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Characteristics of New Sample Medical Gauze

Umurzakova Khalima Khabibullaevna, Akhmedov Jakhongir Adkhamovich, Atabaev

Izzatbek Xayitbay o'g'li, Ortikova E'zoza Zakirjan qizi

Candidate of Technical Sciences, PhD, Tashkent Institute of Textile and Light Industry, Uzbekistan

Doctor of Technical Sciences, Tashkent Institute of Textile and Light Industry, Uzbekistan.

Master of Tashkent Institute of Textile and Light Industry, Uzbekistan.

ABSTRACT: This scientific work is devoted to the development of medical silk gauze with a low surface density, with natural antiseptic properties and with high bursting characteristics. A method has been developed for obtaining medical silk gauze with improved characteristics, low surface density, high breaking load and natural antiseptic properties. The figures illustrate the qualitative characteristics of new samples of silk gauze. The relationship of surface density with capillarity and with the rate of wettability of silk gauze is given. The article also presents the results of the discontinuous characteristics of new samples of medical gauze.

KEYWORDS: raw silk, silk thread, silk yarn, breaking load, elongation at break, density, speed, wettability silk yarn, capillarity, sorption properties.

I. INTRODUCTION

Natural silk is one of the most valuable types of textile raw materials, which has unique physical, mechanical and technological properties that provide it with a stable range of applications as delicate women's clothing, linen, as well as for beautiful interiors and other household products.

Silk also has unique natural antiseptic properties; it is no coincidence that since ancient times it has been used in medical practice [1]. Currently, surgical silk suture materials with different linear density are successfully used in surgical practice.

Scientists from the United States have developed a new drug delivery system using microneedles based on natural silk. Professor of Engineering and Chemical Engineering David Kaplan, Professor of Biomedical Engineering Fiorenzo Omenetto and their colleagues at TAFIS University have developed microneedles based on natural silk fibroin protein. This system is a multifunctional solution to overcome a number of limitations. Scientists have proven that their silk microneedles are biodegradable, can contain, store and in a controlled manner shed easily destructible skin infections. Kaplan and his colleagues, using silk fiber, based on the proteins that make up its composition, have created a special film that protects biologically active molecules of drugs [2].

Treatment of wounds and wound infections is a task that has to be constantly addressed not only by surgeons, but primarily in everyday life. At the same time, as in medical practice, the bandage method is most widely used, when a dry gauze contour bandage with various drugs is applied to the wound. The method of treating wounds under the bandage attracts with its accessibility and simplicity, it is applicable in any living conditions.

Until today, mainly cotton medical gauze and dressings from it are produced with a high surface density of 22,5-36,0 g/cm². The requirements of GOST 9412-93 for dressings are known according to which the gauze is bleached, made of cotton fiber and has a plain weave and the following main technical characteristics: breaking load on the basis of at least 8,0 kgf; duck 3,5 kgf; accordingly, the elongation at break at the base is not less than 7,5% and at the weft of 5.5%; areal density 21-36 g/m²; wettability rate no more than 10 s; capillarity is not less than 10 cm/g [3].

The disadvantage of such gauze is its increased mass capacity and reduced air permeability and strength. An important direction is the development of a new range of medical gauze from raw silk and silk yarn.

For more than 25 years in the countries of Europe and Asia (Germany, Japan, etc.), the anti-inflammatory properties of serrapeptase (serratiopeptidase), a proteolytic enzyme of natural origin, have been used in clinical practice [4]. Serrapeptase is naturally produced in the intestines of the silkworm. This enzyme is involved in digestion and is also used by silkworms to dissolve cocoons during butterfly pecking.

Dr. Hans Alfred Nieper (1928-1998) - German physician who widely used serrapeptase in his practice, calling this enzyme "miraculous". And Robert Redfern, the author of the most complete monograph on serrapeptase to date (Redfern-R 2006), considers it the second gift of the silkworm to mankind [5].

Currently, we have developed methods for producing medical silk gauze with improved characteristics, low surface density, high breaking load and natural antiseptic properties. Experimental and industrial samples of gauze with plain



weave were obtained from silk yarn with a linear density of 14,28 *tex* on the warp, from raw silk on a weft of 3,23 *tex*, with the number of threads per 10 *cm* on a warp of 90-100, on a weft of 265-280, breaking load 90,3-122,2 *N* and 125,6-132,5 *N*; respectively, or from raw silk with a linear density of 3,23 *tex*, with the number of threads per 10 *cm* both on the warp and on the weft, 300-330 each, with a breaking load of 125,6-132,6 and 132,7-151, 1 *N*. A patent was obtained for the invention [6].

II. ANALYSIS OF EXISTING FILTERING MATERIALS AND RESEARCH RESULTS

A patent was obtained for a method for producing yarn from mixed fibers [7]. In production conditions, a multicomponent yarn has been produced, with a linear density of 32 *tex*; relative breaking load (actual) 17,27 *cN / tex*; at a calculated 19,12 *cN / tex*; linear density 32 *tex* pure (100%) wool yarn, the relative breaking load was 8,5 *cN / tex*;

When creating or choosing a particular weave, four main factors must be taken into account: raw materials, the type of knitting equipment, the class of machines and the structure of the weave. The appearance and quality indicators of knitwear depend primarily on the correct selection of the raw material composition and the properties of yarns and threads [8-10].

There is information on the state of development of the silk industry in Uzbekistan,

the tasks set and the work being done. This article describes the causes of defects in the production of high-quality raw silk, the effect of defects in the cocoon shell and methods for their elimination. The effect of the quality of raw silk on the formation of defects in raw silk insilkworm breeding has been studied. The effect of the correct execution of agrotechnical rules on the amount of defective cocoons and the relationship of shell damage during loading were studied. The origin of defects in the process of reeling and methods of their elimination are given. The effect of defective cocoons on the quality of raw silk has been given a practical justification. The results of the experiments are presented in pictures and tables [11].

The law of motion of a cocoon, the method of hydrodynamics are studied, and the motion of a cocoon with variable mass in the form of a ball immersed in an aqueous medium is considered. The graphs of the dependence of the displacement of the center of the cocoon (ball) on times for two values of the coefficient of stiffness of the thread k_0 (*N/m*) and the time of completion of the cycle t (sec) are presented. The theoretical equation and calculations for the location of the ball in the aquatic environment are presented. The paper studies the effect of thread breakage during cocoon unwinding on the quality of raw silk [12].

In the textile industry, a new direction has emerged - the creation of raw materials, materials and medical products. The most widely used materials in medicine are underwear and bedding, sterile and non-sterile napkins, dressings with antimicrobial, anesthetic and hemostatic activity, sterile surgical silk and synthetic threads, blood vessel prostheses, compression products, products for general and cardiovascular surgery, tubular woven and knitted dressings.

III. EXPERIMENTAL RESULTS

Treatment of wounds and wound infections is a task that has to be constantly addressed not only by surgeons, but primarily by people in everyday life. At the same time, as in medical practice, the bandage method is most widely used, when a dry gauze contour bandage is applied to the wound or with various drugs. This is determined, first of all, by the possibility of its universal application due to a set of unique properties in terms of sorption parameters, retention capacity, plasticity, drape, as well as the manufacturability of processing into various medical products. The method of treating wounds under the bandage attracts with its accessibility and simplicity, it is applicable in any living conditions.

The developed new range of silk gauze have high breaking characteristics compared to existing cotton gauze.

Silk yarn with a linear density of 14,28 *tex* was used as a raw material; raw silk 2,33 and 3,23 *tex*, also viscose 31 *tex*. Depending on the number of threads per 10 *cm* along the warp and weft, new samples of medical gauze with surface density from 19,3 to 31 *g/m²* were obtained.

Physicomechanical and chemical properties of all 9 gauze samples were investigated.

Analysis of the results of the study showed that pure silk and in a mixture with viscose gauze with a surface density of more than 25 *g/m²* in capillarity and wetting rate did not meet the requirements of medical gauze.

Gauze made from silk yarn and raw silk with a surface density of 19 to 25 *g/m²* in all quality indicators is higher than the requirements of GOST.

Therefore, we have recommended three types of sample for industrial approbation: 1 - warp and weft of silk yarn 14,28 *tex*, the number of threads per 10 *cm* on the warp 60 and on the weft 75; areal density 19,3 *g/m²*; 2 - warp and weft silk - raw 3,23 *tex*, with the number of threads per 10 *cm*, respectively, 460 and 440 surface density 21,5 *g/m²*; 3 - warp and weft silk - raw 2,33 *tex* with the number of threads per 10 *cm* on the warp 530 and on the weft 510, areal density 19,8 *g/m²*. (Fig 1.)

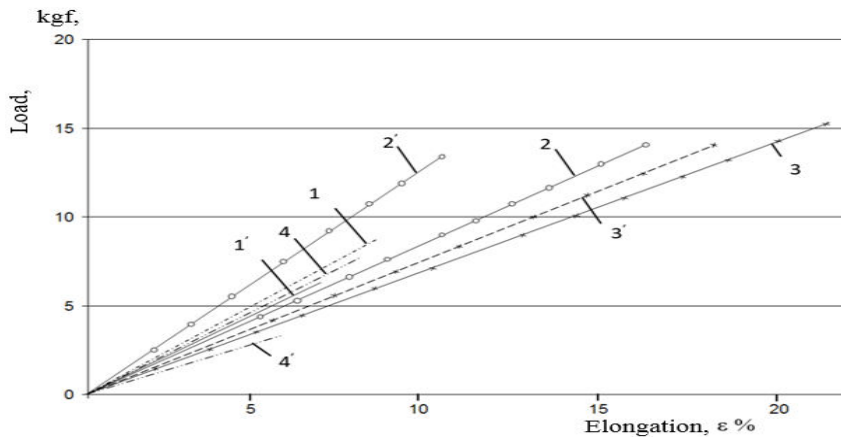


Fig 1. Discontinuous characteristics of samples of medical gauze. 1-silk yarn 14,28tex; 2-raw silk 3,23 tex; 3-raw silk 2,33 tex; 1- on the warp; 1'- weft.

It can be seen from the figures that the breaking load and breaking elongation of the new samples of gauze made of silk yarn are 10-15%; the gauze made of raw silk is 1,8 – 2,5 times higher than the indicators of the technical requirement for medical gauze made of cotton yarn. This was facilitated by the high strength characteristics of the raw material composition. The results of the experiment of a medical cloth made of natural silk are shown in the table.

Table. Strength and elongation of medical cloth made of natural silk

title	Load	Elongation
<i>Units</i>	<i>Kgf</i>	<i>%</i>
warp=0	15,3620	15,8285
warp 1-2	15,3180	15,6140
warp 1-3	18,3281	18,2630
medium	16,3360	16,5685
weft2-1	15,6105	14,5965
weft 2-2	16,7775	15,2830
weft 2-3	14,3302	13,2805
medium	15,5727	14,3866
warp=1	11,4565	15,7800
warp3-2	10,1920	17,2825
warp3-3	9,58661	14,7650
medium	10,4117	15,9425
weft4-1	7,27886	13,8840
weft 4-2	7,35088	13,7160
weft 4-3	7,60708	14,7160
medium	7,41227	14,1053
warp=3	11,9090	13,1150
warp5-2	12,2295	13,5650
warp5-3	10,8013	14,4505
medium	11,6466	13,7101
weft6-1	8,42604	13,5810
weft 6-2	6,55869	17,1875
weft 6-3	8,88205	15,7495
medium	7,95559	15,5060
Overallaverage	11,5558	15,0365



In medical gauze, along with other characteristics, indicators such as: wettability rate (no more than 10 s) and capillarity (no less than 10 cm/h) are important. These indicators are interconnected by the value of the surface density (g/m^2) of gauze.

The research results are shown in Figures 2 and 3. The composition of raw materials in the samples: 1- warp and weft from silk yarn linear density 14,28tex; 2- warp silk yarn 14,28 tex, weft viscose 31,0 tex; 3- warp and weft raw silk 3,23 tex; 4- warp and weft raw silk 2,33 tex; 5- warp and weft raw silk 3,23 tex; 6- warp and weft raw silk 2,33 tex [13].

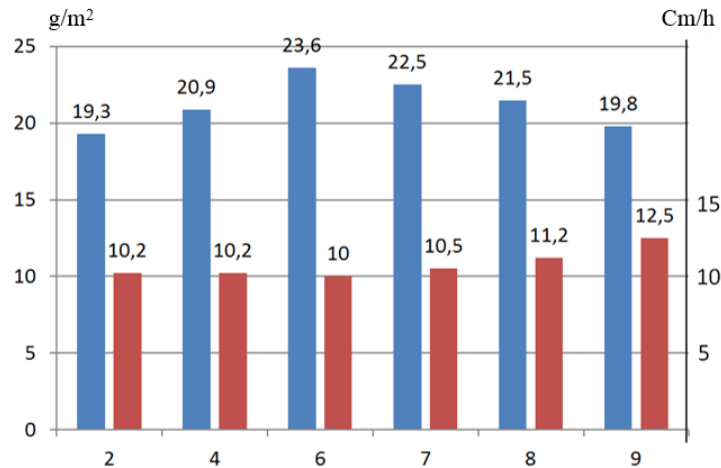


Fig 2. Relationship between surface density and capillarity of new samples of medical gauze

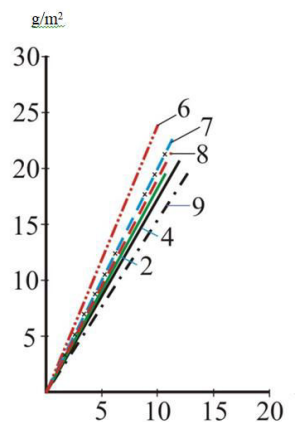


Fig 3. Relationship between surface density and the wettability rate of medical silk gauze

The analysis from Figures 2 and 3 shows that with a decrease in the surface density of medical silk gauze, both capillarity and wettability characteristics improve. Taking into account these circumstances, for industrial approbation, it is recommended to produce medical gauze from silk yarn 14,28 tex and from raw silk 2,33 and 3,23 tex with a surface density from 19,8 to 23,6 g/m^2 .

One of the important indicators of medical gauze is air permeability; according to technical requirements, it should be at least 260.5 $cm^3/m^2 \text{ sec}$. A new range of silk gauze with a surface density of 23,6 g/m^2 air permeability was 276,6 $cm^3/m^2 \text{ sec}$; respectively: at 22,5 g/m^2 – 290,1; at 21,5 g/m^2 – 29,5 and at 19,8 g/m^2 – 309,0 $cm^3/m^2 \text{ sec}$.

The indicator of air permeability is also closely related to the surface density of gauze, with a decrease in the value of the latter from 23,6 to 19,8 g/m^2 , an increase in air permeability was almost 12%. When the standard of whiteness is not less than 80,0%, silk medical gauze is 85%. Thus, the results were obtained that, in terms of its technical quality parameters, the new range of silk gauze meets the requirements of medical gauze.

Industrial samples of medical silk gauze with improved characteristics, low surface density, high breaking load and natural antiseptic properties (fig. 4)[14].

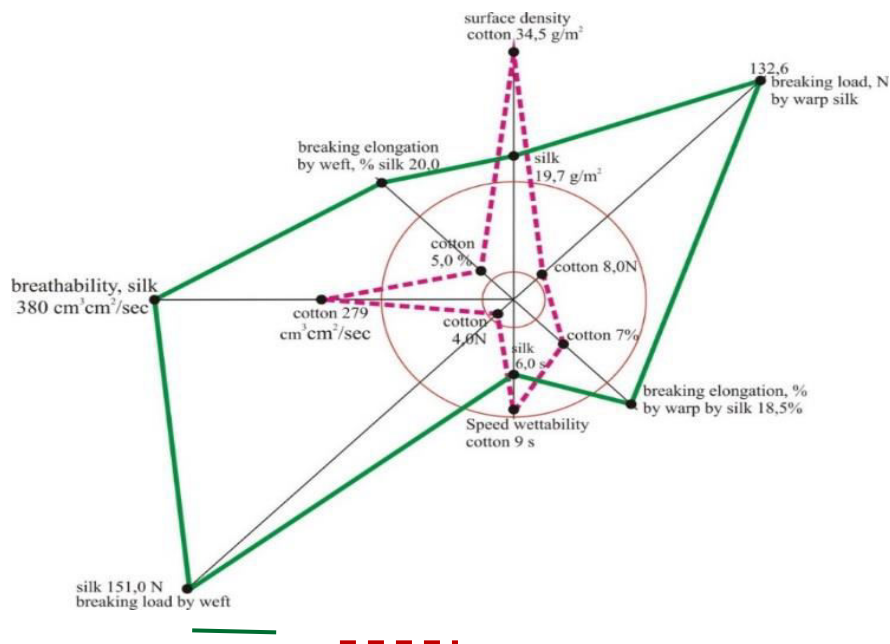


Fig. 3. Quality indicators of gauze silkcotton

As can be seen from Fig. 1. all quality indicators of the new sample of natural silk gauze significantly exceed the indicators of cotton gauze.

IV. CONCLUSION AND FUTURE WORK

Based on the study of sorption properties, it was established that a new range of silk gauze with a surface density of 19.8-23.6 in terms of both capillarity and wettability rate meet the requirements of medical gauze. The research carried out made it possible to develop a method of technology and develop an industrial batch of medical silk gauze with natural antiseptic properties.

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