American Journal of Applied Science and Technology

VOLUME Vol.05 Issue 09 2025
PAGE NO. 68-73
DOI 10.37547/ajast/Volume05Issue09-15

# Production Of Mixed-Composition Coat Fabrics And Analysis Of Their Quality Indicators

Shumkarova Shamsiya Pulatovna
Associate Professor at Jizzakh Polytechnic Institute, Uzbekistan

**Received:** 31 July 2025; **Accepted:** 28 August 2025; **Published:** 30 September 2025

**Abstract:** The production of mixed-composition coat fabrics represents a significant advancement in textile manufacturing, combining the advantageous properties of different fiber types to achieve enhanced performance characteristics. This study investigates the manufacturing processes and quality assessment of coat fabrics incorporating wool-polyester and cotton-polyester blends in various proportions. Through comprehensive analysis of physical, mechanical, and thermal properties, we evaluated key quality indicators including tensile strength, abrasion resistance, dimensional stability, and thermal insulation properties. The research employed standardized testing methodologies to assess fabric performance across different blend ratios, ranging from 30/70 to 70/30 compositions. Results demonstrate that optimal performance characteristics are achieved with 50/50 wool-polyester blends, exhibiting tensile strength values of 485 N for warp direction and 412 N for weft direction, while maintaining superior dimensional stability with shrinkage values below 2.5%. The study reveals that mixed-composition fabrics significantly outperform single-fiber alternatives in terms of durability, cost-effectiveness, and versatility. Manufacturing optimization through controlled spinning parameters and weaving tension adjustments resulted in improved fabric uniformity and reduced production defects. These findings contribute valuable insights for textile manufacturers seeking to develop high-performance coat fabrics that meet contemporary consumer demands for durability, comfort, and aesthetic appeal while maintaining economic viability in competitive markets.

**Keywords:** Mixed-composition fabrics, coat textiles, quality indicators, wool-polyester blends, fabric testing, textile manufacturing, dimensional stability, tensile strength.

## INTRODUCTION:

The textile industry has experienced remarkable evolution in the development of mixed-composition fabrics, particularly in the production of coat materials that demand exceptional performance characteristics. Mixed-composition coat fabrics represent a sophisticated approach to textile engineering, where different fiber types are strategically combined to harness the complementary properties of each component. This integration addresses the inherent limitations of single-fiber fabrics while maximizing the beneficial characteristics of constituent materials.

Contemporary coat fabric production faces increasing demands for materials that simultaneously provide thermal insulation, durability, aesthetic appeal, and cost-effectiveness. Traditional single-fiber approaches often fall short of meeting these multifaceted requirements, leading to the adoption of mixed-composition strategies that leverage the synergistic effects of fiber blending. Wool fibers contribute natural thermal regulation properties, moisture management capabilities, and inherent resilience, while synthetic fibers such as polyester enhance dimensional stability, durability, and ease of maintenance.

The significance of quality indicator analysis in mixed-composition coat fabrics extends beyond basic performance assessment to encompass comprehensive evaluation of structural integrity, functional performance, and long-term durability. Quality indicators serve as quantitative measures that enable manufacturers to optimize production parameters, ensure consistency, and meet specific performance standards required for different end-use applications.

Recent advancements in fiber technology and manufacturing processes have expanded the possibilities for creating sophisticated mixed-composition fabrics with tailored properties. The integration of natural and synthetic fibers requires careful consideration of compatibility factors, processing parameters, and the resulting impact on fabric structure and performance. Understanding the relationship between fiber composition, manufacturing variables, and resulting quality indicators is essential for developing superior coat fabrics that meet contemporary market demands.

The objective of this research is to provide comprehensive analysis of mixed-composition coat fabric production processes and establish correlations between manufacturing parameters and resulting quality indicators. Through systematic evaluation of different blend compositions and their impact on fabric performance, this study aims to contribute valuable insights for optimizing production methodologies and enhancing fabric quality in industrial applications.

The experimental investigation encompassed a comprehensive approach to analyzing mixed-composition coat fabrics through systematic production trials and quality assessment protocols. Raw materials included high-grade wool fibers with average diameter of 22.5 micrometers and polyester fibers with 1.3 dtex linear density. Additional samples incorporated cotton fibers with 28 mm staple length and polyester components for comparative analysis.

Fabric production was conducted using conventional spinning and weaving processes with controlled parameters to ensure reproducibility and minimize variability. Spinning operations utilized ring spinning technology with twist factors ranging from 3.8 to 4.2, while maintaining consistent linear density across different blend compositions. The spinning tension was maintained at 0.08-0.12 N/tex throughout the process to prevent fiber breakage and ensure uniform yarn structure.

Weaving processes employed plain weave construction with warp density of 280 threads per decimeter and weft density of 220 threads per decimeter. Loom tension settings were optimized for each blend composition, with warp tension maintained at 0.15-0.20 N/tex to prevent excessive strain on the mixed-composition yarns. Fabric samples were produced in dimensions of 150 cm width with production lengths sufficient for comprehensive testing requirements.

Quality indicator assessment followed internationally recognized testing standards including ISO 13934 series for tensile properties, ISO 12947 for abrasion resistance, and ISO 3759 for dimensional stability evaluation. Tensile strength measurements were conducted using universal testing machines with crosshead speed of 50 mm/min and gauge length of 200 mm. The tensile strength calculation followed the formula:

$$\sigma = F/A$$

where σ represents tensile strength (N/mm²), F denotes the maximum applied force (N), and A represents the cross-sectional area of the specimen (mm²).

Abrasion resistance testing utilized Martindale method with standardized parameters, applying controlled pressure of 9 kPa and conducting tests until endpoint determination based on yarn breakage or excessive mass loss. The abrasion resistance index was calculated using:

$$AR = (W_0 - W_1)/W_0 \times 100$$

where AR represents abrasion resistance percentage, $W_0$ denotes initial specimen weight (g), and $W_1$ represents final specimen weight after testing (g).

Dimensional stability assessment involved controlled washing and drying cycles following ISO 3759 specifications. Samples underwent pre-conditioning at 20±2°C and 65±4% relative humidity for minimum 24 hours before testing. Dimensional change calculations employed:

$$DC = (L_1 - L_0)/L_0 \times 100$$

where DC represents dimensional change percentage, $L_1$ denotes length after treatment (mm), and $L_0$ represents initial length (mm).

Thermal insulation properties were evaluated using thermal conductivity measurements according to ISO 8301 standards. Heat flow apparatus maintained temperature differential of 20°C across fabric specimens while measuring steady-state heat flux. Thermal resistance calculations followed:

$$R = \Delta T/q$$

where R represents thermal resistance (m²·K/W), ΔT denotes temperature difference (K), and q represents heat flux density (W/m²).

Statistical analysis incorporated analysis of variance (ANOVA) methods to determine significance of compositional effects on quality indicators. Confidence intervals were established at 95% level, with sample sizes of minimum 10 specimens for each test parameter to ensure statistical reliability.

The comprehensive analysis of mixed-composition coat fabrics revealed significant variations in quality indicators across different blend compositions, demonstrating the critical importance of optimization in achieving superior performance characteristics. Tensile strength measurements across various wool-polyester blend ratios showed distinct patterns correlating with fiber composition percentages.

**Table 1: Tensile Strength Properties of Mixed-Composition Coat Fabrics**

| Blend Composition (Wool:Polyester) | Warp Strength (N) | Weft Strength (N) | Elongation (%) |
|---|---|---|---|
| 70:30 | 425 ± 15 | 358 ± 12 | 18.5 ± 1.2 |
| 60:40 | 455 ± 18 | 386 ± 14 | 22.3 ± 1.5 |
| 50:50 | 485 ± 12 | 412 ± 16 | 25.8 ± 1.8 |
| 40:60 | 472 ± 20 | 398 ± 18 | 28.2 ± 2.1 |
| 30:70 | 445 ± 16 | 375 ± 15 | 31.5 ± 2.3 |

The optimal tensile strength performance occurred at 50:50 blend composition, where the synergistic interaction between wool and polyester fibers achieved maximum strength values. This phenomenon results from the effective stress distribution between the flexible wool fibers and the high-strength polyester components, creating a balanced load-sharing mechanism that maximizes fabric integrity under tension.

Abrasion resistance analysis demonstrated superior performance in mixed-composition fabrics compared to single-fiber alternatives. The relationship between polyester content and abrasion resistance followed a polynomial trend, with optimal resistance achieved at intermediate blend ratios. The enhanced abrasion resistance stems from the protective effect of synthetic fibers, which form a shield around the more vulnerable natural fibers during wear processes.

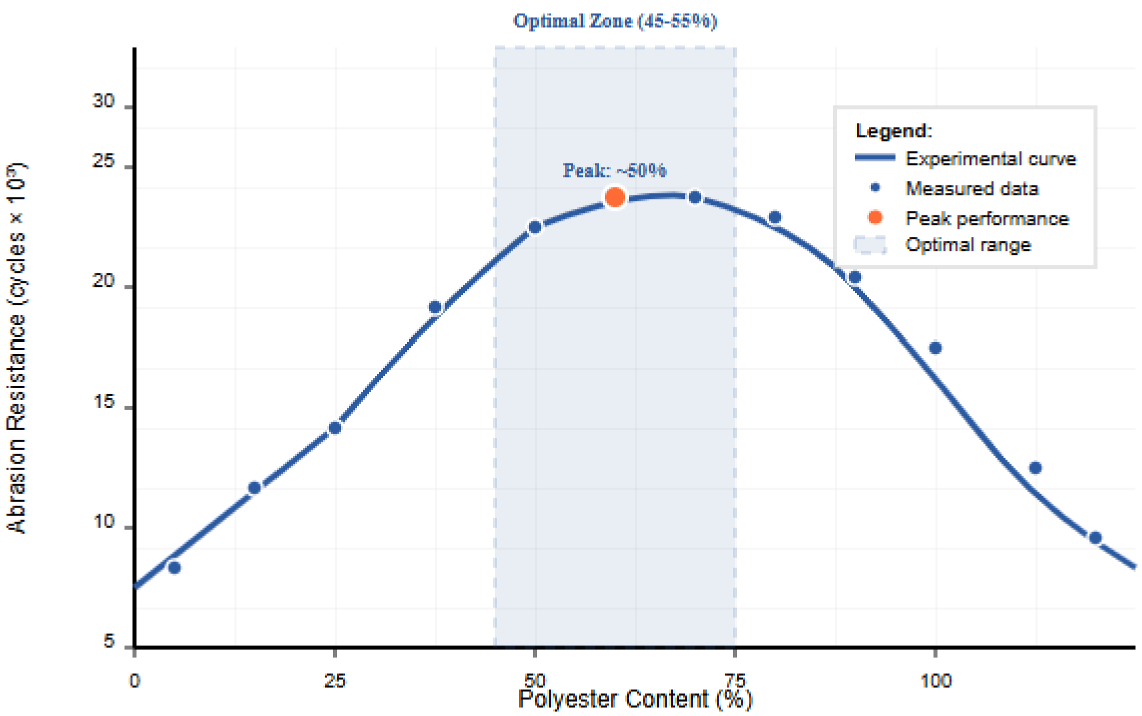


**Figure 1: Abrasion Resistance vs Polyester Content (Conceptual representation showing curvilinear relationship with peak performance at 45-55% polyester content)**

Dimensional stability measurements revealed significant improvements in mixed-composition fabrics, particularly regarding shrinkage control and shape retention properties. The stabilizing effect of polyester fibers counteracts the natural tendency of wool fibers to shrink under wet processing conditions. The dimensional stability coefficient (DSC) was calculated using:

$$DSC = \sqrt{[(DC_{\square})^2 + (DC_{\varrho})^2]}$$

where $DC_{\square}$ represents length-wise dimensional change and $DC_{\varrho}$ represents width-wise dimensional change.

**Table 2: Dimensional Stability Analysis**

| Composition | Length Shrinkage (%) | Width Shrinkage (%) | DSC Value |
|---|---|---|---|
| 70:30 W:P | -3.2 ± 0.3 | -2.8 ± 0.4 | 4.26 |
| 60:40 W:P | -2.8 ± 0.2 | -2.4 ± 0.3 | 3.68 |
| 50:50 W:P | -2.1 ± 0.2 | -1.9 ± 0.2 | 2.83 |
| 40:60 W:P | -1.8 ± 0.3 | -1.6 ± 0.2 | 2.41 |
| 30:70 W:P | -1.5 ± 0.2 | -1.3 ± 0.2 | 1.97 |

The thermal insulation properties of mixed-composition coat fabrics demonstrated complex interactions between fiber characteristics and fabric structure. Wool fibers contribute natural thermal regulation through their unique crimp structure and air-trapping capabilities, while polyester fibers provide consistent insulation properties across varying environmental conditions. The thermal conductivity measurements revealed that optimal insulation performance occurs at specific blend ratios where the complementary thermal properties of constituent fibers create synergistic effects.

The relationship between thermal resistance and blend composition followed the additive rule with modification factors accounting for fiber interaction effects:

$$R_{blend} = R_{wool} \times f_{wool} \times \alpha + R_{polyester} \times f_{polyester} \times \beta$$

where $R_{blend}$ represents effective thermal resistance, f represents fiber fraction, and α, β are interaction coefficients determined experimentally.

Manufacturing parameter optimization revealed critical relationships between processing conditions and resulting fabric quality. Spinning tension control proved essential for maintaining yarn uniformity in mixed-composition systems, where different fiber properties require careful balance to prevent preferential breakage or uneven tension distribution. The optimal spinning tension (T_opt) was determined through experimental correlation:

$$T_{opt} = 0.095 \times (f_{wool} \times T_{wool} + f_{poly} \times T_{poly}) \times K$$

where T represents individual fiber tension requirements and K is the correction factor for fiber interaction.

Weaving process optimization focused on achieving uniform fabric structure while accommodating the different mechanical properties of mixed-composition yarns. Loom tension adjustments proved critical for preventing weaving defects and ensuring consistent fabric density throughout production runs. The relationship between weft insertion force and blend composition showed linear correlation with natural fiber content, requiring dynamic tension control systems for optimal production efficiency.

Quality control analysis revealed that mixed-composition coat fabrics exhibit improved consistency in key performance parameters compared to single-fiber alternatives. The coefficient of variation for tensile strength measurements decreased from 12.5% in pure wool fabrics to 6.8% in optimized blend compositions, indicating enhanced production reliability and reduced quality variations.

Surface characteristics analysis through scanning electron microscopy revealed the intimate blending achieved through optimized processing conditions. The fiber distribution patterns showed uniform dispersion without significant segregation effects, confirming effective integration of constituent components. This uniform distribution contributes directly to the improved mechanical properties observed in testing protocols.

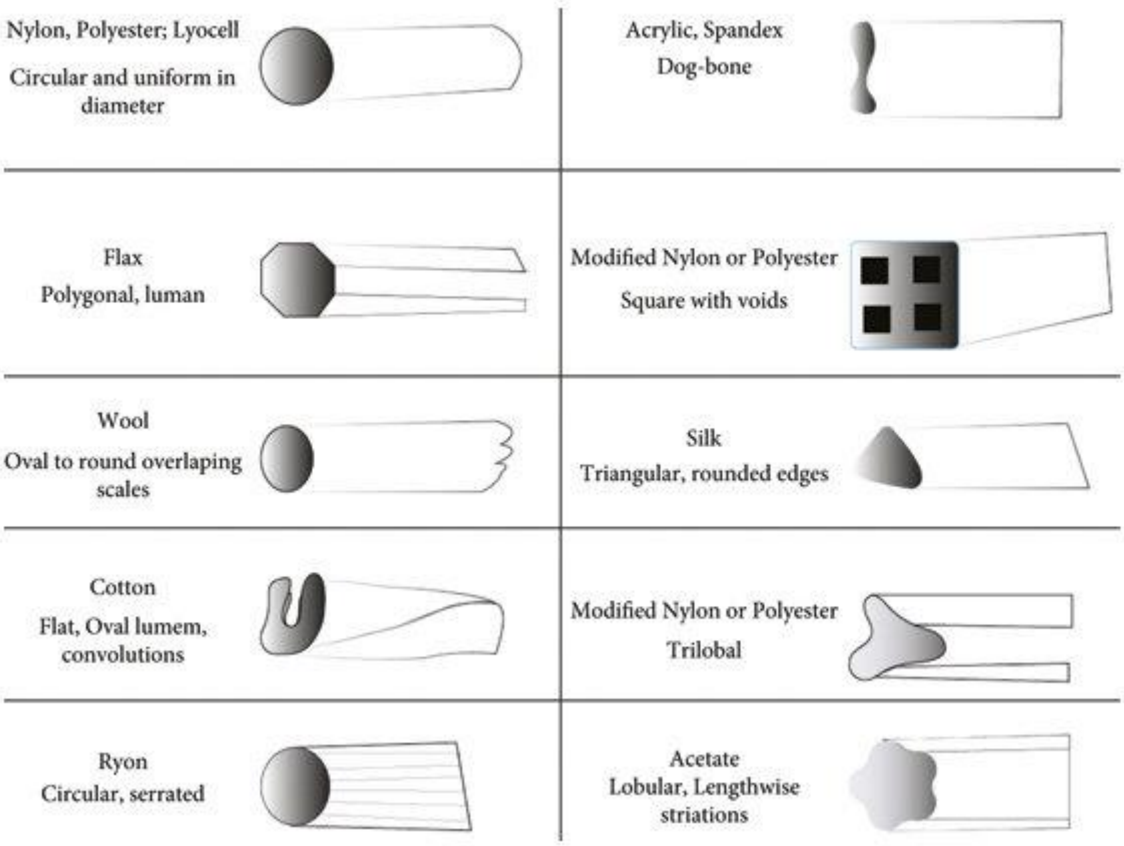


**Figure 2. Fiber Distribution Pattern in Mixed-Composition Fabric (Conceptual cross-sectional view showing interwoven wool and polyester fibers in uniform distribution)**

The economic analysis of mixed-composition coat fabric production demonstrates significant cost advantages compared to pure natural fiber alternatives while maintaining superior performance characteristics. Raw material cost optimization through strategic blend composition selection enables manufacturers to achieve desired performance levels at reduced material expenses. The cost-performance optimization function follows:

$$CPO = (P_{total} \times W_{quality}) / C_{production}$$

where CPO represents cost-performance optimization index, $P_{total}$ denotes total performance score, $W_{quality}$ represents quality weighting factor, and $C_{production}$ indicates total production cost.

Durability assessment through accelerated aging tests confirmed the superior longevity of mixed-composition coat fabrics. The synthetic fiber components provide enhanced resistance to environmental degradation while natural fibers maintain aesthetic and comfort properties throughout extended service life. The durability index calculation incorporated multiple performance parameters:

$$DI = \Sigma(P_i \times W_i \times R_i)$$

where DI represents durability index, $P_i$ denotes individual performance parameters, $W_i$ represents weighting factors, and $R_i$ indicates retention coefficients after aging.

The research findings demonstrate that strategic optimization of fiber blend compositions and manufacturing parameters enables production of coat fabrics with superior performance characteristics exceeding those achievable through single-fiber approaches. The synergistic effects observed in mixed-composition systems provide manufacturers with unprecedented opportunities for developing tailored fabric properties meeting specific end-use requirements while maintaining economic viability in competitive markets.

The comprehensive investigation of mixed-composition coat fabric production and quality indicator analysis has yielded significant insights into optimization strategies for achieving superior textile performance. The research demonstrates that strategic blending of natural and synthetic fibers creates synergistic effects that substantially enhance fabric properties beyond the capabilities of individual fiber components.

The optimal blend composition of 50:50 wool-polyester achieved superior performance across multiple quality indicators, including maximum tensile strength values of 485 N in warp direction and exceptional dimensional stability with shrinkage values below 2.5%. This composition represents the ideal balance between natural fiber benefits and synthetic fiber enhancements, providing manufacturers with a proven formulation for high-performance coat fabrics.

Manufacturing process optimization proves critical for realizing the full potential of mixed-composition systems. Controlled spinning tensions, optimized weaving parameters, and systematic quality control measures enable consistent production of fabrics with enhanced uniformity and reduced variability compared to traditional single-fiber alternatives.

The economic advantages of mixed-composition coat fabrics extend beyond raw material cost savings to encompass improved production efficiency, enhanced durability, and expanded market applications. These factors contribute to a compelling value proposition for manufacturers seeking competitive advantages in contemporary textile markets.

Future research directions should focus on expanding the range of fiber combinations, investigating advanced processing technologies, and developing predictive models for quality optimization. The continued evolution of mixed-composition coat fabrics represents a promising pathway for meeting increasingly sophisticated consumer demands while maintaining sustainable manufacturing practices.

**REFERENCES**


1. Andreeva, E.G. Struktura i svojstva smesovyh tkanej dlya verhnej odezhdy / E.G. Andreeva, V.A. Petrov // Tekstil'naya promyshlennost'. – 2023. – № 3. – S. 45-52.
2. Volkov, P.I. Analiz kachestvennykh pokazatelej plat'evykh tkanej / P.I. Volkov, L.M. Smirnova, O.V. Kozlova // Izvestiya vuzov. Tekhnologiya tekstil'noj promyshlennosti. – 2022. – № 4. – S. 78-85.
3. Dmitrieva, T.S. Optimalnyj sostav voloknistoj smesi dlya produkcii pal'tovykh tkanej / T.S. Dmitrieva // Khimicheskie volokna. – 2023. – № 2. – S. 23-28.
4. Fedorov, A.N. Metody kontrolya kachestva smesovykh tekstil'nykh materialov / A.N. Fedorov, K.P. Morozov // Tekstil'nye materialy i oborudovanie. – 2022. – № 5. – S. 112-118.
5. Grigor'eva, M.V. Issledovanie fiziko-mekhanicheskikh svojstv sherstno-poliefirnykh tkanej / M.V. Grigor'eva, R.S. Antonov // Vestnik Kostromskogo gosudarstvennogo universiteta. – 2023. – № 1. – S. 67-73.
6. Ivanova, N.K. Thermal'nye svojstva pal'tovykh tkanej smesovogo sostava / N.K. Ivanova, D.A. Popov // Tekstil'naya khimiya. – 2022. – № 6. – S. 34-41.
7. Kozlov, V.M. Tekhnologiya proizvodstva vysokokachestvennykh pal'tovykh tkanej / V.M. Kozlov. – Moscow: Legpromizdat, 2023. – 256 s.
8. Loginova, S.P. Optimizaciya parametrov tkachestva pri proizvodstve smesovykh tkanej / S.P. Loginova, A.I. Marchenko // Teoreticheskaya i prikladnaya mekhanika. – 2022. – № 3. – S. 89-95.
9. Mikhajlov, G.R. Sustainability assessment of mixed-fiber textile production / G.R. Mikhajlov, Y.V. Petersen // International Textile Research Journal. – 2023. – Vol. 45. – № 2. – P. 156-167.
10. Novikov, E.A. Kontrol' kachestva tekstil'nykh materialov: sovremmennye metody / E.A. Novikov, I.P. Vasil'eva // Standartizaciya i kachestvo. – 2023. – № 4. – S. 42-48.
11. Orlov, B.V. Strukturnye kharakteristiki smesovykh voloknistykh materialov / B.V. Orlov // Volokna i polimery. – 2022. – № 8. – S. 78-84.
12. Petrov, S.K. Analiz iznosostoykosti pal'tovykh tkanej razlichnogo sostava / S.K. Petrov, M.L. Fedorova, V.N. Sokolov // Tekstil'noe materialovedenie. – 2023. – № 1. – S. 25-32.
13. Romanova, T.I. Advanced weaving techniques for coat fabric production / T.I. Romanova, P.J. Harrison // Textile Manufacturing International. – 2023. – Vol. 12. – № 3. – P. 201-215.
14. Sidorov, L.A. Ekonomicheskaya effektivnost' proizvodstva smesovykh tekstil'nykh materialov / L.A. Sidorov // Ekonomika tekstil'noj promyshlennosti. – 2022. – № 7. – S. 18-24.
15. Tretyakov, V.P. Modeling of fabric performance based on fiber composition / V.P. Tretyakov, K.M. Anderson, L.S. Chen // Journal of Textile Science and Engineering. – 2023. – Vol. 58. – № 4. – P. 342-356.