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ASSESSMENT OF THE FORMAL STABILITY OF KNITTED FABRICS ON THE CYLINDRICAL BEND OF THE PLATES

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Annotation: The article analyzes the results of theoretical studies of the dimensional stability of knitted fabrics with different fibrous composition. The coefficient of form stability Кф according to the deformability data of knitted fabrics, modeled in the form of bending of a rectangular plate along a cylindrical surface, is proposed.

Key words: fabric shape stability, rigidity, crease resistance, elasticity, strength, extensibility, design and cutting of clothing, fibrous composition, structure, finish.

Form stability together with such parameters as stiffness, crease resistance, elasticity, strength, elongation constitutes an operational subgroup of indicators that are paramount when choosing a set of properties for assessing the quality of textile material in accordance with GOST 28554-90. Since the dimensional stability of garment parts reflects many aspects of its operational, comfortable and aesthetic properties, a quantitative assessment of the dimensional stability is very important, which makes it possible to predict the performance properties of various knitted fabrics at the stage of designing and cutting garments. Analysis of limited information on the assessment of the dimensional stability of the fabric and the liner showed that, for example, in , the dimensional stability was assessed by the change in the angle φ between the warp and weft threads of the main fabric. Taking into account the conditions of wearing the clothes, the dimensional stability was determined after 24-hour storage of the samples under normal conditions, after moistening and the action of repeated stretching.

A.N. Soloviev to assess the dimensional stability of fabrics or products under multiple spatial or uniaxial deformation, he used the final value of the residual deformation and introduced the stability indicator : xm

$$x_m = \left(\frac{10}{a}\right)^{1/b}, \qquad (1)$$

Where xm indicator of resistance to multi-series spatial deformation (the number of deformation cycles in each series - experimental or express wear);

- constants of fibrous composition and structure, determined experimentally;

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10 - the average value of the permanent deformation in mm, at which the sleeves of various fabrics lose their shape in the elbow area.

Thus, a positive characteristic allows us to determine the service life of products in terms of shape stability and is a criterion for assessing the reliability of the fabric.

To increase the dimensional stability of clothing and its individual parts, it is necessary to reduce the influence of deformation forces arising during operation and leading to a gradual irreversible disruption of the shape of clothing due to the weakening of stable fixation of the shape obtained during manufacture. Methods for increasing the dimensional stability of clothing can be divided into two groups . The first group takes into account issues related to the physical and mechanical properties of the original textile materials, depending on their fibrous composition, structure and finish. Of great importance is the elastic-visco-plastic properties of materials, which manifest themselves through rigidity, crease resistance, elastic modulus, extensibility, plasticity, etc.

The main factor in the mechanism of form stability of materials for clothing should be plastic (residual) deformation, which persists after loading, unloading and relaxation processes in certain places of the deformable part of the clothing during operation. The peculiarity of deformation processes of textile materials (fabrics, knitwear) is that residual deformations occur under loads, much less breaking. The fibrous composition of the structure of materials under the action of repeatedly and cyclically acting operating loads undergoes fatigue and the accumulation of deformations in the form of mass microdamages of the fibers, which are responsible for the irreversible deformation process, i.e. plastic deformation. The second group of methods for increasing shape stability concerns the design and manufacture of clothing, when factors are considered both constructive (clothing shape, bag design) and technological (fixing forms with joints and gaskets; thermal fixation and the use of special chemicals). The criterion for dimensional stability, for example, for suit and dress fabrics, can be various indicators with an expert assessment of their significance. (Table 1).

Table 1

Dimensional stability indicators and corresponding weight factor

№ п.п	Indicators of dimensional stability	Indicator weighting factor
1	Crease resistance	0,27
2	Shrinkage	0,25
3	Residual cyclic deformation under repeated tension: spatial flat	 0,18 0,17
3	Bending stiffness	0,07
4	Strain Components at Single Tensile and Rest	0,06

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$$\varepsilon_n = \varepsilon_y + \varepsilon_э + \varepsilon_{пл} (\varepsilon_y$$

Analysis of the data in this table allowed the authors to substantiate the importance and effectiveness of using the viscoelastic properties of clothing leather and components of total deformation -fast component of elastic deformation; - slowed down highly elastic part of deformation;

to determine the dimensional stability through plastic deformation with the introduction of a special coefficient of restoration of elastic properties. In this case, plastic deformation is a negative characteristic of dimensional stability, i.e. the more, the less dimensional stability of clothing leather. Assessment of the dimensional stability of knitted fabrics for clothing can also be carried out according to experimental studies of single-cycle characteristics. However, one should take into account the great laboriousness of these tests associated with careful preparation of the samples, determination of the load value after preliminary tests for half-cycle characteristics (breaking force) and the duration of the experiment. Thus, an accelerated and comparative assessment of the dimensional stability of various canvases is difficult.

For a quantitative assessment of the dimensional stability of knitted fabrics of existing and experimental samples, in the first approximation, the value of plate deflection under the action of biaxial tension at a plane stress state is proposed. As shown in paragraph 2.3, this stress state is easily realized when the plate is bent over a cylindrical surface. The assumption of a single plate width allows the use of a beam fastening scheme on two supports, loaded with axial and transverse forces. The obtained values of the deflection of the beam are somewhat arbitrary and reflect the general picture of the stress-strain state, but if we take into account the specific width of the plate, we can get a particular result.

The advantage of this approach for assessing the dimensional stability of different knitted fabrics is obvious, since it allows, in the express assessment mode, to give a comparative picture of the dimensional stability by calculating the plate deflection, neglecting laborious experiments for semi- and single-cycle characteristics of materials.

The amount of f0 plate deflection is a negative characteristic of the dimensional stability of knitted fabrics, i.e. the larger, the less form-stable the plate. Therefore, it is advisable to introduce the coefficient of form stability Kϕ in the form

$$K_\phi = \frac{1}{f_0}, \text{мм}^{-1} \qquad (2)$$

The patterns of change in the shape stability of knitted fabrics with different fibrous composition, depending on the cylindrical stiffness, are shown in Fig. 1. The coefficient of form stability Kf increases linearly with increasing cylindrical stiffness D.

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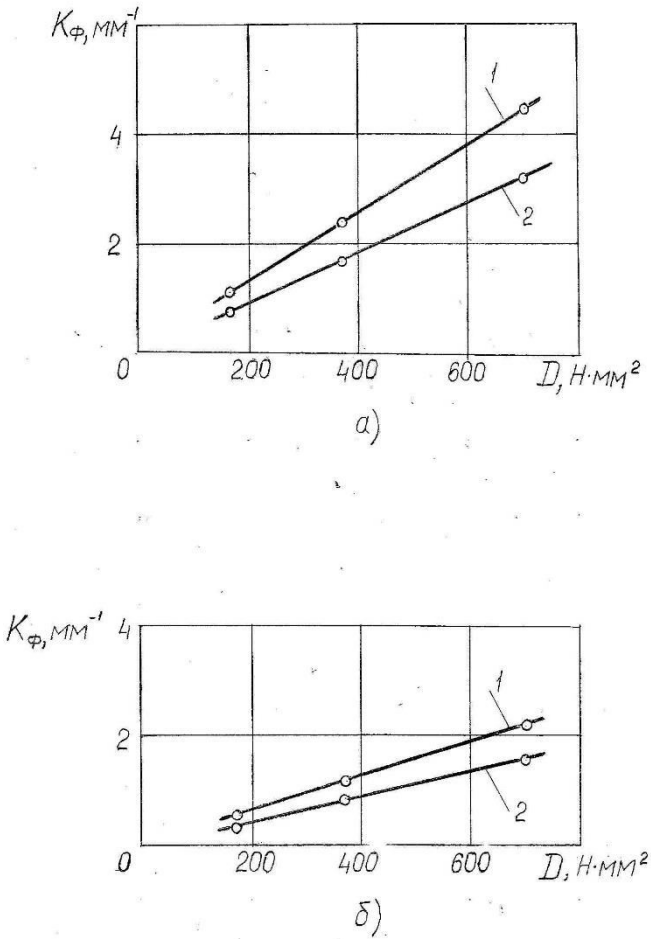

Picture 1. Dependences of the coefficient of form stability Kf on the cylindrical stiffness D of the plates of knitted fabrics at q = 0.074 N / mm2 (a) and q = 0.153 N / mm2 (b):
cotton cloth + silk; 2 - cotton canvas
So, at q = 0.074 N / mm2, Kf = 0.80 ... 3.28 mm-1 and Kf = 0.39 ... 3.10 mm-1 at q = 0.153 N / mm2, D = 123.6 ... 506 , 3 N · mm2 (cotton fiber).
With the same values of uniformly distributed load, the coefficient of form stability is, respectively, Kf = 1.11 ... 4.52 mm-1 and Kf = 0.53 ... 2.18 mm-1 at D = 170.6 ... 698.7 N · mm2 (cotton + silk).
Thus, the calculations on the dimensional stability of knitted fabrics indicate that the addition of silk fibers to the fibrous composition of the knitted fabric structure increases the dimensional stability coefficient by 1.3 times and thereby increases the operational properties of products.
Purposeful and reasonable choice of textile material at the stage of designing clothes according to one of the most important performance characteristics - shape stability, allows predicting the performance of products, which is extremely important in the development of modern innovative technologies of sewing and knitwear production.

CONCLUSIONS

The coefficient of form stability Kф according to the deformability data of knitted fabrics, modeled in the form of bending of a rectangular plate along a cylindrical surface, is proposed. This method for determining the dimensional stability can be attributed to express assessments and allows in an accelerated mode to give a comparative characteristic of the dimensional stability of knitted fabrics with different fibrous composition. It was found that among the investigated knitted fabrics, the coefficient of form stability for fabrics with a fibrous composition of cotton x/b+ silk is 1.3 times higher than for fabrics with cotton.

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