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Analysis of One-Period Extensive Deformation of Fabrics with Different Composition of Secondary Material Resources

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ABSTRACT: In this article, in order to determine the physical and mechanical properties of cotton fiber fabrics, fabrics obtained from a mixture of secondary material resources of cotton and rogoose fibers in different percentages, looms, equipment of Bukhara "Al Hakim Plus", Samarkand "Urguttextil" LLC and fabric samples under TITLI Modern equipment of the testing laboratory "CentexUz" was selected and experimental work was carried out on the basis of state standards.

KEYWORDS: viscous, elastic, plastic, full deformation composition, single-period elongation deformation

I.INTRODUCTION

Lining fabrics derived from secondary material resources produced in textile enterprises differ in fiber content, structure and quality. For example, the upholstery used for bedding in our country is mostly imported from Turkey, China and other foreign countries.

Today, foreign and domestic market consumer demand and the global "fashion and design" industry is developing. This leads not only to the improvement of a number of consumptions, hygienic, physic-mechanical requirements for fabrics currently produced in the textile industry, but also to the increased attention to its aesthetic properties.

Upholstery fabrics must fully meet the hygienic requirements, taking into account the seasons, climatic conditions, age. Taking into account the healing and positive effects of natural fibers on human health gives good results in the creation and production of new assortments of upholstery fabrics.

The produced upholstery fabrics are produced in different ways. For example, upholstery fabrics are produced on looms, knitting machines and in the form of nonwovens. Upholstery fabrics are used for different purposes and are obtained from a mixture of different secondary material resources.

In the production of textile products are constantly subjected to single-cycle elongation deformation. That is, textiles are exposed to the load for a certain period of time, resting after unloading. It is of great practical importance to study the properties of materials during this loading-resting process. If the materials are stretched under load and do not return to their previous state during the rest process, the elastic, elastic properties of such fabrics will be low, i.e. the fabrics will wrinkle and the shape-retaining properties of the garments obtained from them will be impaired.

A one-period class consists of three processes. The fabric is exposed to the load, unloaded and rested. If the properties of the fabric are studied only under the influence of the load, the values obtained from them fall into the semicircular class. If the material is in a single-cycle process, the values obtained from them fall into a single-cycle class. If the material is in a multi-cycle process (single-cycle class is repeated "n" times), the values obtained from them fall into the multi-cycle class. In the semi-circular class, the material is usually stretched and broken in a short time under the influence of the load.



In a periodic class, the material is exposed to loads and at rest for a long time. As a result, the ability of garments to retain their shape is studied.

The complete deformation that occurs in a single-period elongation deformation consists of three parts: elastic deformation, elastic deformation, and plastic (residual) deformation. In this case, the first two deformations (elastic, elastic) are reversible deformations, and the third (plastic) is non-reversible residual deformations. The reason for the formation of elastic deformation is that the distance between the particles of polymeric substances changes slightly under the influence of external forces. In this way, the interdependence of molecules and atoms is preserved. However, the tensile angles increase slightly.

As a result of elastic deformation, the volume of the body increases. The distribution of elastic deformation is equal to the speed of sound. According to Prof. I.V. Kragelsky, the distribution of elastic deformation in baked cotton yarn is 1425 m / s, in linen yarn - 1900 m / s. Thus, the propagation of elastic deformation in 1 m long yarns takes place within 0.0007-0.0005 s, which is very fast.

As the distance between the particles of the fibrous material changes, the deformed fiber accumulates elastic energy in the yarn. Once the loads are removed, the elastic deformation returns at the rate shown above. Fiber with elastic deformation, the properties of the yarns will be similar to the properties of rubber yarns.

The main reason for the formation of elastic deformation is that when the fibers stretch, the particles of their substance flatten out in the direction of the force acting and move a greater distance, the molecules regroup and change their shape. Elastic deformation takes place over a period of time. This deformation is due to the fact that the fiber undergoes a relaxation process in the structure of the yarn. Relaxation is the process of stretching and resting to balance the structure of the fiber, the threads. Elastic deformation develops at a small rate. Its speed depends on the environmental parameter. At high temperatures and with the absorption of water vapor, the development of elastic deformation of the fiber, the yarn is accelerated, because the mutual gravitational force of the molecules of the substance is reduced. It passes quickly during the relaxation process.

Under the influence of external forces, plastic deformation occurs as a result of the long-distance displacement of macromolecule particles. The increase in plastic deformation occurs by breaking the strong intermolecular bonds of fiber macromolecules. Plastic deformation does not return because the fiber does not have the forces that return it after the yarns are released from the impact load. As a result of plastic deformation, the shape of the fibers changes, i.e. the thickness varies along the length.

The plastic deformation part also includes the elongation caused by the sliding or flattening of the loose fibers in the yarns. It is known from the results of scientific work that complete deformation develops simultaneously after loading on the yarns, but at different speeds, i.e., as shown above, elastic deformation increases very rapidly, and elastic deformation increases over time. The return deformation occurs after unloading the load from the ropes in the same way. That is, the elastic deformation returns in a short time, while the elastic deformation returns in a certain time.

II. METHODOLOGY

In order to study the single-cycle elongation deformation of lining fabrics obtained from secondary material resources of different composition, research work was carried out and the test results obtained are presented in Table 1.

Table 1

Variation in single-cycle elongation deformation of fabrics with different composition of secondary material resources

№	From secondary material resources of different composition obtained fabrics	Deformation structure, %		
		flexible	elastic	plastic
1.	70% cotton fiber with 30% cotton fiber secondary material resources	0,42	0,22	0,36
2.	Secondary material resources derived from 10% rogoza plant with 90% cotton fiber	0,60	0,28	0,12
3.	Secondary material resources obtained from 80% cotton fiber and 20% rogoza plant	0,50	0,32	0,18
4.	Secondary material resources obtained from 70% cotton fiber with 30% rogoza plant	0,48	0,30	0,22

Based on the results of the study, a graph of the change in the periodic elongation deformation of fabrics with different composition of secondary material resources in Figure 1 was constructed.

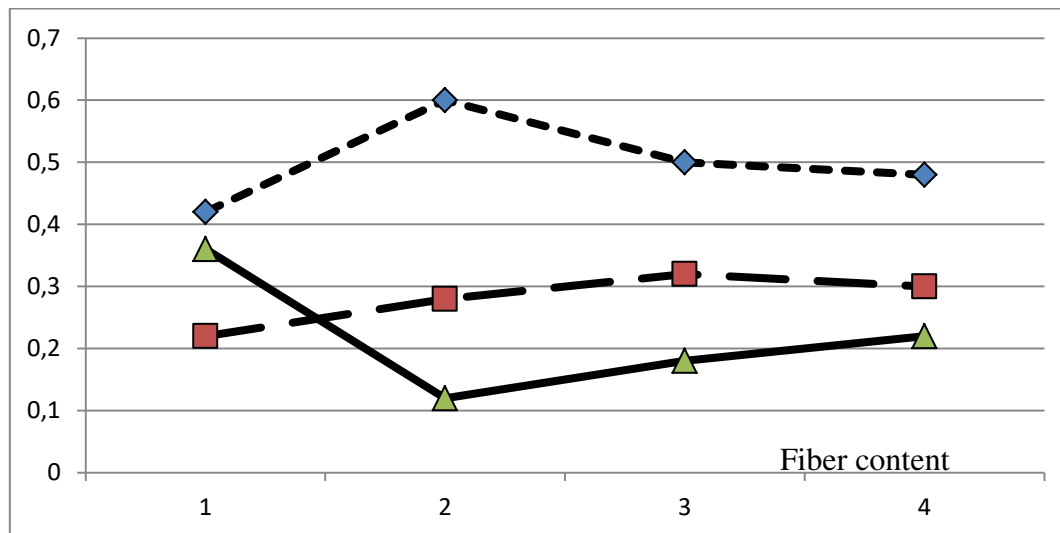


Figure 1. Changes in the single-cycle elongation deformation of fabrics with different composition of secondary material resources.

1 elastic deformation, 2 plastic deformation; 3 elastic deformation.

III. RESULTS AND DISCUSSION

Comparing the results of the study with the single-period elongation deformation of 70% cotton fiber with 30% cotton fiber secondary material resources bedding, the elastic deformation of upholstery fabric obtained from a mixture of Secondary material resources derived from 10% rogoza plant with 90% cotton fiber by 30.0%, elastic deformation by 21.4% plastic (residual) deformation decreased by 66.7%, Secondary material resources obtained from 80% cotton fiber and 20% rogoza plant, elastic deformation of lining fabric by 16.0%, elastic deformation by 31.2% premium, plastic (residual) deformation decreased by 50.0%, elastic deformation of bedding fabric obtained from a mixture of Secondary material resources obtained from 70% cotton fiber with 30% rogoza plant increased by 12.5%, elastic deformation increased by 26.7%, plastic (residual) deformation decreased by 38.9%.

The analysis of the obtained results shows that the elastic deformation content is higher in linen fabric obtained from a mixture of Secondary material resources derived from 10% rogoza plant with 90% cotton fiber than other fabrics.

The deformation properties of the upholstery fabrics of different variants show that the elastic deformation content increased from 12.5% to 30.0%, the elastic deformation content from 21.4% to 31.2%, and the plastic (residual) deformation content from 38.9% to 66.7%.

The assessment of the quality of textile materials and other types of products will be based on the results obtained in the determination and measurement of its quality indicators, as well as in comparison with the standards and regulations. This is because the methods for determining product properties will be detailed in the standards and other normative documents.

There are several methods of assessing the quality of textile materials, including experimental, organoleptic, expert, sociological, calculated, differential, complex and mixed. The dependence of product quality indicators on the nature of the complex assessment is divided into actual and approximate complex assessment.

True complex assessments have a defined physical purpose, which often represents the flexibility of the fiber, as well as the service life of the item in use. A true complex estimate is better than any constant approximate estimate. For example, the lack of cotton fiber content and the amount of secondary material resources is a real complex feature.

The advantage of a complex assessment is that it concludes on a number of final assessments. This evaluation is not without its advantages as well as its disadvantages, i.e. we do not have complete information about its individual

properties. In order to choose the right raw material, it is necessary to know the rational use of the material during the process management and use. It should be noted that the initial properties of this or that material can have a positive impact on the quality of the product and a negative impact on the movement of the technological process. The thinner the fiber, the higher the relative strength and unevenness of the yarn made from it, and the smoother its appearance. It should be borne in mind that a complex assessment of this or that quality can be obtained from different calculations of individual quality indicators. The average complex assessment on the level of a number of quality indicators may not change, some of them may be low and some may be high.

Thus, it is possible to complete the complex assessment without changing the individual quality indicators of the material.

There are different methods of complex assessment of quality indicators of textile materials. The arithmetic mean of the complex is determined using the following formula.

$$K_j = \frac{\sum_{i=1}^n Z_{ij} \gamma_i}{\sum_{i=1}^n \gamma_i} \quad (1)$$

$$\sum_{i=1}^n \gamma_i = 1 \quad K_j = \sum_{i=1}^n z_{ji} \gamma_i \quad (2)$$

If a significant coefficient is not determined, then it will have the same for all properties $\gamma_i = \frac{1}{n}$, is equal to $\sum_{i=1}^n \gamma_i = 1$.

$$K_j = \frac{1}{n} \sum_{i=1}^n z_{ji} \quad (3)$$

The disadvantage of these formulas is that the overall quality index due to a poor individual rating ($B_{ji} = 0$ or $d_{ji} = 0$) will have a higher score than the remaining ratings. Therefore, $z_{ji}=0$ is not calculated by the separate differential estimate and is assumed to be zero.

The average geometric complex estimate is calculated using the following formula.

$$G_j = (z_{j1}^{\gamma_1} z_{j2}^{\gamma_2} \dots z_{jn}^{\gamma_n})^{1/\sum \gamma_i} = \left(\prod_{i=1}^n z_{ji}^{\gamma_i} \right)^{1/\sum \gamma_i} \quad (4)$$

In $\sum_{i=1}^n \gamma_i = 1$ if the significance of the individual indicators is not determined, or if one of the indicators ($z_{ji} = 0$) is equal to zero at the time of determination, the complex value is also equal to 0.

It is analyzed in reliability theories in methods of evaluation on indicators of maturity.

Processing by the method of diagrams of the theory of accuracy (reliability) is also used.

Rejection in the theory of probability (confidence probability) is associated with the study of the laws of external environmental impact performance, long-term resistance.

In this case, the distribution of random values is compared with the current and theories of laws, using the methods of diagrammatic credentials. The test results are evaluated by calculating the strengths of the theories of distribution, such as fatigue, longevity, $\gamma\%$ resource, due to the fact that the distribution law under investigation forms a linear connection from the credentials.

The power of attorney shows the coordinate axes: the values of the indicator studied in the abscissa, the probability limits in the ordinate.

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Theoretical values (U_p) are set on the additional ordinate axis on the right. According to the number of probability tests, when $m \leq 30$

$$W_i = \frac{i - 0.5}{n} \quad (5)$$

where: i is the sorting row number; n is the total number of tests;

When the number of tests is large ($n > 30$), the relative frequencies (f_i) are found as follows:

$$W_i = \frac{\sum U_1 - \sum U_{i-1}}{2n} \quad (6)$$

where: $\sum U_i$ - the sum of frequencies in ascending order; $\sum U_{i-1}$ - the sum of the incremental order frequencies for the previous material; n is the total number of tests.

The distribution parameters can be calculated from the graph according to the proximity of the experimental points to the confidence line. Based on the graphs, the guaranteed service life of the ability to work, $\gamma\%$ resources can be determined.

Thus, it is possible to complete the complex assessment without changing the individual quality indicators of the material.

Thus, it is possible to complete the complex assessment without changing the individual quality indicators of the material.

In order to recommend the most optimal options for the indicators of geometric, physical, physic-mechanical properties obtained in our research work, we use the graphical method of complex assessment. The advantage of this method is that at the same time it is possible to objectively assess the most optimal options of generalized quality indicators of the properties of the requirements for materials.

From the center (m) on the properties for evaluation, the polygons are plotted on the axes or the decreasing values are marked on the appropriate scales using radius vectors. In the distribution of axes should be taken into account the intended function of the material, physical and mechanical properties, the conformity of the accuracy to the established standards. The resulting polygons are divided into triangles, and the variants based on their surface and property indices are the sum of the surfaces of the triangles.

$$S_{\Delta} = \frac{1}{2} ab \sin \alpha \quad (7)$$

where a , b are the dimensions of the radius-vectors of the triangle, mm; α - angle between radius vectors.

A comprehensive assessment of the quality of upholstery fabrics obtained from secondary material resources of different composition is shown in Figure 1.

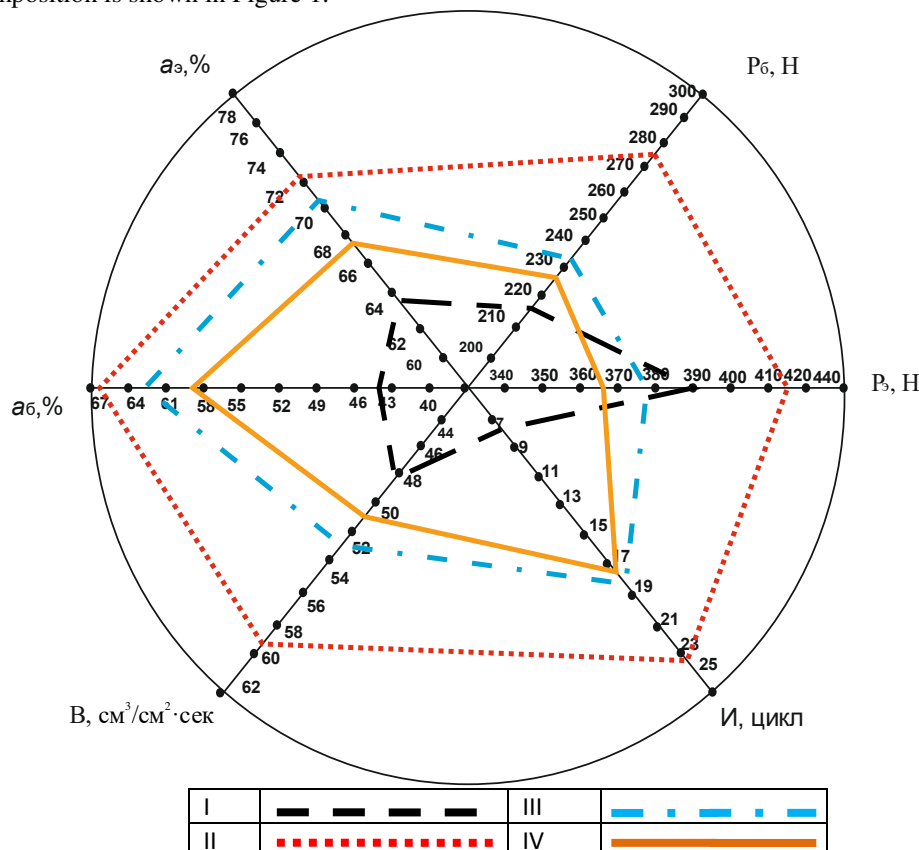


Figure 1. Diagram of complex assessment of quality indicators of upholstery fabrics with different fiber content.

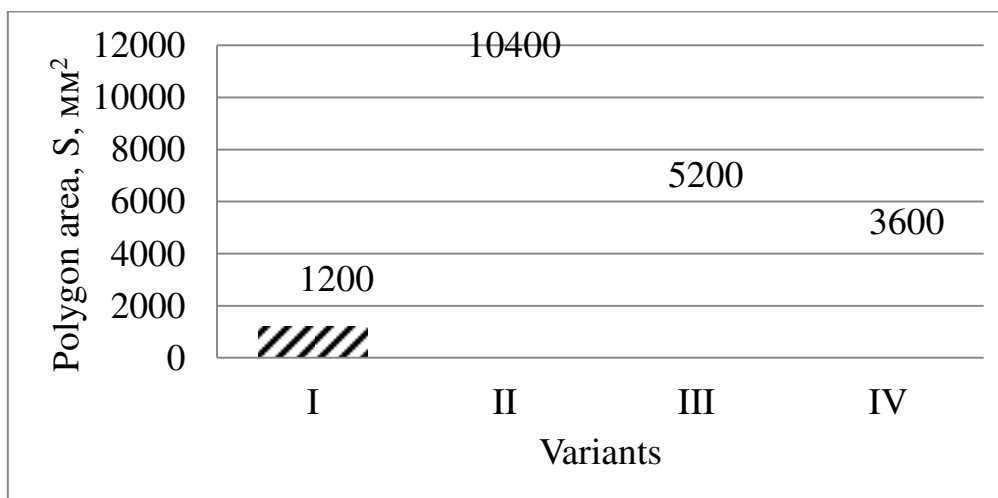


Figure 2. Comparative histogram of quality indicators of bedding fabrics with different fiber content.

The analysis of the results of the study shows that the polygonal area of bedding fabric obtained from 70% cotton fiber with 30% cotton fiber secondary material resources is 1200 mm², polygonal area of bedding fabric obtained from Secondary material resources derived from 10% rogoza plant with 90% cotton fiber is 10400 mm², Secondary material resources obtained from 80% cotton fiber and 20% rogoza plant polygonal area of the fabric 5200 mm², Secondary material resources obtained from 70% cotton fiber with 30% rogoza plant polygonal area of the fabric 3600 mm².

IV. CONCLUSIONS

The study found that the polygonal area of bedding fabric obtained from 70% rogoze plant fiber secondary material resources and 30% cotton fiber secondary material resources had the highest performance compared to the polygonal area of other composite bedding fabrics.

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