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STUDY OF THE QUALITY OF YARNS OBTAINED FROM RECYCLED COMPOSITE FIBERS

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Abstract. The article analyzes the quality of yarns obtained by mixing 33.3% rogoz, 33.3% polyester and 33.3% local wool fibers grown in Uzbekistan. When comparing the produced yarn with a new composite with 20 tack yarn for suit fabric produced by the Bukhara training and production enterprise of the Society of the Blind of Uzbekistan, the following results were obtained. 33.3% local wool, 33.3% polyester, 33.3% reed mace, 20% denier yarn, 20% denier cotton yarn, increases tensile strength by 25.5%, elongation by 37.5%, yarn specific tensile strength Increases by 25.5. %. The results of the study show that the tenacity of the new blended yarn is higher than that of the 100% cotton 20 tack suit yarn.

According to this result, it is possible to ensure that the fabric, from the new yarn, is also of high quality and easily adjustable by the parameters of the equipment

Keywords: mixed yarns, fibers, fiber length, elongation at break and load, relative equal load, linear density of fiber and yarn.

Introduction. ….. is one of the leaders in diversification of competitive products through the processing of textile raw materials, application of new processing methods using modern technical means to obtain threads of various compositions. It should be noted that the demand for textile products is growing every day. To meet this demand, the production of synthetic fibers and the production of finished products from them are developing. Nevertheless, it should be noted that our main task as textile specialists is that we must not forget that the decrease in hygienic properties because of the use of 100% synthetic fibers has a negative impact on human health. Thereby, the use of large amount of natural fibers and a small amount of synthetic fibers is the main purpose of our scientific work.

According to the data of State Statistics Committee of Republic of Uzbekistan, in 2021 the total number of sheep and goats reached 22121870 heads. 21120 tons of wool from these goats and sheep were grown [1].

Most of the wool produced in the country is sheared from sheep. The main part of this wool is obtained from sheep of Karakul and Hissar breeds. Sheep of this breed are widespread in Uzbekistan. Sheep wool is sheared in spring and autumn. In cold winters, wool sheared in spring contains a large amount of fine fibers. The wool of sheep of the Karakul breed is considered coarse and is used for the manufacture of non-woven materials. Coarse woolen raw materials are unsuitable for spinning in the textile industry. Therefore, the development of spinning technology used in weaving with the use of emollients in the processing of coarse wool allows achieving certain results [2].

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Methodical part

In industrial practice and in scientific research, discontinuous characteristics of the mechanical properties of fibers, threads and textile fabrics are widely used, obtained by a single stretching and rupture of the sample.

Summary sample characteristics were determined with a small number of measurements (n<50).

The sample mean is determined by the formula $\bar{X} = \sum_{i=1}^{n} x_i / n$

where, n is the number of measurements (sample size); x_i are individual measurement results.

$\bar{X}$ characterizes the final test result.

The standard deviation is calculated by the formula

$$S = +\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 / (n-1)}$$

The coefficient of variation is determined by the formula $S = 100S / \bar{x}$ [2].

Obtained results

The quality of yarn mixed with wool and other fibers produced in the textile industry depends on the fineness and length of the wool fiber. Depending on the thickness and structure, wool fibers are divided into the following types: downy fibers, intermediate fibers, coarse-wool fibers, dead fibers.

Downy fiber is a thin twisted fiber that forms the entire wool cover of fine-haired sheep, and also clings to the crown of coarse-wool sheep.

Intermediate fibers occupy an intermediate position between downy and coarse hair. The entire wool coat of crossbred sheep consists of these intermediate fibers.

Coarse hair is a thicker fiber than wool and hardly curls, and is semi-coarse wool.

Depending on the fineness, wool fibers are divided into the following 4 groups:

1. Fine wool (up to 25 microns thick) – consists of downy fibers;
2. Semi-fine wool (thickness from 25 to 43 microns) – consists of down and intermediate fibers;
3. Semi-coarse wool is a variety and many different. It has a different average thickness (34–40 micron). The fiber is cut once in the spring. It consists of many types of downy and coarse fibers and is sheared twice a year in spring and autumn.
4. Coarse wool (thicker than 40 microns) - consists of all kinds of fibers.

Different types of wool fibers differ from each other in appearance and technological properties. Wool contains the following fibers: tendril (hair), intermediate fiber, tweet, dead fiber, dry fiber, cover fiber, bristle [3].

Tendril (hair) - are the longest and relatively thick, less twisted fibers with a length of 20 cm or more and a diameter of 75 microns. They form the top layer of the wool lining, which separates into less twisted or wavy sections.

Tendril (hairs) consist of three layers: cuticle cells, skin layer and core layer. Scales vary in shape and size and are arranged in several rows along the cross-sectional surface of the fiber. The core layer has a variable diameter along the entire length of the cirriform fibers. Fragmentation of the stratum corneum indicates that the animals lost weight because of malnutrition. Root fibers are located individually in the core of the root; root bulbs are located deep and reach the lowest layers of the skin. As the diameter of the fibrous fibers decreases, their properties improve. Sheep belonging to different types of wool, the quality of the wool fibers is not the same. In sheep of the rough type, the tendril have a large number of diameters and lengths. In lean sheep of the lean type, the tick fiber is much shorter, thinner and less numerous. In the coarse or non-rough type of sheep, the length and thickness of the wool are intermediate.

Intermediate fiber is the fiber between the tendril and the downy, thicker than the downy, but thinner than the tendril. The fineness of transition fibers ranges from 30 to 50-52 microns. The length of the transitional hair differs little from the long downy and the middle tendril. Therefore, they are sometimes difficult to distinguish. The length and diameter of the intermediate fiber is less than that of the tendril-like fiber and greater than that of the downy fiber. Sometimes it is difficult to distinguish it from the thinnest and shortest fibrous fibers or from the longest and thickest fibers of down. According to its internal structure, the intermediate fiber is close to down. Often it does not have a core layer at all, or it is much less than that of the tendril fibers. The core of the intermediate fiber has a semi-split appearance. The appearance and properties of the intermediate wool fibers in such a mixed character make it difficult to distinguish them accurately. Intermediate wool fiber is technically superior to wool and inferior to down.

Downy fiber is the shortest and thinnest (softest) wool fiber. The downy fiber can have a length of 7 cm, a diameter of 25 microns, and some up to 30 microns. The downy fiber is wavy or curly, forming the undercoat. The downy fiber is very well spun and highly prized.

Dead fiber consists of straight and brittle sword fiber with negative technological properties. Not suitable for yarn and fabric. The technological feature is that it breaks when bent, breaks when pulled. Tensile strength is not high. Dead fiber has a dull sheen and is poorly stained. By morphological properties and internal structure, the tendril is very close to the fiber. The presence of dead fibers in wool reduces its value. It is impossible to allow breeding rams to have dead fiber, as it is inherited and determines the shape of the curls in the wool of future generations.

Dry fiber is the longest tendril fiber and contains no fat at the ends. Therefore, the surface of wool fibers is very rough and brittle. Technologically, dry fiber occupies an intermediate position between the tendril and dead fibers. The splitting of dry fibers in wool reduces its value, and the presence of dry fibers from breeding rams gives a change in curls in the fiber in the tail, thighs and other parts of the next generation.

Integumentary fiber (bald wool) grows only on the muzzle, legs, calves and abdomen of sheep. They are short, hard and very shiny. In thickness and structure, the sword is close to fiber, retaining the color and luster of the lamb at birth.

Bristle is a fiber found in the wool of fine-haired lambs. These fibers are very long, thick and slightly wrinkled. In the first weeks or first month of a lamb's life, such fibers will have the same appearance as normal down fibers.

To obtain high-quality wool fiber in Uzbekistan, it is necessary to take into account the general parameters of wool raw materials. To do this, it is necessary to improve the selection of sheep that produce high-quality wool, feed the sheep separately depending on the breed, and carry out timely shearing. Research has shown that the nutritional status of grazing sheep is directly related to wool productivity. Timely shearing of wool from sheep will allow growing high-quality raw materials. For example, the period of cutting the fiber of the Karakul breed of sheep falls on the spring and autumn months. When the shearing period is prolonged, the increase in impurities and debris in the wool, which are difficult to use in subsequent processes, reduces the quality of the wool in technological processes. Delaying the shearing period leads to an increase in impurities in the wool fibers and an increase in fat levels.

The quality of wool fiber is determined by its fineness and fiber length. To control the quality of wool and determine its mechanical properties upon acceptance, the woolen bed is inspected by manual corrugation, and then returned to its original state. Quality processing is important in the processing of wool. Moisture content of wool should be 10-18% in some wool fibers, 8-16% in others, and drying after processing should be carried out at a temperature of 90-100°C.

It is important to sort woolen raw materials and classify the fibers in each batch. Mixing different types of wool fibers adversely affects the quality of the product. Therefore, it is necessary to properly organize the spinning process and divide into pieces not only woolen raw materials, but also the coarsest fiber and wool. According to the industry classification, wool is divided into 13 classes depending on its fineness (Table 1).

There are three different ways to classify wool in the world. The Bradford method is designed to determine the classification size class. According to this classification, wool can be divided into 14 classes depending on the fineness of 28, 32, 36, 40, 44, 46, 50, 56, 58, 60, 64, 70, 80, and 90 microns. This does not take into account other properties of the wool fiber. Depending on its application in the Bradford classification method, only the same fibrous wool can be classified, i.e. fine and semi-fine, spun wool. The Bradford method cannot be used to classify mixed and coarse wool.

In Germany, the Azov method for determining the fineness of wool determines the number of fiber strands per 1 cm. According to this classification, wool is divided into 10 classes from 5A to F, and these classes have from 3 to 11 strands (number of waves) per 1 cm of wool length, and the thickness can range from 18 micrometers to 60 micrometers.

Table 1
The fineness of wool according to industrial classification

No.	Class	Fineness of wool fiber micrometer (μm)		Class	Fineness of wool fiber micrometer (μm)
1	32	55.1-67	8	56	27.1-29.0
2	35	43.1-55.0	9	58	25.1-27.0
3	42	40.1-43.0	10	60	23.1-25.0
4	44	37.1-40.0	11	64	20.1-23.0
5	46	34.1-37.0	12	70	18.1-20.0
6	48	31.1-34.0	13	80	16.1-18.0

7	50	29.1-31.0	14	-	-

According to the Hartmann classification, wool fiber is divided into 9 classes. According to this classification, the number of wool curls per 1 cm of length can be from 4 to 13 or less, the thickness is from 12-16 microns to 37 microns or more. In the research work, a new mixed composition was prepared using second-grade karakul wool. To obtain samples of the blend, the wool fibers were decontaminated and subjected to a washing process. The cotton-plant stalk powder and softener was used to soften the washed coarse wool fibers and passed through a tumble dryer. The blend is made from 33,3% astrakhan wool fiber, 33,3% polyester fiber and 33,3% reed mace fiber. Threads No. 17 and 20 tack were spun on RITER equipment at the Bukhara training and production enterprise of the Society of the Blind of Uzbekistan. Physical and mechanical properties of fibers and threads are given in Table. 2.

Table 2
Research results

No.	Name	Variants of yarn			
		1st variant	**2nd variant**		
1	Yarn composition	100% cotton	33,3% wool (coarse)	33,3% polyester	33,3% reed mace
2	Fiber length, mm	32	35	35	20-27
3	Fiber linear density, mtack	18	0.36	18	16
4	Relative strength Sn/mtack		12		
5	The linear density of the resulting yarn, tack	20	20		
6	Breaking load of the thread, cN	332	449		
7	Yarn elongation at break, %	33	40		

Analyzing the climatic conditions of Uzbekistan, most of the fabrics for seasonal costumes are imported from China. All fabrics imported from China are 100% synthetic fiber. It is clear that the use of fabrics with such a composition is harmful to the human body and can cause various diseases. To solve this problem, Uzbekistan managed to produce a new blended yarn using local raw materials, which will allow producing suit fabrics that meet the requirements of world standards with high physical, mechanical and hygienic properties [6, 7, 8, 9].

When comparing the produced yarn with a new composite with 20 tack yarn for suit fabric produced by the Bukhara training and production enterprise of the Society of the Blind of Uzbekistan, the following results were obtained. 33.3% local wool, 33.3% polyester, 33.3% reed mace, 20% denier yarn, 20% denier cotton yarn, increases tensile strength by 25.5%, elongation by 37.5%, yarn specific tensile strength Increases by 25.5. %. The results of the study show that the tenacity of the new blended yarn is higher than that of the 100% cotton 20 tack suit yarn.

According to this result, it is possible to ensure that the fabric, from the new yarn, is also of high quality and easily adjustable by the parameters of the equipment [10. 11. 12. 13]. In addition, the appearance of the new compound yarn has a different sheen, which can be fully reflected in the structure after the manufacture of the fabric [14. 15], presented in the figures.

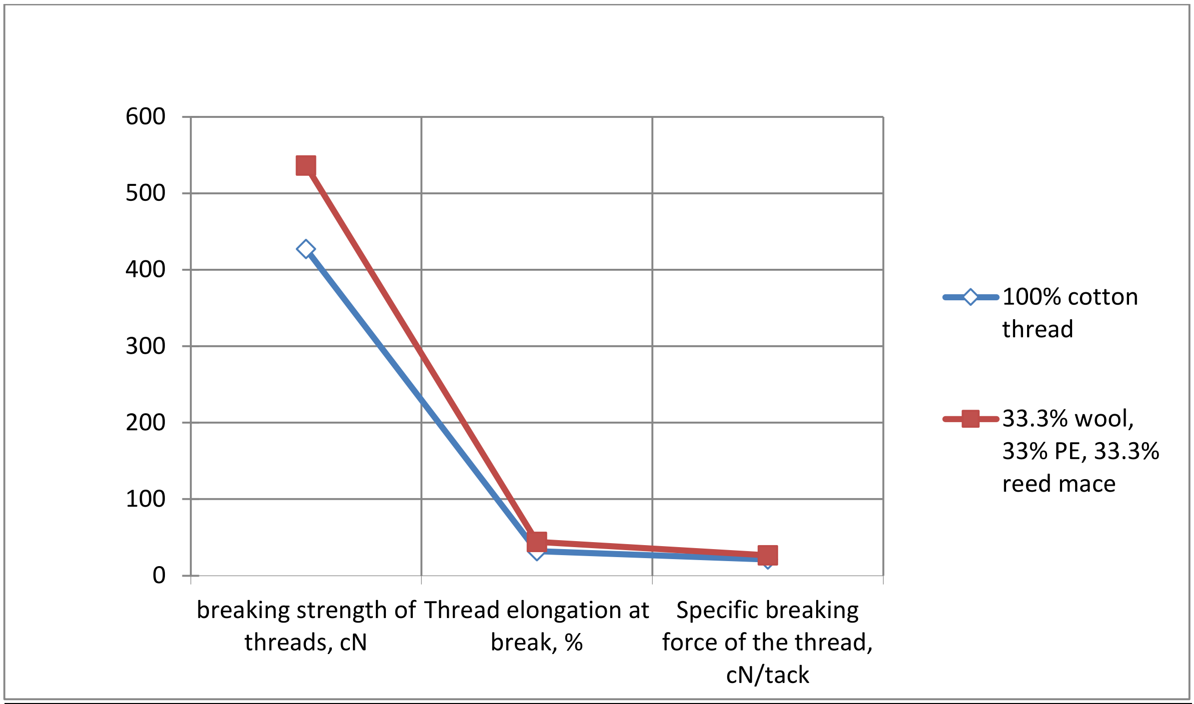
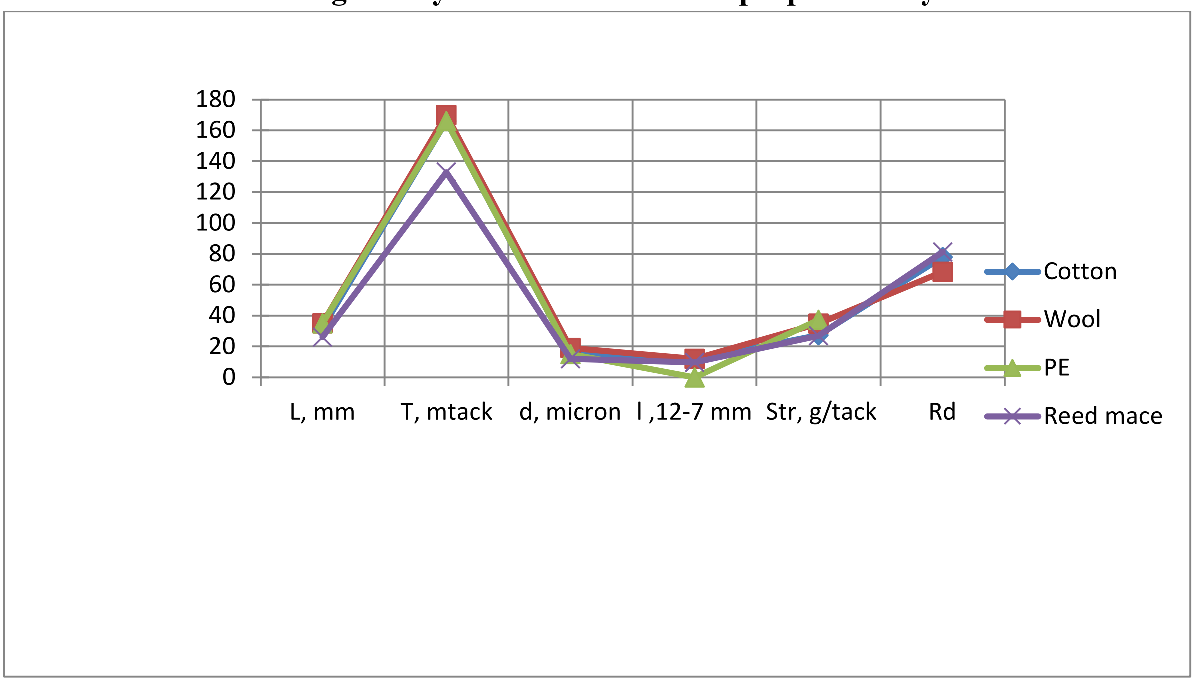


Fig. 1. Physical and mechanical properties of yarn



L is fiber length, mm; T is the linear density of the fiber, mtack; d is the fiber diameter, micron; l is short wave index, 12-7 mm; S is the specific tensile strength of the fiber, g/tack; Rd is beam reflectance

Fig. 2. Intrinsic performance of the fiber

Conclusion. According to the results of the study, the tensile strength of yarns made from 33.3% local wool, 33.3% polyester, 33.3% reed mace fiber relative to 100% cotton with a linear density of 20 tack increased by 25.5%, elongation at break by 37.5%, specific breaking load by 25.5% . The results of the study show that the tenacity of the new composite yarn is higher than that of 100% cotton 20 tack clothing yarn. This result allows producing threads of various linear densities for the production of textiles, expand the product range and produce competitive finished products.

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