

**COTTON–POLYESTER BLENDED YARN PRODUCTION:
MODERN TECHNOLOGIES AND FUTURE PROSPECTS**

*To‘ychiyev I.I. Senior Researcher, Scientific research institute of natural
fibers of Uzbekistan (SRIONFOUz) (+998902303701)*

*Esonzoda R.S. Phd Student, Namangan State University (NamTSU)
(+998902919594, sardoresonzoda9595@gmail.com)*

Abstract: *This article highlights the advantages, contemporary trends, and ecological as well as innovative aspects of yarn production based on the blending of cotton and polyester (PES) fibers. The study analyzes the integration of artificial intelligence-based quality control systems, the use of recycled fibers, and prospects for the development of technical textiles. The paper further examines the physical–mechanical properties of blended fibers, the sequence of technological processes, the capabilities of existing machinery, factors influencing product quality, economic efficiency, and pathways for sustainable development.*

Keywords: *Spinning, fibers, blended yarns, hygroscopicity, polyester.*

Introduction

Today, the textile industry stands among the fastest-growing sectors of the global economy. The increasing demands of international markets and consumers’ need for high-quality, affordable, and eco-friendly products have made yarn production from cotton and polyester (PES) blends a highly relevant topic. The introduction of advanced technologies—particularly artificial intelligence (AI)-based control systems and green innovations—plays a crucial role in this process. Developing new technological solutions through the blending of cotton and PES fibers represents an innovative approach in modern textile manufacturing.

1. Technological Advantages of Cotton and PES Fibers

Cotton fibers are known for their natural origin, breathability, and hygroscopic properties, while polyester (PES) fibers are valued for their high strength, elasticity, and quick-drying capability. Their combination leads to:

- Higher-quality yarns: blending enhances elasticity and durability.



- Lower production costs: polyester is comparatively inexpensive and increases manufacturing efficiency.
- Expanded applicability: from everyday fabrics to technical textiles.

In Uzbekistan, where cotton is abundantly available, combining it with imported PES fibers enables the production of high value-added products, thereby increasing export potential, satisfying domestic demand, and boosting industrial competitiveness.

2. Artificial Intelligence and Automated Control Systems

Leading enterprises are increasingly introducing AI-based automated systems for fiber identification and classification in blended yarn production.

These systems:

- Monitor structural stability of yarns;
- Ensure precise blending ratios;
- Significantly reduce the rate of defects.

Uzbekistan's advanced textile companies—such as “Textile Technologies”—have begun implementing such systems on an experimental basis.

3. Green Technologies and Environmental Sustainability

Polyester fibers derived from recycled plastic bottles can be blended with cotton to achieve environmentally sustainable production. This approach:

- Reduces plastic waste;
- Minimizes the carbon footprint of textile manufacturing;
- Enables certification under green standards.

Within Uzbekistan's “Green Economy Transition Strategy,” the development of such eco-friendly technologies has become a national priority.

4. Innovative Products: Technical Textiles

Future applications of cotton–PES blends include the production of specialized technical fabrics with the following properties:

- Antibacterial textiles (for medical applications);
- UV-resistant fabrics (for outdoor apparel and tents);
- Flame-retardant materials (for industrial and protective clothing).



Initial research in this area has been conducted by Bukhara Textile, Indorama, and experimental scientific institutions across Uzbekistan.

5. Physical–Mechanical Properties of Cotton and Polyester Fibers

Cotton is a natural fiber known for its softness, hygroscopicity, and eco-friendliness, yet it may exhibit low tensile strength and shrinkage. Polyester fibers, on the other hand, possess high tensile strength, elasticity, and moisture resistance. They are durable, less prone to tearing, and quick-drying. Scientific studies have identified the following optimal blending ratios:

- 65% cotton / 35% PES: balanced hygroscopicity and strength;
- 50% cotton / 50% PES: suitable for general use;
- 35% cotton / 65% PES: ideal for technical and sports fabrics.

The combination of fibers compensates for individual weaknesses, creating a synergistic effect in mechanical and functional performance.

6. Stages of the Technological Process

6.1. Preparation of Blended Fibers: Cotton and PES fibers are cleaned separately to remove impurities, dust, and short fibers. They are then mixed in precise proportions using automated mixers to achieve uniformity, which directly affects the final yarn quality.

6.2. Carding and Primary Spinning: Blended fibers undergo carding and combing to align them linearly and remove residual particles. This stage produces a roving suitable for subsequent spinning.

6.3. Final Spinning: Modern spinning technologies—such as ring spinning, compact spinning, and open-end spinning—are used. Among these, compact spinning provides the smoothest and strongest yarn. Parameters like yarn diameter, twist count, and density are strictly controlled.

6.4. Quality Control and Winding: Finished yarns are tested in laboratories for tensile strength, moisture resistance, smoothness, and residual fiber content. Only yarns meeting quality standards are wound and sent for further processing.



7. Advantages of Blended Yarns

- Physical Properties: tensile strength increases by up to 20%; elasticity improves; fabric pilling decreases.
- Moisture Management: cotton's hygroscopicity is retained, while polyester enables faster drying.
- Aesthetic and Practical Qualities: fabrics maintain shape, resist wrinkling, and have a smoother surface.
- Economic Efficiency: the relatively low cost of PES reduces overall production costs, enhancing competitiveness.

8. Innovative Approaches and Future Prospects

Modern enterprises increasingly rely on AI-based monitoring systems and eco-friendly polyester derived from recycled materials. The integration of such technologies promotes sustainable and efficient production. Future developments in cotton–PES blended yarns are expected to yield advanced technical textiles featuring antibacterial, UV-resistant, and flame-retardant properties.

Conclusion

Blending cotton and polyester fibers in yarn production represents one of the most promising directions in modern textile technology. This approach not only improves product quality but also:

- Reduces production costs;
- Enhances environmental safety;
- Expands export potential;
- Facilitates the development of innovative textile products.

Through ongoing technological advancement and scientific research, the efficiency and sustainability of cotton–polyester yarn production are set to increase, contributing to the growth of Uzbekistan's textile industry.

REFERENCES

1. Karimov, B. Spinning Technology and Mechanization. Tashkent, 2021.
2. Data from the Uzbekistan Textile and Garment Industry Association.
3. ISO 13934-1: Textiles — Tensile properties of fabrics.



4. Sattarov, J. "Properties of Cotton–Synthetic Fiber Blends." Innovation Journal, 2022.
5. Textile Research Journal, "Blended Yarn Performance: Cotton–Polyester," 2023.