

Analysis of yarn structure and equipment for determining yarn properties

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Abstract. The effective application of local raw materials, cotton fibers, wool and downy plants, the production of natural blended threads, improving their physical and mechanical properties in order to ensure the production of high-quality export products with a new blend composition are covered in the article. The yarn of 20% wool, 30% cotton, 50% polyester fiber has been analyzed. It has been established that fiber index results are higher than 100% cotton fiber. This indicates that the use of 50% polyester to solve the problem of allocating cotton growing areas to growing other agricultural products and reducing cotton growing areas, which affects the production of products, and that was considered as saving cotton fiber in such a percentage.

1 Introduction

Application of new tools and methods is associated with the need to research and evaluate the characteristics, technological processes of processing two and three component spinning products obtained from unconventional blends. The distribution of unevenness and fluffiness along the length of the product is shown by diagrams on a personal computer display, in which the program is installed that allows controlling the sample, set the test conditions, analyze the obtained data, save and copy the diagrams. Using the defect setting function allows determining the number of places where the bristles exceed the specified value, and at the same time distinguishing these defective places from the naps and twist areas of the thread [1,2].

In order to process graphic images, a MICROCOLOR 2000 250B-LAB computer system installed on a microscope was used.

The graphic image is studied at a magnification of 10-1-40 times. A video camera is attached to the microscope and the image is stored digitally using Clobal Color Lab software. The resulting images are displayed on a monitor and can be used to measure fiber, thread diameters and determine the distribution of fibers in the cross section of the thread. CorelDRAW graphic editor was used to analyze the received images, which can also be printed and saved [3].

The mechanical properties of threads, as well as any bodies, are called different determinants of their response to movement. When they are deformed and sometimes broken

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under the influence of forces applied to them, the study of the properties of their semi-cycle continuity is of the greatest importance in studying the mechanical properties of threads [4].

2 Materials and methods

The inherent complexity of the structure of a yarn with a mixture of non-uniform fibers significantly affects its properties and the properties of the blended fabrics obtained as a result of its use. Therefore, in order to ensure the stability of technological processes of spinning, weaving and finishing, it is required to evaluate it in more advanced testing devices of the new generation.

Therefore, the experimental yarns were tested in a set of SY 900E Uster-Tester (China) equipment, including: SY 900E Uster-Tester (China) linear density and measurement of yarn, yarn smoothness or rove unevenness, moving product mass using capacitive sensors designed to detect deviations.

SY 900E Uster-Tester (China) model allows checking the unevenness of the thread diameter and fluffiness at the same time. Such a structure can be determined by the following formula:

$$U = C + H + E, \tag{1}$$

where, U is the thread surface structure; C is the core of the thread; H is the diffusion area; E is nap.



Fig. 1. Model of the longitudinal structure of the thread.

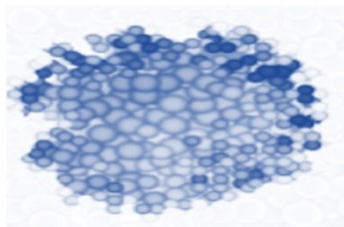


Fig 2. Model of the transverse structure of the thread.

Table 1. Fibers located in the cross section of the threads.

Fiber types	The number of fibers by composition in the cross-section of the thread		
	20% wool, 30% cotton, 50% polyester primary blend yarn	20% wool, 40% cotton, 40% polyester primary blend yarn	20% wool, 40% cotton, 40% polyester primary blend yarn
Cotton	95 pcs cotton	95 pcs cotton	112 pcs cotton
Wool	36 pcs wool	34 pcs wool	-
Polyester	97 pcs polyester	100 pcs polyester	120 pcs polyester

In the research process, in addition to the indicated tools and methods, mathematical planning methods of the experiment were used. Expert methods for evaluating the importance of the characteristics of experimental samples, graphical characteristics, experimental threads, etc. were used for a comprehensive assessment of the quality of options [5-7].

Automation of test equipment partially solves the problem of accelerated evaluation of yarn properties. Another possibility is the development of such a tool and a method of tests of the yarn group, in which it is possible to estimate with sufficient accuracy the properties of the yarn batch, that is, to determine the breaking load and elongation, and also to evaluate the unevenness of the yarn according to these properties [8-10].

The diagram of breaking strength and breaking elongation of yarn groups obtained by pneumatic-mechanical spinning method is shown in Figure 4.

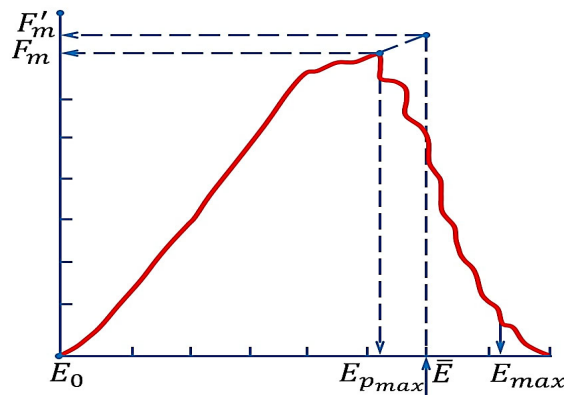


Fig. 3. A copy of the diagram of yarn breaking force and elongation at break obtained on the STATIMAT breaking machine.

The average values of breaking load and elongation at break were determined as follows.

Using the diagram, the range of variation with the elongation of the threads in the set was determined:

$$R = E_{max} - E_{Fmax}$$

Then the average value of elongation was determined according to the following formula:

$$\bar{E} = E_{Fmax} + R \frac{E_{max} - E_{Fmax}}{E_{max} - E_0}$$

And finally, the P_{max} graphic value was determined, after which the breaking strength in the threads was determined according to the following formula:

$$\bar{F} = \frac{F'_{max}}{m}$$

where m is the number of threads in the bundle [9-10].

3 Results and discussion

The analysis of the results of breaking strength and elongation at break of single yarn and yarn group of different pure cotton and blend composition with linear density of 50 tack is shown in Figures 4-7.

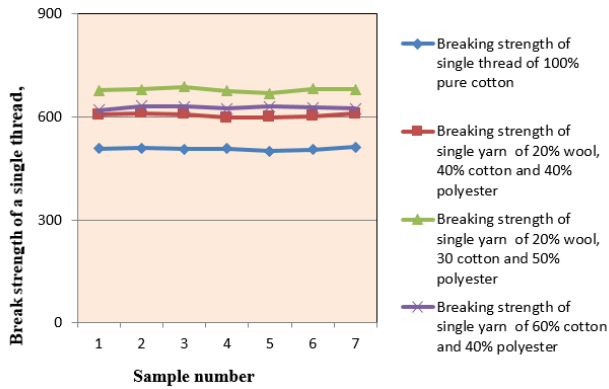


Fig. 4. Breaking strength of single yarns of pure cotton and different blend compositions of linear density 50 tack.

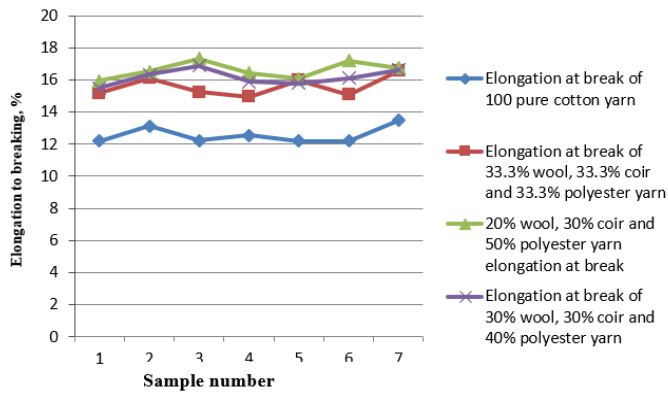


Fig. 5. Elongation to breaking of single yarns of pure cotton and different blend compositions of linear density 50 tack.

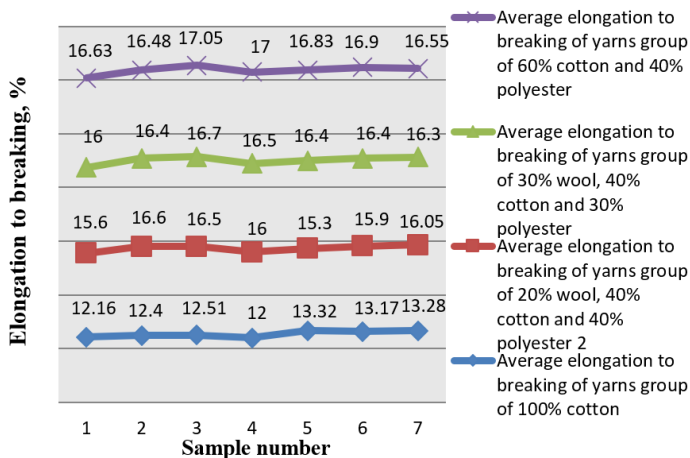


Fig. 6. Elongation to breaking of group yarns of pure cotton and different blend compositions of linear density 50 tack.

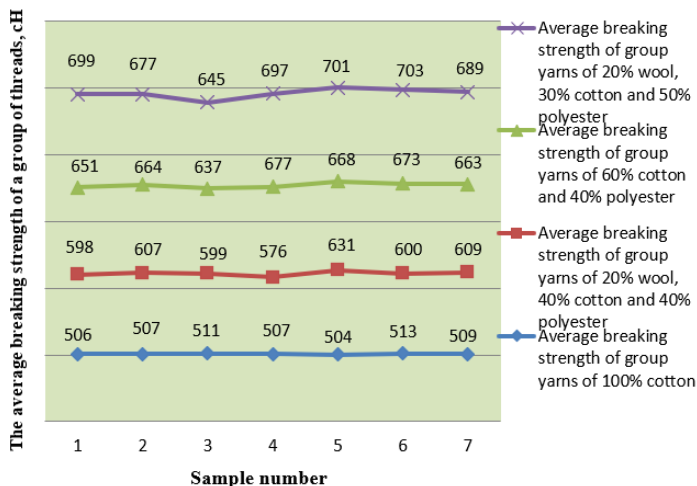


Fig. 7. Breaking strength of group yarns of pure cotton and different blend compositions of linear density 50 tack.

4 Conclusion

In process of analysis of the results of the breaking strength and elongation to breaking of single yarn and group yarns of 50 tack, it was found that the difference in breaking strength of a group of yarns with 1 yarn break was 0.9%, and the difference in elongation at break was 2.2%. Therefore, in order to save the time of laboratory workers, instead of calculating the average result by trying to break 1 thread 10 times, we recommend to determine the breaking strength and elongation to breaking of a group of threads at the same time.

Therefore, the use of the most modern computerized testing equipment and laboratory equipment of foreign companies, based on the determination of the main properties of 100% cotton and wool, cotton and polyester yarns, allows establishing compliance with the standards. When we analyzed the results of breaking strength and elongation to breaking of single yarn and group yarns of 50 tack, the difference in breaking strength of a group of threads with 1 thread breaking strength was 0.9%, and the difference in elongation to breaking was 2.2%.

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