

SOFTENED WOOL AND OTHER FIBERS MIXTURE TECHNOLOGICAL PROPERTIES

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Abstract. *This in the article softened sheep wool other fibers — viscose , polyester and natural fibers with mixed in the state technological properties studied . Mixed in the composition of fibers flexibility , one diversity , physical-mechanical connection level and flexibility analysis The research was conducted results mixture fibrous products working optimal proportions in production definition , product quality increase and energy economical technologies in use important importance has .*

Keywords : *softened wool , blend , technical properties , viscose , polyester , elasticity , quality*

Blending softened sheep wool fibers with synthetic (polyester, acrylic) and natural (cotton) fibers is widely used in today's textile industry. This process serves to combine the advantages of both fibers and improve the quality of the product.

1. Softened wool + Polyester (PET) fiber blend balances the natural heat retention properties of wool + the durability and hygroscopicity of polyester. The properties of the Softened wool + Polyester (PET) fiber blend are presented in Table 4.9.

Table 1

Properties of a blend of softened wool + Polyester (PET) fibers

Indicators	The mixture feature
Mechanical strength	Very high, polyester is tougher and more durable than wool
Hygroscopicity	Through the wool stored (polyester to low hygroscopicity owner)
To wash endurance	30–40% polyester , high- quality is saved
In the product shrinkage	Will be reduced (the natural wrinkling of the wool will be reduced)

Aesthetic appearance	Shiny , soft , hardness and elasticity balanced
Processing temperature	Polyester top at temperature melting possible (max. 180°C), caution need
70% Wool + 30% Polyester	the heat protective and the resulting product is durable
30% Wool + 70% Polyester	economical , light , high resistant to processing

The properties of the softened wool + Acrylic (PAN – polyacrylonitrile) blend are presented in Table 4.10.

Acrylic is called “synthetic wool.” When used with wool, the price of the product decreases and washing becomes easier.

Table 1.2

Properties of the softened wool + Acrylic (PAN – polyacrylonitrile) blend

Index	The mixture feature
Softness	Very high, a krill and softened wool to each other suitable
Heat to keep	Acrylic and wool together provides good insulation
In the wash unexpected contraction	Low (acrylic wool) stabilizes)
To the pilling inclination	In acrylic pilling (collection points) is at risk
Hypoallergenicity	Acrylic allergies possible – caution need
60% Wool + 40% Acrylic	more naturalness keeps
50/50	light , washable durable product
30% Wool + 70% Acrylic	cheap and a very soft product is obtained

3. The properties of the softened wool + cotton blend are given in Table 1. This fiber product is heat-resistant, breathable, lightweight, and highly hygroscopic.

Table 1.3

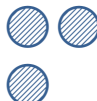
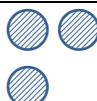
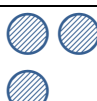
Indicators	Properties of the mixture
Hygroscopicity	Both fibers absorb moisture well.

Softness	High softness based on softened wool
Heat preservation	Wool is good for the price, but cotton doesn't retain heat.
Cleaning and washing	Low shrinkage in washing, easy to release oil
Hypoallergenicity	Natural fibers are comfortable for human skin
70% Wool + 30% Cotton	A warm and soft product is obtained
30% Wool + 70% Cotton	It is intended for the production of light summer products

The results of the comparison of the general properties of the mixture are presented in Table 4.12.

Table 1.4

Results of a comparison of properties of softened wool and other fiber blends

Components	Heat	Softness	Hygroscopicity	Stability in washing	Aesthetics	Price
Wool + Polyester						Average
Wool + Acrylic						Cheap
Wool + Cotton						More expensive

In conclusion, it can be shown that softened sheep wool is polyester Mixing with - for durable, wash-resistant and economical products, acrylic Blending with cotton is preferable for producing soft and inexpensive products, while blending with cotton is preferable for producing hygienic and skin-friendly, high-quality products.

Soft sheep wool, polyester , PAN (acrylic) and cotton fiber dyeing process and parameters

1. Dyeing of softened sheep wool and polyester fibers is carried out in 2 stages. Since wool is a hydrophilic, natural protein-based fiber, and polyester (PET) is a hydrophobic, synthetic polyester fiber, both fibers have different chemical natures, and therefore are dyed at different dyes and temperatures. The types of dyes for dyeing sheep wool fibers and polyester are given in Table 1.5.

Table 1.5

Types of dyes used for dyeing wool and polyester

Fiber	Paint type
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Sheared and softened sheep's wool in the autumn season	Acid (acid), and
acetic acid	1–2%
sulfate salts	0.5%
Polyester fiber	Dispersion
Temperature, °C	70
Storage in motion at the specified temperature, time, min	40
Demineralized water, liter	100

2. Dyeing softened sheep wool and Acrylic (PAN) fibers cannot be dyed at the same time **because** the two fibers have different chemical properties. Therefore, separate two-stage dyeing is recommended.

The parameters of dyes used for dyeing softened sheep wool and Acrylic (PAN) fibers are presented in Table 1.6.

Table 1.6

Dyeing parameters for softened sheep wool and acrylic (PAN) fibers

Step	Temperature	pH	Time	Paint type
1. Dyeing wool	85–95°C	4.5	30–40 min	Acetic acid, chlorides as acid dye and catalyst
2. Acrylic painting	95–105°C	3.5–4.5	20–30 min	As a basic dye and catalyst, dispersants, stabilizers

3. It is possible to dye softened sheep wool + cotton blend fibers in one step , for which a reactive-acid mixture dye should be used. The dyes and parameters used for dyeing softened sheep wool + cotton blend fibers in one step are also presented.

Table 1.6

Dyes and parameters used for one-step dyeing of sheep's wool + cotton blend fibers

Fiber content	Paint type and parameters
Wool + Cotton	Acid + Reactive dyes
Temperature, °C	80
Storage in motion at the specified temperature, time, min	40

Regarding fiber dyeing, it can be concluded that dyeing wool and polyester fibers is difficult, has poor mechanical strength and aesthetic appearance, while dyeing wool and acrylic is not difficult, the resulting product is soft and inexpensive, and although it is more difficult to dye wool and cotton, the product produced from it is hygienic and natural.

Economic efficiency of research

By softening the wool fiber, the improvement of its physical and mechanical parameters, as well as the increase of efficiency in technological processes, bring significant economic benefits.

After the softening process, the strength of the wool fiber is increased, the length and uniformity of the fiber is improved, the fiber is thinner and more elastic, and it is cleaned from impurities. Processing requires less energy and time, and allows for a higher quality product.

The following formula is used to determine economic efficiency:

$$\text{Economic efficiency (in soums)} = (\text{High-quality product output difference}) \times (1 \text{ kg product price}) - \text{Mitigation costs}$$

Based on the result of softening 1 ton of spring wool in Bukhara region, it was calculated using the values given in table 4.9.

Table 1.7

Indicator name	Unbleached wool	Softened wool
Product output from sheared wool	60%	75%
Price of 1 kg of finished yarn	80,000 sum	80,000 sum

Softening costs (for 1 t of wool)	-	4,000,000 sum
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Output of wool fiber from 1 ton of wool without softening:

$$1000 \text{ kg} \times 60\% = 600 \text{ kg}$$

Fiber output from 1 ton of softened wool:

$$1000 \text{ kg} \times 75\% = 750 \text{ kg}$$

$$\text{Difference: } 750 - 600 = 150 \text{ kg}$$

Difference in income (profit): $150 \text{ kg} \times 80000 \text{ soums} = 12000000 \text{ soums}$

Economic efficiency:

$$12000000 \text{ soums (income)} - 4000000 \text{ soums (expenses)} = 8000000 \text{ soums profit}$$

By softening 1 ton of wool, you can get a profit of about 8 million soums. This will simultaneously increase processing efficiency, improve product quality, and allow you to sell it on the market at competitive prices .

Summary for Chapter 4:

1. In conducting a full-scale experiment, the adjustment factors in the wool fiber processing equipment were thoroughly studied and X_1 - the speed of the cleaning-cleaning drum, rpm, X_2 - the rotation speed of the fan, rpm, X_3 - the mass of the emulsion content, % were chosen as the input factors. U_1 - fiber diameter, micron, U_2 - strength, sN/mtex, U_3 - fiber elasticity, %, U_4 - fiber elongation at break, % properties were selected as output parameters .
2. It was found that in order to obtain high results in terms of diameter, strength, fiber elasticity, and elongation at break of softened karakul sheep wool fibers as a result of processing wool fibers shorn in the autumn season, it is necessary to set the X_1 - cleaning drum speed to 800 rpm, X_2 - fan rotation speed to 1500 rpm, and X_3 - emulsion composition Ciba Sapamine OC - 2 kg, Triamon - 3 kg .
3. Since the multivariate regression models for $F'_R < F_T$ soft wool sheared in the autumn season were dead , the hypothesis that the model obtained under the effect of the output parameter is significant, was not rejected.
4. Softened sheep wool polyester Mixing with - for durable, wash-resistant and economical products, acrylic Blending with cotton was considered preferable for soft and inexpensive products, and blending with cotton was considered preferable for the production of hygienic and skin-friendly, high-quality products.
5. Dyeing wool and polyester fibers is difficult, but they have mechanical strength and aesthetic appearance. Dyeing wool and acrylic is not difficult, the resulting product

is soft and inexpensive. Although it is more difficult to mix wool with cotton, the product made from it is hygienic and natural.

shorn in the fall, an economic benefit of 8 million soums can be achieved due to increased efficiency and improved product quality. This will allow the softened wool shorn in the local fall to be sold at competitive prices in the market.

The research demonstrated that blending softened sheep wool with synthetic and natural fibers such as polyester, acrylic (PAN), and cotton provides significant improvements in the technological properties and economic efficiency of textile products. Experimental analysis confirmed that each blend offers specific advantages depending on the fiber ratio. A wool–polyester blend produced durable, wash-resistant, and cost-effective fabrics, where 70% wool + 30% polyester ensured heat retention and strength, while 30% wool + 70% polyester resulted in lighter, economical fabrics with high processing resistance. Wool–acrylic blends delivered excellent softness and insulation at lower cost, though pilling tendency and possible allergenic effects require consideration. A 50/50 composition yielded washable, durable textiles, while higher acrylic content enhanced softness and affordability. Wool–cotton blends provided superior breathability, hygroscopicity, and skin comfort, making them ideal for hygienic, high-quality products; however, they are relatively more expensive. Dyeing analysis revealed that wool–polyester blends require two-stage processing due to their differing chemical natures, making coloration more complex but aesthetically attractive. Wool–acrylic blends are comparatively easier to dye, producing soft and inexpensive outcomes, while wool–cotton blends can be dyed in a single step using acid–reactive combinations, yielding natural, hygienic fabrics. From an economic perspective, softening wool significantly increased processing efficiency and product quality. Calculations showed that processing one ton of softened wool in Bukhara increased fiber yield from 600 kg to 750 kg, generating an additional profit of about 8 million UZS. Furthermore, optimal machine parameters (800 rpm cleaning drum speed, 1500 rpm fan speed, and specific emulsion composition) improved fiber diameter, strength, elasticity, and elongation at break.

In conclusion, blending softened wool with polyester, acrylic, or cotton enables the production of high-quality, energy-efficient, and market-competitive textiles. These findings demonstrate practical solutions for modernizing the Uzbek textile industry and enhancing global competitiveness.

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