UTILIZATION OF RAW MATERIALS THROUGH RECYCLING OF ROVING WASTE

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Annotation: This article discusses the effective utilization of raw materials in the textile industry through the recycling of roving waste generated during the spinning process. Roving waste, often produced during the preparation of yarn in roving frames, has traditionally been discarded or used for low-value purposes. However, modern sustainable approaches highlight the potential to reuse and recycle this waste to produce quality yarns, nonwoven fabrics, or other textile products. The research focuses on methods of collecting, cleaning, and processing roving waste to reintroduce it into the production cycle, thereby reducing raw material consumption, production costs, and environmental pollution.

Keywords: Roving waste, recycling, cotton, raw material utilization, sustainability, circular economy, textile industry.

Аннотация: В данной статье рассматривается эффективное использование сырья в текстильной промышленности посредством переработки отходов ровницы, образующихся в процессе прядения. Отходы ровницы, часто образующиеся при изготовлении пряжи на ровничных машинах, традиционно выбрасывались или использовались в малоценных целях. Однако современные подходы к устойчивому развитию открывают потенциал повторного использования и переработки этих отходов для производства качественной пряжи, нетканых материалов и других текстильных изделий. Исследование сосредоточено на методах сбора, очистки и переработки отходов ровницы для их повторного вовлечения в производственный цикл, что позволяет снизить расход сырья, производственные затраты и загрязнение окружающей среды.

Ключевые слова: отходы ровницы, переработка, хлопок, использование сырья, устойчивое развитие, экономика замкнутого цикла, текстильная промышленность.

Annotatsiya: Ushbu maqolada yigirish jarayonida hosil bo‘lgan pilik chiqindilarni qayta ishlash orqali to‘qimachilik sanoatida xom ashyodan samarali foydalanish muhokama qilinadi. Ko‘pincha pilik chiqindisi halqali yigiruvda ip tayyorlash jarayonida hosil bo‘lgan pilik chiqindilari an’anaviy ravishda tashlab yuborilgan

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yoki arzon maqsadlarda ishlatilgan. Biroq, zamonaviy barqaror yondashuvlar ushbu chiqindilarni sifatli iplar, to‘qilmagan matolar yoki boshqa to‘qimachilik mahsulotlarini ishlab chiqarish uchun qayta ishlatish va qayta ishlash imkoniyatini yaratmoqda. Tadqiqot pilik chiqindilarni yig‘ish, tozalash va qayta ishlash usullariga qaratilgan bo‘lib, ularni ishlab chiqarish sikliga qayta kiritish, shu bilan xom ashyo iste’molini, ishlab chiqarish xarajatlarini va atrof-muhit ifloslanishini kamaytirishga qaratilgan.

Kalit so‘zlar: Pilik chiqindilari, qayta ishlash, paxta, xom ashyodan foydalanish, chidamlilik, aylanma iqtisodiyot, to‘qimachilik sanoati.

Introduction

Today, textile enterprises generate a lot of waste. Therefore, their recycling is one of the urgent problems facing the enterprise. In view of this, sustainability and resource utilization have become key priorities in the modern textile industry.

In the modern textile industry, sustainability and resource efficiency have become key priorities. With the growing global demand for cotton-based products, the industry faces challenges related to raw material costs, waste generation, and environmental impact. One of the significant waste types generated during spinning is roving waste, also known as pilik waste, which arises during the conversion of slivers into rovings in the roving frame machine.

Roving waste accounts for approximately 2–5% of the total fiber loss in a spinning mill [1]. In many cases, this waste is discarded or used for cleaning purposes, which leads to a loss of valuable cotton fibers. Considering that cotton is one of the most resource-intensive crops, its optimal utilization is crucial for sustainable production. Recycling roving waste allows manufacturers to minimize losses, improve fiber yield, and contribute to the circular economy.



Figure1. Cotton roving waste

Roving waste is a semi-twisted strand of fibers produced during the intermediate stage between carded or combed sliver and yarn. It consists of fibers

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that have already been processed through several cleaning and drafting stages, meaning it retains good quality and spinnability [2].

The main sources of roving waste include:

- **Machine end breaks:** When the roving breaks during winding or doffing.
- **Piecing waste:** Fiber strands used during machine threading or repair.
- **Sliver-to-roving transfer losses:** Small pieces that accumulate at the start or end of a bobbin.
- **Roving frame cleaning:** Waste generated during routine machine cleaning operations [3]

METHODOLOGY

In order to achieve high-quality recycling of roving waste, a detailed technological workflow must be followed. The process begins with waste classification, where roving waste is separated based on fiber origin, cleanliness. Proper classification ensures that the recycled fibers can be used for specific end products without major contamination issues. After classification, mechanical opening machines are employed to loosen compacted fibers. The opened fibers are then passed through a fine cleaning system equipped with micro-dust extractors to remove short fibers and impurities.

Subsequently, blending plays a vital role in improving the uniformity of the recycled fiber mass. In most textile mills, a 70:30 or 80:20 blending ratio of virgin cotton to roving waste is considered optimal for maintaining yarn quality. The blended fiber is then carded and drafted to align the fibers parallelly before spinning. Advanced open-end spinning technology has proven particularly efficient in processing recycled fibers because it tolerates shorter fiber lengths and provides better yarn regularity.

Moreover, recent innovations such as air-jet and compact spinning systems have enabled further utilization of recycled cotton fibers by minimizing neps and unevenness. In addition, the application of enzyme-based treatments helps soften the recycled fibers, improving their spinnability and final fabric handle. The use of optical fiber sensors in the production line allows real-time monitoring of fiber parameters, which helps maintain consistency in recycled yarn quality. These technological interventions mark a significant step towards automation and smart recycling in the textile industry [4].

Mechanical recycling involves opening, cleaning, and recarding the roving waste to regenerate usable fibers. The process includes opening, cleaning, blending, and re-spinning. This method is cost-effective and suitable for mills equipped with open-end or ring-spinning systems [5].

In chemical recycling, cellulose from roving waste is dissolved to produce regenerated fibers such as viscose or lyocell. Although more expensive, this

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method is advantageous for producing high-quality fibers with uniform properties [6].

For nonwoven applications, roving waste can be directly used without complete fiber regeneration. It can be processed into wadding, padding, insulation materials, or cleaning mops [7].

Recycling roving waste leads to significant cost savings by reducing the need for virgin cotton. The regenerated fibers can replace 10–15% of the raw material without compromising yarn quality [8].

By minimizing cotton waste, recycling reduces the environmental footprint associated with cotton cultivation — such as water usage, pesticide consumption, and carbon emissions. It aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 12: Responsible Consumption and Production [9].

Efficient waste management enhances the image of textile industries as environmentally responsible entities. It also creates new opportunities for waste-based product innovation and employment in recycling sectors.

DISCUSSION AND RESULTS

Further analysis of recycled yarn properties revealed that introducing 15% roving waste into the fiber blend caused only a 3–5% reduction in tensile strength, which is acceptable for knitted and woven fabric applications. The elongation and uniformity indices were also within the acceptable range defined by ISO textile standards

Economic assessments indicate that the recycling of roving waste results in approximately 8–12% reduction in overall production costs for spinning mills[10]. This cost saving arises mainly from the reduced purchase of virgin cotton and lower waste disposal expenses. In regions where cotton prices are volatile, such as Central Asia, this approach contributes directly to the profitability and stability of the textile industry.

Experimental studies conducted at Namangan State Technical University have also demonstrated that the incorporation of roving waste improves fiber utilization by up to 10%, significantly reducing the waste load entering landfill systems[11]. These findings reinforce the global trend toward adopting circular economy principles in textile production.

Studies conducted in several textile mills have shown that recycled roving waste blended with virgin cotton can produce acceptable yarn for knitting and weaving applications. For example, a 10% addition of roving waste in ring-spun yarn showed no significant loss in tensile strength compared to pure cotton yarn [12].

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Blending ratio of 80:20 (cotton to roving waste) produced yarns with improved evenness and reduced neps. Open-end spinning systems were found to be more suitable for processing recycled fibers due to their tolerance for shorter fibers [13]. The efficient utilization of roving waste reflects the transition of the textile industry toward a circular economy. Instead of treating roving waste as a by-product, it can be transformed into a valuable secondary raw material. However, challenges remain regarding fiber length reduction and quality consistency. Ongoing research focuses on developing automated waste separation and fiber recovery systems that ensure better quality control and minimize human error [14].



Figure2. Cotton roving waste recycling machine.

CONCLUSION

In conclusion, the efficient recycling of roving waste not only provides economic benefits but also serves as an essential pillar of sustainable textile manufacturing. It fosters the reduction of environmental pollution, conserves natural resources, and promotes innovation in material science. In the context of Uzbekistan, where cotton-based textile production represents a major sector of the national economy, the implementation of roving waste recycling systems could lead to remarkable economic and ecological outcomes.

Future research should focus on integrating digital monitoring systems and AI-based sorting technologies to improve the precision and speed of waste classification. Collaboration between academic institutions and industry can further accelerate the adaptation of sustainable technologies. Encouraging policy frameworks and financial incentives will also be critical to motivate small and medium textile enterprises to invest in recycling units.

Ultimately, the successful utilization of roving waste is not merely a technical solution—it represents a paradigm shift toward circular production and responsible consumption. By embracing these strategies, the textile industry can progress toward achieving the Sustainable Development Goals while maintaining competitiveness in the global market.

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The recycling of roving waste plays a vital role in achieving sustainable textile production. It reduces raw material costs, minimizes waste, and contributes to environmental protection. Both mechanical and chemical recycling methods offer potential for different product categories. Future advancements in automation and fiber recovery technologies will further enhance the efficiency of roving waste utilization.

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