Analysis of the methods of determining their hardness indicators during stretching of textile fabrics

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Abstract: In this article, the stretching properties of fabrics during the production of textile fabrics are analyzed based on the standard requirements.

Keywords: vellur, fabrics, material, indicator

Currently available methods for determining the stiffness of textile fabrics during stretching differ in the type of fabrics under study, the shape and size of the samples, the nature and parameters of the tests, and the measuring devices (Table 1). Tensile hardness indicators (as properties) are determined by the force-elongation diagram obtained when determining the strength properties of textile fabrics [1]. The tests are carried out on various construction testing machines equipped with an automated device for recording the diagram. According to the stress-strain diagram, the conditional stiffness D_y can be calculated and the stiffness modulus (elastic modulus or modulus of type 1)E:

$$D_{\text{ó}} = \frac{100\text{Đ}}{\varepsilon_{\text{ó}}}, (1)$$

here Đ - conditional action; $\varepsilon_{\text{ó}}$ - conditional deformation.

$$D_{\text{ó}} = \text{EF}, (2)$$

here E - stiffness modulus; F - cross-sectional area of the sample.

$$\text{Å} = \frac{100\sigma}{\varepsilon}, (3)$$

here σ - tension developed in the fabric; ε - relative strain of fabric for plot of directly proportional relationship on stress strain diagram.

The stiffness modulus can also be described by the slope angle α_1 and α_2 of the straight section in the stress-strain diagram [2]:

$$\text{Å} = \text{tg}\ \alpha. (4)$$

The object of study and the method used	Measured performance	Tools and equipment
Textile fabrics [3]	Hardness index (1) Modulus of elasticity (3)	Various construction breaking machines with force-extension diagram recording device
Knitted fabrics, artificial knitted fur for domestic and technical purposes, hard goods fabrics of all types of yarns [4]		

Non-woven fabrics of all types of fibers of various production methods [5]		
Technical fabrics [6]		
Textile threads [7]	Hardness indicator (1) Modulus of elasticity (3)	A miscellaneous structure with a force-extension diagram recording device
Synthetic textured yarns [8]		

Standard methods for determining the continuous properties of textile fabrics implement static loading of the specimen, where the fabric is subjected to tension at a low strain rate and is limited to a single loading of the specimen. Examples of dynamic tests to determine the tensile strength of textile fabrics include free vibration of a mass suspended on a sample and harmonic vibrations of a sample caused by forced multiple deformation [9]. Using these methods, the stiffness coefficients of textile fabrics are determined from the parameters of sample vibrations recorded by an oscillograph. When studying the free vibration of the mass suspended in the sample, the stiffness coefficient is determined by the following formula:

$$Ñ = \frac{4\pi^2 m}{T^2}, (5)$$

here m - the mass of the cargo; T - period of oscillation of the load (according to the oscillation curve Dynamic stiffness is defined as follows:

$$D = \frac{\sigma_{max}}{\varepsilon_{max}}, (6)$$

here σ_{max} - the highest voltage; ε_{max} - the highest deformation.

The dynamic modulus of stiffness is determined using the following formula:

$$Å = \frac{\lambda_\gamma \cdot 10^3}{T} m\omega^2, (7)$$

here ℓ, γ, T - yarn length, size and linear density; m - load weight; ω - cyclic oscillation frequency. The stiffness coefficient is expressed by the following formula:

$$k = m\omega^2.$$

Based on the analysis of the existing methods for determining the quality indicators of the tensile strength of textile fabrics, it is appropriate to use the deformation of the sample during the test as the main classification sign. The analysis of the methods of determining the stiffness indicators in the tension of textile fabrics was carried out, and the main classification feature was established for them depending on the nature of the deformation: static or dynamic [10].

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