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Features of the Choice of Fabric for Special Clothing of Medical Workers

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ABSTRACT: The article provides the results of studies of the influence of the fibrous composition of medical fabrics on their physical and mechanical characteristics, since the tissues must protect a person from the harmful effects of the external environment, create normal conditions for life, be harmless (fibers and preparations applied to the fabric should not emit harmful impurities) and create maximum wearing comfort. Therefore, main attention is paid to the hygienic properties of fabrics, which are indicators of the safety of textile and light industry products in accordance with the technical regulation "On the Safety of Light Industry Products".

KEY WORDS: fabric for special clothing for medical workers, breathability, hygroscopicity, electrification, surface density, crease resistance.

I. INTRODUCTION

Special clothing is a professional outfit that is used in various fields of activity and meets the requirements for ensuring human safety. The main features of the material for workwear are reliability and high wear resistance. In the production, high-quality natural and synthetic materials, which retain their performance characteristics with regular wear, are used. Medical clothing must be light and comfortable, not restrict movement. It should be breathable - regardless of the temperature conditions, it should not cause allergies from prolonged wear. But, in addition, clothing must be safe for patients and prevent the growth and spread of bacteria. After all, doctors go from patient to patient, and the risk of transferring disease-causing microbes is very high. Therefore, the choice of professional clothing for medical staff is a responsible task.

The uniform of medical personnel should not only be of high quality and neat, but also meet certain industry standards, taking into account the sanitary and hygienic requirements for clothing already at the development stage. It is very important that the fabric for medical clothing is ergonomic, as most of the costs of medical institutions are associated with the regular replacement of clothing sets.

The main properties for medical tissue are hygroscopicity, air permeability and electrification [1,2,3].

Heat protection properties and water resistance are important for outer medical clothing - jackets, windbreakers, lifeguard suits and ambulance personnel. The properties of the fabric depend both on its structure, density of weaving, and on additional impregnations - compositions with which medical fabric is treated before sewing gowns, underwear, suits or clothes from it.

The combination of synthetic and man-made, synthetic and natural fibers in the manufacture of a fabric allows a significant increase in the quality composition of the fabric. The desired properties are achieved by the percentage of fibers. A blended fabric is a fabric of mixed type. It contains natural, artificial and synthetic components. The natural fibers are responsible for the hygienic characteristics, while the synthetic part expands the performance capabilities. This unique combination results in a fabric of high comfort, strength and durability [5,6].

Blended fabrics have many advantages: they are hygroscopic, like cotton, also "breathe", but much less creased and do not sag during the washing process, hold the shape of the product. Mixed fabrics in recent years have gained particular popularity, because they are very easy to care for, they are comfortable, pleasant to the touch, hygroscopic. Like cotton fabrics, these fabrics breathe, but they are much less creased and do not shrink when washed, which is very important for the uniform of a medical worker [7].

All these qualities are very important for a medical professional.

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The main requirements that are imposed on medical clothing are:

- antistaticity;
- breathability;
- hygienic.
- not rumpled.

II. METHODOLOGY

Determination of the quality characteristics of the selected samples was carried out in accordance with the requirements established in standard methods in accordance with GOST 29298-2005 in a testing certification laboratory at the Tashkent Institute of Testing and Light Industry [3].

Objects of research in this work were the following samples of suit fabrics: I - 100% cotton fibers, II - 65% viscose fibers+35% polyester fibers, III - 50% cotton fibers+50% polyester fibers, IV - 100% polyester fibers, V - 40% viscose fibers+60% polyester fibers.

Before testing, the samples were kept in normal climatic conditions according to GOST 10681-75 [4]. Comparative characteristics of the test results of fabrics samples for medical purposes of different fiber compositions are presented in table 1.

Table 1 Physical and mechanical properties of fabrics for medical purposes

№	Name of indicators	Unit of measure	Fiber composition of fabrics				
			100% cotton fibers	65% viscose 35% polyester	50% cotton 50% polyester	100% polyester	40% viscose 60% polyester
			Sample number				
			1	2	3	4	5
1	Surface density	g/m^2	136,1	123,4	128,5	115,0	119,3
2	Thickness	Mm	0,30	0,20	0,25	0,15	0,20
3	Number of threads per 10 cm on the warp weft		300 260	280 220	280 220	240 180	280 240
4	Weave		linen	Linen	linen	linen	linen
5	Air permeability	sm^3/sm·sek	72,6	78,0	52,1	11,48	17,07
6	Hygroscopicity	%	11,8	11,6	6,6	2,8	7,3
7	Electrification	V	88	315	298	859	521
8	Crease resistance	%	45,6	61,4	58,9	79,5	71,5

III. RESULTS AND DISCUSSION

According to the results shown in table 1, samples №. 1 (100% cotton) and № 2 (65% viscose + 35% PE) have the best air permeability. The hygroscopicity of fabrics depends on the ability of their constituent fibers and threads to be moistened with water, on the structure of fabrics and on their finishing. The highest hygroscopicity is found in natural cotton, cellulose hydrate. It is from them that underwear and underwear medical clothing are sewn [2,3,12]. As can be seen from Table 1, in terms of hygroscopicity, sample No. 1 is superior to the others, i.e. 1.7% more than sample № 2, 44.1% more than sample № 3, 2.7% more than sample №. 4 and 38.1% more than sample № 5.

According to the obtained indicators of tissues for medical devices, taking into account the positive and negative indicators of quality, a comprehensive assessment was made and a diagram of comparison of quality indicators, shown in Fig. 1, was built.

A complex (petal) diagram is an excellent tool for displaying the functional dependence of three or more variables. This provides a visual representation that is useful for comparing specific trends. Petal charts are used to compare the statistical

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values of multiple data series. This type of diagram is displayed as a curved polygon with vector lines extending from a common center. These vector lines are the coordinate axes for each of their categories.

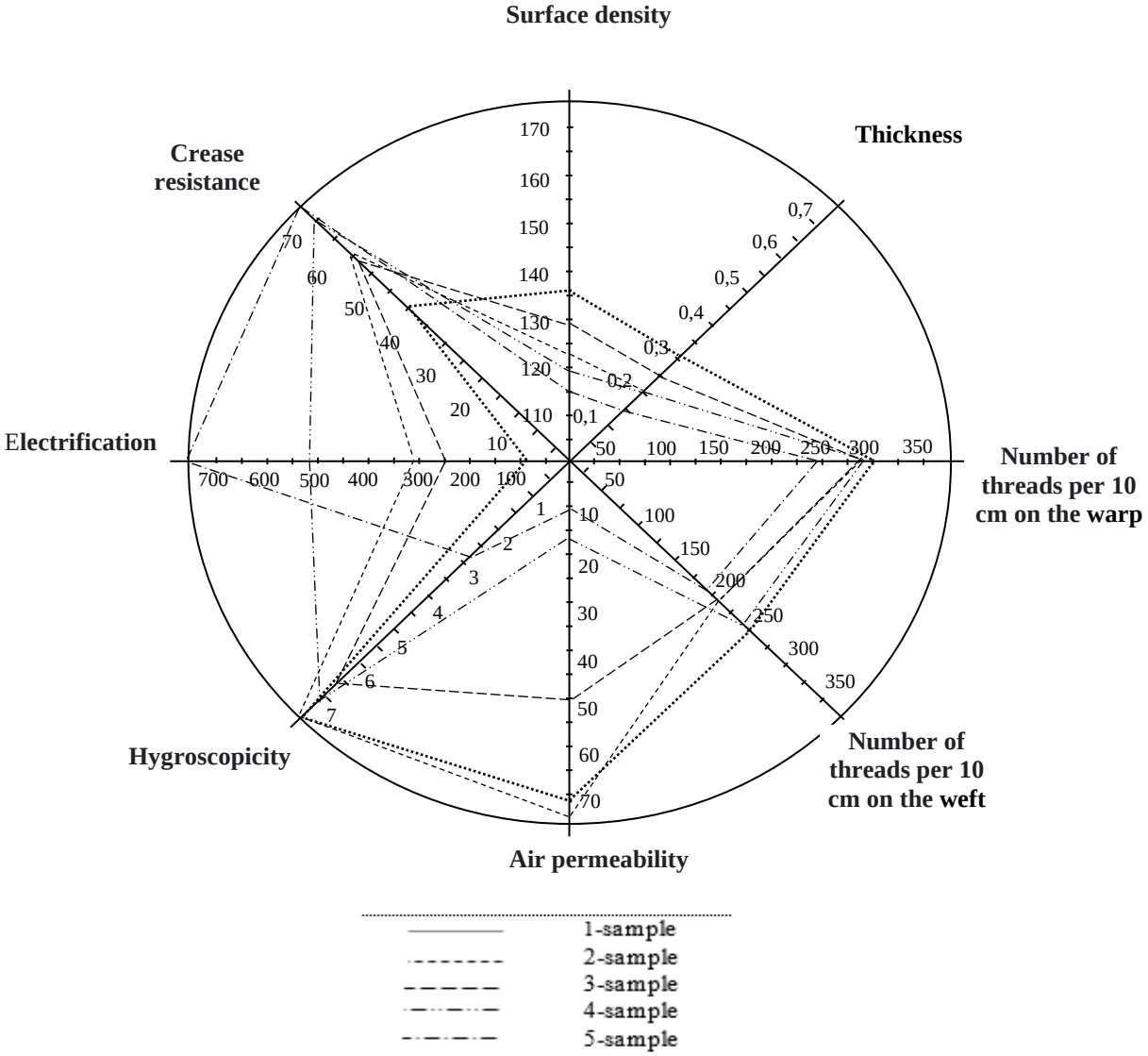

Fig. 1 Diagram of comparison of quality indicators

A quantitative assessment of the significance of the Quality Indicators for medical fabrics was carried out using an expert method. As a result, the defining quality indicators for medical fabrics are: antibacterial properties, air permeability, raw material composition, hygroscopicity, crease resistance, shrinkage, artistic and aesthetic design , pilling , abrasion resistance .

According to this diagram for the analysis and calculation of the areas of polygons according to formula 1, it is possible to determine the best in terms of the qualitative characteristics of the samples under study.

$$S=1\backslash 2(a\cdot b\sin\varphi) ,(1)$$

To facilitate the determination of a larger polygon in area, it is possible to cut the resulting polygons along the contour and weigh their mass. The results of certain masses of polygons are shown in the table 2. By analyzing the results by weight, sample III (50% cotton 50% polyester) had the highest values. Relative to other values, sample № 1 is 16.7% less than that of sample № 3, for sample №2 it is 11.1% less than that for sample №3, for sample № 4 it is 22.2% less than that for sample № 3 and sample № 5 is 33.3% less than sample №3.

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Table 2 Indicators of mass areas of samples

№	Sample type	Weight , mgr
1	Sample 1	0,30
2	Sample 2	0,32
3	Sample 3	0,36
4	Sample 4	0,28
5	Sample 5	0,24

IV. CONCLUSION

Sample №1 (100% Cotton) and №2 (65% viscose+35% PE) have the best air permeability, sample № 4 is the worst 100% synthetic PE. Electrification is the ability of materials to accumulate static electricity on their surface. The electrification of textile materials has daily and seasonal fluctuations associated with the ionization of the atmosphere. For example, in summer, the electrification of materials is higher, since solar activity is stronger during this period.

In most cases, the electrification of textile materials is a negative phenomenon: it complicates the technological processes for the production of materials and the manufacture of garments from them. It is known that a positive electric field on the surface of human skin causes a number of pathological reactions [8,9,10,11]. The smallest indicator is for sample №1 (100% cotton) and № 3 (50% cotton+ 50% PE), the largest sample №4 - 100% synthetic PE. The crease of fabrics directly depends on the fibrous composition, weave and linear density of the yarn. Yarn creasing is a negative property of textile materials and spoils the appearance of finished products. In laboratory conditions, tissue tests have been carried out to determine the crease resistance, which shows how the fabric resists creasing and is expressed in%. [12]. The largest index of crease resistance is in sample№1 (100% cotton fibers) and №3 (50% cotton+ 50% PE), the largest sample №4 is 100% synthetic PE.

It can be seen from the studies that the most optimal samples for sewing and operating special clothing for medical workers in terms of their indicators are sample № 2 (65% viscose+ 35% PE) and № 3 (50% cotton +50% PE).

It should be born in mind that during operation, textile materials are exposed to complex wear factors. The most common wear factor is the complex effect of washing process. The change in the linear dimensions of products during the washing process is influenced by mechanical influences (multiple deformations, abrasion), the temperature and composition of the washing solution, the features of spinning, and drying conditions. To preserve the wear life of products, it is necessary not to violate the operational properties of the fabric during the wet-heat treatment [12].

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