THE STUDY OF IRREGULARITY ELONGATION OF YARNS OF WOOL IN MIXTURE WITH SILK USING THE USTER® TENSOJET 4 MACHINE

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Abstract: *The purpose of the study is to assess the irregularity elongation of wool yarn in a mixture with silk with the smoothness and torque of 470 Nm 34/1 twists / m, for knitted products. The study was conducted on two groups of yarns, batch 1 came from South Africa, and batch 2 from Asia, which was painted. In both groups there was 75% wool yarn and 25% silk. The measurements were carried out using the USTER® TENSOJET 4 machine, the analysis being performed on ten samples from each batch of yarns.*
During the mechanical processing and also during the use of textiles, the yarns are solicited by tensile forces, but most often by forces inferior to tearing forces. To highlight the behavior of yarns during strains to smaller stresses than those causing tearing itself, we must examine the stress-elongation diagrams and the irregularity regarding stress (tearing load and elongation to tearing). These stress characteristics have a major influence on deformability characteristics, dimensional stability, knitted products for which these yarns are intended.
Thus it was found that the yarns from Asia, have a higher quality from the point of view of the tensional proprieties having a lower irregularity defect from this point of view, contributing to obtaining a higher quality of the knitted product with a better dimensional stability than the products obtained from South Africa.

Key words: *yarns, tensile properties, fineness, irregularity, USTER® TENSOJET 4.*

1. INTRODUCTION

During the mechanical processing and also during the use of textiles, the yarns are solicited by tensile forces, but most often by forces inferior to tearing forces. To highlight the behavior of yarns during strains to smaller stresses than those causing tearing itself, we must examine the stress-elongation diagrams and the irregularity regarding stress to tearing load and elongation to yarns tearing. It is necessary to analyze the main tensile proprieties of yarns and their irregularities, in order to create knitted or vowen textile products of good quality.

When the yarns are being stretched they are deformed longitudinally, deformation that occurs at the moment of tearing and is called elongation to tearing. It is needed a study of yarns deformability in the field of knitted fabrics due to their specific contexture and also due to the fact that yarns with less torsion are necessary compared to warp and weft yarns used for knitted fabrics [1] [2].

The resistance of yarns, is a transfer characteristic of the yarns resistance depending on the following factors:

- nature of raw materials
- yarns fineness
- torsion (depending on final use)
- fiber characteristics (strength, fineness, length, surface condition)
- yarns structure
- mechanical, chemical, thermal treatments, etc. [3].

The irregularity to resistance is considered according to the variation coefficient to tearing load and it influences the behavior of yarns when being processed, determining the work efficiency during mechanical processing machines and also the quality of the final product [4] [5].

2. THE EXPERIMENTAL PART

USTER® TENSOJET 4 is a unique control system that gives an accurate forecast of yarn behavior in subsequent processing, especially on high-performance weaving and knitting machinery. Its precise measurements of tensile force and elongation also verify the yarn's suitability for the end-product, as well as facilitating analysis of the yarn production process and fault tracing. The USTER® TENSOJET 4 measures across 100 000 breaks, the basis for an accurate and targeted forecast of yarn processability on downstream machinery. Its enormous test capacity of 30 000 breaks per hour means it can detect seldom-occurring yarn faults or isolated weak places – an important benefit, since such problems are difficult or impossible to predict reliably with conventional testers or on the basis of statistics or probability theory. The massive increases in weaving-machine speeds over the years have resulted in ever higher peak loads on both warp and weft yarns, and when this leads to more frequent thread breakages the impact on production efficiency is similarly magnified. So, weavers need to source yarns with no weak places at which strength and elongation are insufficient to cope with peak stresses on their machines. The causes of infrequent and isolated weak places can include extremely thin places, thick places with little twist, and yarn contamination with vegetable matter, fly or foreign fibers. The only way to detect such faults is to make a large number of random tests within a short time frame, and it is essential to ensure this is done with realistic loads to recreate mill conditions.

Tests have shown that on weaving machines, force is applied on yarns within about 3 milliseconds of a break. The high test speed of the USTER® TENSOJET 4 actually simulates the dynamometric stress on the yarn during weft insertion, which occurs during the 3 – 6 milliseconds time phase. The pressing need to avoid end breaks is illustrated by the example of yarns used in the beaming process, before weaving. Whereas other applications would regard one end break more or less in 100 000 meters of yarn as way of classifying a yarn as 'good' or 'bad', for beaming the critical figure can be as little as 0.8 end breaks in one million meters! The USTER® TENSOJET 4 thus has an obvious and highly significant role in quality control for weaving yarns. But there is an increasing realization that knitting machines too need stronger yarns, in contrast to the faulty perception that strength testing is not required for this application. Knitting productivity has risen considerably in the past 20 years and high needle speeds on today's knitting machines call for improved yarn tenacity, as well as the accepted elongation factor. The high degree of precision and accuracy of measurements on the USTER® TENSOJET 4 provide test results with increased statistical significance, and their value is enhanced by the fact that the instrument has inbuilt correlation with the USTER® TENSORAPID tester, as well as integration with USTER® STATISTICS benchmarks.

Thus we have analysed two batches of yarns, batch 1 coming from South Africa, and batch 2 from Asia, which was painted. In both batches, there is 75% wool and 25% natural silk with the fineness Nm 34/1 and torsion of 470 twists/m, for knitted products. The measurements were carried out using the USTER® TENSOJET 4 machine from Figure 1, analysing ten samples from each batch

Fig.1: *The USTER® TENSOJET 4 machine [6]*

The first batch taken for analysis is the woolen yarn from South Africa (Batch 1)

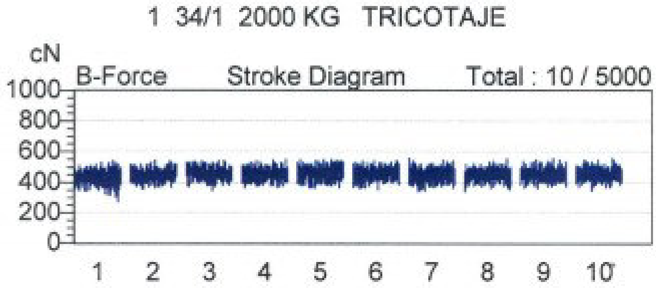

***Fig.2:** Dispersion diagram of resitance to tearing for the yarns from batch 1*

In Figure 2, is represented the dispersion diagram of resitance to tearing for the yarns of batch 1, rendering, the irregularity of the resistance to tearing of yarns for the ten samples from batch 1.

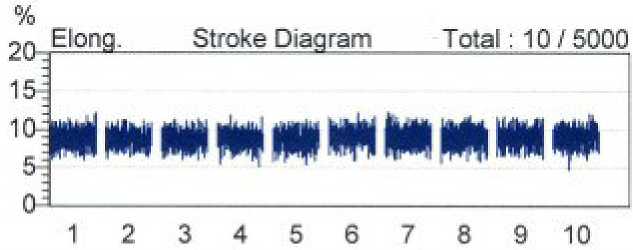

***Fig.3:** Dispersion diagram of yarns elongation up to tearing from batch 1*

In Figure 3 is shown the dispersion diagram of the elongation to tearing for the yarns from the batch 1, rendering, the irregularity of elongation to tearing for the ten samples of yarns from batch 1.

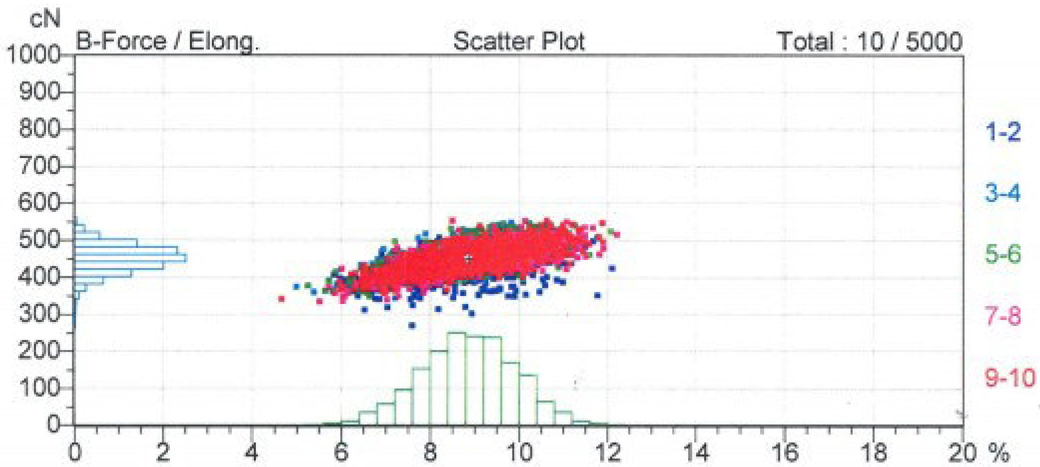

***Fig.4:** Diagram of yarns effort - elongation from batch 1*

In Figure 4, is represented the effort-elongation diagram that shows the variation of tensile strength and elongation to tearing for the ten yarns from batch 1.

Total : 10 / 5000 Single test(s)

Nr	B-Force cN	Elong. %	Tenacity cN/tex	B-Work cN.cm
1/500	430.9	8.77	14.65	1253
2/500	445.5	8.69	15.15	1274
3/500	456.0	8.72	15.51	1306
4/500	453.9	8.73	15.43	1305
5/500	456.9	8.76	15.54	1314
6/500	456.0	9.13	15.50	1358
7/500	447.9	9.01	15.23	1324
8/500	447.8	8.87	15.23	1308
9/500	447.8	8.94	15.23	1328
10/500	451.4	8.95	15.35	1323
Mean	449.4	8.86	15.28	1309
CV	7.95	12.02	7.95	19.31
s	35.74	1.07	1.22	252.8
Q95	0.991	0.03	0.03	7.009
Min	267.8	4.66	9.11	459.8
Max	551.9	12.21	18.77	2161
P0.01 (0)				
P0.05 (2)	310.3	5.23	10.55	546.7
P0.1 (5)	316.1	5.52	10.75	604.7
P0.5 (25)	348.4	6.05	11.85	694.9

Fig.5: *The statistical and mathematical processing of yarns individual data - batch 1*

In Figure 5 are found the individual values for the tensile forces of the ten samples of yarns and elongation to tearing corresponding to these forces. Based on these data it is achieved the statistical and mathematical processing of such individual data thus obtaining: tenacity, arithmetic mean, coefficient of variation, for yarns from - batch 1.

The second batch is taken for analysis of woolen yarn from Asia (batch 2)

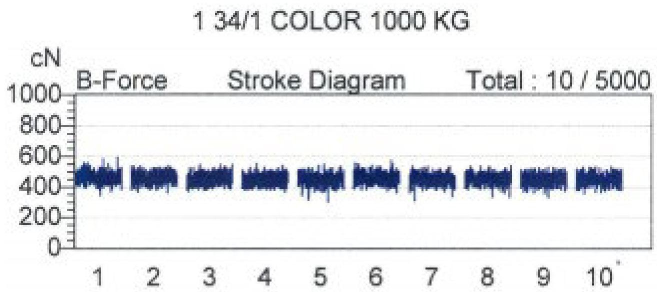

Fig.6: *Dispersion diagram for the resitance to tearing of the yarns from batch 2*

In Figure 6 is represented the disperson diagram of the resistance to tearing of the yarns from batch 2, rendering, the irregularity of tear-resistant yarns for the ten samples from batch 2.

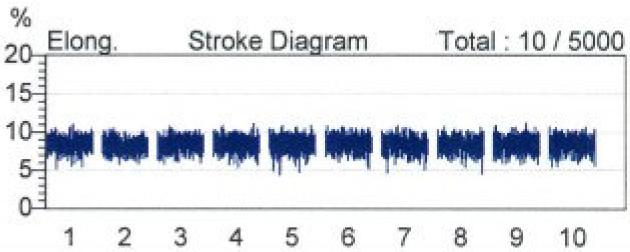

Fig.7: *Dispersion diagram of yarns elongation up to tearing from batch 2*

In Figure 7, there is shown the diagram of the dispersal of the elongation at rupture of the yarn from batch 2, rendering, the irregularity of elongation at tearing for the ten samples of yarns from batch 2.

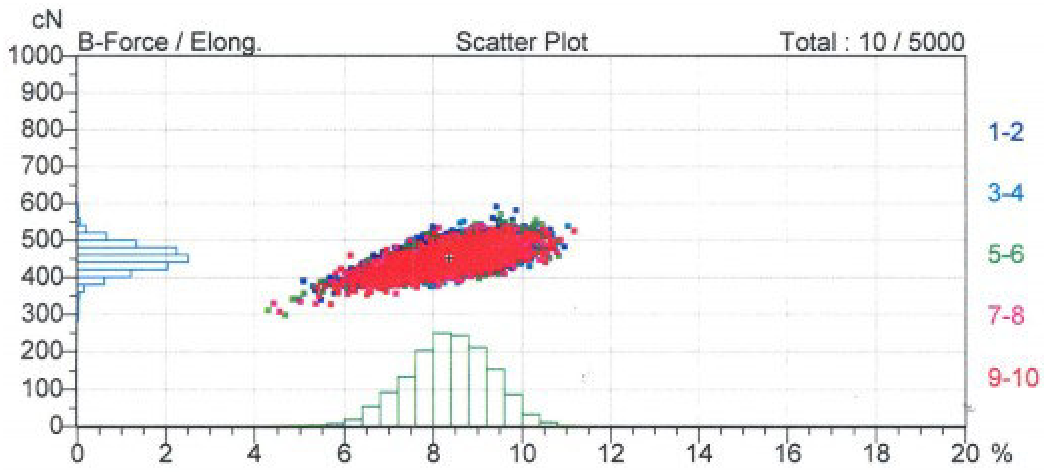

Fig.8: *Diagram effort-elongation of yarns from batch 2*

In Figure 8, is represented the diagram of effort-elongation that shows the variation of tensile strength and elongation to tearing for the ten yarns in batch 2.

Total : 10 / 5000 Single test(s)

Nr	B-Force cN	Elong. %	Tenacity cN/tex	B-Work cN.cm
1/500	459.5	8.32	15.62	1252
2/500	459.0	8.19	15.61	1229
3/500	451.8	8.39	15.36	1247
4/500	446.2	8.36	15.17	1228
5/500	447.0	8.38	15.20	1235
6/500	459.7	8.53	15.63	1289
7/500	447.3	8.30	15.21	1213
8/500	446.5	8.30	15.18	1218
9/500	448.6	8.37	15.25	1233
10/500	449.1	8.40	15.27	1245
Mean	451.5	8.35	15.35	1239
CV	7.60	11.23	7.60	18.33
s	34.30	0.94	1.17	227.1
Q95	0.951	0.03	0.03	6.297
Min	297.7	4.28	10.12	410.8
Max	590.7	11.17	20.08	2029
P0.01 (0)				
P0.05 (2)	310.6	4.53	10.56	437.7
P0.1 (5)	327.3	4.83	11.13	507.0
P0.5 (25)	364.0	5.72	12.38	666.8

Fig.9: *The statistical and mathematical processing of yarns individual data - batch 2*

In Figure 9 are found individual values for the tensile forces of the ten samples of yarns and elongation to tearing corresponding to these forces. Based on these data it is achieved the statistical and mathematical processing of such individual data, thus obtaining: tenacity, arithmetic mean, coefficient of variation, for yarns from - batch 2.

3. CONCLUSIONS

As a result of the analysis made, statistical and mathematical processing was performed resulting the coefficient of variation of resistance to tearing for the two groups of yarns: CV1 = 7.95 for the first batch and CV2 = 7.6 for the second batch.

Thus it was found that the yarns from Asia, have a higher quality from the point of view of the tensional proprieties having a lower irregularity defect from this point of view, contributing to obtaining a higher quality of the knitted product with a better dimensional stability than the products obtained from South Africa.

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