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MICRONAIRE PERFORMANCE COMPARISON

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Abstract

The purpose of this research was to determine the effects of varying micronaire in raw cotton on yarn and fabric production. Micronaire is an indirect measure of the linear density of a cotton fiber. The micronaire value acquired during High Volume Instrument (HVI) testing roughly indicates the fineness of fibers in a given bale of cotton. For a given yarn count, the micronaire of the fibers will affect the number of fibers in the cross-section of the yarn. While holding all other fiber qualities constant, an increase in the micronaire value will result in a decrease in yarn strength. Especially for finer yarn counts or high yarn strength requirements, the higher micronaire values can create yarn count and strength limitations for a given bale quality. Two sets of bales were used to make up the groundwork, 4.0 and 5.2 Mic. In addition, three laydown blends were made up from these high and low micronaire bales, resulting in 4.3, 4.6 and 4.9 micronaire conditions. All five micronaire conditions were run through three major spinning systems, ring, rotor, and vortex spinning.

Background

U.S. upland cottons having a micronaire (Mic) value of 5.0 or greater are heavily discounted on the New York Cotton Exchange. The amount of discount varies depending on the growth region. According to February 2003 USDA data, the average discount for U.S. upland cotton with a Mic value between 5.0 and 5.2 was 343 points or 3.43 cents/lb. Mic values of 5.3 and higher receive an average discount of 450 points or 4.50 cents/lb.

Micronaire is an indirect measure of the linear density of a fiber. The micronaire value acquired during High Volume Instrument (HVI) testing roughly indicates the fineness of fibers in a given bale of cotton. The non-discounted range has been 3.5 – 4.9 Mic. As micronaire increases, the fineness or actual diameter of the fiber will also increase. For a given yarn count, the micronaire of the fibers will affect the number of fibers in the cross-section of the yarn. While holding all other fiber qualities constant, an increase in the micronaire value will result in a decrease in yarn strength. Especially for finer yarn counts or high yarn strength requirements, the higher micronaire values can create yarn count and strength limitations for a given bale quality.

On the other hand, higher micronaire cotton usually means that the fiber is more mature. Higher maturity decreases the fiber's tendency to form neps during ginning and fiber processing. High Mic cottons seem to be easier to open and clean through a spinning mill's opening, cleaning, and carding line. Assuming proper fiber processing techniques, most fabrics will lack the neps and white specs commonly found in low Mic cotton fabrics. In addition, the high Mic fabrics will generally dye to a deeper shade with the same dye formulation.

It has been well documented that small variations in average micronaire from laydown to laydown or high C.V. of micronaire within a given laydown can create fabric barré. Micronaire control is essential to a mill's success or failure for a given yarn. As mentioned above, yarn strength and yarn count limitations are certainly affected by increases of micronaire in the laydown. Other fiber qualities, such as fiber length, short fiber content and length uniformity, can also contribute to decreases in yarn strength. A decrease in yarn strength can contribute to many of the following mill concerns:

- Decreased spinning efficiency (weaker yarn, increased ends down)
- Decrease in productivity (increasing twist in order to maintain strength)
- Decreased knitting and/or weaving efficiency
- Decreased fabric strength, holes in knit fabrics
- Increased number of piece-ups/imperfections in yarn
- Increased fiber fly/cleaning cycles due to increased ends down
- Increased imperfections in fabric

Yarn manufacturers producing yarns for heavy to medium weight knit and woven fabrics are very receptive to high micronaire cottons. These spinners tend to blend a high percentage of higher Mic cotton with medium and low Mic cotton. In fact, spinning mills willingly search for high Mic cotton in order to take advantage of its dyeing properties and reduce their raw material cost. Mills either buy discounted high Mic cotton or can reduce overall cotton price by allowing a wider Mic range in purchasing contract.

For coarse to medium count mills, it is typical for 20% or more of a mill's cotton inventory to contain bales with 4.8 and higher micronaire value. These mills will blend in the high micronaire cotton or use it at 100% exclusively for yarns going into products like socks and ground yarns for fleece. An additional raw material cost saving option is to comb the high Mic cotton blend with acceptable length for finer ring counts (up to Ne 40/1). The resultant combed fabric can have increased value because of the lack of immature fiber and white specs.

Seemingly, as long as there is plentiful supply of premium range (3.8-4.4) Mic cotton, a certain percentage of high micronaire bales in the crop should not present any problems for spinners. The main concern is that the average micronaire for recent U.S. crops has been on the increase. This may be presenting an imbalance of high Mic to the industry; hence some members of the spinning industry are suggesting that additional discounts apply to 4.8 and 4.9 micronaire cotton.

Introduction

When comparing USDA fiber qualities for the U.S. upland 2001–2002 crop (through Jan 31st, 2002) with the 2000–2001 crop, the average micronaire for all classing offices had increased from 4.30 (2000 crop) to 4.56 (2001 crop) micronaire. The micronaire has been slowly increasing over the last ten years. In some states, more than 50% of the 2001-2002 cotton crop was grown at or above 5.0 micronaire. This trend has raised concern from the spinning industry. The spinning industry buys cotton based on the fiber quality requirements for the yarns produced. As micronaire increases, perhaps the available supply of medium Mic cotton (4.0 – 4.5) is not sufficient for market demand. Why would this concern the spinning mills? To answer this question, this evaluation will compare the performance of a lower-micronaire cotton (Mic=4.0) with a higher-micronaire cotton (Mic=5.2).

Objective

- To determine the fiber processing and yarn manufacturing performance from two values of micronaire (4.0 and 5.2 Mic). In addition, to evaluate three laydown blends made up from these high and low micronaire bales.
- To determine spinning limits and any special considerations for these five micronaire conditions on the ring spinning, rotor, and MVS spinning systems and resultant knit fabrics.

Procedures

Fiber Processing
FPL procured four bales for this comparison. Two bales represented the lower (4.0 Mic) micronaire range and two bales represented the higher (5.2 Mic) micronaire range. Five fiber blends were processed into card sliver as follows:

1. 100% 4.0-micronaire Cotton – two bales
2. 75% 4.0-micronaire Cotton/ 25% 5.2-micronaire Cotton
3. 50% 4.0-micronaire Cotton/ 50% 5.2-micronaire Cotton
4. 25% 4.0-micronaire Cotton/ 75% 5.2-micronaire Cotton
5. 100% 5.2-micronaire Cotton – two bales

To ensure accurate blending, weigh pan hoppers were utilized for the various blends (2 through 4).

All five fiber blends were processed into breaker and finisher sliver under controlled conditions. The finisher sliver from each condition was then delivered to rotor spinning, MVS spinning, and roving/ring spinning. No auto-leveling was performed on either the breaker draw or finisher draw.

Ring Spinning Procedure
Based on initial spinning trials with the 100% 5.2 Mic cotton and 100% 4.0 Mic cotton, it was determined that Ne 30/1 was the finest yarn count that could be spun while maintaining acceptable spinning efficiency. Twist curves, from a 3.3 twist multiple (TM) up to a 5.1 TM, for all five of the fiber conditions were developed on the ring spinning frame. Additional yarn for knit fabric production was spun using a 3.5 TM.

Rotor Spinning Procedure
Based on initial spinning trials with the 100% 5.2 Mic cotton and 100% 4.0 Mic cotton, it was determined that Ne 18/1 was the finest yarn count that could be spun while maintaining acceptable spinning efficiency. Twist curves, from 3.6 TM to 5.6 TM, for all five conditions were developed on the rotor spinning frame. Additional yarn for knit fabric production was spun using a 3.8 TM.

MVS Spinning Procedure
Based on initial spinning trials with the 100% 5.2 Mic cotton and 100% 4.0 Mic cotton, it was determined that Ne 28/1 was the finest yarn count that could be spun while maintaining acceptable spinning efficiency for all fiber conditions. Only three conditions – 100% 4.0 Mic cotton, 50/50 4.0 Mic/ 5.2 Mic cotton, and 100% 5.2 Mic cotton – were spun on the MVS spinning frame. No fabrics were produced from the MVS spinning system.

Fabric Production

All five fiber conditions of ring spun yarns were knit into a 28 cut single jersey construction for evaluation and comparison of the various fiber blends. With respect to the rotor yarns, two conditions, the 100% 4.0 Mic and 100% 5.2 Mic cotton, were knit into an 18 cut single jersey fabric for evaluation and comparison. The MVS yarns were not knit into fabric.

Ring Spun Fabrics – 28 Cut Single Jersey (SK-1702)

1A – 100% 4.0-Micronaire cotton
1B – 75% 4.0-Micronaire cotton/ 25% 5.2-Micronaire cotton
1C – 50% 4.0-Micronaire cotton/ 50% 5.2-Micronaire cotton
1D – 25% 4.0-Micronaire cotton/ 75% 5.2-Micronaire cotton
1E – 100% 5.2-Micronaire cotton

In addition, the ring yarns were knit as feeder stripes in the following combinations to show possible problems with barré when combining yarns of different micronaire levels.

2A – 20 Feeds – 100% 5.2-Micronaire cotton
40 Feeds – 100% 4.0-Micronaire cotton
2B – 20 Feeds – 100% 4.0-Micronaire cotton
40 Feeds – 25% 4.0-Micronaire cotton
75% 5.2-Micronaire cotton
2C – 20 Feeds – 100% 5.2-Micronaire cotton
40 Feeds – 50% 4.0-Micronaire cotton
50% 5.2-Micronaire cotton
2D – 20 Feeds – 100% 4.0-Micronaire cotton
40 Feeds – 50% 4.0-Micronaire cotton
50% 5.2-Micronaire cotton
2E – 20 Feeds – 25% 4.0-Micronaire cotton/75% 5.2-Micronaire cotton
40 Feeds – 75% 4.0-Micronaire cotton/25% 5.2-Micronaire cotton
2F – 20 Feeds – 50% 4.0-Micronaire cotton/50% 5.2-Micronaire cotton
40 Feeds – 75% 4.0-Micronaire cotton/25% 5.2-Micronaire cotton

Rotor Spun Fabrics – 18 cut Single Jersey

SK 1691-2 – 100% 4.0-Micronaire cotton
SK 1691-3 – 100% 5.2-Micronaire cotton

In addition to the two fabrics listed above, another fabric was produced to show a 1.2 difference in micronaire.

SK 1691-4 – 12 feeds – 5.2-Micronaire cotton
24 feeds – 4.0-Micronaire cotton

Results and Discussion

Fiber Properties

The four bales employed for this project had the following HVI properties shown in Table I. The micronaire range represents the lower and upper ranges of micronaire typically available from U.S. upland cotton. Length and uniformity index values are better than the average for most upland cottons. The strength, elongation, and short fiber content were about average for upland cottons. Appendix A contains definitions for HVI and AFIS values.

Table I. HVI Fiber Quality for Raw Cotton.

	Mic	Upper Half Mean Length (UHML) (inches)	Length Uniformity Index (%)	Strength (g/Tex)	Elongation (%)	SFC (%)
Higher Micronaire	5.2	1.11	82.9	27.8	4.4	7.3
	5.1	1.09	82.2	27.0	4.4	8.3
Lower Micronaire	4.1	1.08	82.1	28.4	6.0	9.8
	3.9	1.09	81.1	27.4	6.0	9.6

Fiber Processing: Opening, Blending, Cleaning, and Carding

All five fiber conditions (listed below) were processed through a set of Fiber Controls opening hoppers, a Rieter B10/B60 cleaning line, and a Truetzschler 803 card using the same machinery settings and production rates.

1. 100% 4.0-Micronaire cotton – two bales
2. 75% 4.0-Micronaire cotton/ 25% 5.2-Micronaire cotton
3. 50% 4.0-Micronaire cotton/ 50% 5.2-Micronaire cotton
4. 25% 4.0-Micronaire cotton/ 75% 5.2-Micronaire cotton
5. 100% 5.2-Micronaire cotton – two bales

Fiber samples from each blend were taken just before the card and were tested for micronaire on an HVI testing line.

HVI Micronaire Results Card Batt

100% 4.0-Micronaire cotton 4.0
75% 4.0-Micronaire /25% 5.2-Micronaire 4.3
50% 4.0-Micronaire /50% 5.2-Micronaire 4.6
25% 4.0-Micronaire /75% 5.2-Micronaire 4.9
100% 5.2-Micronaire cotton 5.2

The HVI results reveal a 0.3 progression in micronaire from 4.0 up to 5.2 micronaire. From this point forward this report will identify each condition by its actual HVI Micronaire values (4.0, 4.3, 4.6, etc.), as opposed to its blend level.

The card production rate was set at 100 lb/hour for each condition. Chart 1 displays the card sliver evenness data for each fiber condition. The general trend for card sliver seems to be that evenness improves as micronaire increases. Seen later in this report, the evenness information for downstream fiber processing does not follow along this same trend.

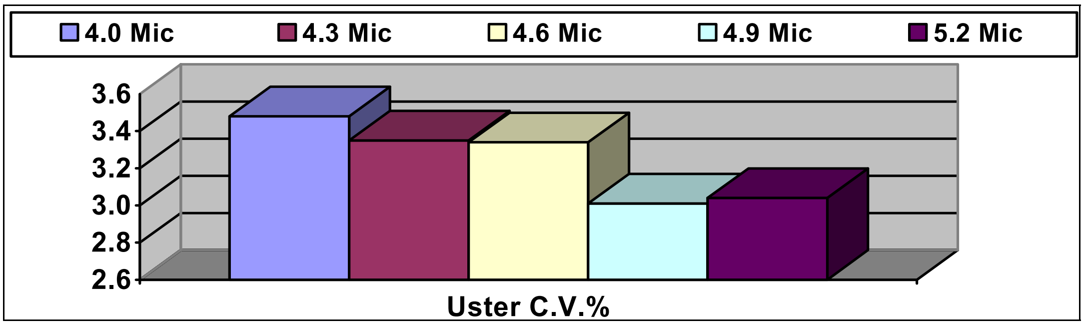


Figure 1. Card Sliver Evenness.

Drawing

Sliver for Ring and Rotor Spinning. All five conditions were drawn twice without the use of an auto-leveler. The breaker (first process) drawing took place on a Rieter DO/5 incorporating approximately a 6- total draft. The finisher drawing was run on a Rieter D-30 draw frame and delivered a sliver weight of 75 grains/yard. Table II shows the results of the Uster C.V. percentage for each process.

Table II. Uster® Evenness – Breaker and Finisher Sliver.

Fiber Condition	Breaker Draw	Finisher Draw
4.0 Mic cotton	3.38	2.55
4.3 Mic cotton	3.34	2.94
4.6 Mic cotton	3.17	2.92
4.9 Mic cotton	3.39	3.09
5.2 Mic cotton	3.41	2.98

The Uster® evenness data through drawing does not indicate that micronaire has any effect on sliver evenness. The AFIS data for the finisher sliver is included in Appendix B.

Sliver for MVS Spinning

Yarn was spun from three fiber conditions on the MVS spinning system – no fabrics were produced. Three cotton conditions – 1) 4.0 Mic, 2) 4.6 Mic, 3) 5.2 Mic cotton – were processed through three processes of drawing. Table III shows the Uster® evenness data for the 50 grains/yard finisher drawing process.

Table III. Uster® Evenness – Finisher Draw for MVS Sliver.

Fiber Condition	Finisher Draw
4.0 Mic Cotton	3.27
4.6 Mic Cotton	3.28
5.2 Mic Cotton	3.29

Yarn Manufacturing

Ring Spinning. With respect to concerns made by yarn manufacturers, yarn strength is one of the main issues surrounding increases in micronaire. All five conditions were processed into 1.0 hank/lb roving. Initial spinning trials included performing an extensive twist curve study. The twist multiples ranged from a 3.3 TM up to a 5.1 TM. Chart 2 displays the single end yarn strengths from the twist curve trials.

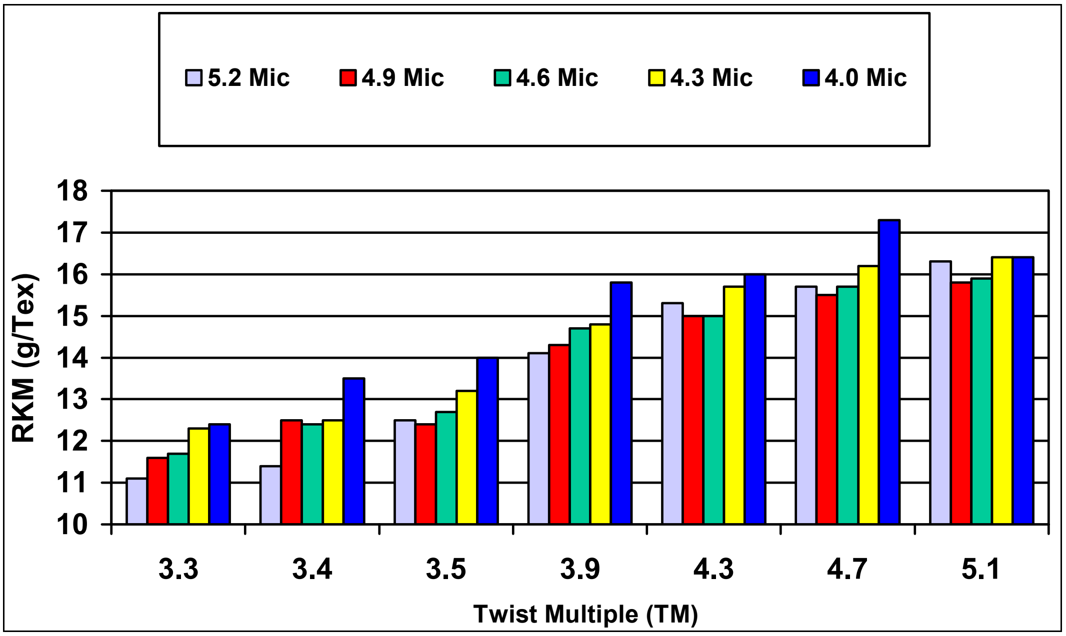


Figure 2. Ne 30/1 Twist Curves – Single End Strength RKM (g/Tex).

This information graphically shows the effect of micronaire on resulting yarn strength. Within any given twist level, there is a general trend that lower Mic cotton produces stronger yarns. The strength increase in lower Micronaire cotton is because there are more fibers in the cross section of the yarn. For additional yarn quality data from the twist curve trials refer to the charts in Appendix C and D.

Based on yarn quality data and observed spinning efficiency from the twist trials, a 3.5 TM was selected for the "production run" of all fiber conditions and for use in knit fabric production. Similar to the previously spun twist trials, the production run confirms the same relationship between micronaire and yarn strength (see Chart 3).

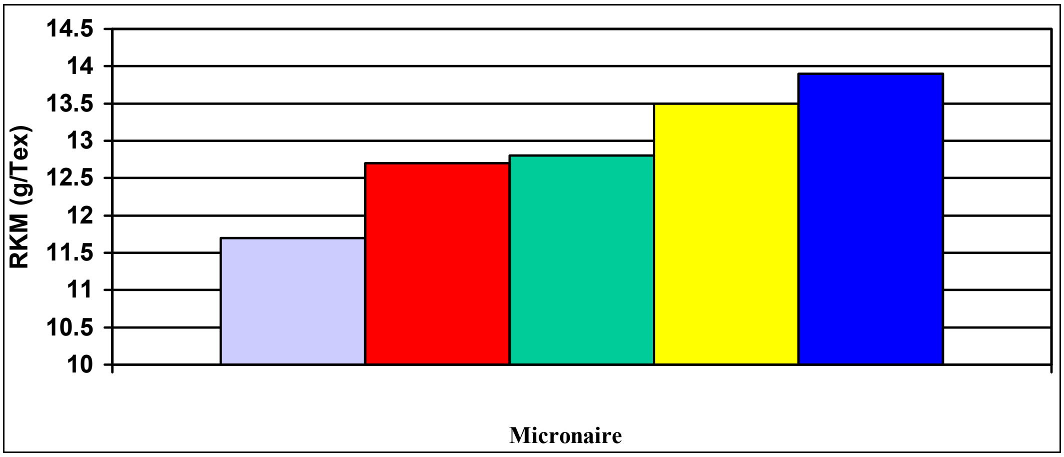


Figure 3. Single End Strength RKM (g/Tex) – Ne 30/1 3.5 TM Production Run.

Other important yarn qualities, shown in Table IV and V, appear to be also affected by a change in micronaire. Every yarn quality category was negatively affected to some degree from an increase in Micronaire.

Table IV. Yarn Strength and Elongation Results – Ne 30/1 Ring @ 3.5 TM.

	Skein Break Factor	Single End (minimum)	Single End (maximum)	Single End Elongation (%)*
4.0 Mic	2150	201.4	353.8	6.31
4.3 Mic	2068	205.1	337.0	6.06
4.6 Mic	1999	187.1	314.8	5.62
4.9 Mic	1868	171.6	313.6	5.38
5.2 Mic	1822	164.8	299.5	5.07

*Note: the elongation difference in the yarn is probably because the cotton bales have different elongation values – 4.4% for the 5.2 Mic and 6.0% for the 4.0 Mic cotton.

Table V. Yarn Evenness and Imperfections Results- Ne 30/1 Ring @ 3.5 TM.

	Evenness (C.V.%)	Thins	Thicks	Neps	Total IPI	Hairiness
4.0 Mic	16.30	28	283	390	701	6.10
4.3 Mic	17.35	56	409	505	970	6.02
4.6 Mic	16.90	37	392	537	966	6.11
4.9 Mic	17.73	61	524	661	1246	6.21
5.2 Mic	17.92	64	568	804	1436	6.28

Spinning performance is overlooked as a serious consequence when mill management decides to lower the overall fiber quality of laydowns. Most mill managers will agree that the key to meeting the demands of production is directly associated with keeping spinning efficiency at a high level. In other words, management has to associate the cost of lower spinning efficiency with raw material savings. Based on Cotton Incorporated's experiences in the field, this association is not always considered when raw material savings are computed. Chart 4 displays the Ne 30/1 ring yarn results for ends down per 1,000 spindle hours for the production run.

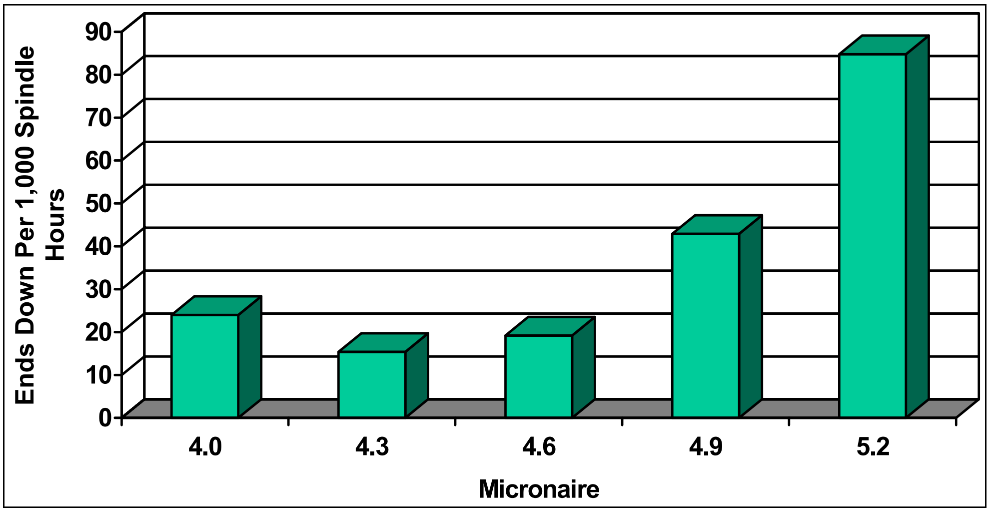
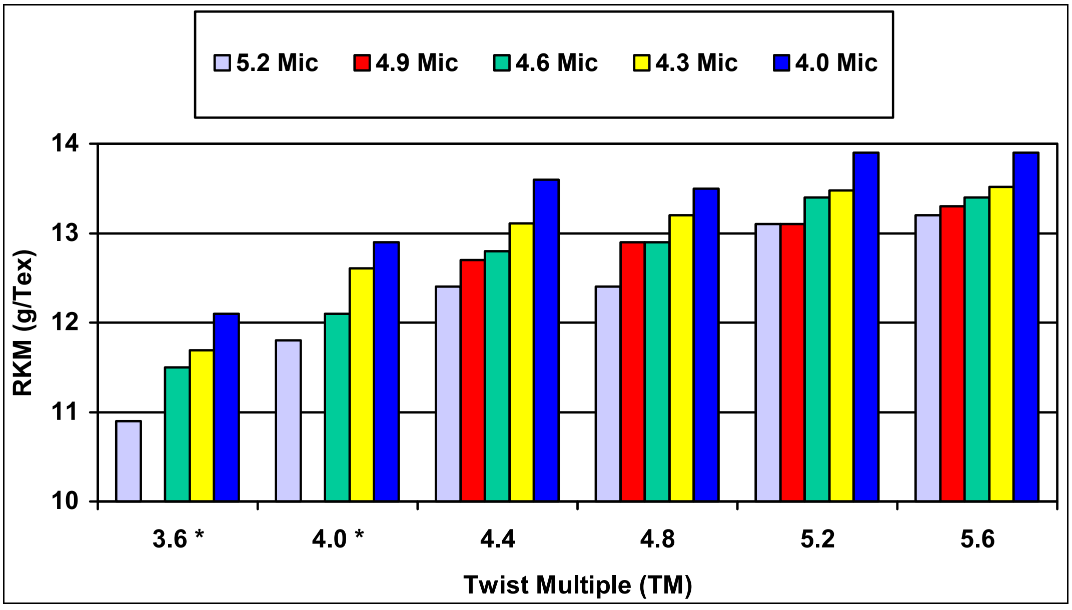


Figure 4. Ne 30/1 Ring Yarn @ 3.5 TM – Spinning Performance.

Rotor Spinning. After delivering a 75-grain/yard finisher sliver to the Rieter R1 rotor spinning frame, a twist curve study, similar to the ring, was performed for Ne 18/1 yarn count. The twist multiple ranged from 3.6 – 5.6 TM for all spinning conditions.

Chart 5 displays the single end strength for each condition at every twist multiple. The 4.9 Micronaire cotton sample would not spin at the 3.6 or 4.0 twist multiple. No explanation for this phenomenon could be determined, especially since the 100% 5.2-Mic cotton was spun successfully at both of these twist multiples. As was the case with the ring yarns, the single end yarn strength for the rotor yarns is affected by increases in micronaire values. Please refer to appendix E and F for additional information on the twist curve.



(*Unable to produce (75/25) yarns at 3.6 and 4.0 TM).

Figure 5. Ne 18/1 OE Twist Curve – Single End Strength RKM (g/Tex).

Based on yarn quality data and observed spinning efficiency from the twist trials, a 3.8 TM was selected for the "production run" of all fiber conditions and for use in knit fabric production. Chart 6, representing the 'production runs', confirms the same relationship between micronaire and single-end yarn strength that came out of the twist trials.

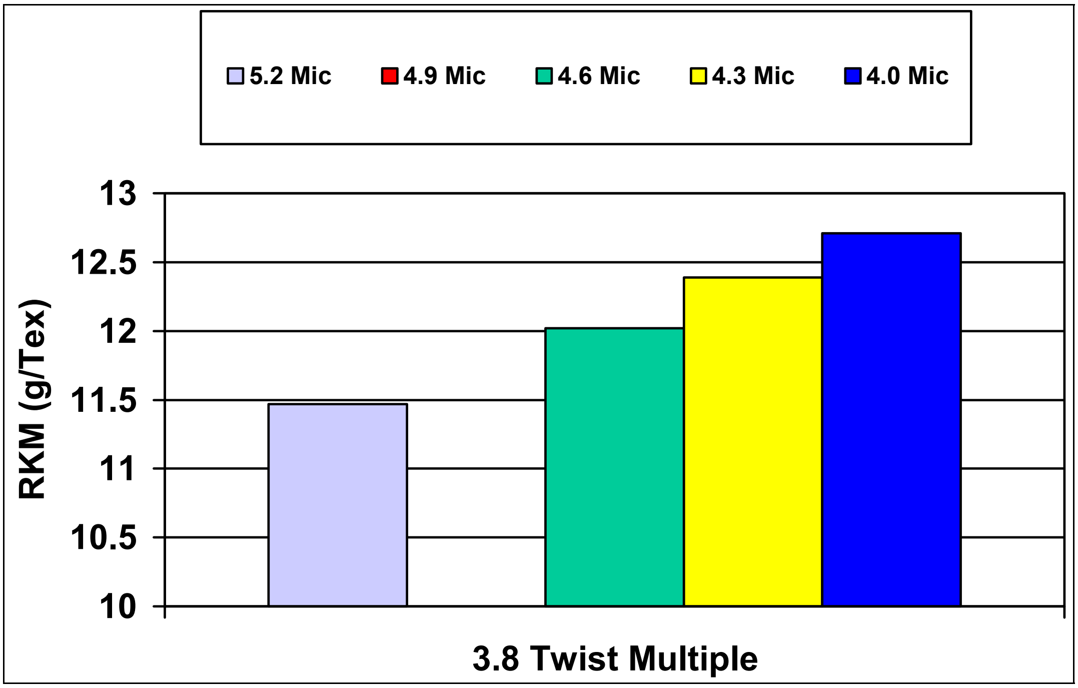


Figure 6. Ne 18/1 OE – Single End Strength RKM (g/Tex).

The data in Table VI and VII show the complete yarn testing results for the rotor yarns. The trend of increasing skein break values and single end minimum and maximum values correlated directly to the results on ring spinning system. The evenness and imperfections results were not significantly affected by the increases in micronaire value.

Table VI. Yarn Quality Results – Ne 18/1 Rotor Yarn @ 3.8 T.M.

	Skein Break Factor	Single End (minimum)	Single End (maximum)	Single End Elongation (%)*
4.0 Mic	2086	354.5	489.2	7.16
4.3 Mic	1964	339.8	480.8	6.71
4.6 Mic	1891	319.2	462.2	6.36
4.9 Mic	N/A	N/A	N/A	N/A
5.2 Mic	1819	277.8	440.3	5.72

Table VII. Yarn Quality Results – Ne 18/1 Rotor Yarn @ 3.8 T.M.

	Evenness (C.V.%)	Thins	Thicks	Neps	Total IPI	Hairiness
4.0 Mic	13.26	8	15	62	85	4.43
4.3 Mic	13.31	9	15	52	76	4.46
4.6 Mic	13.27	9	12	41	62	4.46
4.9 Mic	N/A	N/A	N/A	N/A	N/A	N/A
5.2 Mic	13.65	12	17	64	93	4.63

Referring to previous comments made about ring spinning performance, a mill cannot afford to overlook the consequences of changing standards for raw material. Chart 7 reveals the results of ends down/ 1,000 rotor hours for the Ne 18/1 rotor yarns.

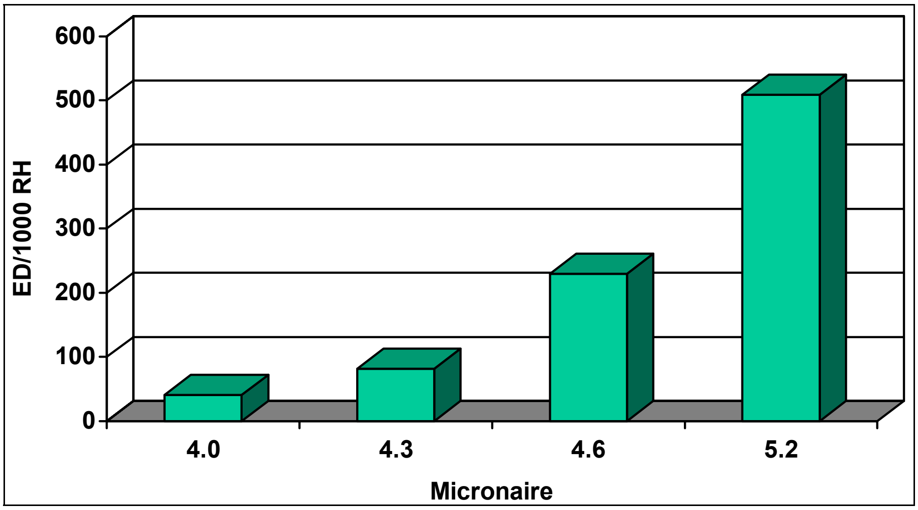


Figure 7. Ne 18/1 with 3.8 TM – Spinning Performance.

MVS Spinning

The MVS spinning frame was incorporated in this project work to obtain yarn-testing results. No fabrics were produced from these yarns. The single end strength results are displayed in Chart 8. Although the 5.2 Mic yarn is weaker than the 4.0 Mic yarn, the difference is not as great compared with the ring and rotor yarn conditions.

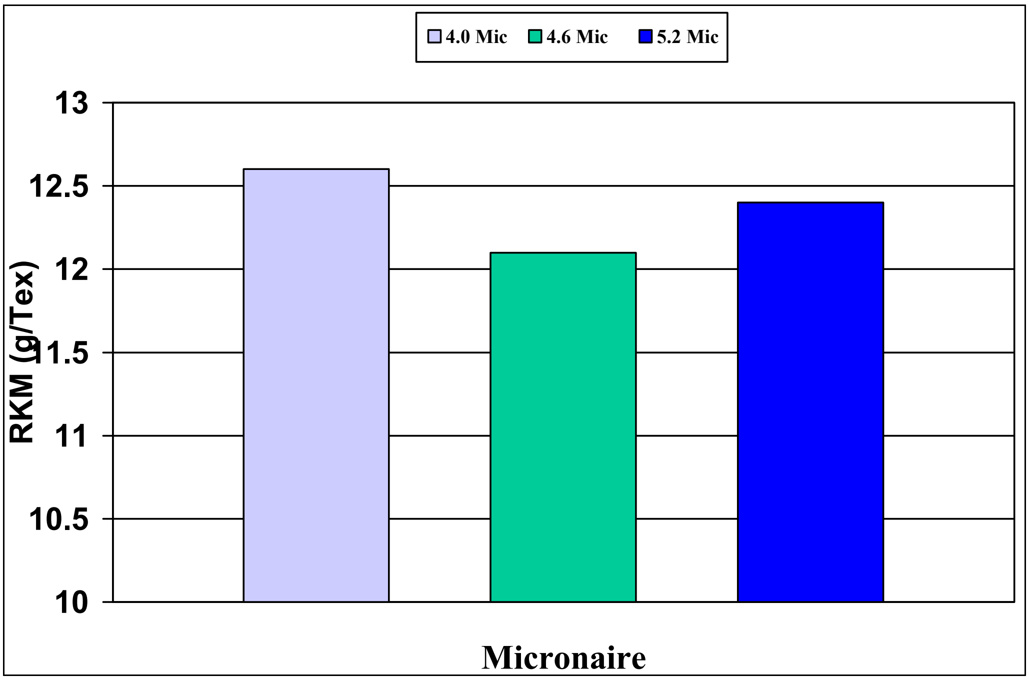


Figure 8. Ne 28/1 MVS Spinning – Single End Strength – RKM (g/Tex).

Tables VIII and IX display other pertinent yarn data for the MVS yarns. The skein break for the 4.0 Mic MVS yarn is 7.2 % stronger than the 5.2 Mic. Comparing the 4.0 and 5.2 Mic conditions, the skein break increased 18% for the ring spun yarn and 14.7% for the rotor spun yarn. Similar to the ring yarn, the evenness and imperfection results are negatively affected by the increase in micronaire.

Table VIII. Yarn Strength and Elongation- Ne 30/1 MVS.

	Skein Break Factor	Single End (minimum)	Single End (maximum)	Single End Elongation (%)
4.0 Mic	1915	164.4	327.8	6.66
4.6 Mic	1814	196.7	324.5	6.04
5.2 Mic	1787	179.0	339.0	5.52

Table IX. Yarn Evenness and Imperfections- Ne 30/1 MVS.

	Evenness (C.V.%)	Thins	Thicks	Neps	Total IPI	Hairiness
4.0 Mic	18.19	206	482	488	1176	4.52
4.6 Mic	18.65	252	558	528	1338	4.52
5.2 Mic	19.37	328	668	805	1801	4.44

Fabric Results

All five ring-spun conditions were knit into commercial 28-cut single jersey fabrics. The resultant knit fabrics were scoured, bleached, and dyed with red direct dyes as one lot in a soft-flow jet-dyeing machine. The fabrics were dried tubularly in a relaxation dryer. The fabrics were slit open and then finished with the Cotton Soft 200 formula on a tenter frame.

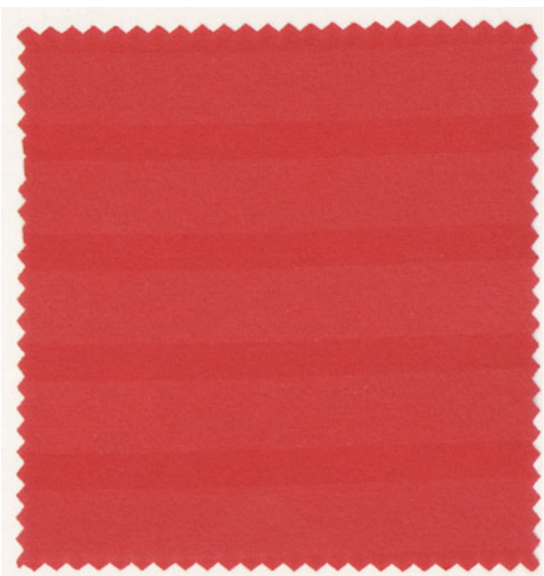
Each fabric was tested in the Textile Services Laboratory at Cotton Incorporated. Table X shows testing results of the dyed and finished fabric before and after three home launderings and tumble dryings (HLTD's). The main difference in the fabric test results is specific to the fabric strength or Mullen burst results. Before washing, the 4.0 Mic fabric is 14.25% stronger than the 5.2 Mic fabric. After washing, the difference was reduced to 9.1%. Pilling results, especially after 3 HLTD's, do not indicate any conclusive trends with respect to Micronaire values.

Table X. Ne 30/1 Ring Yarns – Fabric Test Results - 28 cut Single Jersey.

		oz/yd^2	Smoothness	Mullen Burst	Ramdom Tumble Pill	% Skew
Dyed and Finished	4.0 Mic	4.2	3.3	91.4	3.0	17.40
	4.3 Mic	4.1	3.7	87.4	2.7	14.80
	4.6 Mic	4.0	3.3	88.5	2.5	15.87
	4.9 Mic	4.1	3.4	88.4	2.7	13.60
	5.2 Mic	4.0	3.5	80.0	2.3	13.20
After 3 Hltd's*	4.0 Mic	-	2.8	89.6	2.2	14.93
	4.3 Mic	-	2.7	87.4	2.5	15.60
	4.6 Mic	-	2.6	85.8	2.3	15.73
	4.9 Mic	-	2.4	87.5	2.3	15.47
	5.2 Mic	-	2.2	82.1	2.3	17.07

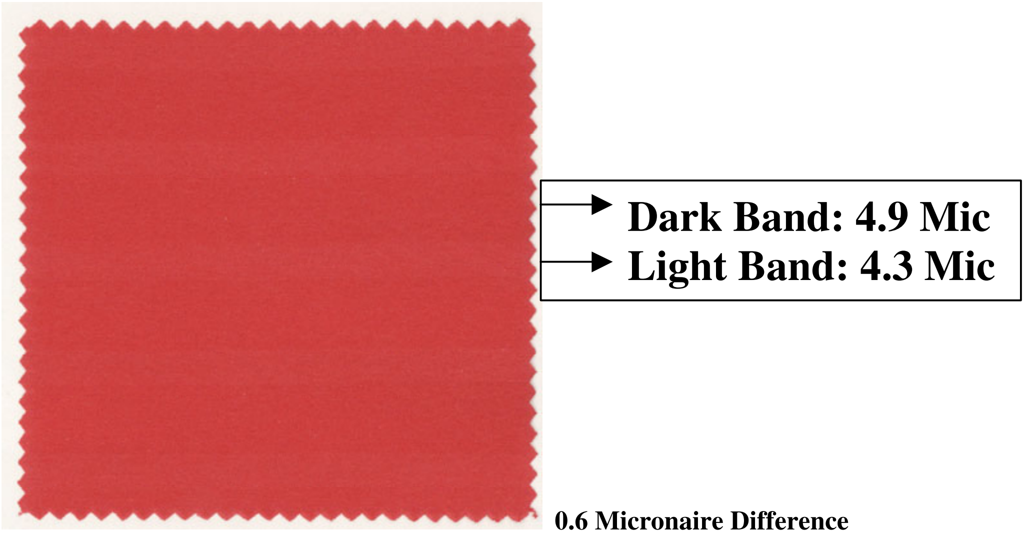
* HLTD's – Home Launderings and Tumble Dryings.

Six fabrics were produced using various combinations of the ring yarns to simulate mixing yarns of different Mic values on the knitting frame. The resultant fabrics ranged from a Mic difference of 1.2 down to as little as a 0.3 difference in Mic. After dyeing and finishing the fabrics, barré was evident in all six fabrics. Two of the six fabrics are displayed below.



Dark Band: 5.2 Mic
Light Band: 4.0 Mic

1.2 Micronaire Difference



0.6 Micronaire Difference

Conclusions

The project provided a comprehensive insight into the effects of changing micronaire on yarn and fabric properties. Though the work is representative of a laboratory situation, mills have incurred similar micronaire related experiences with respect to losses in efficiency, variations in yarn quality, and costly claims related to fabric barré.

The initial spinning limit curves determined the finest counts that could be spun with the cotton used in this comparison. The 5.2 Mic cotton was the limiting factor in making yarn count determinations on the various spinning systems. The ring and MVS spinning systems were capable of spinning Ne 30/1 and 28/1, respectfully. With the same cotton, the rotor spinning system was restricted to Ne 18/1. As yarn count is reduced or coarser yarns are produced for a given spinning system, micronaire becomes less of a factor in producing acceptable yarn quality and performance. The following general conclusions can be made based on the yarn counts produced and the yarn results reported in this micronaire performance comparison:

- Micronaire affects the spinning limit for a given cotton to a certain degree for every spinning system.
- For a given spinning system and yarn count, as micronaire increased, overall yarn quality was decreased.
- As micronaire increased, productivity in spinning decreased due to an increase in yarn breaks per 1,000 spindle or rotor hours.
- Compensations, like adding more twist, made at spinning to increase the yarn strength of higher micronaire cottons, lead directly to decreased production rates and possible downstream problems, like fabric torque.
- The overall micronaire average, from one laydown to another and within a yarn shipment made to the knitter, should be strictly maintained in order to avoid downstream fabric barré claims. A difference of only 0.3 Mic in the yarns at knitting resulted in fabric barré.
- Whether a yarn spinner is shipping yarn or using it internally in a vertical operation, the knitter should use yarn in a ‘first-in/ first-out’ format. It is best to date code every box or pallet of yarn as it is produced to help facilitate this process.

Higher micronaire cotton is perfectly suitable for certain yarn counts on a given spinning system and in given end uses. The higher Mic cotton in this evaluation resulted in fabrics with a deeper (darker) depth of shade. This is a very positive trait since less dye chemicals can be used to obtain desired shades.

Notes

This paper is Cotton Incorporated Fiber Processing Research Report Number 2003-1.

Appendix A: HVI and AFIS Terminology and Definitions

HVI = High Volume Instrumentation – Definitions

Mic = Micronaire - A relative method to estimate fiber fineness. Air resistance behavior of a calibrated fiber plug in an air stream is tested under constant air pressure conditions. The scale is not linear, but the values can be converted approximately, using the following formula: Mic/2.54 = dtex.

UHML (in.) = Upper Half Mean Length – Mean length by number of the longer one-half of the fibers by weight.

LUI % = Length Uniformity Index – Expresses the ratio of the mean value (Mean Length) to the UHML. It is a measure of the fiber length scatter within the population. If all fibers were the same length, UI would have a value of 1 or 100%.

Strength (g/Tex)= Specific strength of the fiber bundle in which the individual fiber fineness (mTex) is calculated from the micronaire value.

Elongation (%) = Elongation is the measure of the tensile-elastic behavior of a material and provides information on anticipated spinability.

SFC % = Short Fiber Content in percent – This is the percent (by weight) of the fiber sample that is less than 0.5 inches in length.

AFIS Definitions
AFIS = Advanced Fiber Information System

Nep Cnt/gram (g) = Total nep count normalized per gram. This includes both fiber neps and seed coat neps.

L(w) (in.) = Average or mean fiber length of all fibers by weight computed on a weight basis.

UQL(w) (in.) = Upper Quartile Length, length which is exceeded by 25% of fibers by weight.

L 5.0% = Length exceeded by the longest 5.0% of fibers by number (inches or mm).

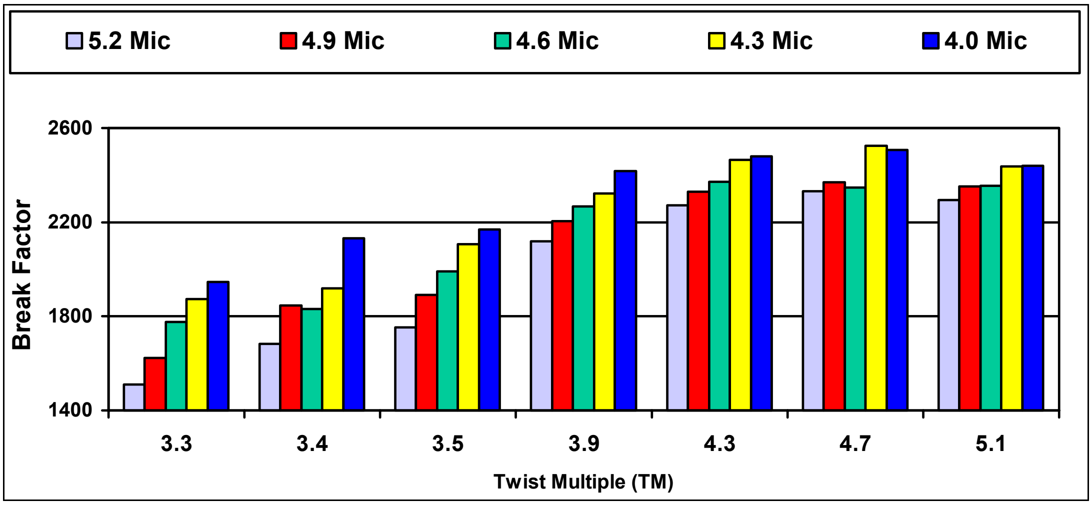
L 2.5% = Length exceeded by the longest 2.5% of fibers by number (inches or mm).

SFC (w)% = Short Fiber Content = percent of the fibers, calculated by weight, that are shorter than 0.50 inches or 12.7 mm.

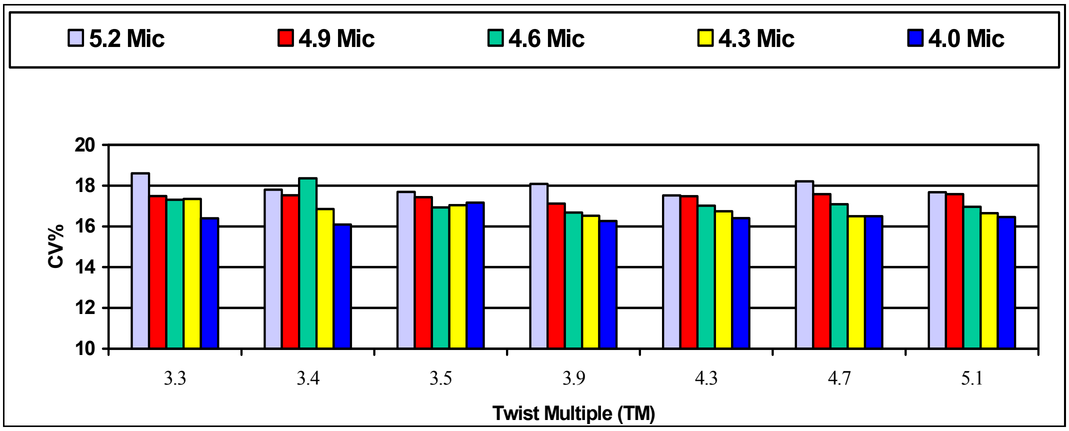
Appendix B: AFIS Finisher Draw Sliver

	Neps/Gram	UQL (w) in.	SFC (W)	Fineness (mTex)	Mat. Ratio
4.0 Mic	74	1.2	9.3	190	.90
4.3 Mic	59	1.2	9.2	195	.92
4.6 Mic	57	1.19	9.9	199	.93
4.9 Mic	57	1.20	8.0	202	.95
5.2 Mic	43	1.22	7.5	210	.97

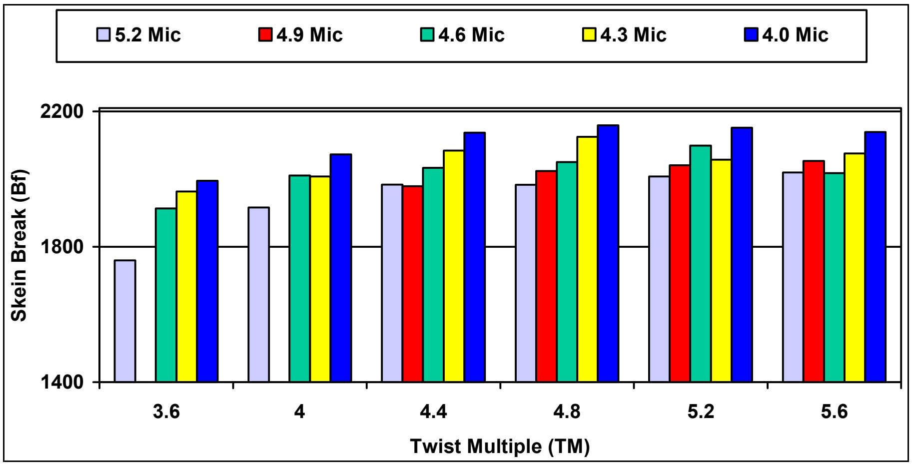
Appendix C: Ne 30/1 Ring Yarns From Twist Curve – Skein Break Factor



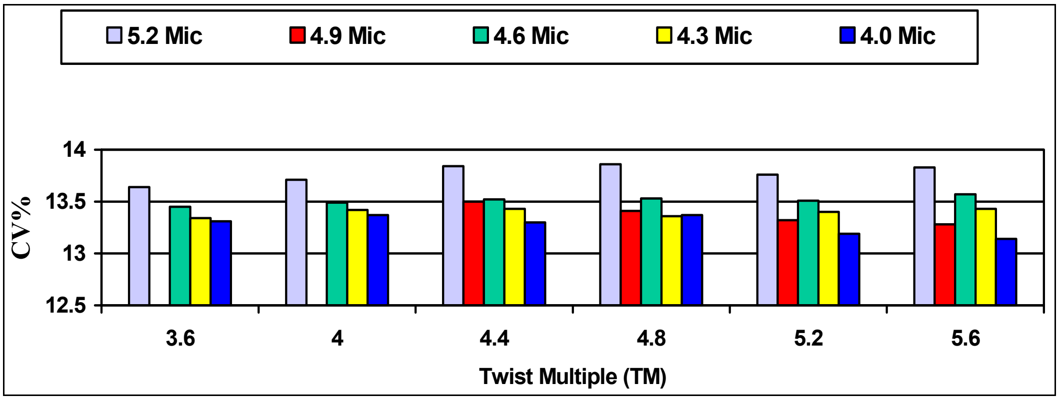
Appendix D: Ne 30/1 Ring Yarns from Twist Curve – Yarn Evenness (C.V. %)



Appendix E: Ne 18/1 Rotor Yarns from Twist Curve – Skein Break



Appendix F: Ne 18/1 Rotor Yarns from Twist Curve – Yarn Evenness (C.V.%)



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