ISSN NO: 2770-4491
Date of Publication:28-01-2024

Mechanics of Textile Materials Analysis of Their Characteristics and Corrosion Resistance Indicators

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Abstract: The mechanical properties of textile fabrics show their response to various forces. And these forces are different, they can be big or small, and they can act once or repeatedly. During the production and finishing processes of textile yarns, and especially when using them, the structure of yarns changes and their properties gradually deteriorate. This process is called aging of gases. As a result of wear and tear, gases are eroded. If the surface of the gas is completely eroded, the erosion in this case is called general erosion. If the surface of the gas is partially eroded, the erosion in this case is called in situ erosion. General decay completely disables items. This article discusses the mechanical properties of textile materials and their indicators of resistance to decay.
Key words: textile, gasification, properties, analysis, elongation, elongation, deformation.

Textile fabrics can be affected by forces in the direction of length and width of fabrics or at a certain angle relative to them.

As a result, bending, stretching, twisting, etc. deformations appear in textile fabrics. Professor G.N. According to Kukin's classification, the mechanical properties of gases are divided into three classes - half-cycle, one-cycle and multi-cycle properties. "Period" is defined as the time when gases are under the influence of force (loading), released from the influence of force (release) and resting (rest).

1. Half-cycle mechanical properties include tensile strength, elongation at break, work done at break, relative tensile strength, etc. These properties are used to indicate the maximum mechanical potential and quality of gasification. To determine them, rectangular samples of 50 mm width and 200 mm length, i.e. 50x200 mm, are prepared. For textile fabrics - determined separately in transverse and longitudinal directions. Tests are conducted on RT-250 cutting machine. The distance between the clamps of the machine is equal to 100 mm for textile fabrics.

The tensile strength of the gasses is the force used to tear the above-mentioned dimensional samples. It is denoted by the letter "P" and is expressed in the unit of Newton (N). Tensile strength indicates the strength of the gas. The strength of gauzes depends on their fiber composition, the structure and linear density of the forming yarns, the type of weaving, density, and finishing. The thicker and denser the thread, the stronger it is. Finishing processes such as pressing and appretting increase the strength of fabrics, while bleaching and dyeing processes slightly reduce the strength.

At the same time as the breaking strength is determined, the elongation of the samples is also determined. Elongation in elongation is defined as the difference between the initial length of the samples and the length when stretched before breaking. If this indicator is expressed in millimeters, it is called absolute elongation and is marked as "l_{uz}". If the elongation of the samples is expressed as a percentage, it is called the relative elongation ε_n and is calculated based on the absolute elongation:

$$\varepsilon_n = \frac{l_{uz}}{l_{kis}} \cdot 100\ ,\ \%$$

here: l_{uz} – is the absolute elong[illegible] l_{kis} – is the distance between the clamps of the cutting machine, mm.

The amount of energy spent to break the samples is the actual amount of work done in breaking them. To determine the breaking work, the elongation diagram of the sample is recorded using the diagram recorder

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of the breaking machine while the breaking force and elongation are determined (Fig. 1).

In practice, the breaking work Rp (D) is calculated using the following formula:

$$R_p = P_p \cdot l_{uz} \cdot \eta ,$$

here: P_p – gas breaking strength, N ... gas, sm; η – the coefficient of completeness of the diagram.

$$\eta = \frac{S_{xak}}{S} = \frac{S_{OBC}}{S_{OABC}} ,$$

here: S_{xak} – the surface representing the actual breaking work done on the diagram; S is the surface representing the conditional work done on the diagram.

For sodas η = 0,25 ÷ 0,75; for knitted fabrics η = 0,15 ÷ 0,4; for non-woven fabrics obtained by the gluing method η = 0,5 ÷ 0,8.

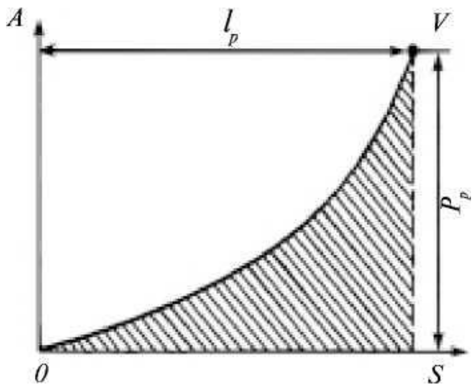

Fig. 1. Namunaning cho‘zilish diagrammasi.

Nisbiy uzish kuchi P_n *(mN)* — gazlamalarni hosil qiluvchi tarkibiy qismiga (trikotaj gazlamalarining bitta halqa qatoriga yoki ustuniga) keladigan uzish kuchi miqdorini ko‘rsatadi:

$$P_n = \frac{K \cdot P_p \cdot 10^3}{Z} ,$$

bu yerda: P_p – namunaning uzish kuchi, *N*; *Z* – namunaning zichligi; *K=1* – trikotaj gazlamalari uchun, K=2 – gazlamalar uchun.

Uzilishda bajarilgan ishning solishtirma miqdori gazlamalarning vazni yoki hajmi birligiga to‘g‘ri keladigan uzilishda bajarilgan ishning miqdorini ko‘rsatadi:

$$r_m = \frac{R_p}{m} \text{ (Dj/g) yoki } r_v = \frac{R_p}{V} \text{ (Dj/sm}^3\text{)}$$

here: Rp is the work done on breaking the sample, Dj; m is the mass of the processed part when cutting the sample, g; V is the volume of the sample, cm3.

The forces affecting the gases will not be so great. The total elongation caused by such a force consists of elastic, elastic and plastic components:

$L_m = L_k + L_e + L_p$.

The full extension and its parts that occur during stretching are included in the single-period mechanical properties.

All parts of full elongation appear and develop at the same time as the force exerts on the gas.

The strap part is formed at a high speed and changes the external bonds by an insignificant amount depending on the elasticity of the gas fibers.

The elastic part is formed during a certain period of time, and due to its influence, the bonds in the structure of the gas are changed, and new forms of bonds appear.

ISSN NO: 2770-4491
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The plastic part is associated with irreversible changes in the external and internal bonds of the gas and changes the structure of the components that make up the gas.

After releasing the gases from the force, they return to their initial state, which is called relaxation. The elastic stretch disappears as the force is applied. Elastic elongation gradually dissipates after application of force, and plastic elongation does not. The ratio of elastic, elastic and plastic elongation of gauzes depends on the fiber content and affects their wrinkle resistance and the ability of the garment to keep its shape.

Equipment called relaxometers of various structures are used to determine the total elongation during stretching and its parts. Sample selection and testing conditions for testing are as follows:

1. Sample sizes:

25 x 200 mm for gauzes;

for knitted and non-woven fabrics: 50 x 100 mm.

2. The number of samples is 10.

3. Loading time: For gas bottles - 60 min; for knitting - 180 min; for non-woven fabrics - 20 min.

4. Rest period: For gassing - 120 min; for knitting - 240 min; for non-woven fabrics - 20 min.

5. The magnitude of the impact force (amount compared to the breaking force): For gases - 25 percent; for knitwear - 5 percent; for non-woven fabrics - 10 percent.

In the production of textile fabrics, and especially in the use of finished products, they are affected by small but repeated forces.

As a result, gases are subjected to various deformations with many cycles. This changes the structure of gases and worsens their properties. The process of gradual changes in the structure and properties of gases as a result of repeated deformations is called fatigue. As a result of fatigue, fatigue occurs in gases, that is, deterioration of their properties. The mass of gases does not change significantly.

Changes in the structure of gases during repeated deformation occur in three stages. In the first stage, after a number of periodic stretching, the structure of the gauze improves, the threads become tighter, and their strength increases. In the second stage, due to the improved structure of the gaskets, it withstands repeated deformations in the long term. In the third stage, as a result of accumulation of residual deformations in the gas, its structure deteriorates and the gas is eroded in a short time.

The following multi-cycle mechanical properties of gasses are determined during repeated stretching.

1. Durability of gauzes is measured by the number of cycles from the beginning of repeated deformations in gauzes until they collapse.

2. The long-term durability of the gaskets - t is measured by the time from the beginning of the multi-period deformations of the gasket until they collapse.

3. Residual periodic deformation is the deformation accumulated in a certain number of repeated cycles. It consists of plastic deformations and irreversible elastic deformations of each period.

Multi-cycle mechanical properties of gases are determined by various pulsator devices.

The ability of textile fabrics to resist decay factors for a long time is called their resistance to decay.

Factors affecting gases during decomposition can be divided into the following groups:

1. Mechanical factors.

2. Physico-chemical factors.

3. Biological factors.

4. Complex or mixed factors.

Mechanical factors include frictional wear and fatigue from repeated deformations. As mentioned above, as a result of fatigue, the structure of gases changes and the objects lose their shape, their properties deteriorate and they are destroyed. During this decomposition, the weight of the gases does not change. Due to friction, the mass of gases changes a lot. This, in turn, leads to a decrease in their strength.

Physico-chemical factors include the influence of the weather, i.e. its temperature, relative humidity, the influence of the sun, ultraviolet rays, as well as the composition of the washing solution when washing things, in the case of chemical cleaning - the influence of chemicals, etc.

Biological factors include the effects of various bacteria, microorganisms, fungi, insects (moths). The type of influencing factors in the process of use depends on the quality of the product made from it and the conditions of its use. For example, underwear shrinks after many washes. The deterioration of window blinds is affected by light, sunlight, air temperature and relative humidity, the amount of dust in the air, etc.

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Degradation of textile fabrics is mainly due to the effect of friction. The abrasion resistance of textile fabrics depends on their fiber content and surface structure.

First of all, the ends of fibers sticking out on the surface of the gauze are affected by friction. Fibers protruding into the bent places of the threads in the gauze begin to crumble. Some areas of the fiber surface are damaged and the fibers are broken. Yarns are also broken due to individual fibers or fiber parts coming out of the yarn composition. The bent places of the threads sticking out on the surface of gauzes are the first to be eroded by friction. These areas are called the support surface of the gas, that is, the larger the support surface of the gas, the better its resistance to decay. At the same time, when the yarns forming the knitted fabric are broken due to the shearing of the gauze, the loops in the columns or rows of the loops come out of one another and the structure of the gauze is destroyed. In the process of friction, the fibers in the fiber package of the gauze are not well connected to each other, so they come out of the structure of the gauze, the threads connecting the fibers are rubbed and eroded.

Frictional deterioration of gaskets usually begins with the appearance of pilling. Soft balls - pilling - are formed from tangled fibers in the most frequently rubbed parts of the product. First, the ends of the fibers come to the surface of the gauze and they become tangled. When it gets tangled, some fibers come out of the gauze structure. Later, the fibers in the pilling break off from the surface of the gauze. As a result, the thickness of the gas is reduced and it is easily absorbed.

Devices that determine the friction resistance of gas can be divided into three groups:

1. Devices that perform only friction effects on gas.
2. Devices that perform simultaneous stretching, bending and friction effects on gas.
3. Tools for crumpling and rubbing the gas.

According to the type of gauze, friction is carried out with the help of fine-toothed metal surfaces, sharp stones, a coarse woolen brush, a brush made of kapron single fiber, etc.

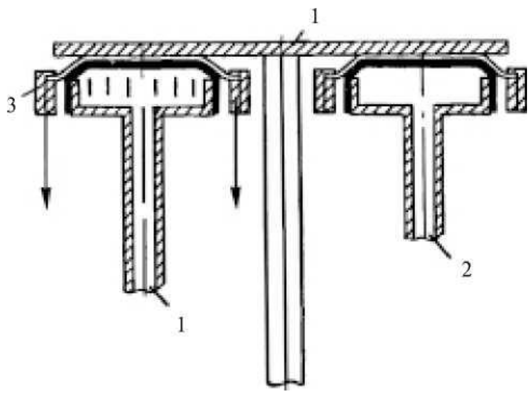

Fig 2. TI-1M the shape of the tool.
1-disc; 2-head; 3-example.

The rubbing surface affects the entire surface of the sample or its part, and is in forward-reciprocating or rotating motion. The TI-1M instrument is widely used for conducting tests.

The TI-1M instrument (Fig. 2) determines the abrasion resistance of knitted fabrics made from different fibers.

A rough stone or coarse wool is used as an abrasive surface. Samples are attached to three working parts below it. Compressed air is supplied to the cavity of the working part to contact the samples with the rubbing surface. Under its influence, the rubber gap of the working part rises and brings the sample closer to the rubbing surface. Due to the fact that the friction surface and the working parts are rotated in one direction, random friction occurs in the samples. Since the friction is based on soft rubber, the test conditions in this device are close to the conditions of friction of gas on the human body. One rotation of the working parts is considered as one friction cycle. The abrasion resistance of gauzes is characterized by the number of abrasion cycles from the beginning of the test to the appearance of a hole in the sample. In this tool, samples can be subjected to a certain amount of friction cycles.

In this case, a change in any of its properties (mass, strength, thickness, etc.) is determined in order to evaluate the abrasion resistance of the gas.

Therefore, several indicators can be used to evaluate the friction resistance of gasses:

1. A change in one of its properties after rubbing the gauze.

2. The number of friction cycles that passed from the beginning of the test to the appearance of a hole in the gasket.

3. The amount of time spent from the start of the test to the appearance of a hole in the gasket.

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