

Report

Trade Issue Results

Compact Yarn Compared to
Conventional Ring Yarn

Participants

Slide Added 4/29/11

- Parkdale, Hillsville, VA plant provided the common carded and combed roving selected at random for compact or conventional spinning
- Conventional carded and combed ring spun yarns were spun in the Parkdale Hillsville, VA plant.
- Suessen conducted the compact spinning trials on their machine located in RL Stowe, Belmont
- All yarns (including the alternative yarns) were wound on the Murata C21 in the Muratec lab in Charlotte, NC.
 - The Zweigle hairiness data was provided by Muratec
 - The Zweigle with and without the Perla attachment was provided by Muratec
- NCSU conducted the knitting
- Liberty Textiles Finished the fabrics
- Texas Tech University provided the fabric analysis
- Photomicrographs from randomly selected packages
 - Belmont Textile Center
 - Parkdale Fiber Research Center

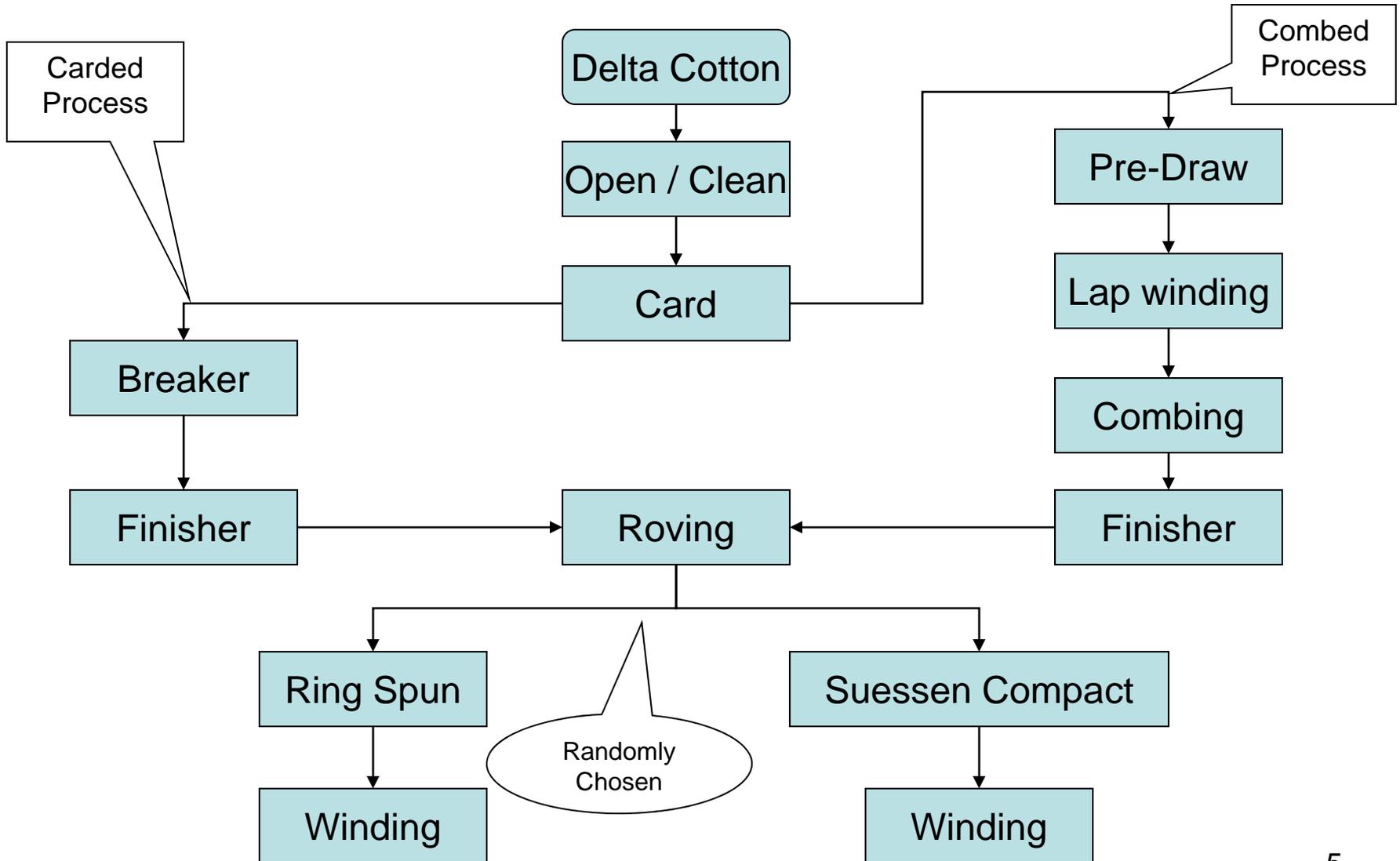
Test Plan

- Spin Ne 30/1 KP and Ne 30/1 CP Conventional Ring Spun and Compact Spun yarns from a common roving
- Collect yarns from the industry that represent a range of fiber types and different processes readily available to the spinner
- Knit the yarns into the same fabric structure
- Dye the fabrics in the same process
- Perform a battery of tests commonly used for fabric acceptance evaluations

Sample Descriptions

- Controlled Portion:
 - 30/1 CP Compact Spun Delta
 - 30/1 CP Ring Spun Delta
 - 30/1 KP Compact Spun Delta
 - 30/1 KP Ring Spun Delta
- Representative Samples from the Industry:
 - 30/1 CP RS California Cotton
 - 30/1 CP RS Supima
 - 60/2 CP California Gassed Mercerized
 - 60/2 CP Supima Gassed Mercerized

Delta Cotton Controlled Test



Common Delta Fiber Source

High Volume Instrument (HVI) Cotton Parameters For Ne 30/1 Delta Cotton on Ring Spun and Compact					
Samples	Mic	UHML (in)	Uniformity Index	Strength (g/tex)	Classer Grade
Delta KP RS	4.61	1.11	81.5	30.0	37
Delta CP RS	4.61	1.11	81.5	30.0	37
Delta KP Compact	4.61	1.11	81.5	30.0	37
Delta CP Compact	4.61	1.11	81.5	30.0	37

Advanced Fiber Information System (AFIS) Sliver In Process

Process	L(w) (in)	UQL(w) (in)	SFC(w) (%<0.5 in)	5.0% (in)	2.5% (in)	Neps Cnt/g	Dust Cnt/g	Trash Cnt/g	%VFM
Card	0.94	1.16	10.3	1.31	1.41	74.2	96.5	6.2	0.103
Combed Process:									
Prep	0.94	1.17	11.5	1.34	1.45	65	159	9	0.37
Combed	1.01	1.21	5.2	1.41	1.55	34	47	1	0.02
Finisher	1.01	1.22	5.4	1.41	1.55	23	21	0	0.01
Carded Process:									
Breaker	0.94	1.17	10.3	1.33	1.42	63	74	2	0.06
Finisher	0.98	1.20	9.8	1.38	1.49	67	79	4	0.06

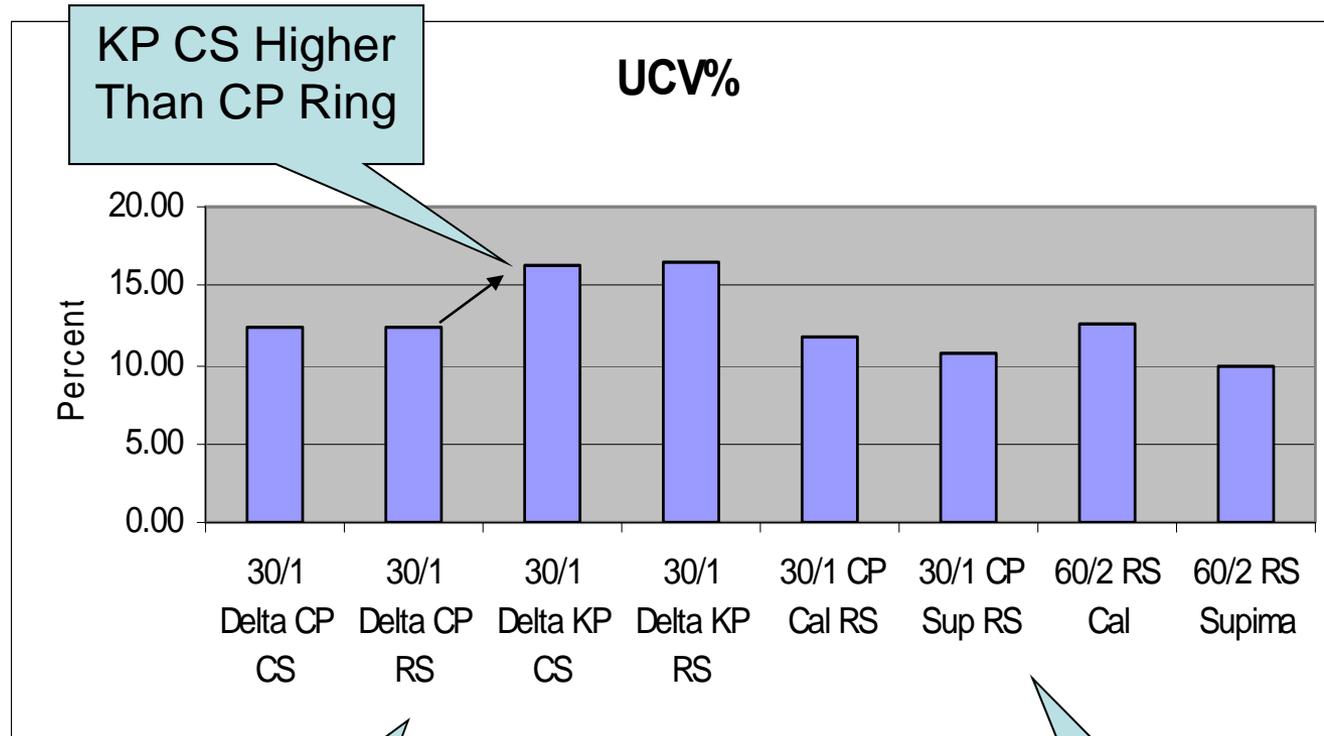
Uster Evenness Test of Sliver In Process

Process	UCV%	CV%_1	CV%_3	Inert	Min_1	Max_1
Cards	2.86	1.63	1.27	1.29	-4.4	5.2
Combed Process:						
Prep	3.45	1.2	1.09	1.09	-3.1	2.7
Combed	3.22	1	0.81	0.81	-3.1	2.3
Finisher	2.34	0.51	0.37	0.37	-1.2	1.7
CP Roving	3.49	1.2	0.74	0.75	-2.9	3.7
Carded Process:						
Breaker	3.33	0.93	0.75	0.76	-2.1	2.4
Finisher	3.08	0.34	0.2	0.21	-0.9	0.9
KP Roving	5.49	1.46	0.9	0.9	-3.7	4.5

Yarn Quality Tests Performed

- Yarn test results from the Fiber Research Center
 - Uster Evenness and Imperfections
 - Tensojet Single End Strength
 - Classimat Defects
- Zweigle Hairiness (Packages and Bobbins) provided by Muratec

Uster Yarn Evenness

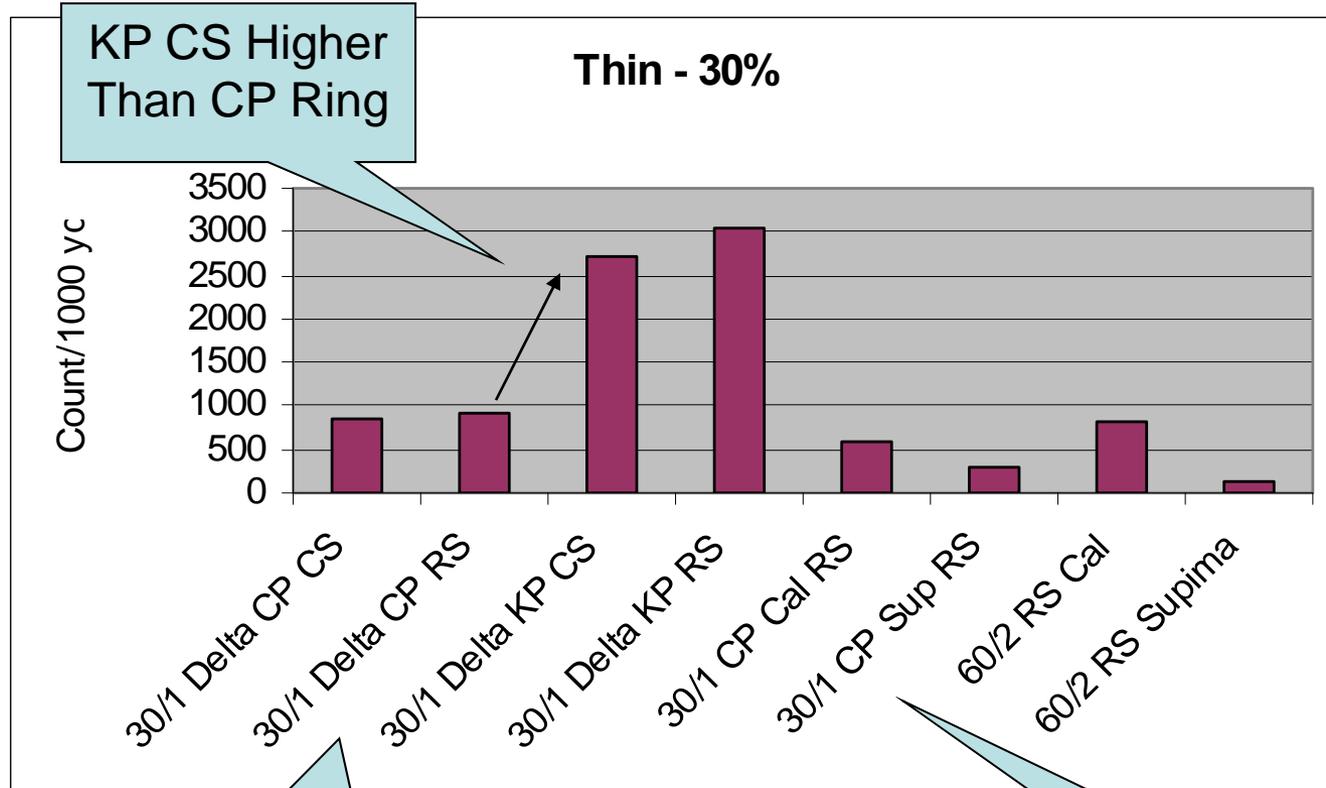


KP CS Higher Than CP Ring

Similar Levels In Controlled Portion

Alternative Yarns as Low or Lower

Uster -30% Thin Places



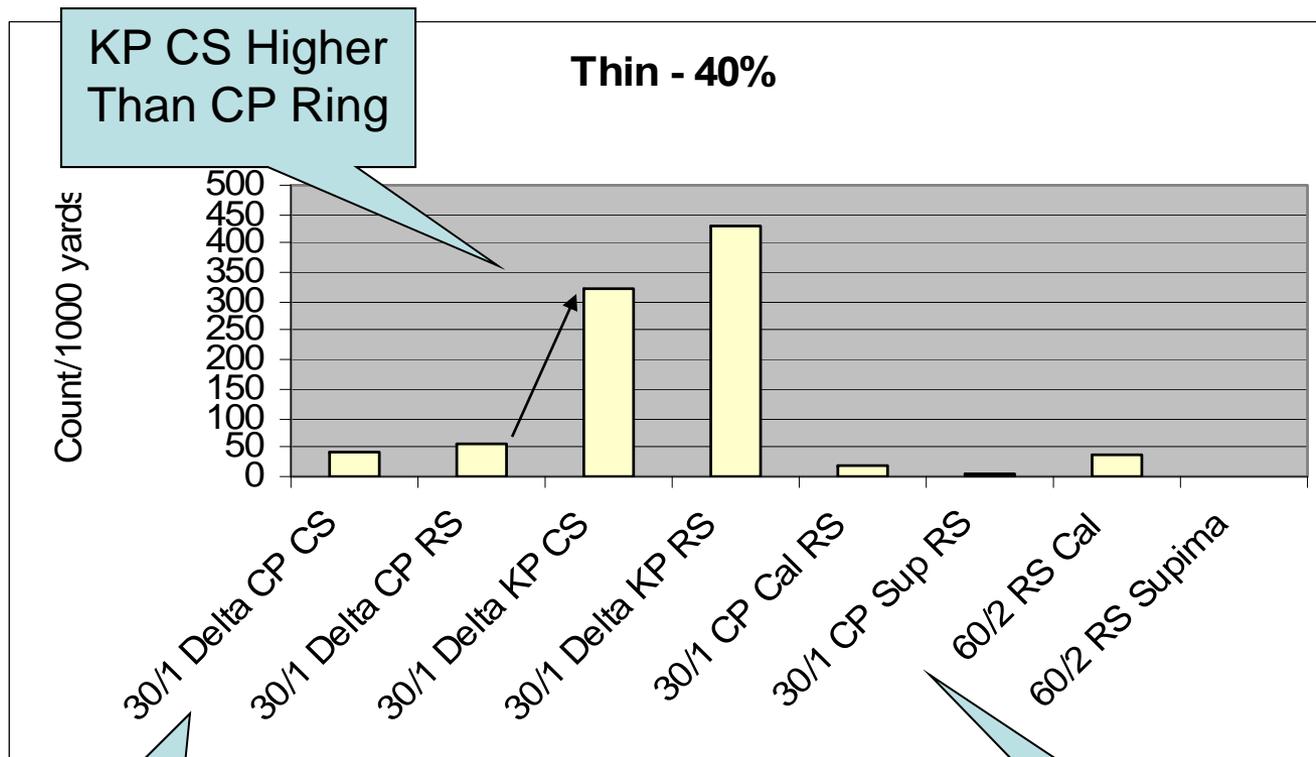
KP CS Higher Than CP Ring

Count/1000 yc

Similar Levels In CP Yarns

Alternative Yarns as Low or Lower

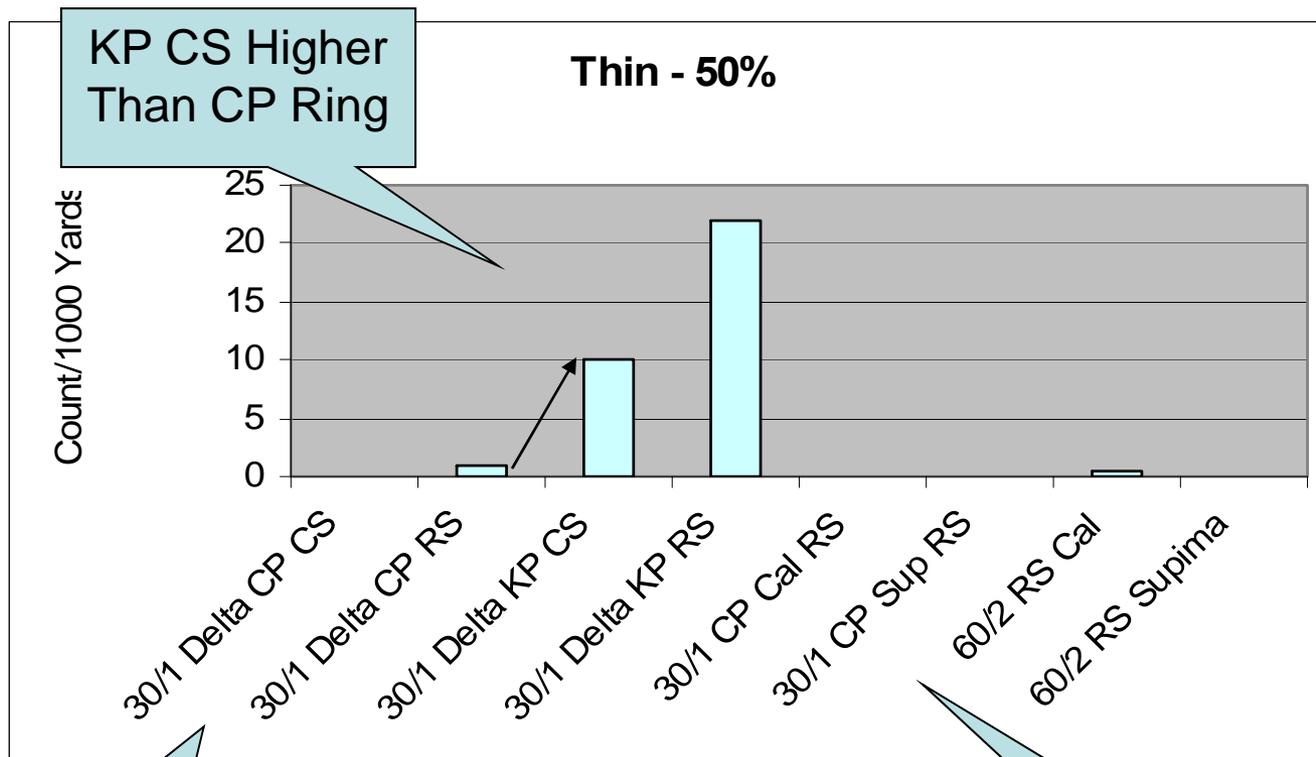
Uster -40% Thin



Similar Levels In
CP Yarns

Alternative
Yarns had
Lower Values

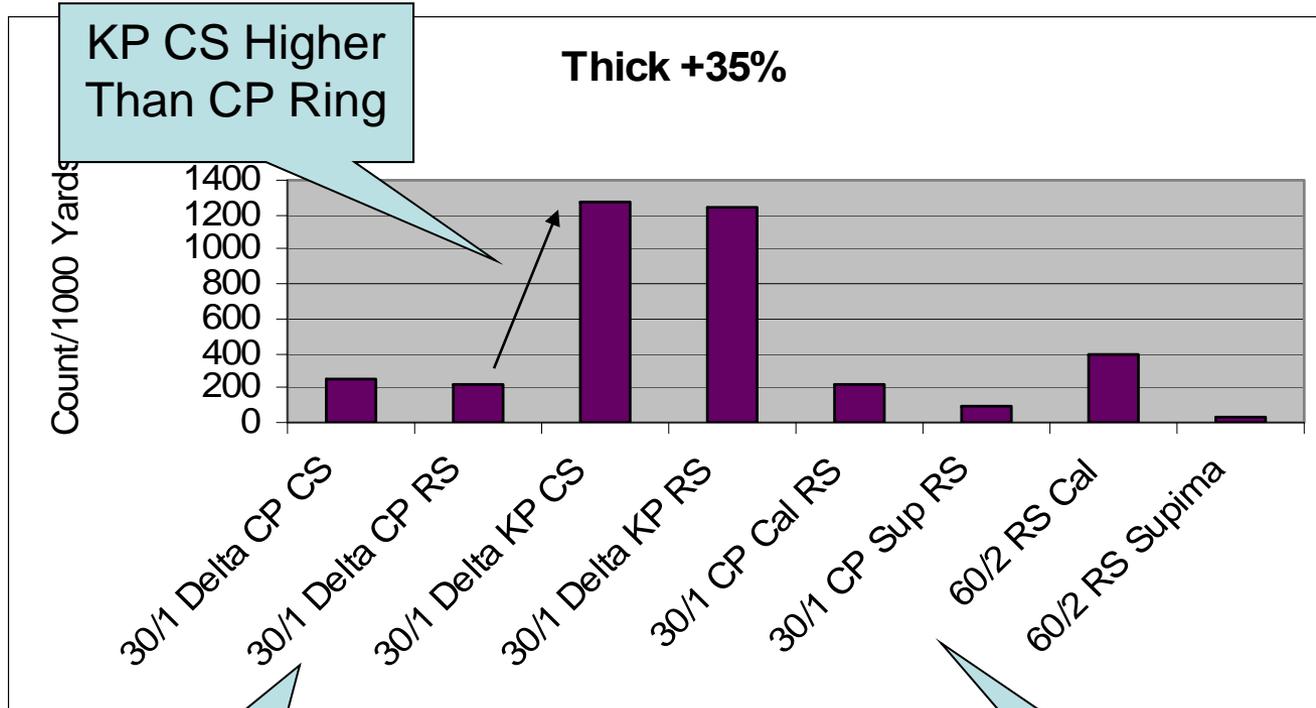
Uster -50% Thin



Similar Levels In
CP Yarns

Alternative
Yarns as Low
or Lower

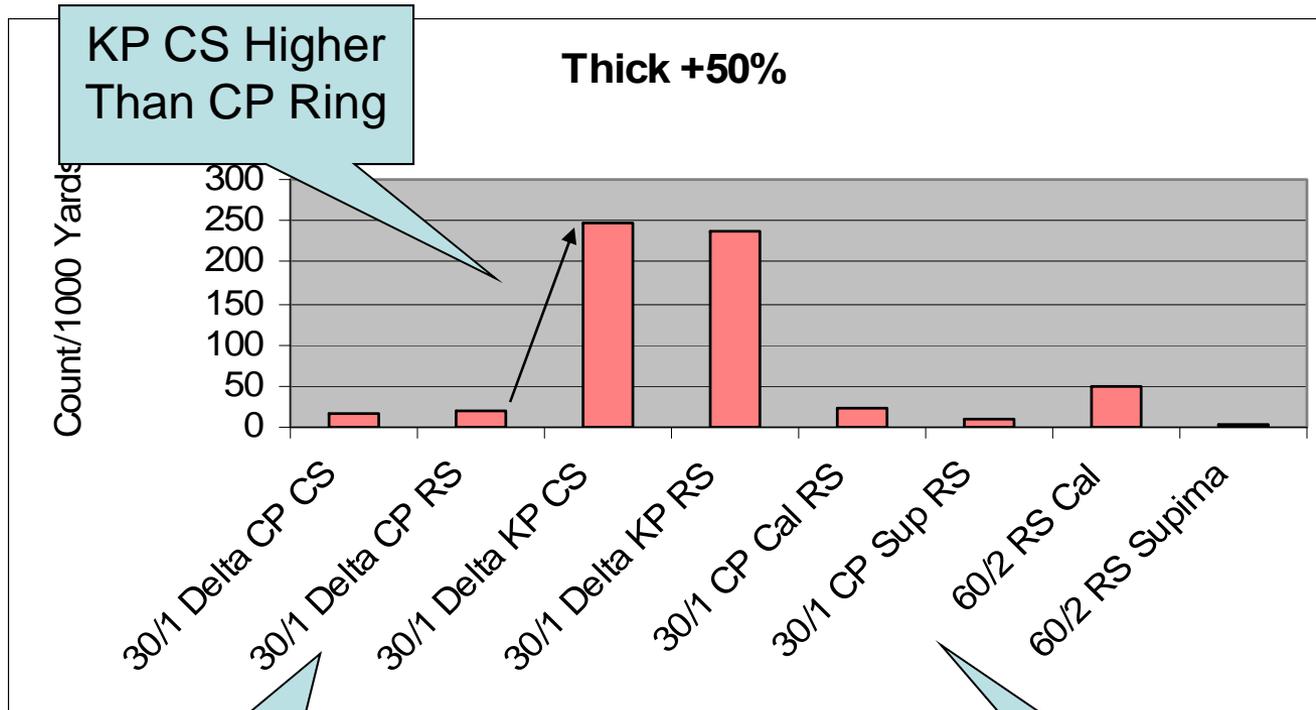
Uster +35% Thick



Conventional Ring Spun Yarns had Lower values in Controlled Portion

Three Alternative Yarns had Lower Values

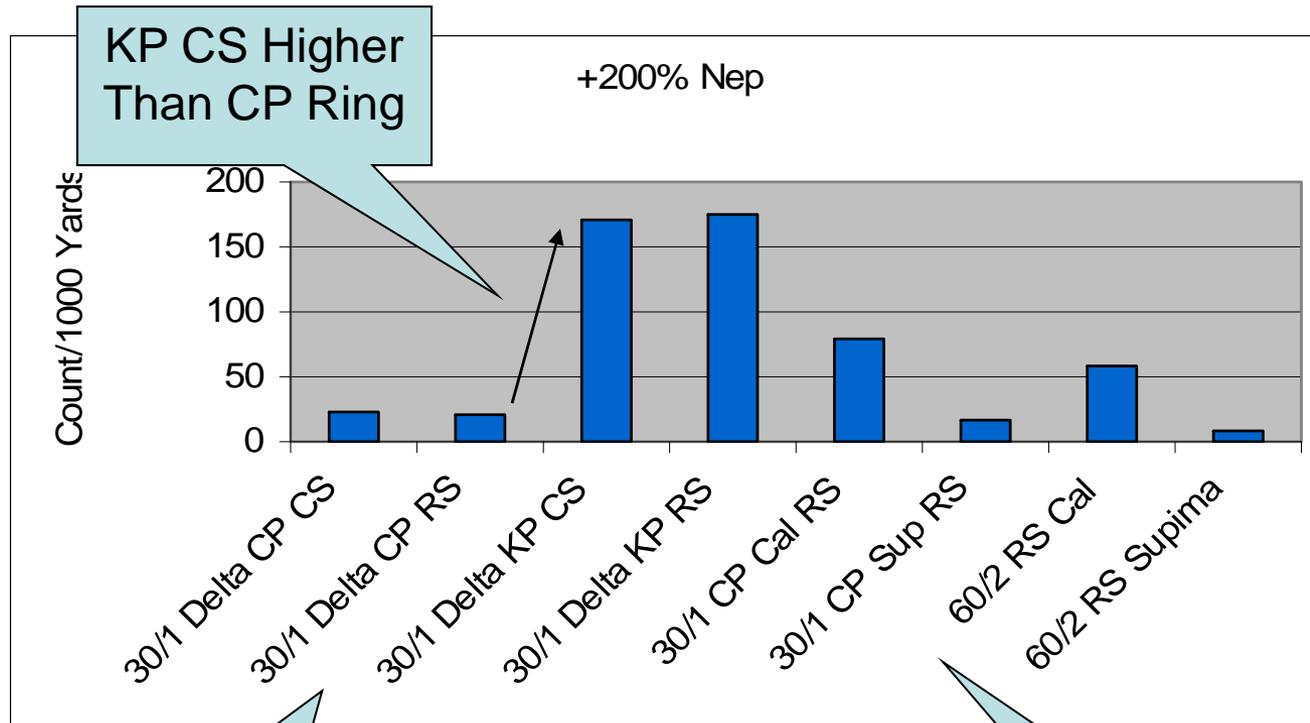
Uster +50% Thick



Conventional Ring Spun Yarns Were as Low or Lower in Controlled Portion

Two Alternative Yarns had Lower Values

Uster +200% Neps



Conventional Ring Spun Yarns Were as Low or Lower in Controlled Portion

Two Alternative Yarns had Lower Values

Uster Evenness Results

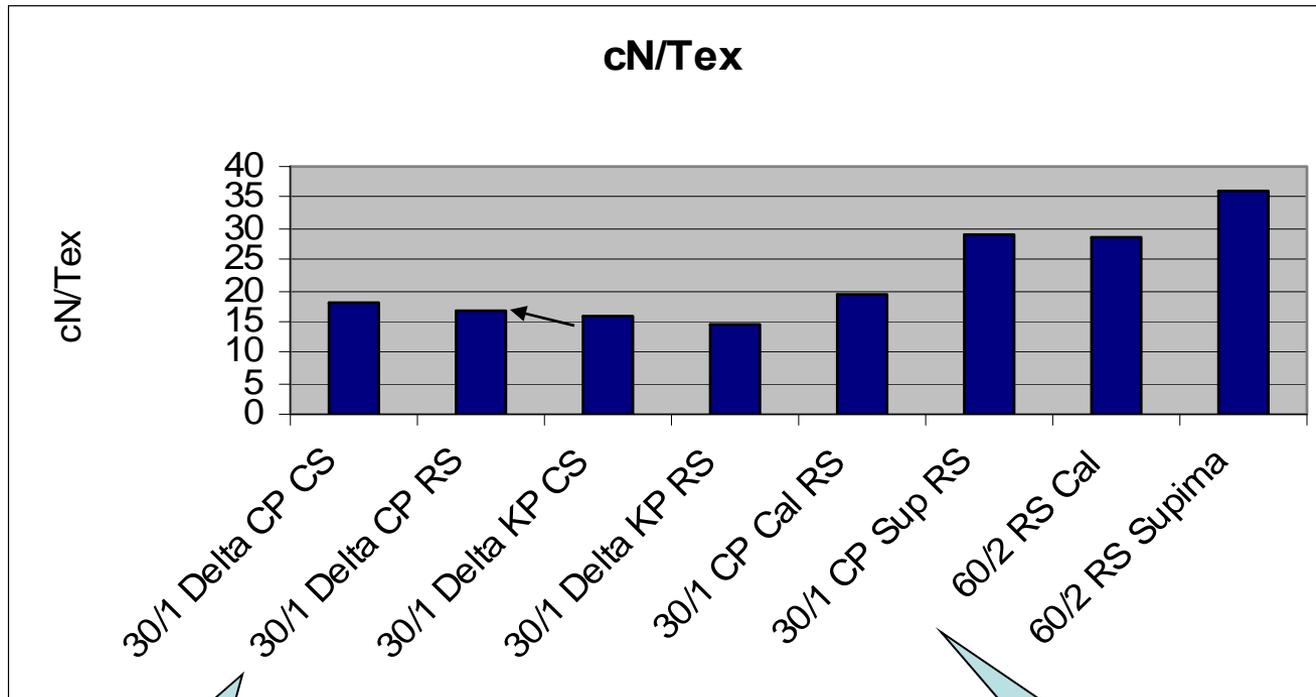
Uster Value	Combed Ring	Combed Compact	Carded Ring	Carded Compact
UCV%	12.45	12.42	16.4	16.23
-30% Thin	925	838	3029	2712
-40% Thin	56	40	432	321
-50% Thin	1	0	22	10
+35%Thick	215.5	257	1248	1270
+50% Thick	19.5	18	236	246
+200% Nep	20	23	176	171

Uster Evenness On a Relative Basis

Uster Value	Combed Ring vs. Compact	Carded Ring vs. Compact	% Increase (CS KP over RS CP)
UCV%	+0.24%	+1.0%	+30.4%
-30% Thin	+10.4%	+11.7%	+193.2%
-40% Thin	+40.0%	+31.8%	+473.2%
-50% Thin	+100.0%	+120.0%	+900.0%
+35% Thick	-16.4%	-1.7%	+489.3%
+50% Thick	+8.3%	-4.1%	+1161.5%
+200% Nep	-13.0%	+2.9%	+755.0%

Substitution of Carded Compact for
Combed Ring Spun Is Not Feasible

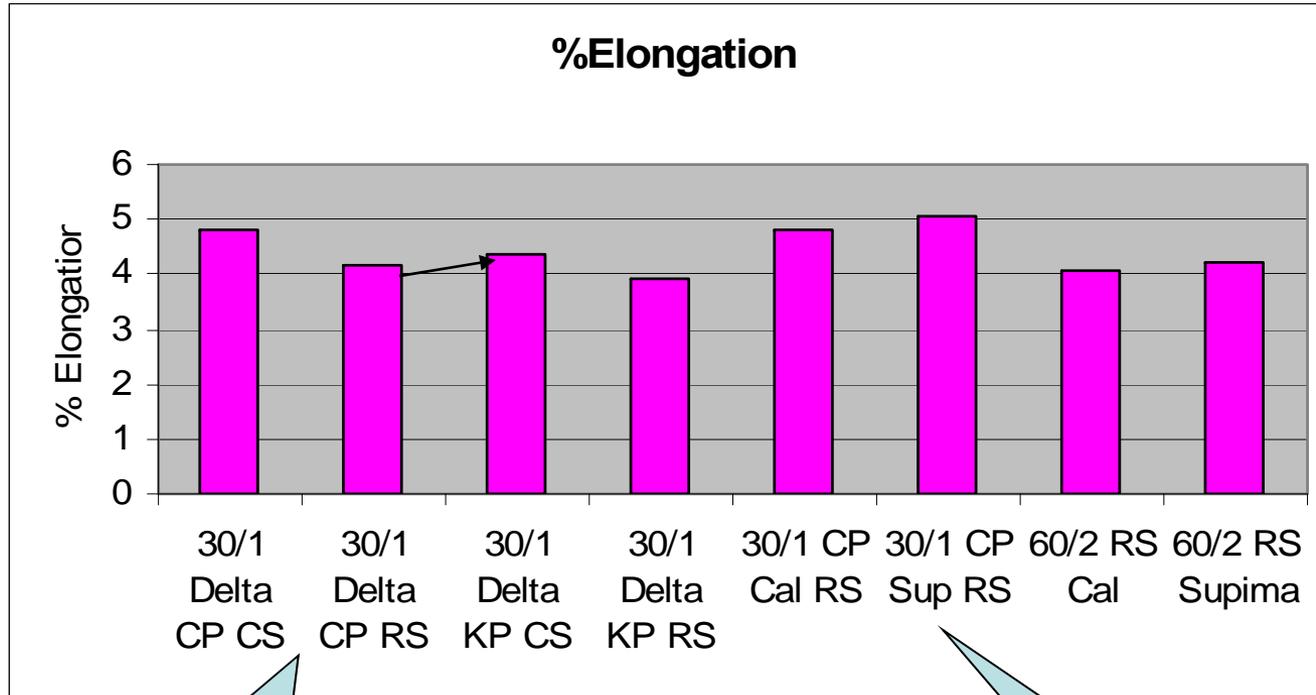
Tensojet Tenacity (cN/Tex)



Slight Differences in
Controlled Portion

All Alternative
Yarns had Higher
Strength Values

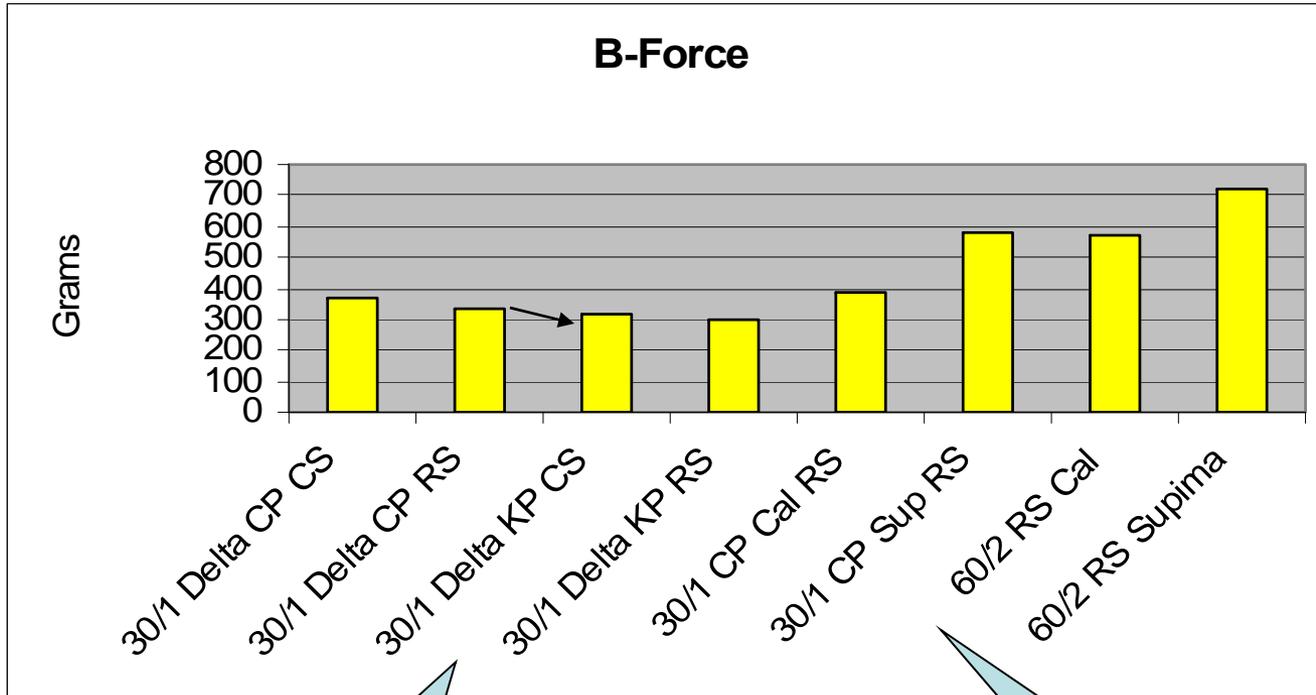
Tensojet Elongation (%)



Conventional Ring Spun Yarns Had Slightly Lower Values in Controlled Portion

Two Alternative Yarns had Higher Values

Tensojet Break (grams)



Slight Differences in Controlled Portion

All Alternative Yarns had Higher Strength Values

Tensojet Results

Tensojet Value	Combed Ring	Combed Compact	Carded Ring	Carded Compact
cN/Tex	16.66	18.14	14.68	15.7
% Elongation	4.16	4.81	3.91	4.36
B-Force (g)	334.4	369.2	294.6	315.15

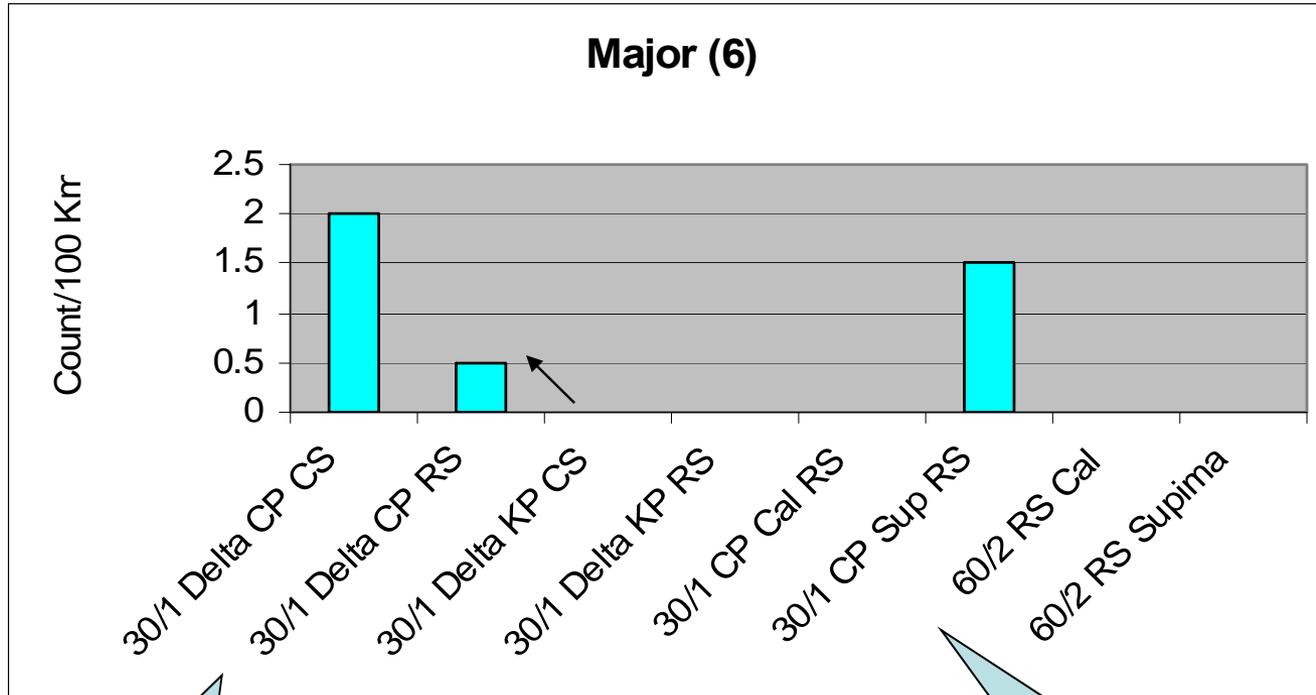
Tensojet Relative Basis

Value	Combed Ring vs. Compact	Carded Ring vs. Compact	% Decrease (CS KP sub RS CP)
cN/Tex	-8.2%	-7.0%	-6.1%
% Elongation	-13.5%	-10.3%	+4.1%
B-Force (g)	-9.4%	-9.4%	-5.8%



Substitution Not Feasible

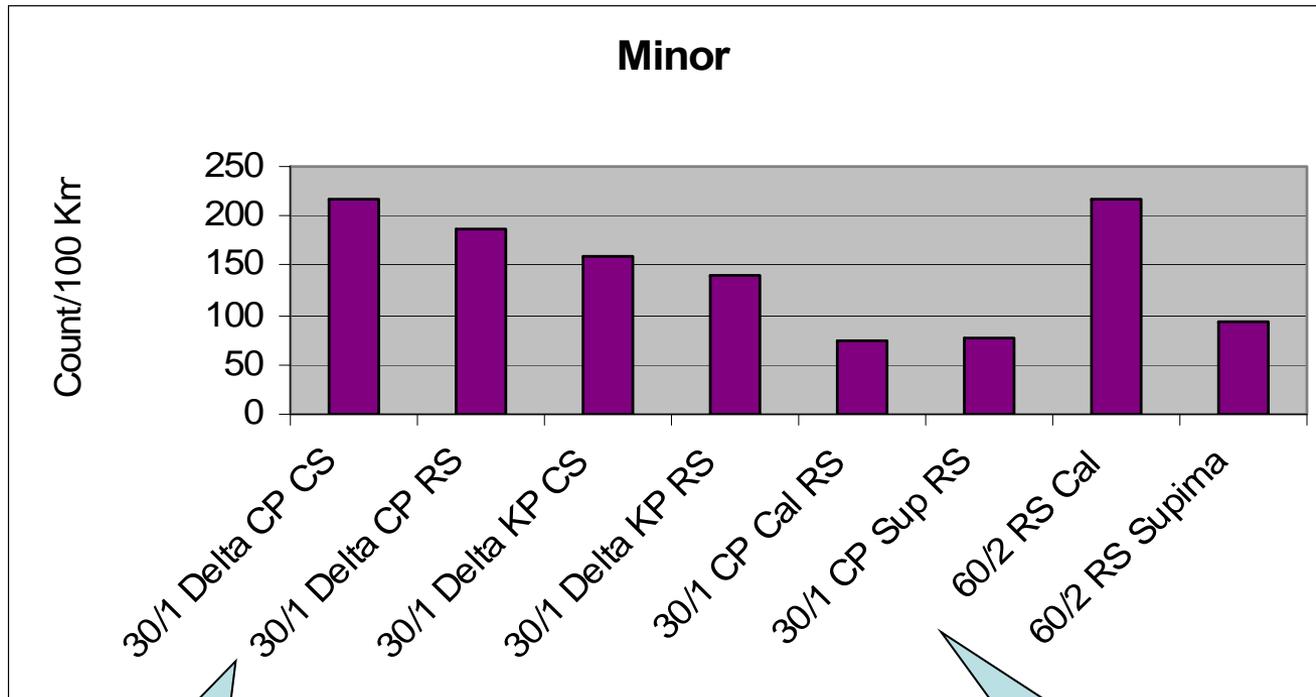
Classimat Majors (6)



Conventional Ring Spinning was Lower

Three Alternative Yarns had Much Lower Values

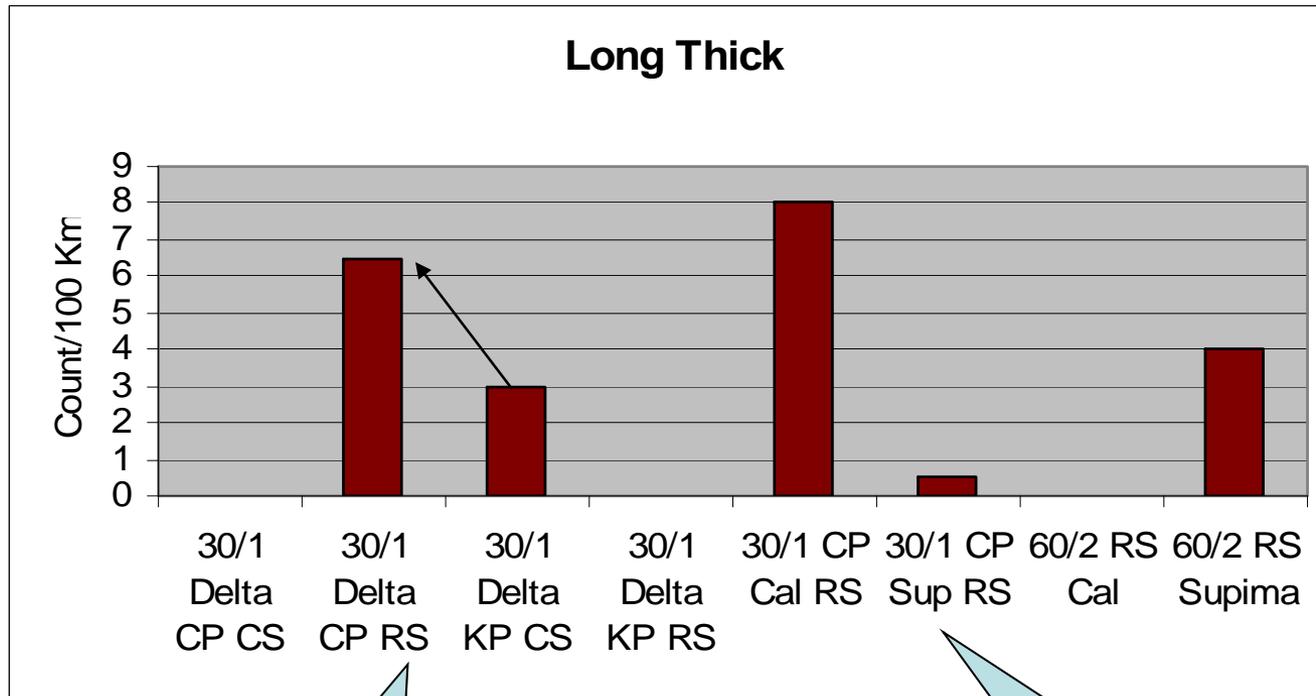
Classimat Minors



Conventional Ring Spinning was Lower

Three Alternative Yarns had Much Lower Values

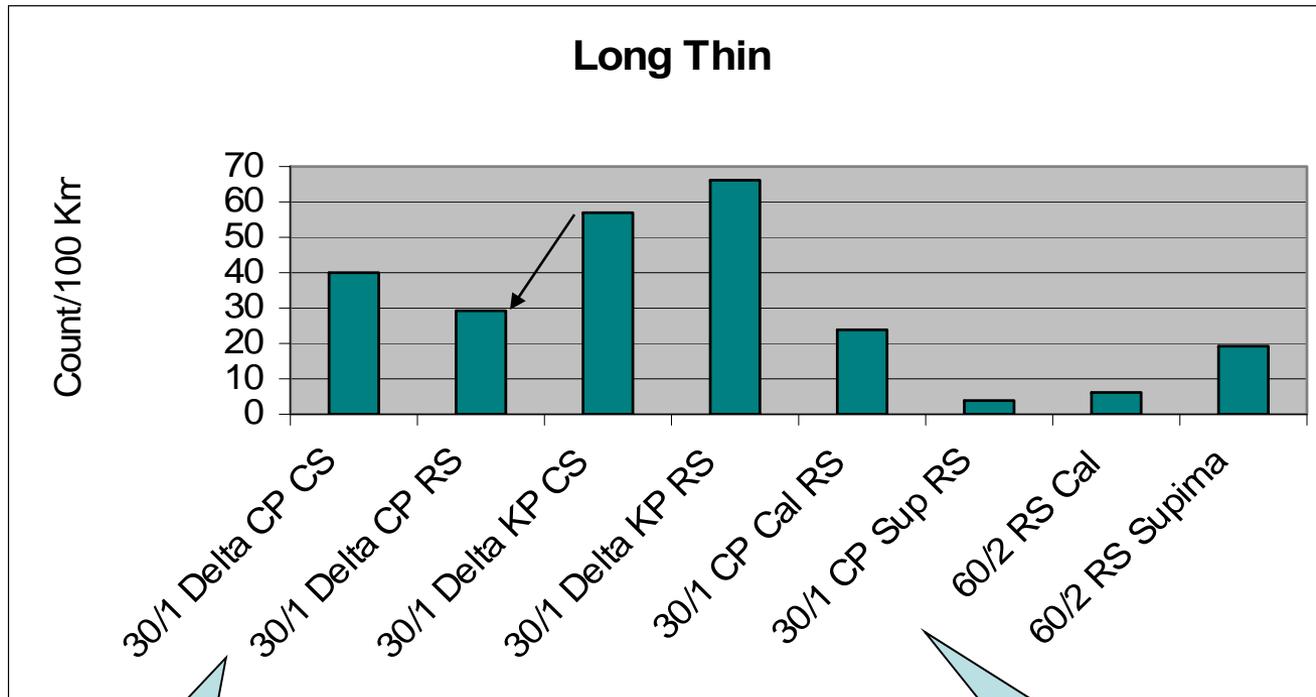
Classimat Long Thick (EFG)



Mixed Results in Controlled Test

Two Alternative Yarns had Much Lower Values

Classimat Long Thin (H, I)



Mixed Results in
Controlled Test

All Alternative Yarns Had
Much Lower Values

Delta Classimat Values

Value	Combed Ring	Combed Compact	Carded Ring	Carded Compact
Majors	0.5	2.0	0.0	0.0
Minors	186.8	218.4	140.7	160.7
Long Thick	6.5	0.0	0.0	3.0
Long Thin	29	40.1	65.9	56.9

Alternative Classimat Values

	30/1 CP CS Delta	30/1 CP Supima	30/1 CP Cal	60/2 Cal Mer	60/2 Sup Mer
Majors	2.0	1.5	0.0	0.0	0.0
Minors	218.4	76	74.1	218.2	92.9
Long Thick	0.0	0.5	8.0	0.0	4.0
Long Thin	40.1	3.5	24.0	6.0	19.0

Alternative yarns produced better results

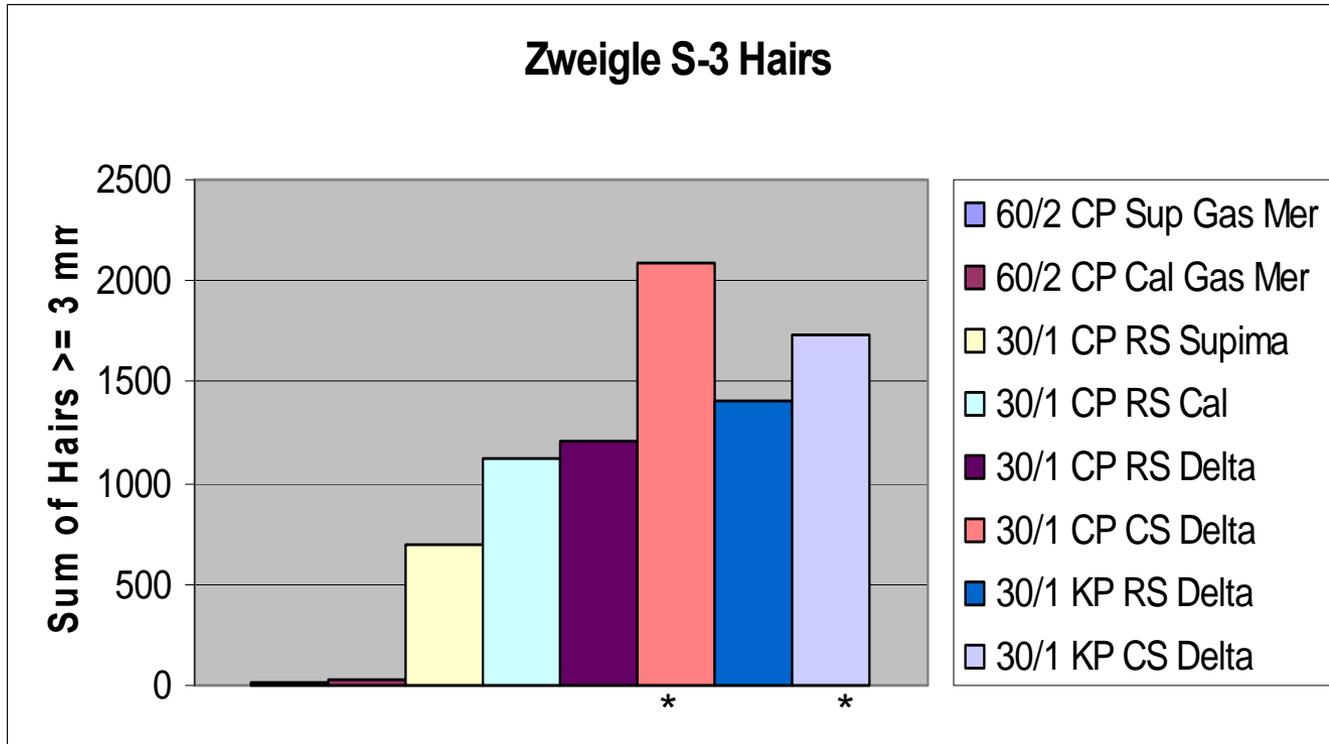
Uster H-Index

Value	Combed Ring	Combed Compact	Carded Ring	Carded Compact
Uster H	5.82	5.22	6.73	5.71

Zweigle Hairs/100 m - Muratec

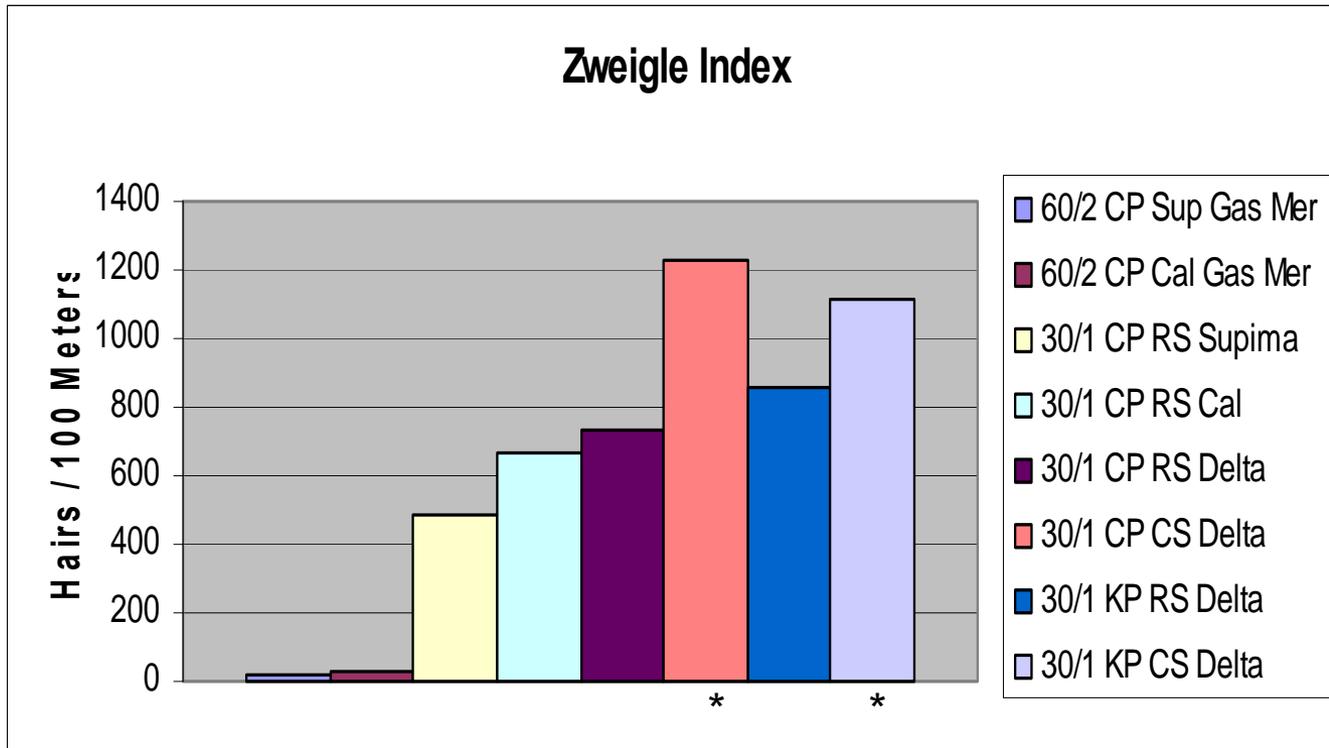
Sample	1 mm	2 mm	3 mm	4 mm	6 mm	8 mm	10 mm	12 mm	S3	Index
60/2 Sup Gas Mer	744	43	11	1	0	0	0	0	12	18
60/2 Cal Gas Mer	1119	102	20	5	0	0	0	0	25	30
30/1 CP Supima	9363	1018	465	195	28	3	1	0	691	484
30/1 CP Cal	11088	1346	674	348	81	14	1	0	1117	666
30/1 Delta CPRS	12184	1586	753	350	80	15	3	0	1201	732
30/1 Delta CPCS	15957	2747	1388	603	79	12	1	0	2082	1232
30/1 Delta KPRS	15259	1936	895	422	76	17	2	0	1411	861
30/1 Delta KPCS	16943	2672	1221	450	53	9	1	0	1734	1117 31

Zweigle Package Tests



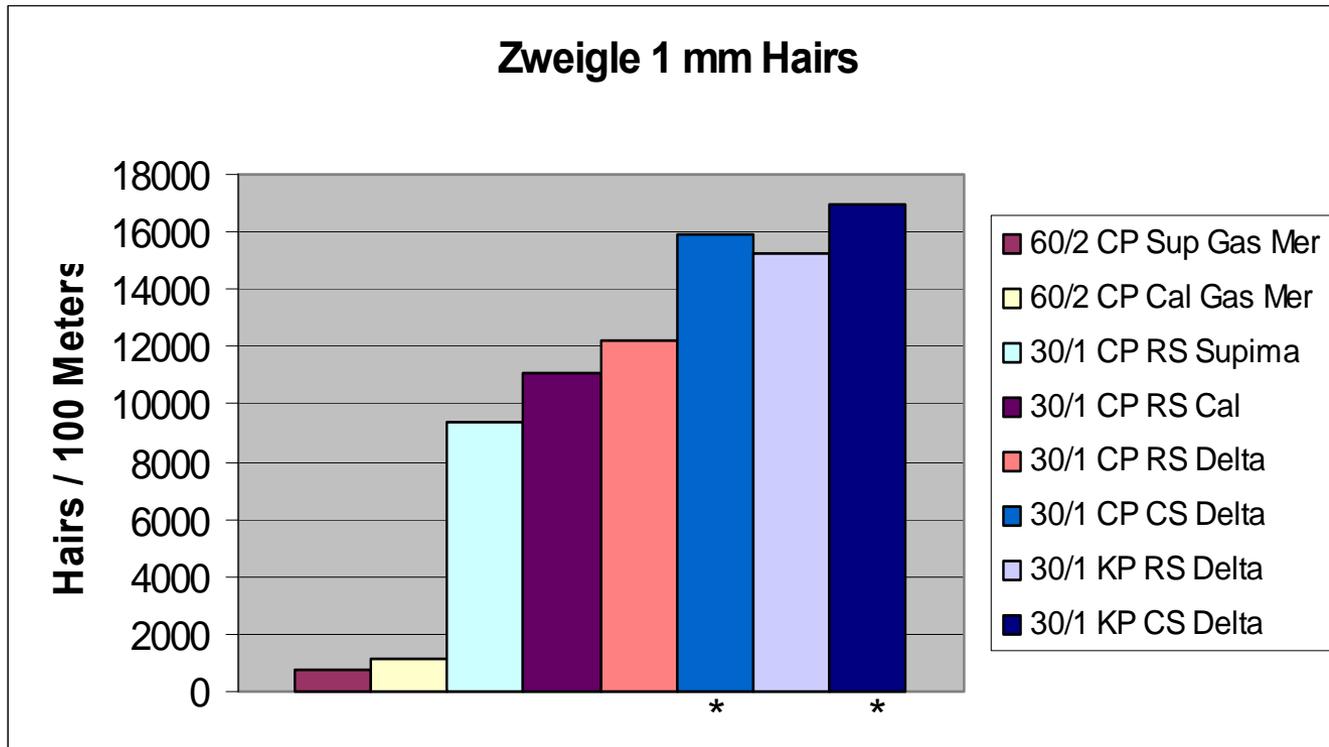
* Denotes Compact

Zweigle Package Tests



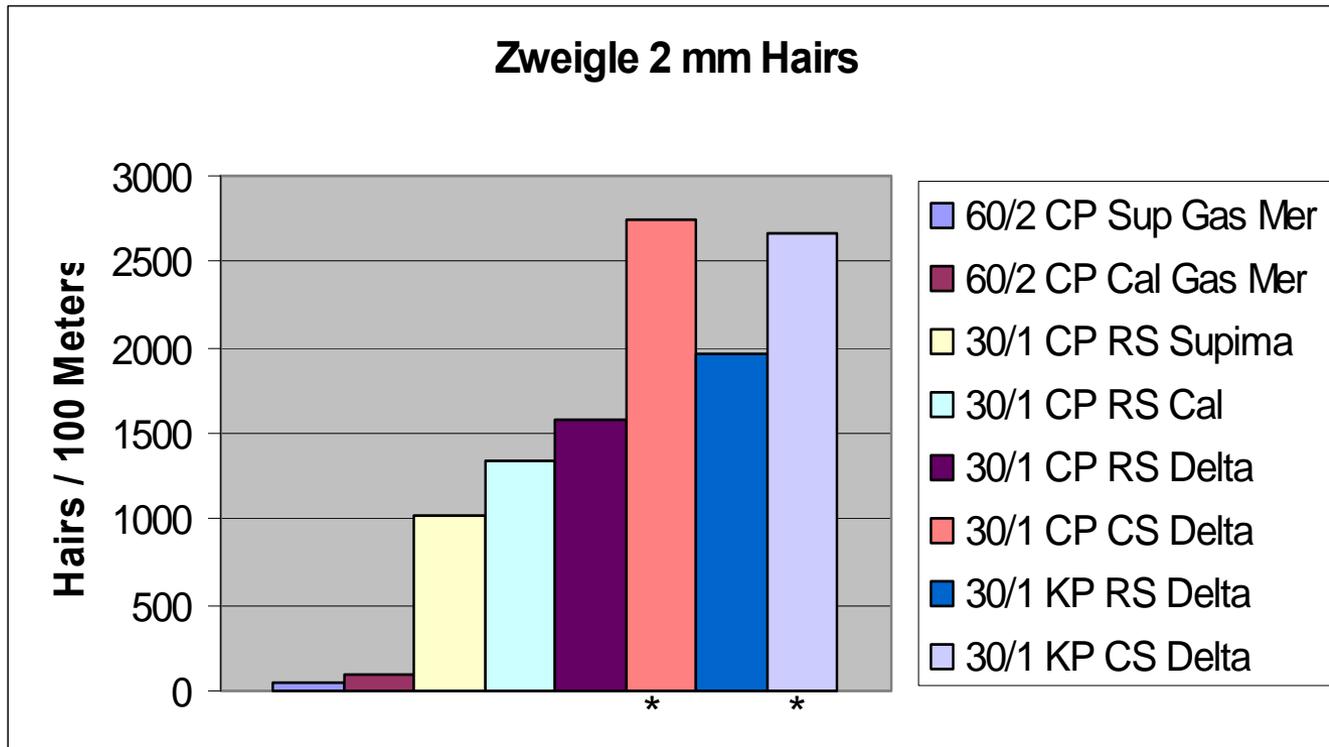
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Zweigle Package Tests



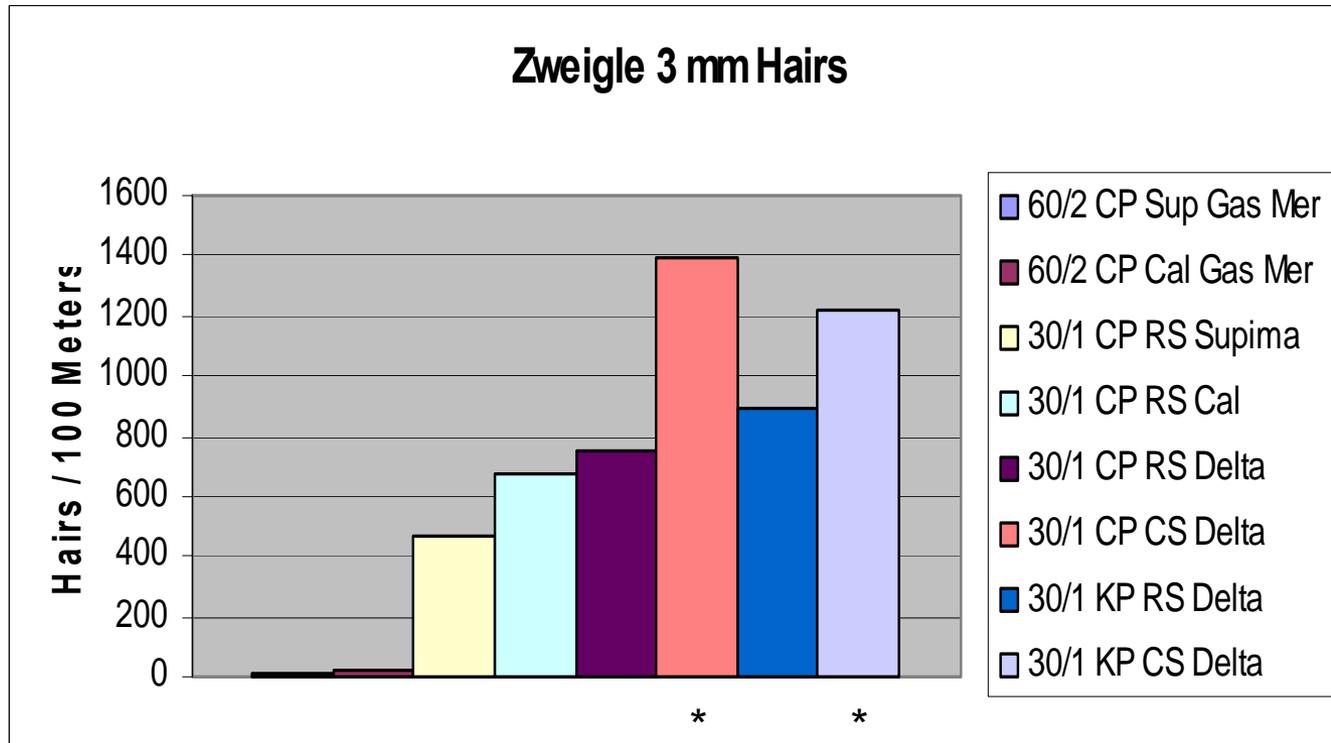
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Zweigle Package Tests



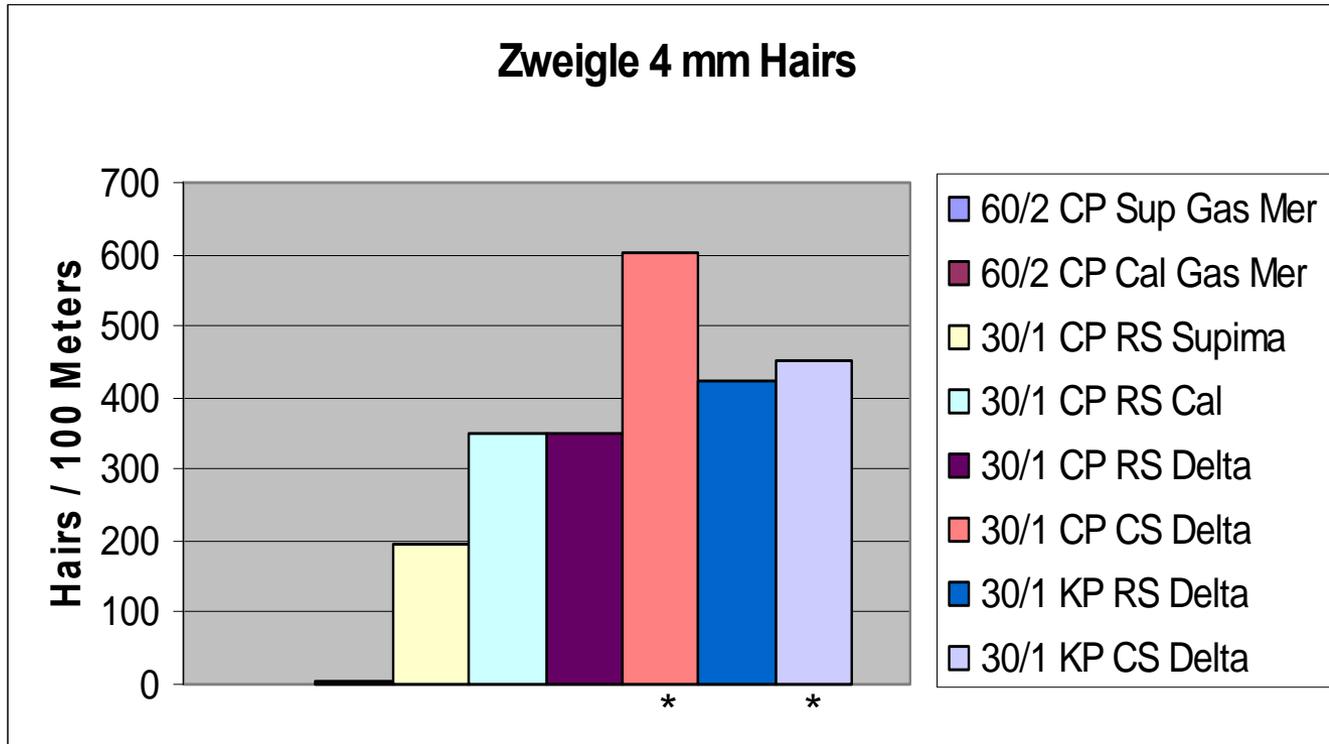
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Zweigle Package Tests



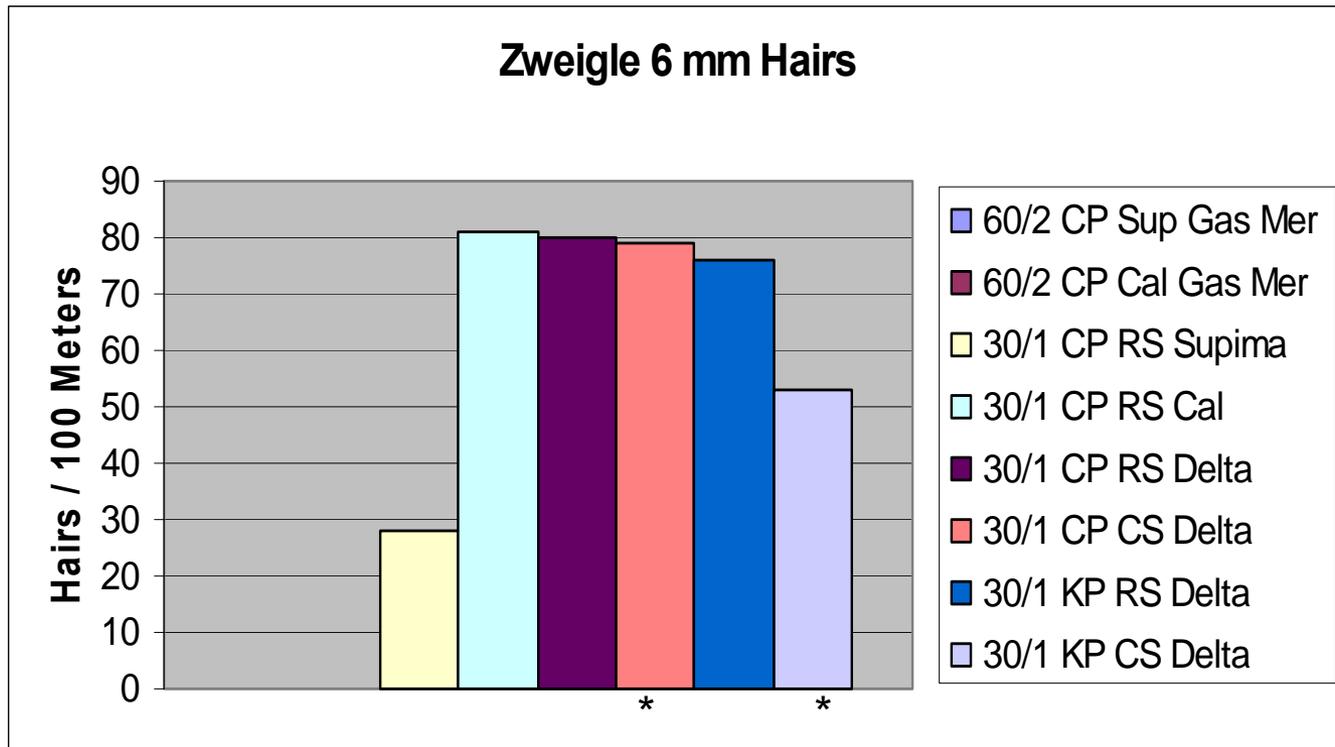
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Zweigle Package Tests



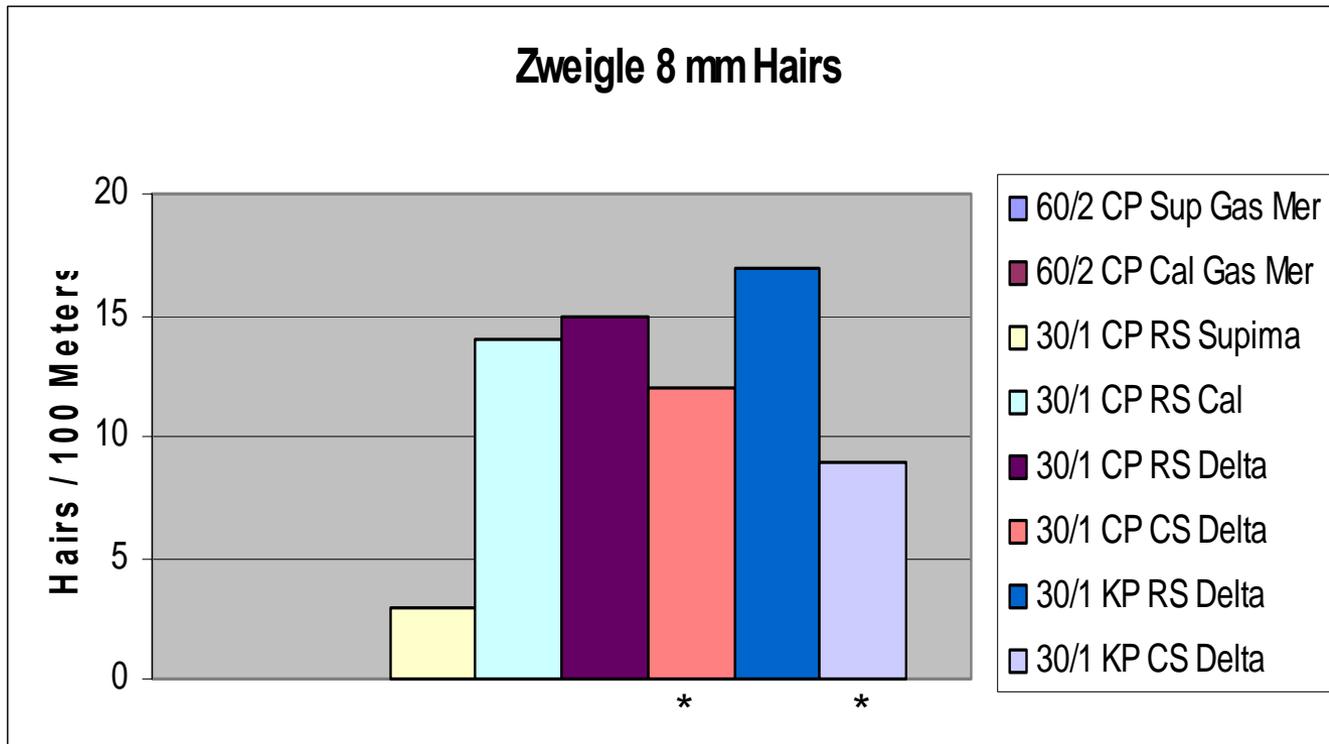
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Zweigle Package Tests



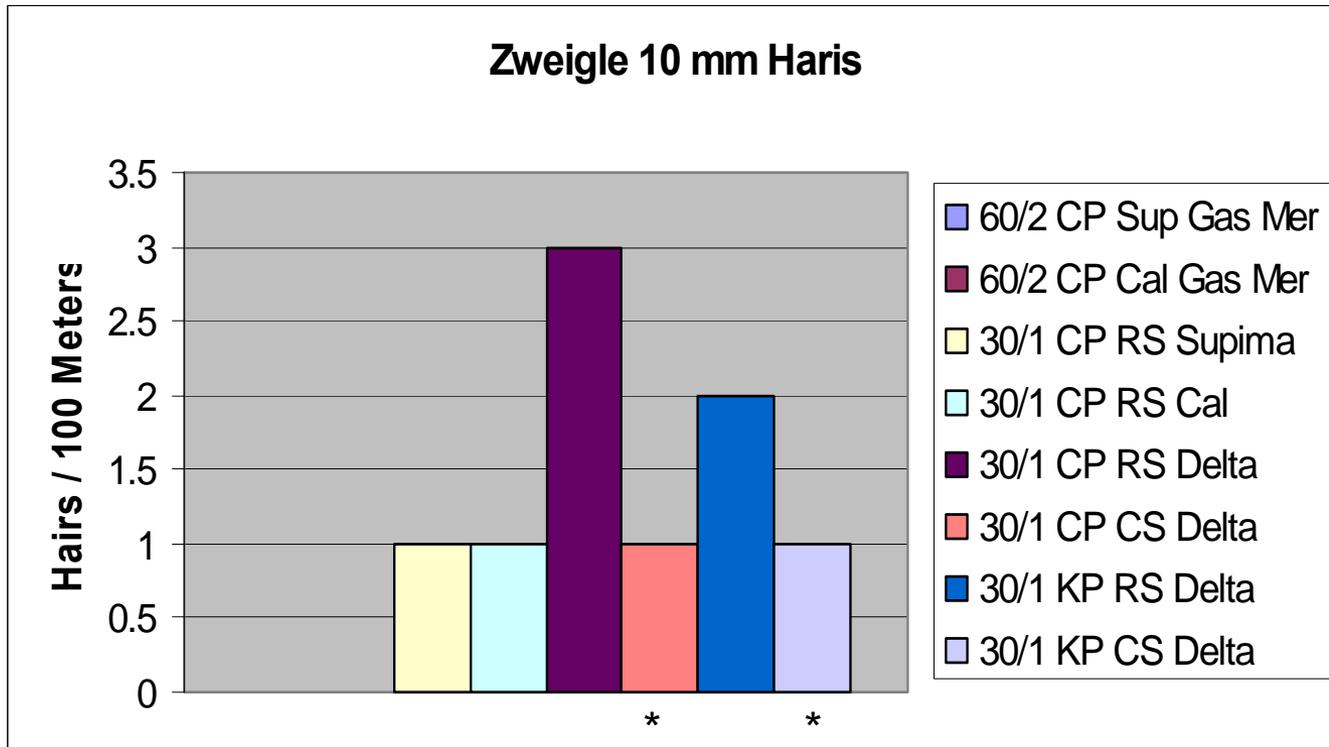
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Zweigle Package Tests



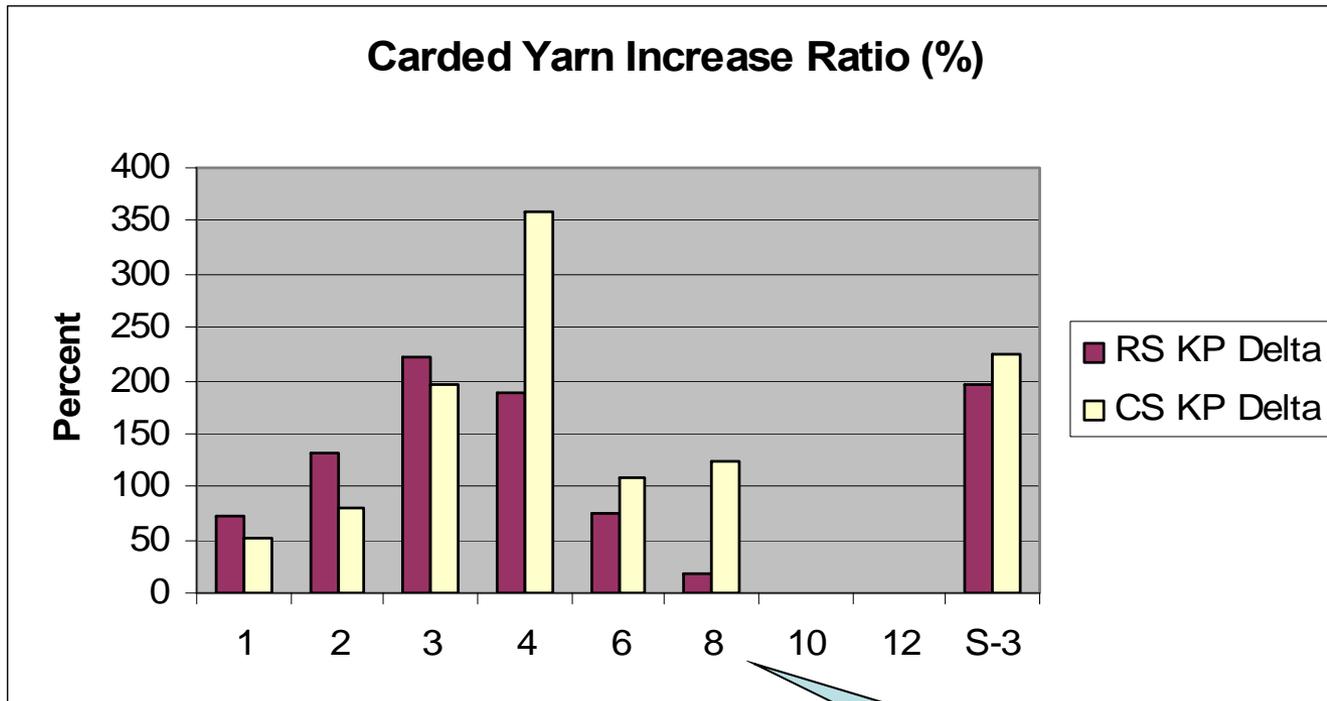
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Zweigle Package Tests



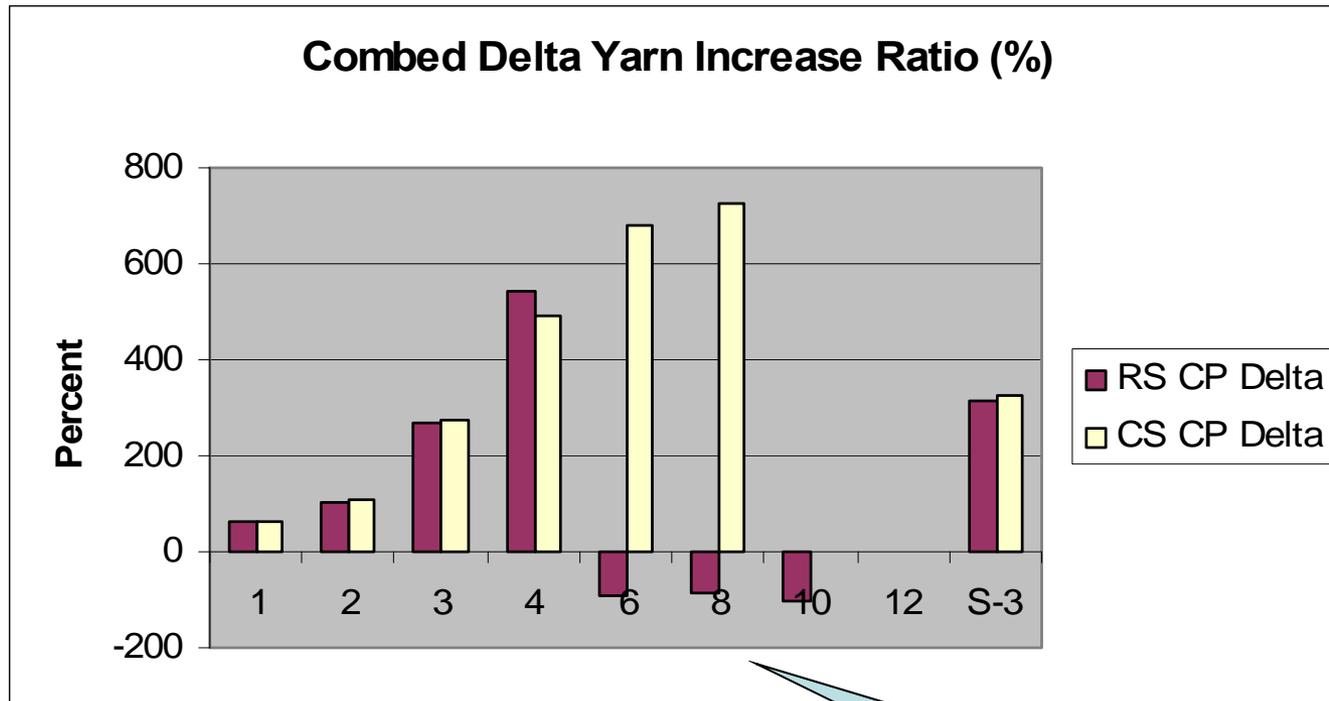
* Denotes Compact

Murata Perla Hairiness Reduction Tests



Compact Yarn had Greater Increases in Longer Lengths

Murata Perla Hairiness Reduction Tests



Compact Yarn had Greater Increases in Longer Lengths

Perla Device Effectiveness

	CP RS Delta			CP CS Delta		
	Bobbin	W/O	With	Bobbin	W/O	With
mm			←	→		
1	8576.2	14003.8	11005.3	7631	12570.3	9059.5
2	1143.3	2323.7	1309.3	976.2	2060.3	943
3	356.2	1303.0	529.3	279.3	1039.7	236
4	120.2	769.3	263.5	70.8	420.7	72.5
5	20.2	1.5	0	7.8	57	7.3
8	5.8	1.0	0	0.7	5.5	1.2
10	0.2	0	0	0	0.7	0
12	0	0	0	0	0	0
S-3	502.7	2074.8	792.8	358.2	1523.5	317

Ring spun combed Delta wound using the Perla device had better hairiness than the compact combed Delta without the Perla device.

Perla Device Effectiveness

	CP RS Supima			CP CS Delta		
	Bobbin	W/O	With	Bobbin	W/O	With
mm			←	→		
1	6406.2	13125.8	11010.5	7631	12570.3	9059.5
2	499.8	1691.8	1024.2	976.2	2060.3	943
3	132.5	875	378.3	279.3	1039.7	236
4	68	336.8	130.7	70.8	420.7	72.5
5	26	44.5	21	7.8	57	7.3
8	4	4.5	2.5	0.7	5.5	1.2
10	0	0	0	0	0.7	0
12	0	0	0	0	0	0
S-3	230.5	1260.8	532.5	358.2	1523.5	317

The combed ring spun Supima bobbins had less hairiness than the compact combed Delta bobbins. Combed ring spun Supima wound with the Perla had less hairiness than the combed Delta yarn without using the Perla device.

Zweigle Summary

- Conventional Ring Spun yarns had:
 - Lower S-3
 - Lower Index
 - Fewer shorter and very numerous 1, 2, 3, 4, 6 mm
- Only in the far less numerous 8 mm and longer lengths did the compact yarn begin to show an advantage
 - The caveat is that a difference of 1-2-3 hairs over 100 meters is not significant
- The alternative yarns faired as well or better
- At no time did the compact yarns even approach the plied yarns

Photomicrographs

- One set of packages were provided to the Parkdale Fiber Research Center
- Another set of packages were provided to the Gaston County Textile Center
- Operators at the Belmont Textile Center and the Parkdale FRC were unaware of the Zweigle test results, worked independently and randomly chose their own sections of yarn for the photomicrographs that they felt represented what they were seeing along the length of yarn

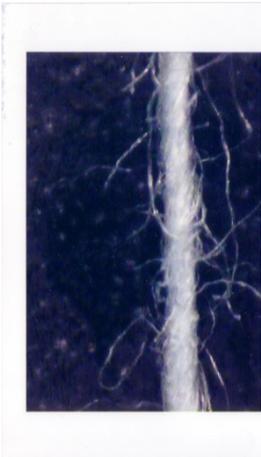
Which are Compact Yarns?



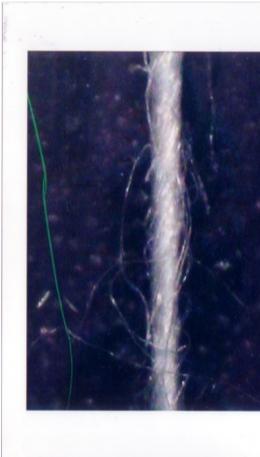
KP
Compact
Delta



KP
Ring
Delta

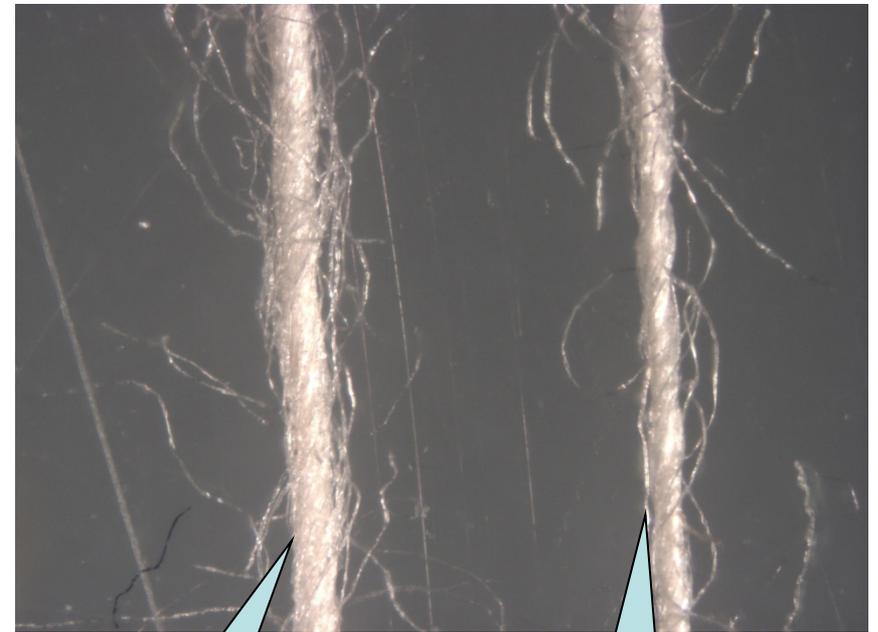
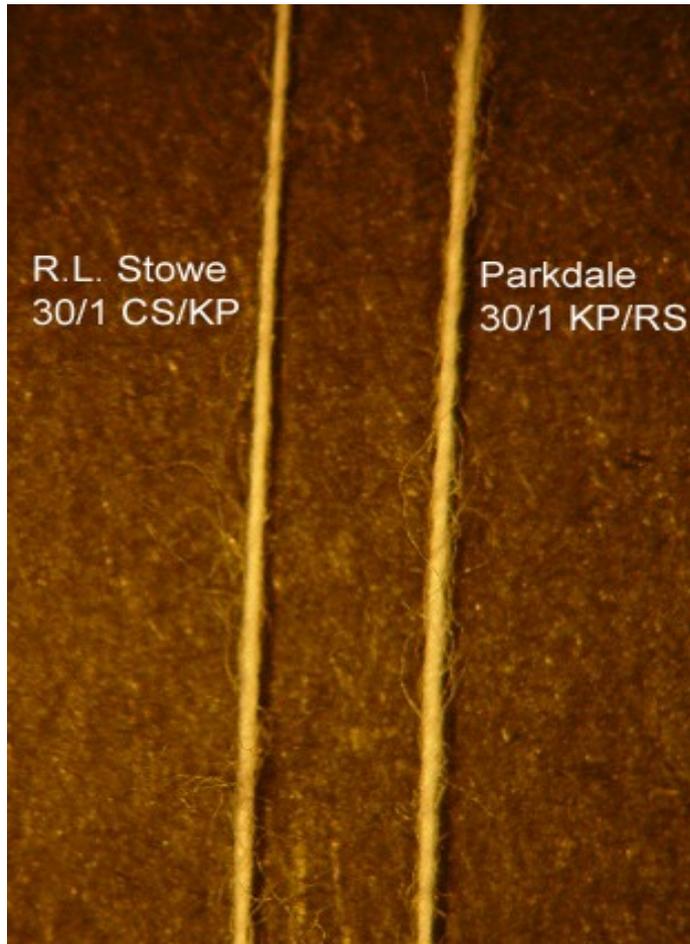


CP
Compact
Delta



CP
Ring
Delta

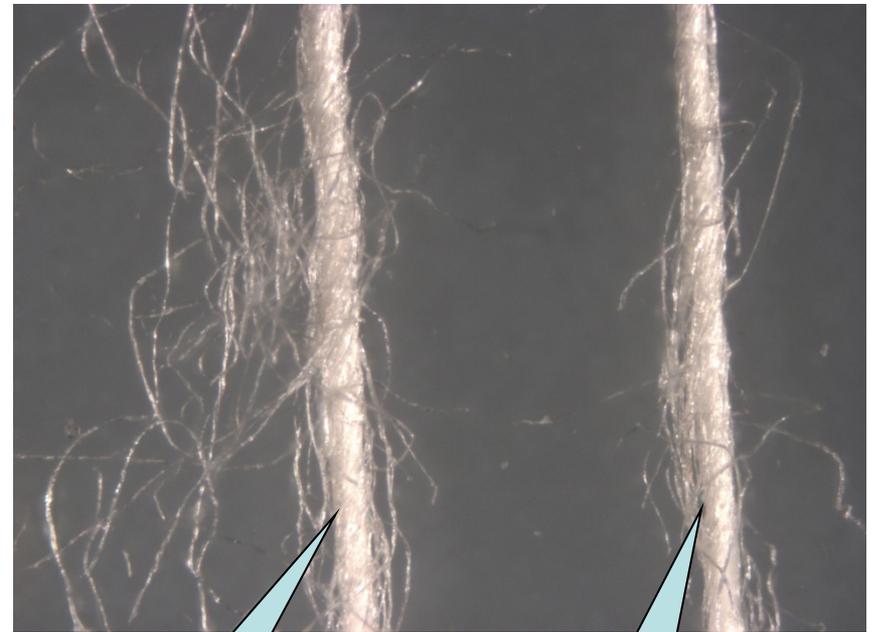
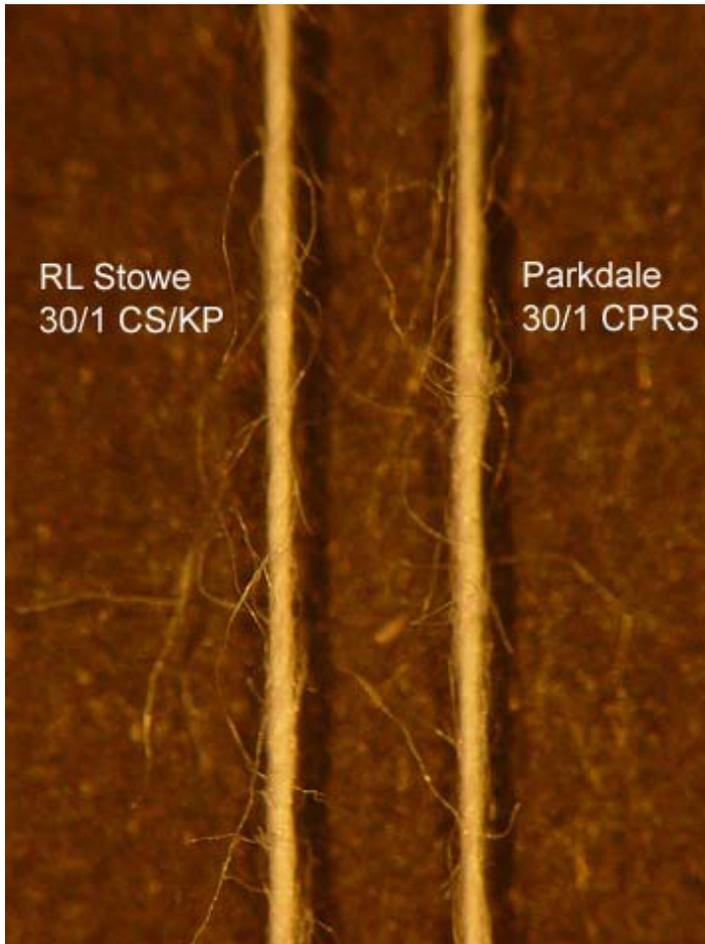
30/1 Compact KP Delta vs. 30/1 Ring KP Delta



Compact

Ring

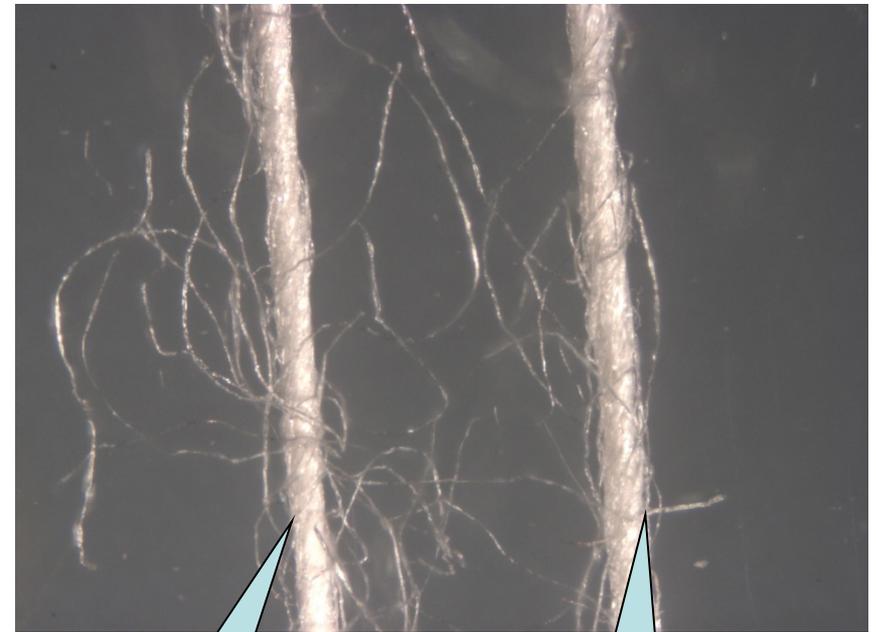
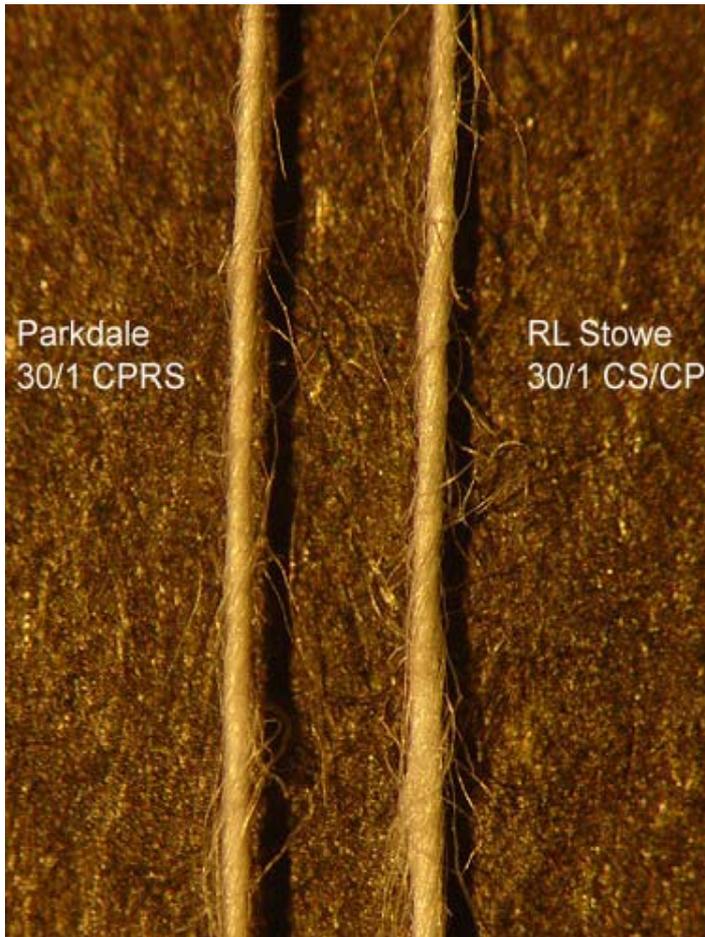
30/1 Compact KP Delta vs. 30/1 Ring CP Delta



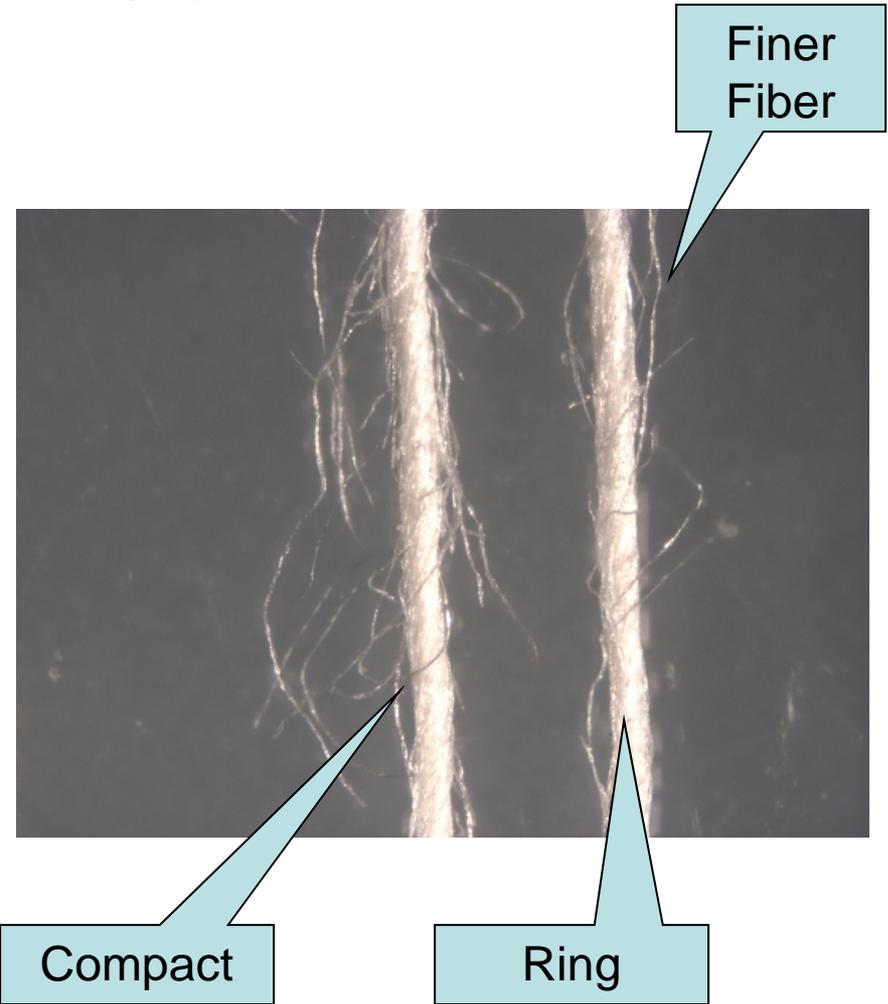
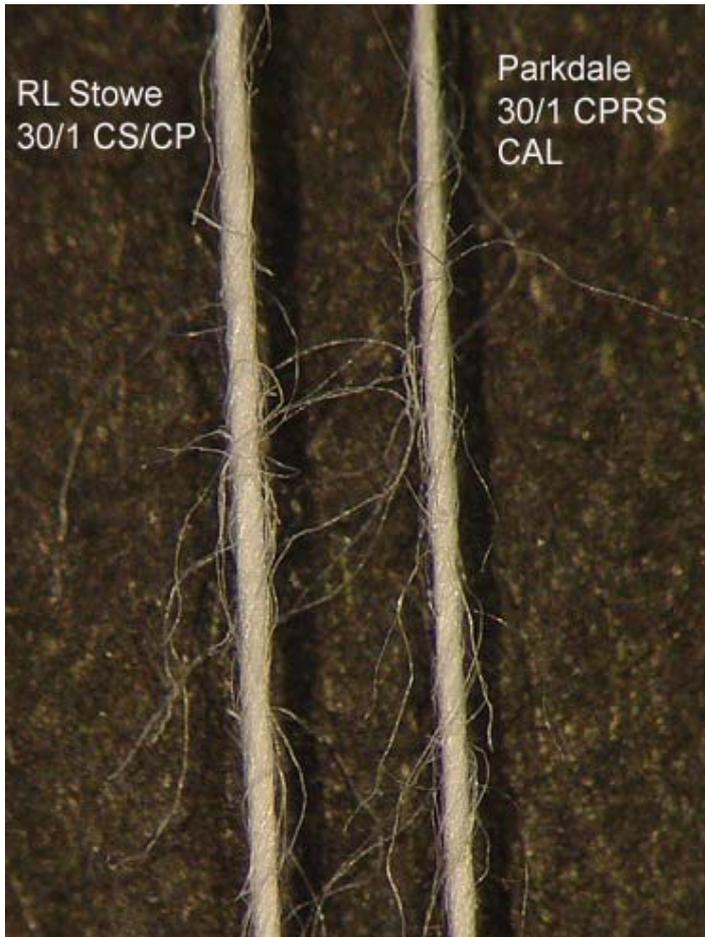
Compact

Ring

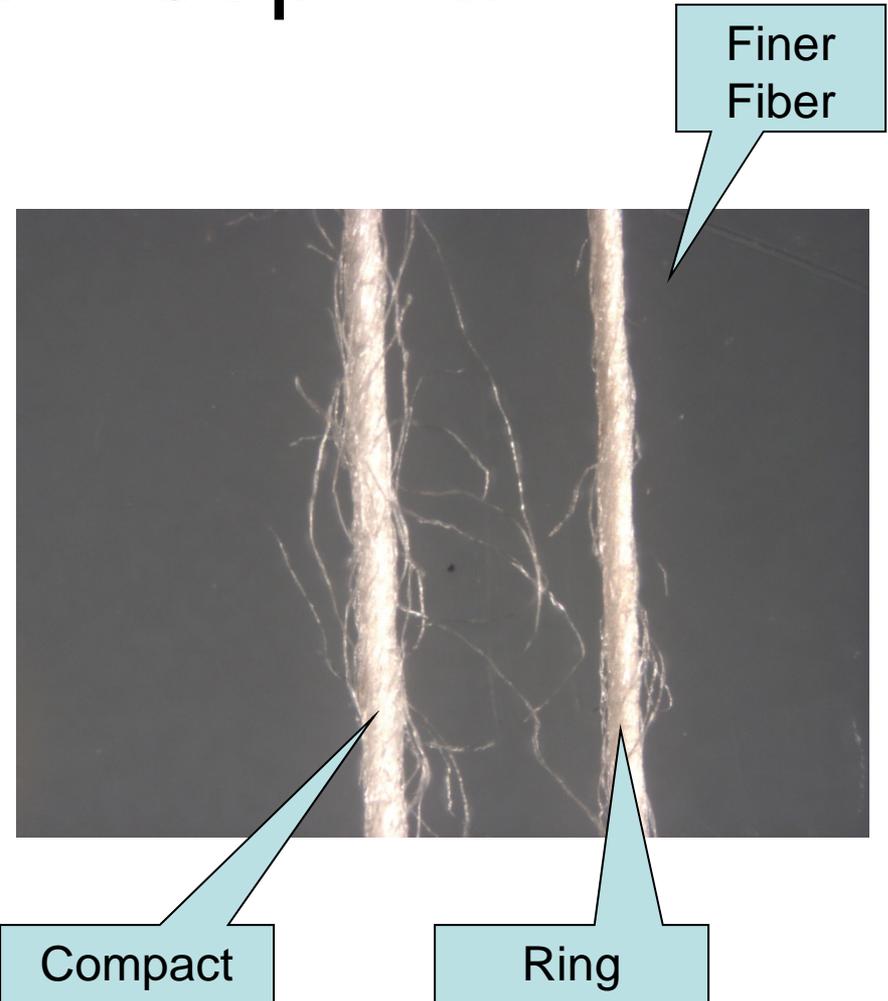
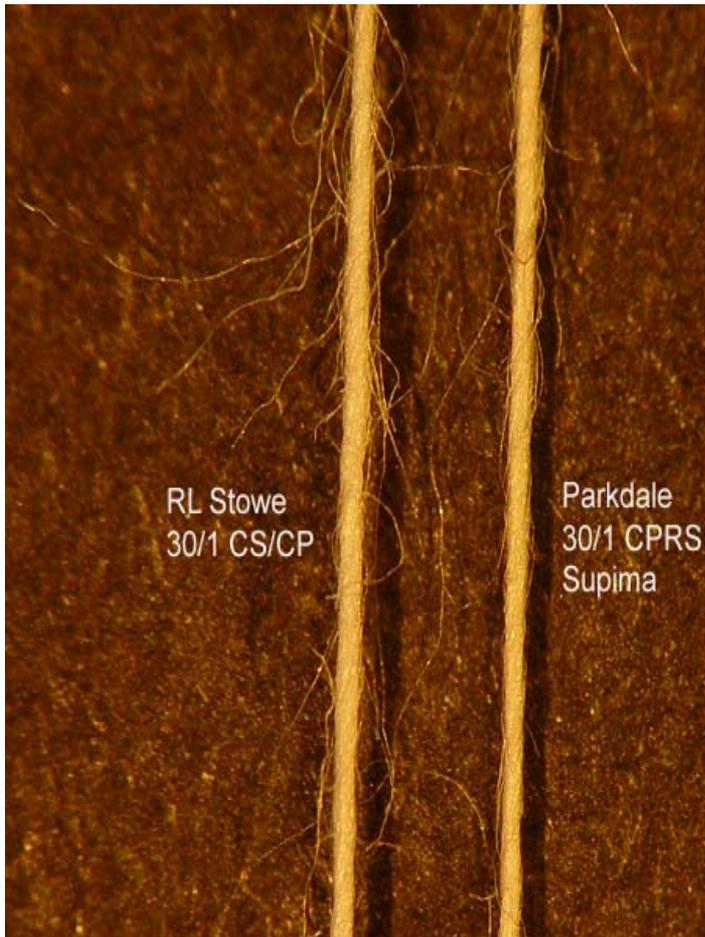
30/1 Compact CP Delta vs. 30/1 Ring CP Delta



30/1 Compact CP Delta vs. 30/1 Ring CP California



30/1 Compact CP Delta vs. 30/1 Ring CP Supima

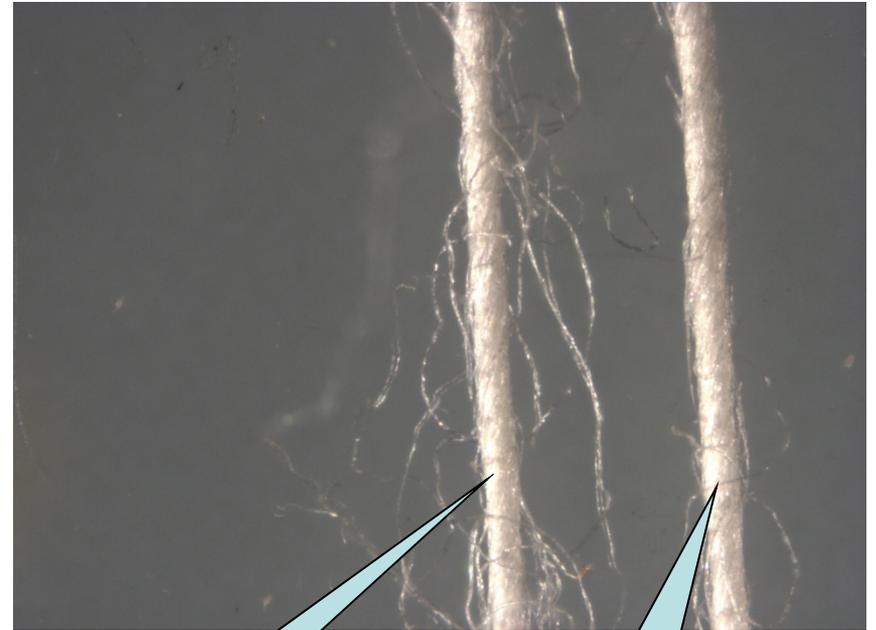


30/1 Compact KP Delta vs. 30/1 Ring CP California



Compact

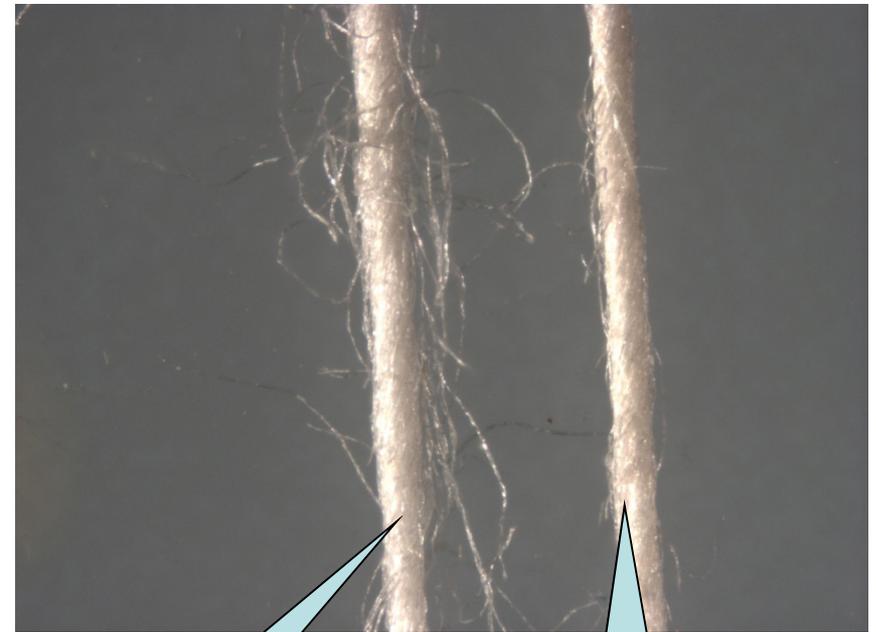
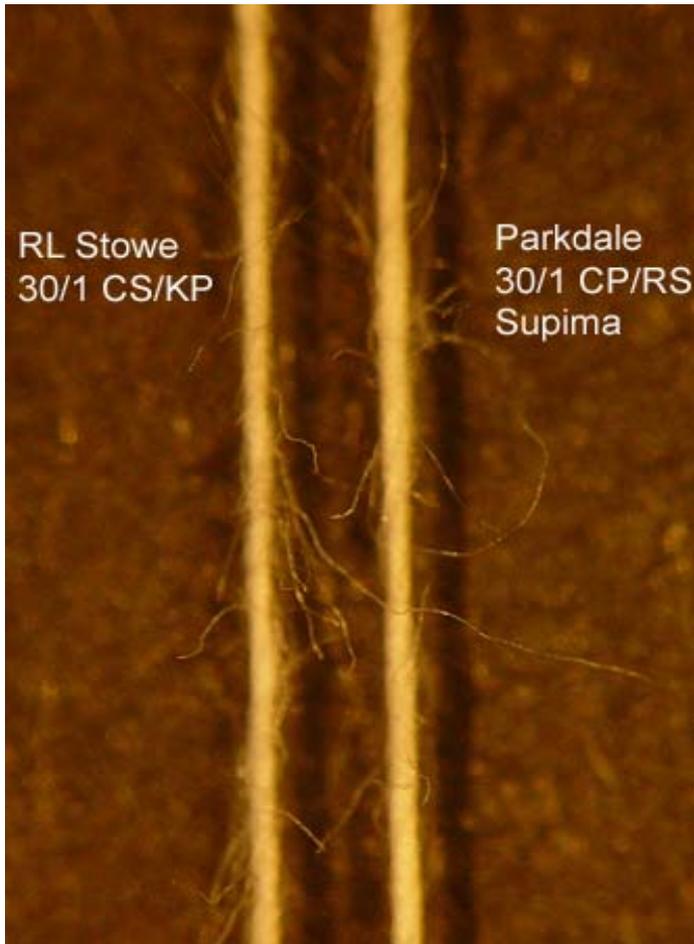
See Also Slide 47



Compact

Ring

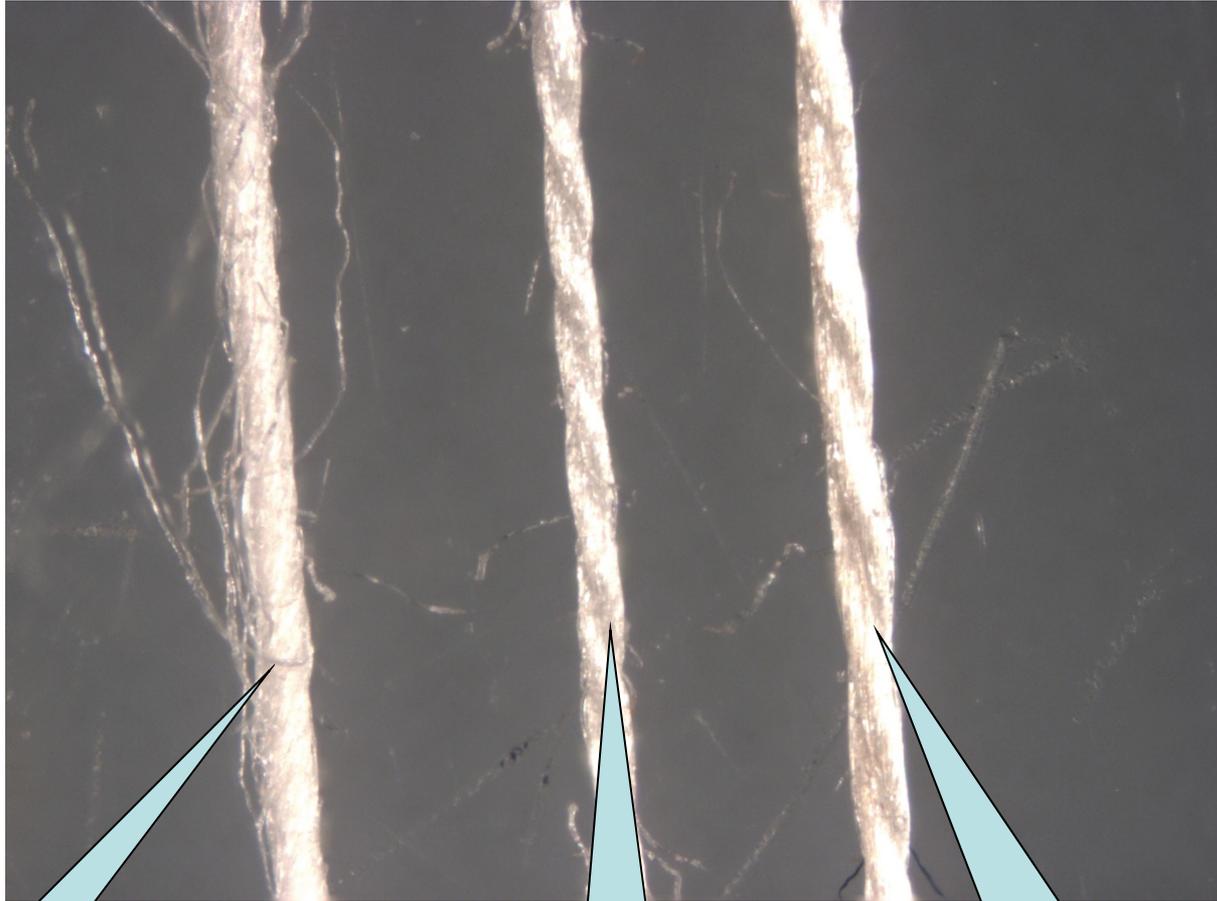
30/1 Compact KP Delta vs. 30/1 Ring CP Supima



Compact

Ring

30/1 Compact CP Delta vs. 60/2 RS CP California and Supima



Compact

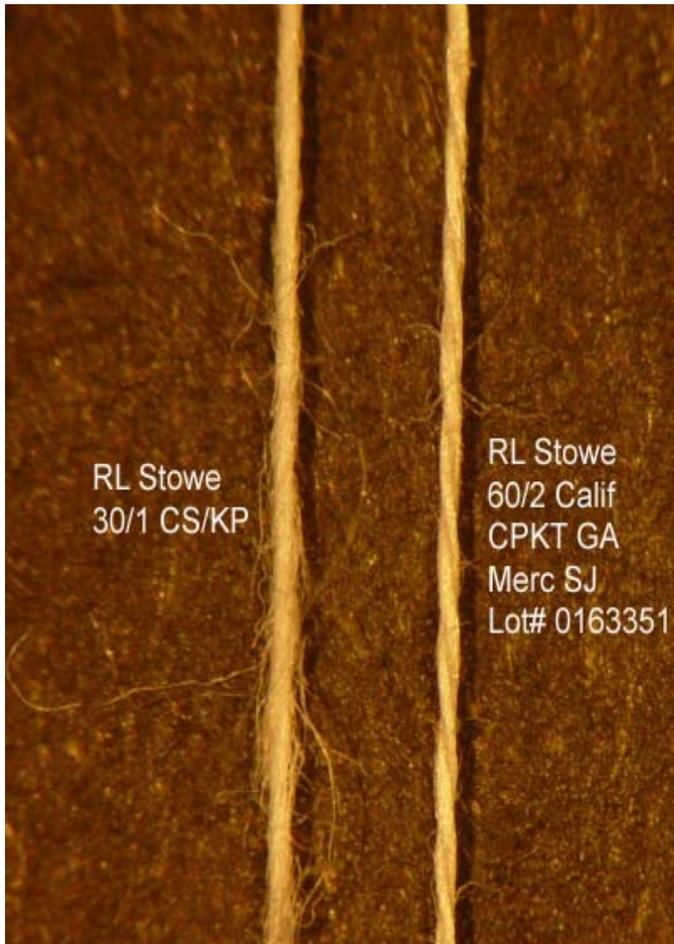
Cal 60/2

Supima 60/2

30/1 Compact CP vs. 60/2 Ring CP Mer. Cal. & Supima



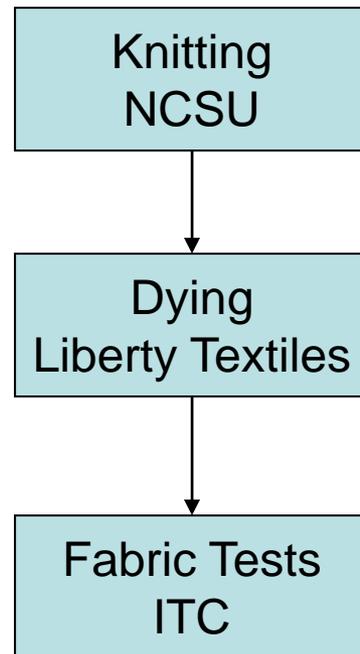
30/1 Compact KP vs. 60/2 Ring CP Mer. Cal. & Supima



Intermittent Loss of Compacting Effect

- Depending upon the type of compacting system, waste build up can clog the pores of lattice aprons, lint build up can cause aprons to stop turning, or a loss of suction can occur on the whole frame as lint builds up on the filter media and lowers the suction, thus the compacting effect can be reduced or even lost completely
- Mechanical condition of the ring frame contributes to increased levels of imperfections and hairiness

Fabric Processing



Fabric Test Standards Used

- ASTM D3776 weight per sq. yd
- ASTM D3775 courses and wales
- ASTM D3787 ball burst
- ASTM D3774 width
- ASTM 3512 random tumble pill
- AATCC 135 shrinkage
- AATCC 16-2004 light fastness
- AATCC 61 color fastness to laundering
- AATCC 116 colorfastness to crocking
- AATCC color retention procedure DEcmc

ASTM 3512 Tumble Pill Test

- Expressed on a 5 point scale
 - A score of 4 or higher means that the fabric will perform satisfactorily –consumers will not perceive a difference
- 5 No Pilling
 - 4 Slight Pilling
 - 3 Moderate Pilling
 - 2 Severe Pilling
 - 1 Very Severe Pilling

Fabric Structural Characteristics

Sample ID	ASTM D3776 Weight (oz/yd ²)	ASTM D3775 Course Wales	ASTM D3787 Ball Burst (lbf)	ASTM D3774 Width (in)	ASTM 3512 Tumble Pill
30/1 CP Delta RS	3.6	Courses: 40 Wales: 37	Courses: 68.9 Wales: 73.3	29	4
30/1 CP Delta CS	3.6	Courses: 40 Wales: 37	Courses: 74.1 Wales: 64.9	28	4
30/1 KP Delta RS	3.4	Courses: 40 Wales: 37	Courses: 56.5 Wales: 57.4	28	4
30/1 KP Delta CS	3.4	Courses: 37 Wales: 37	Courses: 54.6 Wales: 60.5	27	4
30/1 CP Cal RS	3.4	Courses: 39 Wales: 37	Courses: 74.6 Wales: 74.5	27	4
30/1 CP Supima RS	3.7	Courses: 37 Wales: 37	Courses: 103.4 Wales: 103.8	27	4
60/2 CP Cal RS Mer	3.6	Courses: 41 Wales: 35	Courses: 84.0 Wales: 76.9	29	5
60/2 CP Sup RS M	3.5	Courses: 42 Wales: 37	Courses: 74.6 Wales: 81.0	28	4

Significant

ITC Structural Results

- For pilling, all fabrics should perform satisfactorily and there were no significant differences among them
- In the controlled portion of the test, there were no significant differences between compact spun and ring spun fabric strengths. Fabric weight was essentially the same
- However, an alternative yarn, Ne 30/1 Supima Ring Spun was significantly stronger

Dimensional Stability and Colorfastness to Light

Sample ID	AATCC 135 %Dimensional Change	AATCC 16-2004 Colorfastness to Light Gray Scale Change	
		ΔE_{cmc}	Gray Scale
30/1 CP Delta RS	Courses: -11.0% Wales: -0.1% Skew: Left, 16.8%	20 Hours: 1.00 100 Hours: 1.08	4.2 4.2
30/1 CP Delta CS	Courses: -16.2% Wales: -1.2% Skew: Left, 26.7%	20 Hours: 0.43 100 Hours: 0.67	4.1 4.0
30/1 KP Delta RS	Courses: -11.0% Wales: -0.5% Skew: Left, 17.0%	20 Hours: 0.33 100 Hours: 0.70	4.1 4.1
30/1 KP Delta CS	Courses: -15.7% Wales: -0.7% Skew: Left, 16.7%	20 Hours: 0.33 100 Hours: 0.64	4.5 4.0
30/1 CP Cal RS	Courses: -16.7% Wales: -1.4% Skew: Left, 11.0%	20 Hours: 0.60 100 Hours: 0.88	4.3 4.0
30/1 CP Supima RS	Courses: -14.1% Wales: -3.1% Skew: Left, 19.5%	20 Hours: 0.39 100 Hours: 0.94	4.3 4.2
60/2 CP Cal RS Mer	Courses: -13.1% Wales: - 6.7% Skew: Right, 10.0%	20 Hours: 0.51 100 Hours: 0.90	4.5 4.4
60/2 CP Sup RS Mer	Courses: -16.0% Wales: +2.9% Skew: Right, 27.4%	20 Hours: 1.01 100 Hours: 1.67	4.2 4.1

ITC - Dimensional Stability to Laundering Results

- Shrinkage of the courses was greater for the compact spun yarns, in both the Delta KP and the Delta CP
- 30/1 CP Delta compact yarn had more skew than the 30/1 CP Delta Ring Spun
- Fabrics made using Conventional ring spun were more stable

Color Fastness to Light

- ΔE_{cmc} indicates the change in color shade after the fabrics were exposed to light for 20 hours and 100 Hours
 - The human eye can not detect a shift smaller than 1.80
- Gray Scale:
 - 5 No color change
 - 4-5 Slight color change
 - 2-3 Moderate color change
 - 1 Severe color change
 - Want to see gray scale values between 4 to 5

ITC Colorfastness to Light Results

- A gray scale change between 4-5 is not detectable to the human eye
- A ΔE_{cmc} less than 1.8 is not detectable to the human eye
- The Gray scale and ΔE_{cmc} results taken together indicate that there is no difference in the color change between the 8 sample fabrics – all fabrics passed the colorfastness tests

Colorfastness to Laundering

Sample	AATCC 61 Colorfastness to Laundry	AATCC Evaluation ΔE_{cmc} after 5 & 20 Washings	AATCC 8 – 2005 Colorfastness to Croaking
30/1 CP Delta RS	5	5 Washes: 1.12 20 Washes: 1.17	Dry 5 Wet 4
30/1 CP Delta CS	5	5 Washes: 1.35 20 Washes: 1.44	Dry 5 Wet 5
30/1 KP Delta RS	5	5 Washes: 1.35 20 Washes: 1.42	Dry 5 Wet 4.5
30/1 KP Delta CS	5	5 Washes: 1.13 20 Washes: 1.51	Dry 5 Wet 4
30/1 CP Cal RS	5	5 Washes: 1.25 20 Washes: 1.31	Dry 5 Wet 5
30/1 CP Supima RS	5	5 Washes: 1.19 20 Washes: 1.22	Dry 5 Wet 4
60/2 CP Cal RS Mer	5	5 Washes: 1.04 20 Washes: 0.94	Dry 5 Wet 4
60/2 CP Sup RS Mer	5	5 Washes: 1.02 20 Washes: 1.00	Dry 5 Wet 4

ITC Colorfastness to Laundering Results

- Standards are the same as the slide shown above for gray scale and ΔE_{cmc}
- “Crocking” is the rubbing off of dye from a fabric
- Colorfastness and crocking (dye rub off) after 5 and 20 washings are all satisfactory results
- There is no basis to discriminate between the fabrics

ITC Observations

- The main focus of the fabric tests was on objective/measurable measurements commonly used in fabric acceptance testing
- While the light fastness and color fastness values indicate no difference between the types of yarns there was a visual difference in color depth noted by the ITC
- Fabric made with the 60/2 mercerized California and the 60/2 mercerized Supima had a much deeper color and a sheen and luster not seen in other samples
- Spectroscope tests at the ITC confirmed that the dye was the same
- ITC concluded that the differences are what is typically found with mercerized yarns

Fabric Summary

- When made from the same Delta fiber in a controlled test, fabrics made from compact spun yarns had no advantage in fabric strength, light fastness, colorfastness, dimensional stability, or pilling offering no advantage to the consumer
- By choosing different fibers, and by making choices in process that are readily available to the manufacturer it was possible to make a superior yarn using the conventional ring spun system

KP Delta CS Does Not Compared to CP Delta Ring

Property	Carded Compact Spun	Combed Ring Spun
UCV%	16.23	12.45
-30% Thin	2712	925
-40% Thin	321	56
-50% Thin	10	1
+35% Thick	1270	215.5
+50% Thick	240	19.5
+200% Nep	171	20
H-Index	5.71	5.82
cN/Tex	15.7	16.66
Elong	4.36	4.16
B-Force	315.15	334.4

Zweigle Hairiness h/100 m	Carded Compact Spun	Combed Ring Spun
S-3	1734	1201
Index	1117	732
1 mm	16943	12184
2 mm	2672	1586
3 mm	1221	753
4 mm	450	350
6 mm	53	80
8 mm	9	15
10 mm	1	3
12 mm	0	0

Discussion

- A compact yarn offered no advantages in evenness, imperfections, or Classimat faults
- The very slight yarn strength difference compact yarns had offered no advantages in fabrics
- A carded compact spun yarn did not substitute a for a combed ring spun yarn
- A singles compact spun yarn did not substitute for a plied yarn or a mercerized yarn

Discussion (Cont.)

- Should the consumer value fabric strength, then fabrics made with the Supima fiber in conventional ring spinning made a stronger fabric
- Should the consumer value depth of color, sheen, and luster, then the mercerized Ne 60/2 yarns had a depth, sheen and luster not found in the other yarns, including the compact spun yarns
- Should the user value a stable fabric structure, then fabrics made with conventional ring spinning systems had less skew and shrinkage

Closing Remarks

- Advocates of the compact yarn system make several claims that were not supported by the objective measurements in the trial
- In addition, subjective or esthetic reasons to select compact spinning over conventional ring spinning were not substantiated

