MODELING THE PRINCIPLES GOVERNING THE FORMATION OF COMPOSITION, STRUCTURE, AND PROPERTIES OF FIRE-RESISTANT FABRICS WITH ENHANCED FUNCTIONAL CHARACTERISTICS USING ARTIFICIAL INTELLIGENCE

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Abstract. *This article presents the results of research conducted to improve the quality indicators of suit fabrics. The study demonstrates the enhancement of fabric quality and provides an analytical conclusion based on test results obtained through the evaluation of quality parameters.*

Keywords: *physical-mechanical properties, tensile strength, elongation at break*

In recent years, scientific research in the world has been directed toward developing new scientific and technological solutions for resource-efficient technologies and technical means used in the production of suit fabrics. In this regard, particular attention has been given to producing suit fabrics from locally sourced raw materials, ensuring high production efficiency when using various fiber blends, reducing energy and resource consumption, and obtaining high-quality end products. Special emphasis is placed on designing energy- and resource-efficient machines capable of accomplishing these tasks, as well as justifying their technological processes, parameters, and operating modes.

Within the framework of the study *"Determining and Evaluating the Mechanical Properties of Fabrics with Different Fiber Compositions,"* the mechanical characteristics of fabrics with various fiber compositions were examined. A deformation law for the elongation of such fabrics until rupture was established, and a methodological approach to determining their mechanical quality was developed. Additionally, a mathematical model describing the deformation of fabrics with different compositions under applied force was created.

To describe the tensile deformation process of fabrics with different fiber compositions, the following equation was proposed:

To determine the fabric's tensile strength, a corresponding equation was derived. Using this equation, it becomes possible to identify the value of the tensile force **Fk**, that is, the fabric's strength at the point of rupture. The tensile strength indicators obtained from elongation-to-break tests conducted in both warp and weft directions for fabrics composed of 40% wool and 60% cotton, 40% polyester and 60% cotton, and 40% linen and 60% cotton are presented in Table 1.

Mechanical Properties of Fabric Composed of 40% Acrylic and 60% Bamboo Fibers

Experiment No. — Direction of Tensile Testing	F_k, %	t_k, sek	E_S, sN	F_k, N tajriba	F_k, N nazariya
1 warp yarn	20,895	10,75	43,759	472,38	466,83
2 warp yarn	20,996	9,87	40,0	439,84	446,93
3 warp yarn	31,442	10,11	40,345	457,59	450,98
4 weft yarn	22,673	11,23	16,50	360,94	369,28
5 weft yarn	24,571	12,81	15,61	383,63	381,38
6 weft yarn	28,526	11,48	16,46	390,533	381,13

The tensile force values for various fabrics with different compositions were calculated using the developed equation, and comparative tables of experimental and theoretical results were presented. It was shown that the difference between the theoretical and experimental tensile deformation values of fabrics in both warp and weft directions does not exceed 2.3%.

The obtained theoretical results, equations, and established regularities serve as a methodological basis for determining one of the most important quality characteristics of suit fabrics—their deformation behavior and tensile strength during elongation.

"Research and Analysis of Quality Indicators of Yarns and Fabrics with Different Fiber Compositions"

Figures 1 and 2 present the changes in the quality indicators of yarns with different fiber compositions obtained for suit fabrics.

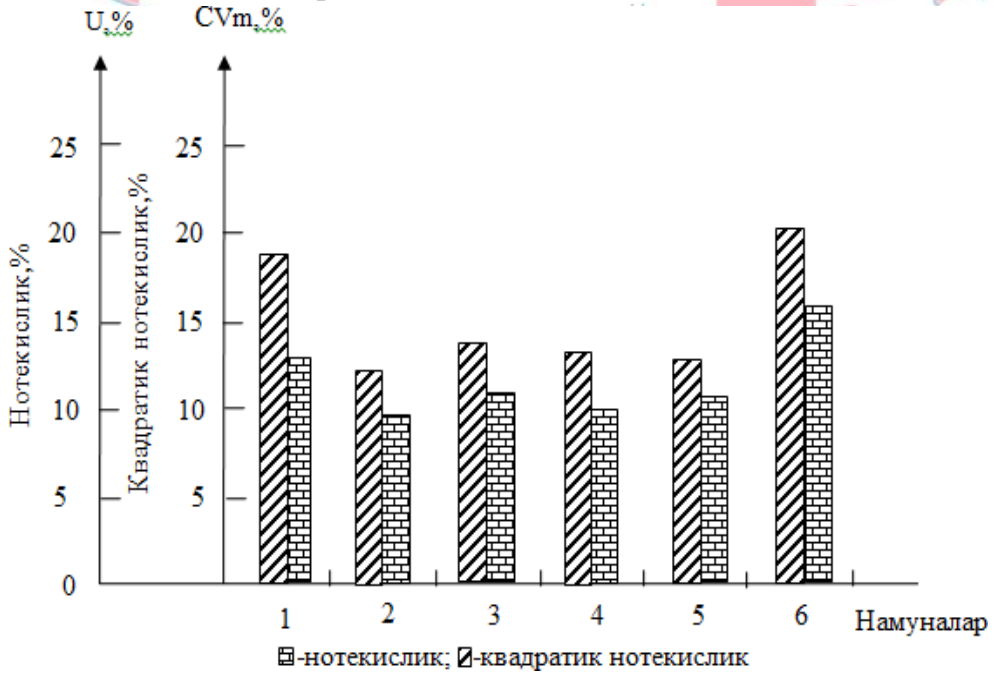
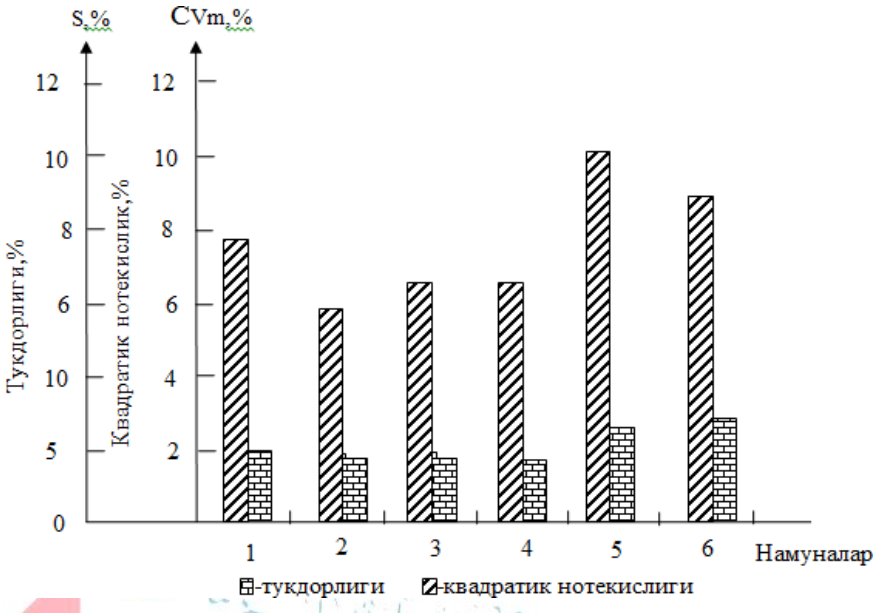


Figure 1. *Changes in nep content and quadratic nep content indicators for yarns with various fiber compositions intended for suit fabrics.*



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The analysis of the obtained results showed that the nep content and variation coefficient of the yarns produced in variants 1 and 6 were higher compared to yarns obtained from other fiber blends.

The physical-mechanical properties of yarns with different fiber compositions, produced at linear densities of 400, 500, and 600 m/tex for suit fabrics, were examined. It was determined that yarns with different fiber compositions exhibited higher quality indicators at 400 m/tex than at 500 and 600 m/tex. Based on the analysis, it was concluded that at subsequent stages of fabric production, yarns of 400 m/tex represent the optimal variant and should be used as weft yarns.

The changes in technological and mechanical properties of suit fabrics composed of various fiber types, along with the test results obtained,

Conclusion

Based on the test results obtained from evaluating the quality indicators of suit fabrics with different fiber compositions, the following conclusions can be drawn:

A review of the literature provided information on the assortment of suit fabrics, the requirements placed upon them, and previous studies investigating the influence of fiber composition on fabric quality. These data were collected and analyzed. The quality indicators of yarns with various fiber compositions intended for suit fabrics were examined. It was determined that yarns produced at 400 m/tex exhibited higher quality indicators compared to those produced at 500 and 600 m/tex.

The analysis demonstrated that, for subsequent stages of fabric production, yarns of 400 m/tex represent the optimal variant and were therefore selected for use as weft yarns. A comprehensive assessment of the physical-mechanical properties of suit

fabrics was conducted. It was found that fabrics produced using 100% cotton in the warp and fiber blends of 40% wool + 60% cotton, 40% polyester + 60% cotton, and 40% linen + 60% cotton in the weft possessed higher surface density compared to fabrics made from other compositions.

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