently an analysis was made at a spinning mill to determine if there was a significant difference between bales from the same gin. During this same time period we also decided to analyze the results from testing several different gin locations within the same growing area. Figures 4, 5, and 6 show the AFIS results for neps and short fiber content of ten bales, each from three different gin locations. These results highlight the variability of

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neps and short fiber content in bales processed at the same gin location. Nep values ranged from a low of 246 neps/gram to a high of 630 neps/gram. Short fiber content also had a significant difference between low and high, ranging from 6% to 13.5% by weight. Figures 7 and 8 give the results for neps and short fiber content respectively of 12 different gin locations within the same growing area. Variations of neps and short fiber content are significant between gin locations within the same growing area.

Long-term changes in the ginning process can also be analyzed using the AFIS instrument. A gin with two lint cleaners was monitored over a three month period. Bale samples were obtained throughout the shift and an average was calculated for each day of production. AFIS results were monitored for neps and short fiber content. Figures 9 and 10 highlight the results over time of one gin plant for neps and short fiber content respectively.

Conclusions

Controlling pre-cleaners, ginstands, and lint cleaners process are critical in maintaining the optimum fiber properties necessary for spinning a quality yarn. The additional fiber properties of neps, short fiber content, and trash as measured by the AFIS instrument are necessary to optimize today's high-speed spinning and ginning processes. Process control in ginning can reduce variation in nep levels from bale to bale and from gin plant to plant. Necessary machine maintenance and repair can be scheduled during the ginning season using the AFIS instrument to insure a consistent quality of the cotton being processed into bales. International competitive pressure on the U.S. textile industry is greater than ever, requiring improvement and consistency of the raw materials used in producing world-class yarns and fabrics. High quality, raw cotton will help to ensure a healthy textile industry which, in turn, can afford prices that fairly compensate cotton farmers and ginners.

References

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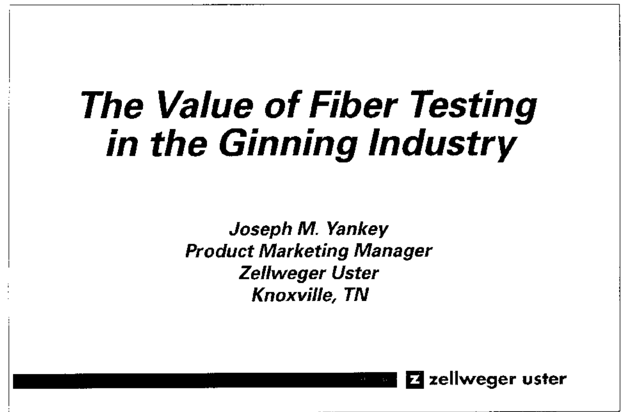

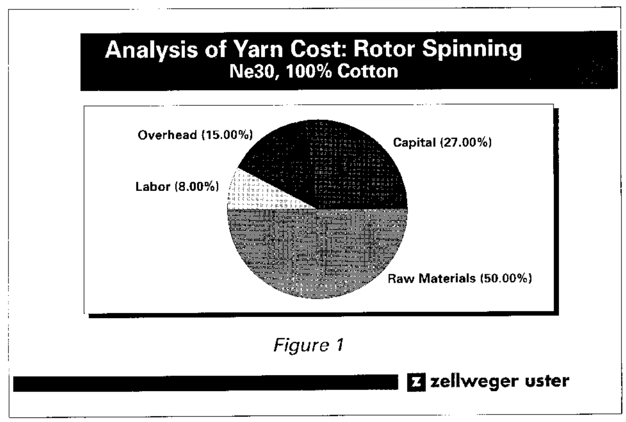

Figure 1

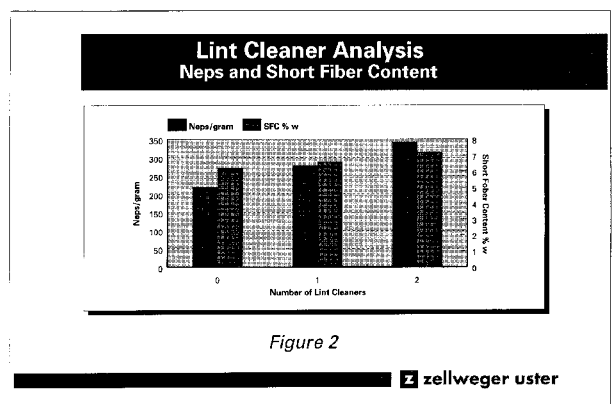

Figure 2

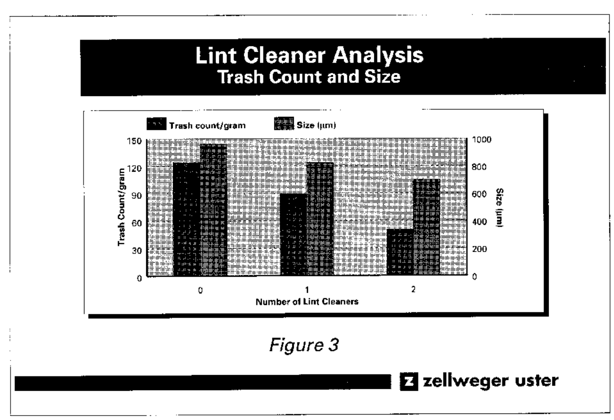

Figure 3

Variation Within Gin Location 1
Neps and Short Fiber Content

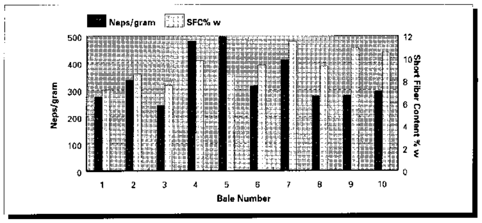

Figure 4

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Variation Within Gin Location 2
Neps and Short Fiber Content

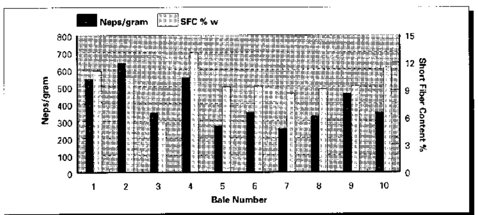

Figure 5

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Variation Within Gin Location 3
Neps and Short Fiber Content

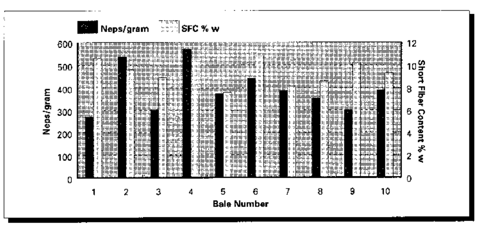

Figure 6

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Variation Between Gin Locations
Neps

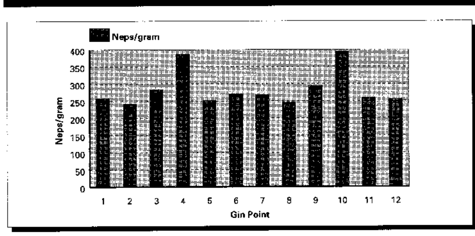

Figure 7

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Variation Between Gin Locations
Short Fiber Content

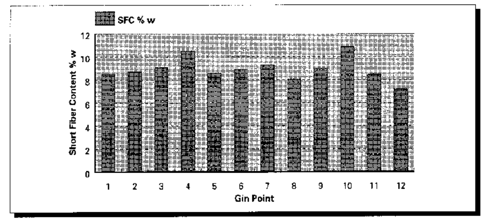

Figure 8

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Gin Long Term Analysis
AFIS Neps Content

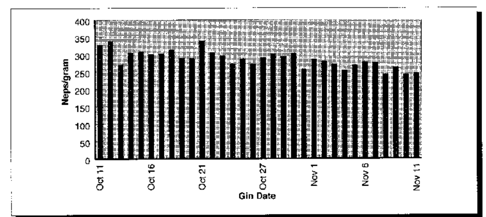

Figure 9

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Gin Long Term Analysis
AFIS Short Fiber Content

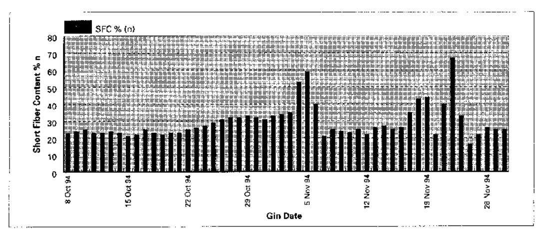

Figure 10

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