



Revolutionizing Sustainability Wearable Socks In A Circular Weaving Method Using Modal Fiber Blended With Lycra Fiber And Recycled Cotton Blended With Lycra Fiber Finishing Of Neem Essence And Salt Coated

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ABSTRACT

The global textile industry is facing increasing pressure to adopt sustainable practices that minimize environmental impact while enhancing product functionality. This study introduces an innovative approach to sustainable sock production by integrating a circular weaving method with neem essence infusion and salt-coated finishing. This novel combination enhances not only the eco-friendliness of the product but also its antimicrobial, odor-resistant, and skin-friendly properties. Unlike conventional sock manufacturing, which generates excessive fabric waste and relies on chemical treatments, the circular weaving method optimizes material utilization by creating seamless, continuous-loop structures. This technique reduces production waste, improves durability, and enhances fabric breathability. By incorporating natural neem essence, the socks gain inherent antibacterial and antifungal properties, reducing the need for synthetic additives that contribute to environmental pollution. Additionally, the salt-coated finishing acts as a natural preservative, further boosting antimicrobial effectiveness while maintaining the fabric's softness and comfort. This research examines the technical feasibility, material efficiency, and sustainability benefits of this combined method. It includes a comparative analysis of durability, moisture absorption, odor resistance, and environmental impact between traditionally manufactured socks and those produced through circular weaving with neem and salt finishing. The study also evaluates consumer acceptance, market potential, and the role of circular economy principles in promoting eco-conscious textile innovations. By integrating biodegradable materials, natural antimicrobial agents, and waste-reducing weaving technology, this approach represents a significant advancement in sustainable fashion. The findings highlight the potential of circular

weaving with neem and salt finishing as a scalable, cost-effective, and environmentally responsible solution for the next generation of functional and sustainable wearables.

KEY WORDS: sustainable, environmental friendly, antimicrobial, odor-resistant, waste-reducing.

OBJECTIVES

- To innovate fabric using circular weaving method
- Processing applied in neem and salt coated finishing
- These are eco-friendly, recyclable and reusable

INTRODUCTION

The textile industry is one of the largest contributors to environmental pollution, with conventional fabric production processes generating significant waste, excessive water consumption, and reliance on synthetic chemicals. In response to the growing demand for sustainable and eco-friendly textiles, the industry is shifting towards innovative solutions that prioritize environmental responsibility without compromising product quality and functionality. This study explores a revolutionary approach to sustainable sock manufacturing by integrating a circular weaving method with advanced fiber blending and natural finishing techniques.

The proposed method utilizes modal fiber blended with Lycra fiber and recycled cotton blended with Lycra fiber, ensuring a balance between comfort, durability, and sustainability. Modal fiber, derived from renewable beechwood, is known for its softness, breathability, and moisture-wicking properties, making it an ideal choice for wearable textiles. Meanwhile, recycled cotton promotes waste reduction by repurposing post-consumer or industrial cotton waste, contributing to a circular economy. The incorporation of Lycra fiber enhances elasticity and shape retention, ensuring a better fit and longer lifespan of the socks.

Beyond sustainable fiber selection, this research introduces a neem essence and salt-coated finishing technique, further elevating the functional benefits of the socks. Neem essence, a natural antimicrobial agent, provides anti-bacterial and anti-fungal properties, reducing the risk of skin infections and odor buildup. The salt-coated finishing enhances durability and serves as an additional natural preservative, minimizing the need for synthetic chemical treatments. Together, these innovations contribute to a healthier, skin-friendly, and more sustainable alternative to traditional sock production.

The circular weaving method plays a critical role in maximizing material efficiency by minimizing fabric waste and ensuring seamless construction, which enhances the overall comfort and durability of the socks. Unlike conventional knitting, which often leads to material off-cuts and increased production waste, circular weaving offers a more sustainable and resource-efficient approach.

This study aims to analyze the technical feasibility, environmental impact, and commercial viability of this novel manufacturing approach. It will evaluate the physical properties of the socks, including durability, breathability, elasticity, and antimicrobial effectiveness, while also assessing the sustainability benefits through lifecycle analysis. Additionally, consumer

acceptance and market potential will be explored to determine the scalability of this innovative method in the fashion and textile industry.

By integrating circular weaving, sustainable fiber blending, and natural finishing techniques, this research presents a holistic and forward-thinking solution for the future of sustainable wearables. The findings will highlight how this approach can contribute to reducing environmental impact, enhancing product longevity, and promoting circular economy principles, ultimately revolutionizing sustainable textile manufacturing.

PROPERTIES

Mechanical Properties

- High Elasticity & Shape Retention.
- Durability & Abrasion Resistance:
- Tensile Strength
- Pilling Resistance

FUNCTIONAL PROPERTIES

- Antimicrobial & Odor Resistance
- Moisture Management
- Sweat & Odor Control
- Salt-Coated Preservation

COMFORT PROPERTIES

- Softness & Skin Friendliness
- Temperature Regulation.
- Seamless Comfort.
- Lightweight Yet Strong:

METHODOLOGY:

1. Material Selection

- Modal Fiber + Lycra Blend: Enhances softness, breathability, and elasticity
- Recycled Cotton + Lycra Blend: Reduces waste and improves sustainability while maintaining durability and stretch.

2. Circular Weaving Process

- Utilizes advanced circular knitting technology for seamless construction.
- Ensures optimal elasticity and shape retention with Lycra integration.
- Reduces fabric waste compared to traditional knitting methods.

3. Finishing Treatment

- Neem Essence Coating: Natural antibacterial and antifungal properties for odor resistance and skin protection.
- Salt Coating: Enhances moisture absorption, provides a cooling effect, and extends fabric longevity.


4. Sustainability & Quality Testing

- Assess durability, stretch recovery, and biodegradability.
- Ensure compliance with eco-friendly textile standards.

TEST REPORT:

- Anti-Microbial test
- PH test

Modal blended lycra :





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ISO/IEC 17025 NABL ACCREDITED VIDE CERTIFICATE NO. TC-6944

Test Report No : M2400613	ULR: TC69442570002829F	Report Date : 12-02-2025
KSR College Of Arts And Science For Women		Ref : Letter Dt.04.02.2025

Test Name : Antibacterial activity-Quantitative -ISO 20743 -2021

Test Condition:

Test Organisms used : *Staphylococcus aureus* ATCC 6538, *Klebsiella pneumoniae* ATCC 4352

Sample size : 0.4 ± 0.05 g

Dilution medium used : SCDLP medium

Media Used : Tryptic soya agar

Method of plating : Pour plate method

Inoculum / plate : 1 mL

Incubation conditions : 37°C for 24 h

Quantitative measurement method : Absorption method

Method of Sterilization : Steam sterilization

Observation :

M2400613-1		
Described by the customer : Fabric: Modal Bleached Lycra		
	Staphylococcus aureus ATCC 6538	Klebsiella pneumoniae ATCC 4352
Test organisms used		
Inoculated bacterial concentration (CFU / mL)	2.6 x 10 ⁵	2.5 x 10 ⁵
Difference of extremes for three control specimens initial (Criteria = Not more than 1.0)	0.01	0.01
Difference of extremes for three control specimens final (Criteria = Not more than 1.0)	0.01	0
Difference of extremes for three antibacterial test specimens initial (Criteria = Not more than 1.0)	0.01	0.02
Difference of extremes for three antibacterial test specimens final (Criteria = Not more than 1.0)	0	0
Growth value (F)	1.04	1.02
Growth value of (G)	-5.02	-5.40
Antibacterial activity value	6.46	6.42

Result : The Test sample showed 6.46 logarithmic antibacterial activity against *Staphylococcus aureus* ATCC 6538 and 6.42 logarithmic antibacterial activity against *Klebsiella pneumoniae* ATCC 4352 when tested under ISO 20743 - Absorption Method.

0 log reduction = 0%

1 log reduction = 90%

2 log reduction = 99%

3 log reduction = 99.9%

4 log reduction = 99.99%

5 log reduction = 99.999%

2/3



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TC-6944

Test Report No : M2400614 ULR: TC694425700002830F Report Date : 12-02-2025
KSR College Of Arts And Science For Women Ref : Letter Dt.04.02.2025

Test Name : Antibacterial activity-Quantitative -ISO 20743 -2021

Test Condition:

Test Organisms used : *Staphylococcus aureus* ATCC 6538, *Klebsiella pneumoniae* ATCC 4352
 Sample size : 0.4 ± 0.05 g
 Dilution medium used : SCDLP medium
 Media Used : Tryptic soya agar
 Method of plating : Pour plate method
 Inoculum / plate : 1 mL
 Incubation conditions : 37°C for 24 h
 Quantitative measurement method : Absorption method
 Method of Sterilization : Steam sterilization

Observation :

M2400614-1		
Described by the customer : Fabric: Recycled Cotton Bleached Lycra		
	Staphylococcus aureus ATCC 6538	Klebsiella pneumoniae ATCC 4352
Test organisms used		
Inoculated bacterial concentration (CFU / mL)	2.6 x 10 ⁵	2.5 x 10 ⁵
Difference of extremes for three control specimens initial (Criteria = Not more than 1.0)	0.01	0.01
Difference of extremes for three control specimens final (Criteria = Not more than 1.0)	0.01	0
Difference of extremes for three antibacterial test specimens initial (Criteria = Not more than 1.0)	0.01	0.02
Difference of extremes for three antibacterial test specimens final (Criteria = Not more than 1.0)	0	0
Growth value (F)	1.04	1.02
Growth value of (G)	-5.42	-5.41
Antibacterial activity value	6.46	6.43

Result : The Test sample showed 6.46 logarithmic antibacterial activity against *Staphylococcus aureus* ATCC 6538 and 6.43 logarithmic antibacterial activity against *Klebsiella pneumoniae* ATCC 4352 when tested under ISO 20743 - Absorption Method.

- 0 log reduction = 0%
- 1 log reduction = 90%
- 2 log reduction = 99%
- 3 log reduction = 99.9%
- 4 log reduction = 99.99%
- 5 log reduction = 99.999%

PH TEST: Modal blended lycra :

KSR College Of Arts And Science For Women Ref : Letter Dt.04.02.2025

pH Values <small>IS 1390:2022</small>	S2400445-1 Modal Blended Lycra
Mean pH Value	6.62
pH of extracting solution	5.67
Temperature of the extracting solution	31.1°C

Standard : IS 1390 : 2022 Test Solution Used : 0.1 M Potassium Chloride Solution.

This is a computer generated report, hence does not require signature.

- End of Report -

Recycled cotton blended lycra:

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pH Values <small>IS 1390:2022</small>	S2400444-1 Recycled Cotton Bleached Lycra
Mean pH Value	6.55
pH of extracting solution	5.67
Temperature of the extracting solution	31.1°C

Standard : IS 1390 : 2022 Test Solution Used : 0.1 M Potassium Chloride Solution.

This is a computer generated report, hence does not require signature.

- End of Report -

CONCULUTION:

The development of sustainable wearable socks using a circular weaving method with modal fiber blended with Lycra, and recycled cotton blended with Lycra, presents a significant advancement in eco-friendly textile innovation. The integration of neem essence and salt coating enhances the functionality of the socks by providing antimicrobial properties and improved durability. This approach not only reduces environmental impact through the use of recycled and biodegradable materials but also ensures comfort, performance, and longevity. By embracing sustainable fiber blends and innovative finishing techniques, this project contributes to the ongoing revolution in sustainable fashion, promoting responsible production and consumption in the textile industry.

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