

“Development of high-quality yarns from wool–acrylic and wool–polyester blends for the Textile Industry”

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Annotation *The modernization of Uzbekistan's textile sector requires comprehensive analysis of blended yarn quality and performance. This research focuses on the structural and mechanical characterization of yarns produced from local Karakul wool blended with polyester and acrylic fibers. Advanced laboratory instruments, including Uster Tester-5, Statimat-C, and SEM imaging, were employed to evaluate tensile strength, elongation, evenness, and surface morphology. The results demonstrated that wool-polyester blends possess superior durability, while wool-acrylic yarns exhibit greater softness and warmth retention. By applying systematic testing and comparative evaluation, this study provides critical insights into optimizing yarn properties and ensuring high-quality standards in Uzbekistan's textile industry.*

Keywords *Wool, Karakul sheep, Polyester, Acrylic, Yarn testing, Mechanical properties, Tensile strength, Elongation, Evenness, SEM analysis, Yarn morphology, Fiber structure, Textile quality, Uster Tester, Statimat-C, Durability, Softness, Blended yarns, Uzbekistan, Structural analysis, Performance evaluation.*

The present research highlights the importance of developing high-quality yarns from wool–acrylic and wool–polyester blends for advancing Uzbekistan's textile industry. Local Karakul sheep wool, although abundant and unique in its thermal and elastic properties, has long remained underutilized due to its coarseness and low spinnability. By blending it with synthetic fibers such as acrylic and polyester, many of these limitations can be overcome, resulting in yarns that combine the advantages of both natural and synthetic components. The findings of this study confirm that wool–acrylic blends provide superior softness, elasticity, and warmth retention, making them highly suitable for winter clothing and fashion textiles. On the other hand, wool–polyester blends demonstrate enhanced durability, abrasion resistance, and dimensional stability, making them favorable for industrial and technical fabrics. Such diversity of application areas highlights the flexibility and commercial potential of blended yarn production. Moreover, modern spinning techniques and fiber treatment methods, including emulsification, have proven effective in improving the compatibility of wool with synthetic fibers.

In this case, the wool fiber is less damaged during mechanical processing by **cleaning** and **softening**, while the synthetic fiber increases the strength and elasticity of the yarn. Thus, **50% wool + 50% acrylic** and **40% wool + 60% polyester** blends can be used to produce threads for various purposes.

In the stages of raw material preparation, the average length of the cleaned and softened wool fibers is determined first, accordingly, acrylic fiber (PAN - polyacrylonitrile) and polyester fiber (PET - polyethylene terephthalate) are cut into uniform sections, 38–51 mm long, and an emulsion is prepared according to the recipe given in Tables 2.1-2.2, each fiber is sprayed with the emulsion layer by layer, allowed to rest for 24 hours, and dried while maintaining 10% moisture. Then, the first composition of 50% karakul wool + 50% acrylic fibers and the second composition of 40% karakul wool + 60% polyester fibers are separately subjected to the mixture preparation - cleaning process and uniform distribution is ensured in the mixing machine.

Mixture fibers **to comb the hair to the car** is transmitted. At this stage threads spread, parallel to the situation is brought, 4 of the results remainder part is thrown out, first wick harvest will be. Additional combing is used to mix and make the fibers uniform. The 4 rovings are combined and aligned to create a uniform mass and unidirectional fiber flow and to increase the parallelism of the fibers in the direction. The rovings are turned into rovings with a slight twist in **the roving machine**. The roving is an intermediate product ready to be spun into yarn. A ring spinning machine or a pneumatic spinning **machine is used** to spin yarn can be applied.

Ring spinning - for thin, strong and soft yarns, **Rotor spinning** - faster, cheaper and more consumer-friendly yarns are obtained. In a 50% wool + 50% acrylic blend, the yarn thickness (tex) and twist coefficient (α) are selected close to natural fibers. In a **40% wool + 60% polyester** blend, the twist is less due to the high polyester content, but the strength is higher and **The properties of a 50% wool + 50% acrylic blend yarn** are high in softness, because acrylic fiber is a fiber similar in nature to wool, has good **heat retention**, high **color acceptance** (acrylic does not bleed when dyed), and the yarn structure is voluminous and breathable. **40% wool + 60% polyester blend yarn has high strength and durability**, due to the polyester content, it has the ability **to shrink as a result of wetting**, heat preservation is provided by the contribution of wool, it does not lose its shape in the long term.

Wool, polyester and acrylic blended yarns.

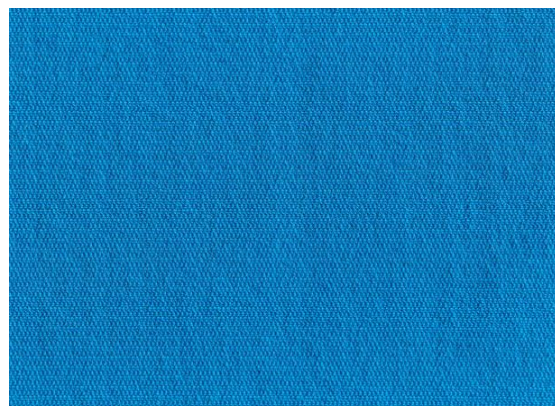
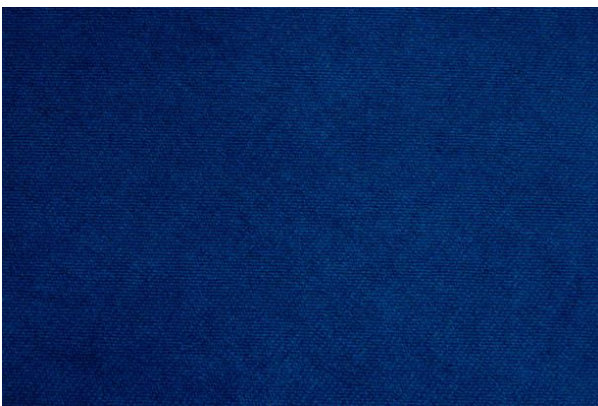
Picture.1-1.1



Suit

fabric woven from a blend of 50% wool and 50% acrylic yarns.

Picture.2-2.1



In
this

technology, cleaned, softened karakul wool fiber is mixed with synthetic fibers in an optimal percentage to obtain high-quality yarn. While a wool-acrylic blend is suitable for soft and warm products (pullovers, scarves, children's clothing), a wool-polyester blend is recommended for durable and shape-retaining products (suits, coats, workwear). The technology developed for obtaining yarns with wool-acrylic and wool-polyester blended fibers is presented in Figures 3.-3.1.

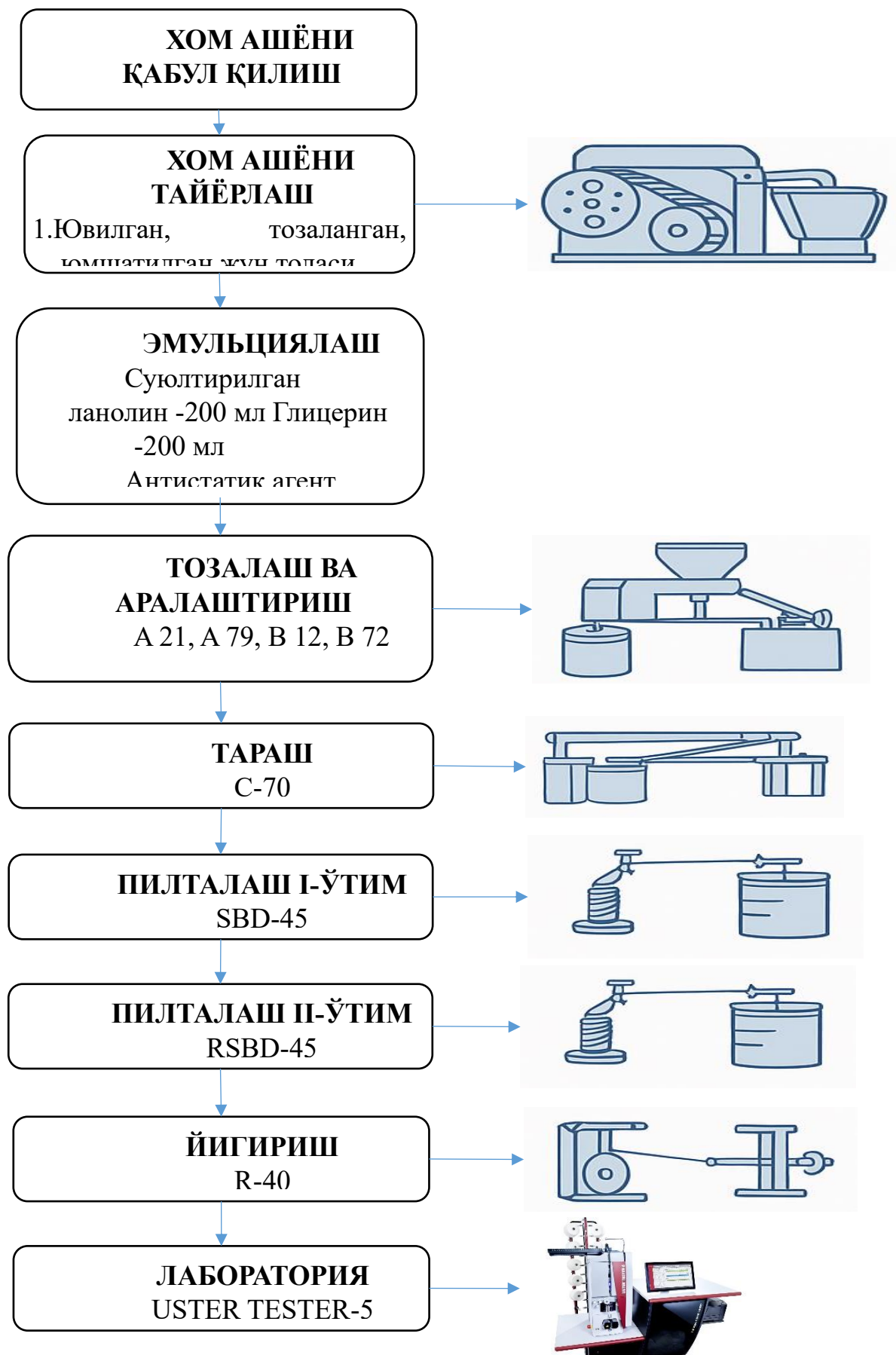


Figure 3. Option 1 technology for producing woolen yarn.

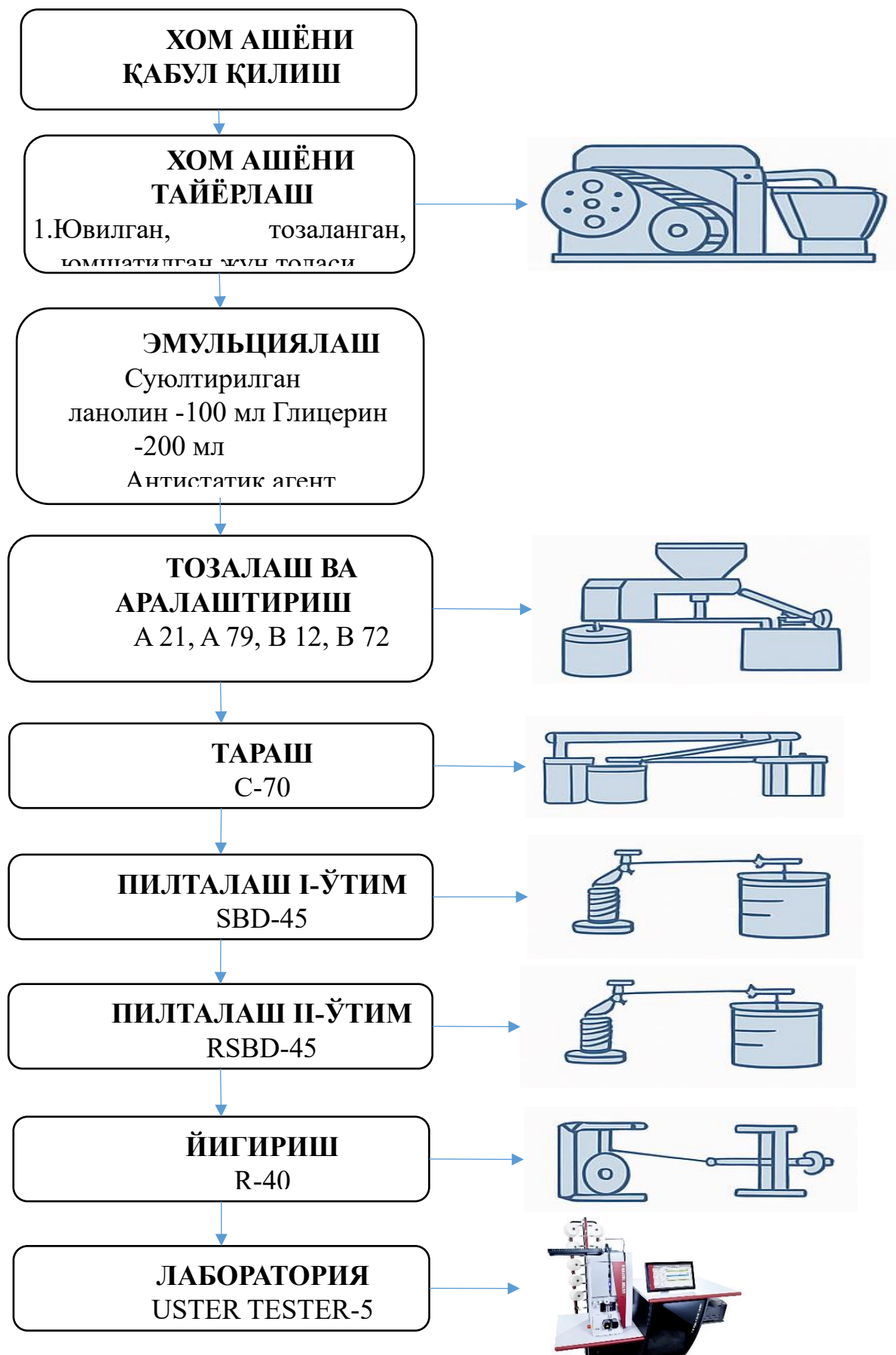


Figure 3.1. Technology for producing wool-acrylic blended yarn for option 2.

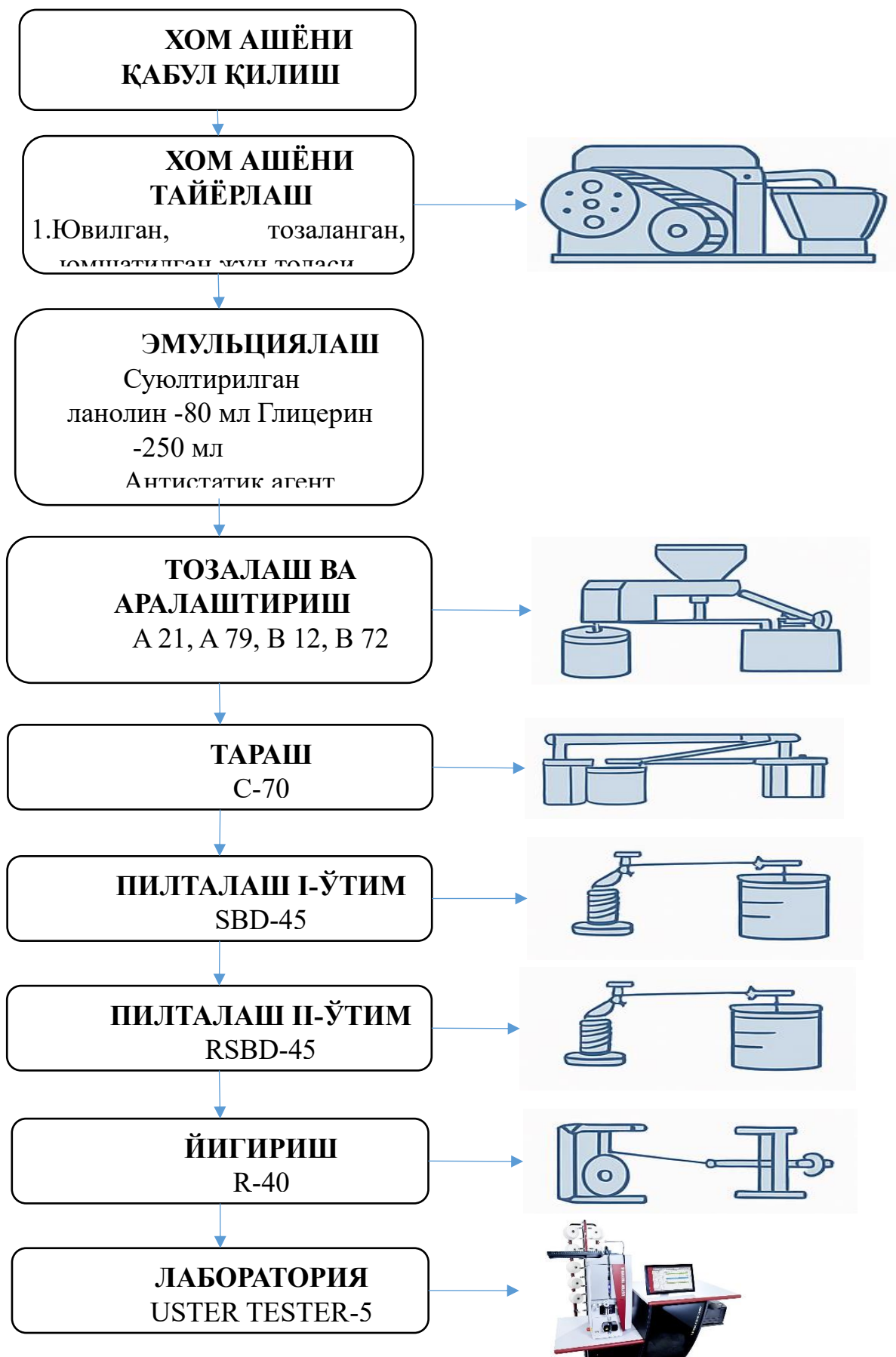


Figure 3.2. Technology for producing wool-polyester blended yarn for option 3.

The strength (tensile strength) and elongation at break of yarns with different compositions obtained on the basis of the developed technology were determined on the "Uster-Tester-5" equipment, the results are presented in Table 1 and Figures 3.1-3.2

Table 1

Changes in the physical and mechanical properties of yarns with different fiber content

Indicator name	100% wool	50% wool+ 50% acrylic	40% wool+ 60% polyester
	Option 1	Option 2	Option 3
Tensile strength, sN	378.25	481.6	506.8
Coefficient of variation in tensile strength, %	12.75	11.14	9.34
Elongation at break, %	17.13	17.21	18.82
Coefficient of variation in elongation at break, %	12.4	15.39	12.68
Relative breaking strength, sN/tex	8.2	9.5	10.1
Coefficient of variation in relative breaking strength, %	12.75	11.75	9.34

Brought table information of wool yarn break strength, breaking strength elongation level and their one such as flatness (coefficient of variation) . basic mechanical properties to study the results illuminating gives These indicators fabric work to release technological processes , in particular weaving in mechanical effects of the material endurance and processing to give characteristic determination for important to the point owner .

The highest breaking strength (506.8 sN) from 40% wool and 60% polyester note in the 3rd option The lowest indicator and (378.25 sN) 100% wool silk correct will come This is the following explained by facts : polyester synthetic fiber high to patience owner is the mechanical strength of the wool yarn noticeable to the extent increases . Acrylic too to strength contribution in addition to polyester relatively to him/her relatively little lower Q is funny aspect , synthetic fiber threads only their own high strength without adding stability both they increase . of the coefficient of variation decrease (12.75% → 9.34%) of results of the spread decreasing and thread of the quality improved , that is of silk all in part one flat high to strength owner that it is shows .

Overall, the research underscores the strategic role of wool-based blended yarns in diversifying Uzbekistan's textile exports, reducing dependency on imported fibers, and increasing the added value of local raw materials. By integrating scientific approaches with industrial practices, the country has the potential to create globally competitive products while fostering sustainable use of its natural resources. Future studies may focus on expanding the range of synthetic blends, exploring eco-friendly finishing technologies, and applying advanced testing methods to further optimize yarn performance.

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