ISSN 2181-8622

Manufacturing technology problems

NAMANGAN MUXANDISLIK-TEXNOLOGIYA INSTITUTI

Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX COPERNICUS INTERNATIONAL

Google Scholar

Crossref doi

SLIB.UZ
Scientific library of Uzbekistan

Volume 8
Issue 3
2023

UDK 677.025

RESEARCH OF KNITTING STRUCTURE STABILITY PARAMETERS

GULYAEVA GULFIA

Associate professor of Tashkent Institute of Textile and Light Industry
E-mail.: uztextile@gmail.com, phone.: (+99890) 935 10-47

SHIN ILLARION

Professor of Tashkent Institute of Textile and Light Industry
E-mail.: i.g.shin04@gmail.com, E-mail.: (+99890) 347 60-03

KHOLIKOV KURBONALI

Professor of Namangan Institute of Textile Industry
E-mail.: qurbonalixoliqov@gmail.com, phone.: (+99894) 462 01-73

MUKIMOV MIRABZAL

Professor of Tashkent Institute of Textile and Light Industry
E-mail.: profmukimov@gmail.com, phone.: (+99899) 886 50-31

Abstract:

Objective. The aim of research is studying the mechanism of deformation of knitwear under the application of an external load is considered as a process of violation of the internal balance of the system of loops using the triangle of possible (limiting) states of the parameters of the loops.

Methods. In the process of studying the deformation processes of knitwear, the triangle of possible (limiting) states of loop parameters was used. And also the algorithm for calculating the dimensional stability coefficient of knitted fabrics according to the loop structure data has also been developed.

Results. The triangle of possible states of the loop parameters thus gives a visual representation about the deformation of knitwear from the position of changing parameters A and B, occurring due to deformable threads in the loop. This triangle allows you to evaluate the extensibility of any combined weave for each of its components, as well as the mobility of the knitwear structure through the geometric parameters of the loop, expressed in terms of the length and modulus of the loop, the linear density of the loop.

Conclusion. It was introduced the designation k_{Π}- the coefficient of irreversible changes in the parameters of the loop and take into account that irreversible (plastic) deformation is a negative parameter for assessing the stability of the loop structure, and hence the knitwear, then it is advisable to introduce a special form stability coefficient

Keywords: knitwear, dimensional stability, deformability, structure, knitwear deformation mechanism.

Introduction. Knitted fabric is a complex spatial structure, consisting of basic elements in the form of a loop and a broach, working as a single system for distributing external loads. In this case, the degree of loading of individual elements and sections of the thread depends on the direction of the applied load and can vary over a wide range. So, if knitwear is subjected to the action of forces directed perpendicularly or at small angles to their length, then compression deformations occur.

The change in the structure of knitwear when applying certain forces occurs due to a change in the configuration of the loops due to the displacement of the contact points between the threads of adjacent loops. Knitwear has a movable loop structure and is deformed as a result of loads that are much less than breaking loads, which is due to the structure of the knitted fabric, the volume of which is the threads formed by the fibers, as well as the air spaces between the threads, fibers and loops of the fabric

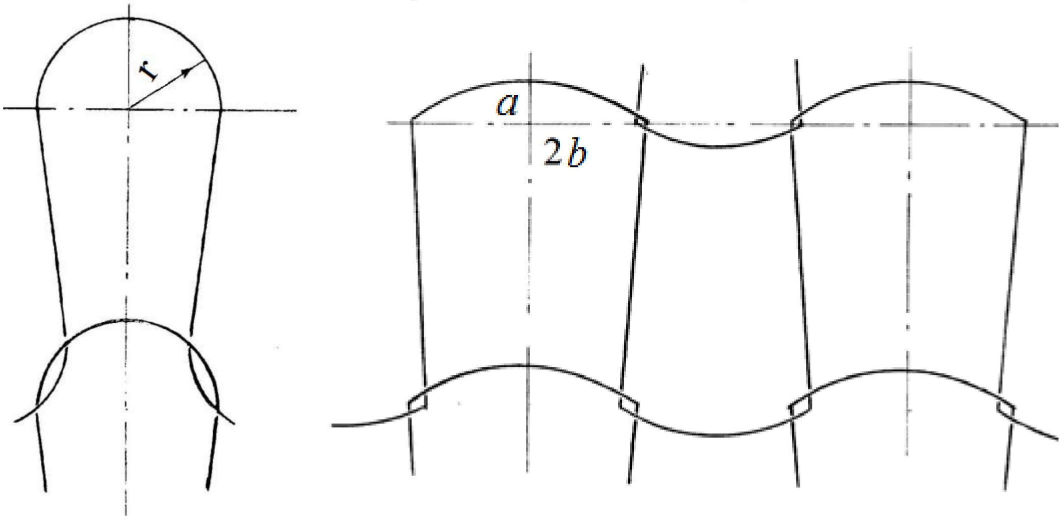
The mechanism of deformation of knitwear under the application of an external load is considered as a process of violation of the internal equilibrium of the loop system. This process includes a change in the configuration (transformation) of a thread bent into a loop, a change in the orientation of the thread, a shift in the points of contact between the threads, and an elongation (tensile strain) of the thread itself [1-3]. In this regard, the term “deformation of the loop structure” [4] is not entirely correct, and the deformation of the loop can only be attributed to a material body, in this case, to a thread.

Under the action of tensile forces across the width of the web, looped arcs from semicircles (Fig. 1, a) are transformed into ellipses (Fig. 1, b). Provided that the length of the thread in this section remains constant, we can write

$$\pi r = \frac{\pi(a+b)}{2} \tag{1}$$

where r is the radius of the circle;

a and *b* are the minor and major semi-axes of the ellipse.



a b

Fig. 1. Scheme of changing the looped arc of the plain during transverse stretching

When the fabric is stretched the small semiaxis will decrease, and the large one will increase and tend to 2r. With full straightening of the arc (a=0), the loop width almost doubles, and the height decreases by r:

$$b = 2r - a; \quad r \leq b \leq 2r \tag{2}$$

In the process of stretching the fabric along the loop bars, the loop sticks straighten. Since the loop sticks in the free state have less curvature, the elongation of the loop in this case will be less. Simultaneously with the straightening of the loop sticks and arcs, the curvature increases at the places where the threads cross. The threads in these sections tend to create full contact with each other and have a minimum length, and the sections of the thread released in this case cause an additional increase in the height and width of the loop.

The load applied to the sample is perceived by different sections of the loop in different ways: large stresses are perceived by parts of the loop that are more oriented in the direction of the acting force than less oriented. Pulling the thread from less loaded areas to more stressed areas helps to equalize stresses and create an equilibrium state.

I.I. Shalov [5] proposed to analyze the extensibility of knitwear using a triangle of possible states of the parameters of the loops (Fig. 2). The expediency of this approach was confirmed by A.N. Solovyov, who recommends that the extensibility of any combined weave (both derivative and patterned) be determined in the form of triangles of possible parameters A and B for each of the component weaves.

Methods. Figure CDE represents a triangle of possible (limit) states of loop parameters. The vertex D of the triangle has coordinates A_{min} and B_{max}, which reflect the tensile strain along the loop row to the limit state - rupture. Vertex E with coordinates A_{max} and B_{min} correspond to the tensile strain in the direction of the loop step.

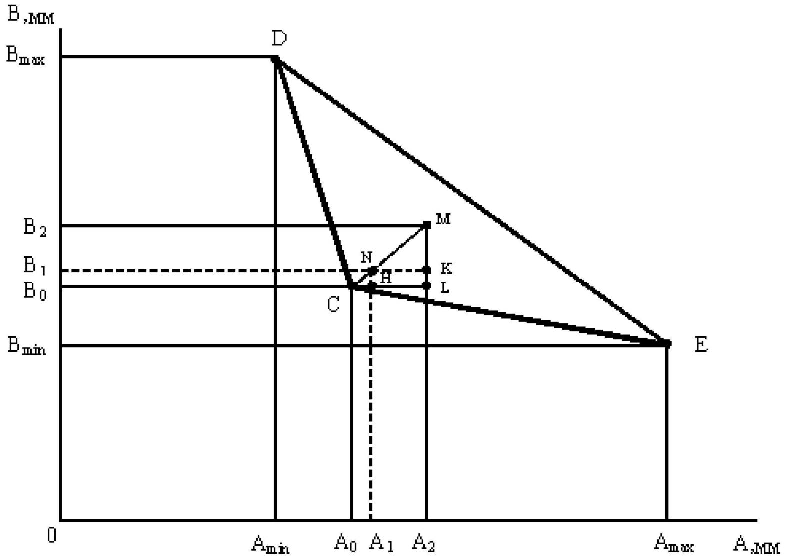


Fig. 2. Triangle of possible parameters A and B (states of loop parameters)

The equilibrium (unloaded) state of knitwear is characterized by the coordinates of the point C (A_0 ; B_0).

When knitwear is stretched, the parameters of the loop A and B change in a linear relationship. So, if you stretch the equilibrium jersey only in the direction of the loop step, then a number of successive values of the parameters of the loop A and B will be located on the straight line CE. When knitwear is stretched only in the direction of the loop row, the values of the loop parameters make up a straight line CD.

DE line characterizes the limiting or limiting values of the loop parameters for biaxial stretching of knitwear, which in most cases corresponds to the actual operating conditions of the products.

Results. An analysis of the triangle of the state of the loop parameters allows us to conclude that point C during the operation of knitwear can move inside the triangle CDE to any position depending on the direction of the external disturbing force in the AOB coordinate system. Under equilibrium biaxial stretching of knitwear, point C moves to the line DE and can take the position of point M with coordinates A_2 and B_2 characterizing this limiting state of the knitwear structure. For example, for a smooth surface, in accordance with the proposed geometric models [6,7], dependencies should be added:

$$\left.\begin{aligned} A_2 = A_p = \frac{l-\pi f}{2};\\ B_2 = B_p = \frac{l-\pi f}{4},\end{aligned}\right\} \qquad (3)$$

where d_y is the nominal diameter of the thread, mm

l – thread length, mm.

The area of the triangle CDE can be considered as a zone of mobility of the loop structure [8], and at the same time, the smaller the amount of displacement CM, the less mobility of the knitwear structure, which ultimately leads to the stability of the shape and dimensions of the product during operation.

In the process of unloading the loop structure, point M tends to take the position of point C, however, the trajectory of movement will most likely be disrupted due to the manifestation of the elastic properties of the loop threads. Knitted fabrics during the operation of products experience a multi-cycle loading, alternating with unloading and rest, which initiates loosening of the knitwear structure. Even with the application of minor loads (less than breaking loads), the knitwear is deformed, accompanied by a change in its structure.

Discussion. The ratio of parts of the total deformation of knitwear is very important for characterizing its mechanical properties both in the manufacturing processes of products and during wear. The higher the proportion of disappearing parts of total deformation (ε_y and ε_e) and, accordingly, the lower the proportion of plastic deformation ε_{pl} , the better the product retains its shape and dimensions.

The triangle of possible states of the loop parameters (Fig. 2) thus gives a visual representation about the deformation of knitwear from the position of changing parameters A and B, occurring due to deformable threads in the loop. This triangle allows you to evaluate the extensibility of any combined weave for each of its components, as well as the mobility of the knitwear structure through the geometric parameters of the loop, expressed in terms of the length and modulus of the loop, the linear density of the loop.

The triangle of possible loop parameters A and B can be used as a reflection of the deformability of knitted fabrics through a single structural component - a loop, which changes its configuration under the action of loads and is characterized by the deformation of the thread.

All components of the total deformation of knitwear can be displayed by the corresponding segments between the nodal points (Fig. 2). So, the segment MN reflects the elastic ε_y and elastic ε_e deformation of the thread in the loop. The segment N C is the plastic ε_{pl} component of the total deformation. The straight line CH characterizes an irreversible change in the loop pitch, equal to the value A_1 -A_0, and the straight line NH - an irreversible change in the height of the loop row, equal to B_1 - B_0 .

From the similarity of right triangles Δ CNH and CML the relations follow:

1) $\frac{CN}{CM} = \frac{NH}{ML};\ CN = CM\ \frac{NH}{ML},$

because

$CM = \sqrt{(ML^2) + (CL^2)}\ = \sqrt{(B_2 - B_0)^2 +\ (A_2 - A_0)^2}$;

NH \u003d B_1 - B_0 ; ML \u003d B_2 - B_0 ,

That

$$CN = \sqrt{(B_2 - B_o)^2 + (A_2 - A_0)^2} \cdot (B_1 - B_0)/(B_2 - B_0) \qquad (4)$$

2) $\frac{CN}{CM} = \frac{CH}{CL};\ \ CN = CM\,\frac{CH}{CL},$

So as CH=A_1-A_0 , CL=A_2-A_0 ,

That

$$CN = \sqrt{(B_2 - B_o)^2 + (A_2 - A_0)^2} \cdot (\mathrm{A}_1 - \mathrm{A}_0)/(\mathrm{A}_2 - \mathrm{A}_0) \qquad (5)$$

If we equate expressions (4) and (5), we obtain the relation

$$\frac{B_1 - B_0}{B_2 - B_0} = \frac{A_1 - A_0}{A_2 - A_0}, \qquad (6)$$

where A_1 and B_1 are the coordinates of point N of the straight line NC, corresponding to irreversible changes in the loop parameters equal to the length of the segment A_1 -A_0 and B_1 -B_0 .

To solve equation (6) with respect to the unknowns A_1 and B_1, it is necessary to take into account the ratio between the parameters of the loop A and B, which for the surface is A_{max} / B_{max} =2; A_{min} / B_{min} =2 according to the geometric model of the loop without taking into account the mechanical properties of the thread. Therefore, we can assume that A_1 / B_1 = 2 or A_1 = $2B_1$. Given this assumption, from expression (6), substituting dependencies (3) instead of A_2 and B_2, we obtain a formula for the calculated value of A_1 and B_1 :

$$\mathrm{B}_1 = \frac{2\mathrm{B}_0(l - \pi f - 2A_0) - A_0(l - \pi f - 4B_0)}{2(4B_0 - 2A_0)}, \text{ mm}; \qquad (7)$$

$$\mathrm{A}_1 = \frac{2\mathrm{B}_0(l - \pi f - 2A_0) - A_0(l - \pi f - 4B_0)}{4B_0 - 2A_0}, \text{ mm}; \qquad (8)$$

Thus, the segment NC, which is responsible for the plastic component of the total deformation of knitwear through irreversible changes in the parameters of the loop structure, can be calculated by the formula

$$\text{NC} = \sqrt{(A_1 - A_o)^2 + (B_1 - B_0)^2} = k_{\Pi} \qquad (9)$$

Conclusion. If, instead of NC, we introduce the designation k_{Π}- the coefficient of irreversible changes in the parameters of the loop and take into account that irreversible (plastic) deformation is a negative parameter for assessing the stability of the loop structure, and hence the knitwear, then it is advisable to introduce a special form stability coefficient:

$$\text{К}_{\text{ф}} = \frac{1}{k_{\Pi}} = \frac{1}{\sqrt{(\mathrm{A}_1 - \mathrm{A}_0)^2 + (\mathrm{B}_1 - \mathrm{B}_0)^2}} \qquad (10)$$

Thus, the coefficient of form stability of the loop structure, taking into account TDNP, is higher than without taking into account irreversible deformation:

$\text{К}_{\text{ф}}$=1,770>1,089 (plain).

Calculations performed for other types of stitches showed that this pattern is preserved and is presented in the following form

$\text{К}_{\text{ф}}$=3,215>1,776 (rib stitch).

$\text{К}_{\text{ф}}$=2,174>1,476 (interlock).

References:

1. Flerova L.N., Surikova G.I. Materials science of knitwear. -M .: Light industry. 1972. - 184 p.

2. Gulyaeva G., Mukimov M.M. Effective Method for Producing Inlaid Knitted Fabrics // International Journal of Advanced Research in Science, Engineering and Technology. Vol. 8, Issue 8 , August 2021, pp/ 17857-17859

3. Gulyaeva G. Kh., Mukimov M.M. Form-Resistant Combined Knited Fabric // The American Journal of Engineering and Technology. October 20, 2021. Pages: 5-9

4. Asnis L.M., Gladysh S.E., Truevtsev A.V., Nesterova N.Yu. Influence of the fibrous composition of mixed flax-containing yarn on the deformation characteristics of knitwear. // Izv . universities. Textile industry technology. -1997. -No. (236). –S.62-65.

5. Shalov I.I. Design of knitting factories. -M .: Light industry. 1968. 296 p.
6. Shalov I.I., Dalidovich A.S., Kudryavin L.A. Knitwear technology. -M .: Light and food industry. 1984. - 376s.
7. Kudryavin L.A., Shalov I.I. Fundamentals of knitting technology. -M .: Legprombytizdat . 1991. 496 p.
8. Rakhimov F.Kh., Shin I.G., Mardonov B.M., Usmonkulov Sh.K. Deformability and mobility of the knitwear structure. // Problems of strength. – Tashkent. 2011. - No. 1. - P. 81-86.

STUDY OF THE INFLUENCE OF DRYING AGENT TEMPERATURE ON RAW COTTON AND ITS COMPONENTS

ROZMETOV RAKHMATJON

Tashkent Textile and Light Industry Institute

Annotation. The fiber heating temperature was studied during the drying of raw cotton selection S-6524 with a humidity of 10.5% and 15.2% in a 2SB-10 drying drum at temperatures of 100 ^{0}C, 150 ^{0}C and 200 ^{0}C with a capacity of 7 t/hour and 10 t/hour. It was established that the heating temperature of cotton fiber increased after passing raw cotton with a moisture content of 10.5% and 15.2% and a productivity of 7 t/h in a drum dryer at temperatures of 100 ^{0}C, 150 ^{0}C and 200 ^{0}C.

When transporting dried raw cotton with air through a pipeline in a UCC unit, cleaning raw cotton in the unit itself, and transporting purified raw cotton with air through a pipeline into a gin, the temperature of the fiber in the gin is reduced due to cooling of the raw cotton during its transportation with air. At the same time, fiber from raw cotton with a moisture content of 10.5% was cooled to 24 ^{0}C, 29 ^{0}C and 37 ^{0}C, respectively, and fiber from raw cotton with a moisture content of 15.2% was cooled to 18 ^{0}C, 23 ^{0}C and 29 ^{0}C, respectively.

When drying raw cotton with a moisture content of 10.5% and 15.2% in a drum at temperatures: 100 ^{0}C, 150 ^{0}C and 200 ^{0}C with a capacity of 10 tons/hour, the heating temperature of the fiber in raw cotton was increased. When the dried cotton is processed and transported into the gin by air, the heating temperature of the fiber in the gin is reduced by cooling the cotton. At the same time, the fiber in raw cotton with a moisture content of 10.5% is cooled to 16 ^{0}C, 24 ^{0}C and 31 ^{0}C, respectively, and the fiber in raw cotton with a moisture content of 15.2% is cooled to 14 ^{0}C, 17 ^{0}C and 22 ^{0}C, respectively.

As a result of research, it was determined that the duration of fiber cooling in raw cotton with high moisture content is lower than the duration of fiber cooling in raw cotton with low moisture content. It has been established that when increasing the productivity of machines, it is necessary to consider the process of heat transfer of fiber in raw cotton.

Keywords: Dryer drum, cotton gin, gin patch, drying agent, heat exchange, temperature, cotton, fiber, productivity.

Introduction. Warming of cotton in the initial processing of cotton has a great effect on the cleaning of cotton, effective separation of small impurities from its content, and on cotton ginning, productivity, increase of fiber and seed quality [1].

It is known that the processes of heat-mass exchange in cotton and its components mainly start from the period of mutual meeting of cotton with a heat agent in the drying drum. During the preliminary treatment of cotton raw materials after the drying process, when cotton is transported in a pipe using air and due to external influences, mass exchange phenomena occur in cotton and its components due to changes in the heat-moisture state, and the cotton reaches the cleaning and ginning processes at temperatures that are changed compared to the heating temperature after drying. [2].

In a number of scientific studies, theoretical and practical studies have been conducted on the effective use of the heat agent for drying by improving cotton drying

CONTENTS

PRIMARY PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

GROWING, STORAGE, PROCESSING AND AGRICULTURAL PRODUCTS AND FOOD TECHNOLOGIES

CHEMICAL TECHNOLOGIES

MECHANICS AND ENGINEERING

ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

ECONOMICAL SCIENCES