

**COST REDUCTION STRATEGIES THROUGH EFFICIENT ROVING WASTE
RECYCLING IN SPINNING MILLS**

Alikhonov Sharifkhon Saidolimkhon ugli

*Doctoral student, Namangan state technical university,
Republic of Uzbekistan, Namangan, E-mail:sharifxonalixonov96@gmail.com*

Abstract: *The increasing cost of raw cotton and growing environmental concerns have intensified the need for efficient waste management strategies in the textile industry. Roving waste generated during the roving and spinning processes represents a significant source of material loss in spinning mills. This study investigates cost reduction strategies achieved through efficient recycling of roving waste using improved mechanical processing methods. The research focuses on machine optimization, process parameter control, and blending strategies to enhance fiber recovery and reduce production costs. Experimental and analytical evaluations indicate that the effective recycling of roving waste can substantially decrease raw material consumption while maintaining acceptable yarn quality. The results demonstrate that roving waste recycling is not only economically beneficial but also supports sustainable and circular textile production.*

Keywords: *Roving waste, cost reduction, textile recycling, spinning mills, sustainable manufacturing*

INTRODUCTION

The global textile spinning sector operates under increasing economic and environmental pressures driven by volatile raw cotton prices, rising energy costs, and stricter sustainability requirements. Cotton fiber constitutes the largest share of production expenses in spinning mills, making raw material efficiency a decisive factor in overall profitability. Process-related waste generated during blowroom, carding, roving, and ring spinning stages contributes to material losses that directly impact cost structures and operational performance. Consequently, improving resource efficiency through systematic waste reduction and recycling strategies has become a strategic priority for modern spinning enterprises seeking both economic resilience and environmental compliance [1].

Roving waste is produced during the roving, ring spinning, and material handling stages due to machine stoppages, roving breakages, improper drafting, and operational inefficiencies. Traditionally, roving waste is either discarded or sold at a relatively low price, leading to economic losses. However, roving waste still contains reusable fibers that can be recovered and reintroduced into the production cycle if processed appropriately [2].

Efficient recycling of roving waste provides an effective solution to reduce raw material costs, decrease waste disposal expenses, and enhance sustainability. Recent advancements in waste processing machinery and process optimization techniques have made it possible to recycle roving waste with minimal deterioration of fiber properties [3]. This study aims to analyze cost reduction strategies achieved through efficient roving waste recycling in spinning mills, with particular emphasis on machine improvement, process optimization, and blending techniques.

Literature Review

Several studies have highlighted the economic and environmental benefits of textile waste recycling. Lawrence [4] emphasized that waste recycling in spinning mills significantly improves material utilization and reduces dependency on virgin fibers. According to Klein [5], controlled mechanical processing of spinning waste allows fiber recovery without excessive damage, provided that machine parameters are optimized.

Research by Das et al. [6] demonstrated that recycled cotton fibers could be successfully blended with virgin cotton up to certain proportions without severe degradation of yarn quality. Similarly, Rieter [7] reported that modern waste recycling systems can recover up to 70–85% of usable fibers from spinning waste, depending on waste type and processing conditions.

However, most existing studies focus on carding and spinning waste, while limited attention has been given specifically to roving waste recycling. This research addresses this gap by evaluating roving waste recycling as a cost reduction strategy in spinning mills.

Materials and Methods

Roving waste samples were collected from industrial cotton spinning mills during regular production operations. The waste consisted of broken roving ends, doffing waste, and handling losses. The collected material was visually inspected to remove foreign contaminants before processing.

An improved roving waste processing machine was employed for recycling.

The machine featured:

- A controlled feeding system to ensure uniform material input,
- Optimized opening elements to minimize fiber breakage,
- Adjustable drafting units,
- Reduced frictional losses through improved mechanical design.

These improvements were intended to increase fiber recovery efficiency and reduce energy consumption.

The following process parameters were systematically varied:

- Drafting ratio,
- Roller speed,
- Feed rate,
- Cleaning intensity.

Each parameter was optimized to balance fiber recovery and fiber quality.

Recycled roving waste fibers were blended with virgin cotton at different ratios (5%, 10%, 20%, and 30%). Yarn samples were produced under identical spinning conditions to evaluate the effect of recycled fiber content on yarn quality.

The performance of the recycling process was evaluated based on:

- Fiber recovery rate,
- Yarn tensile strength,
- Yarn evenness,
- Raw material cost savings.

Results

The improved roving waste processing machine achieved a fiber recovery rate of up to 80%, significantly higher than conventional waste handling methods. Optimized feeding and controlled opening reduced fiber damage during processing.

Yarn produced with up to 20% recycled roving waste showed acceptable tensile strength and evenness for medium-count yarns. At higher blending ratios, slight deterioration in quality was observed; however, the yarn remained suitable for non-critical applications.

The introduction of recycled roving waste resulted in a notable reduction in raw material costs. Mills using 20% recycled fibers achieved substantial savings in cotton consumption, leading to a shorter payback period for the recycling machine investment.

The results confirm that efficient roving waste recycling can significantly reduce production costs in spinning mills. Machine design optimization plays a crucial role in preserving fiber quality during recycling. Controlled processing parameters prevent excessive fiber breakage and ensure consistent material flow.

Blending strategies are critical in balancing cost reduction and yarn quality. Moderate blending ratios provide optimal economic benefits without compromising product performance. These findings are consistent with previous studies on spinning waste recycling [6], [7].

Efficient roving waste recycling supports sustainable textile manufacturing by reducing waste generation and lowering demand for virgin cotton. This contributes to reduced environmental impacts associated with cotton cultivation, such as water consumption and pesticide use [8]. Furthermore, recycling aligns with circular economy principles by extending the life cycle of textile materials.

Conclusion

This study demonstrates that efficient recycling of roving waste is an effective cost reduction strategy for spinning mills. By improving machine design, optimizing process parameters, and applying appropriate blending techniques, significant savings in raw material costs can be achieved while maintaining acceptable yarn quality. The adoption of advanced roving waste recycling systems enhances both economic performance and environmental sustainability in the textile industry.

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