63rd JOINT TECHNOLOGICAL CONFERENCE

16th & 17th February, 2026

Book of Abstracts

Supported by

वस्त्र मंत्रालय
MINISTRY OF TEXTILES

Hosted by

Ahmedabad Textile Industry's Research Association (ATIRA)

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63rd Joint Technological Conference (63rd JTC- 2026)

First Impression: **February 2026**

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MESSAGE

It is a privilege to share my thoughts on the occasion of the 63rd joint technological conference at ATIRA. As India advances toward becoming a global manufacturing and innovation hub, the Technical Textiles sector stands at the forefront of this transformation.

Technical textiles today are enabling next-generation solutions across infrastructure, healthcare, defence, mobility, agriculture, and environmental sustainability. With rapid advancements in material technologies, digital manufacturing, and sustainable processes, the future of textiles is intelligent, resilient, and globally competitive.

The National Technical Textiles Mission envisions India as a world leader in technical textiles—driven by cutting-edge research, robust domestic manufacturing, skilled human capital, and strong industry-academia collaboration. In this journey, our Research Institutions and Textile Research Associations (TRAs) are playing a pivotal role. Through collaborative research, technology development, product standardization, advanced testing facilities, incubation support, mentoring by top business schools and industry outreach, they are strengthening the innovation ecosystem and accelerating the translation of research into commercially viable solutions. Their collective efforts are critical for the mission.

As India prepares to host and participate in major international sporting events in the coming years, there is a significant opportunity to strategically advance the sports technical textiles segment. High-performance sportswear, protective gear, turf systems, sports composites, smart fabrics, and performance-enhancing materials represent a high-growth and high-value domain. A focused approach—integrating research, design, testing standards, and domestic manufacturing—can enable India to emerge as a preferred global supplier in this specialized segment while supporting our athletes with world-class indigenous products.

Our emphasis must remain on innovation-led growth, integration into global value chains, sustainable and circular production practices, and nurturing a vibrant start-up ecosystem that fosters indigenous technologies and high-value products.

Knowledge platforms such as the JTC serve as catalysts in this transformative journey. I am confident that this edition will stimulate new ideas, deepen collaboration, and further strengthen India's path toward global leadership in technical textiles.

My best wishes to the entire team and contributors for their continued commitment to excellence

Ashok Malhotra
Mission Director, NTTM
Ministry OF textiles Govt. of India

It gives me immense pleasure to welcome you to the 63rd Joint Technological Conference (63rd JTC-2026) at the Ahmedabad Textile Industry's Research Association (ATIRA). This conference is more than an annual gathering; it is a long-standing national forum where ideas are exchanged, collaborations are forged, and directions for the future of India's textile industry are shaped. Hosting JTC at ATIRA reflects our shared belief that when knowledge is guided by purpose and translated into action, it has the power to transform industries and contribute meaningfully to nation-building.

In today's context, textiles are no longer a legacy sector, but a growth engine for employment, exports, and industrial capability. The direction we take now will determine how effectively the sector contributes to India's long-term competitiveness.

Today, the Indian textile sector stands at a defining moment. As one of the country's largest contributors to employment, exports, and inclusive growth, it also carries the responsibility of advancing India's journey toward self-reliance and global leadership. Government initiatives such as the National Technical Textiles Mission (NTTM), PM MITRA Parks, and the Production Linked Incentive (PLI) scheme have laid a strong enabling foundation. The real transformation will come not from scale alone, but from the ability to convert knowledge into deployable technologies, competitive products, and scalable industrial solutions. Platforms like JTC play a crucial role in enabling this convergence by bringing together policymakers, scientists, entrepreneurs, and industry leaders with a shared focus on outcomes.

For decades, ATIRA has remained committed to bridging the gap between science and industry—between ideas and real-world impact. Whether in advanced materials, technical textiles, sustainability, composites, or smart textile solutions, our focus has consistently been on converting research into practical and scalable technologies that strengthen the industrial fabric of the nation. In this sense, JTC aligns closely with ATIRA's mission of supporting industry through relevant research, capability development, and technology translation.

This conference provides a unique platform where startups, industry, academia, and R&D institutions come together to collaborate, innovate, and address real-world industrial challenges. Such synergy is essential to building a resilient and future-ready textile ecosystem. Global leadership in textiles will increasingly be shaped by research capability, skills, and innovation, as much as by manufacturing capacity. Research and development is not a cost; it is a strategic investment in long-term competitiveness and sustainable growth. Through forums such as JTC, India has the opportunity to move beyond manufacturing alone and strengthen its position as a global innovation hub.

I am confident that JTC will stimulate meaningful dialogue, foster purposeful partnerships, and generate technologies that contribute to the next phase of growth for the Indian textile industry. I wish the conference every success and look forward to outcomes that meaningfully support the technological, economic, and sustainable development of our nation.

With best wishes,
Sanjay S. Lalbhai
Chairman
Council of Administration
Ahmedabad Textile Industry's Research Association (ATIRA)
Ahmedabad

Ladies and Gentlemen,
It gives me immense pleasure to extend a warm welcome to all delegates, researchers, industry professionals, academicians, policymakers, and students to the 63rd Joint Technological Conference (JTC) being hosted by the Ahmedabad Textile Industry's Research Association (ATIRA).

The Joint Technological Conference (JTC) is a flagship annual event of India's textile research fraternity and has, over more than six decades, evolved into a nationally recognized platform for showcasing research excellence, technological advancements, and industry-relevant innovations. JTC represents the collective strength of India's textile research associations and has consistently played a pivotal role in bridging the gap between laboratory research and industrial applications, thereby guiding the Indian textile industry towards global competitiveness and technological leadership.

At the outset, I would like to place on record our sincere sense of gratitude to the co-organizers of JTC - BTRA, NITRA, and SITRA - for entrusting ATIRA with the responsibility of hosting the 63rd edition of this prestigious conference. We consider it a privilege and an honour to host this mega event and reaffirm our commitment to upholding the legacy and high standards that JTC represents.
The theme of this year's conference, "*Envisioning a Self-Reliant Textile Ecosystem with Technical Textiles: Pathways to Innovation and Sustainability*," is both timely and significant. Technical textiles are emerging as key enablers of innovation-driven growth, value addition, and sustainability across sectors such as infrastructure, healthcare, defence, mobility, agriculture, and environmental protection. The theme strongly aligns with the national vision of Atmanirbhar Bharat and Viksit Bharat 2047.
The two-day technical programme has been carefully curated to cover a wide spectrum of contemporary and future-oriented topics, including functional fabrics, quality and testing, fibre and process innovation, industrial textiles, sustainability, protective textiles, agro- and geotextiles, along with a panel discussion on the vision for Indian textile industry research. The technical papers presented during the conference reflect focused R&D efforts aimed at delivering practical, scalable, and industry-ready solutions.
ATIRA is proud to host this prestigious conference and provide a common platform for researchers, innovators, industry professionals, and policymakers to exchange ideas, share experiences, and foster meaningful collaborations. We are confident that the deliberations and interactions during the 63rd JTC will contribute significantly towards strengthening India's technical textile ecosystem and accelerating the translation of research outcomes into meaningful industrial and societal impact.
I sincerely thank all participating textile research associations, authors, speakers, session chairs, panelists, sponsors, and members of the organizing committee for their valuable contributions and dedicated efforts in making this conference a success.
I wish all delegates a productive, insightful, and enriching experience at the 63rd Joint Technological Conference.
With warm regards,

Pragnesh Shah
Director
Ahmedabad Textile Industry's Research Association (ATIRA)
Ahmedabad

वस्त्र मंत्रालय
MINISTRY OF
TEXTILES

63rd Joint Technological Conference

Envisioning a self-reliant textile ecosystem: Pathways to innovation and sustainability

PROGRAM STRUCTURE

Time	Day 1: 16th Feb 2026
9:00 – 10:00 AM	Registration
10:00 – 11:30 AM	Ceremonial Inauguration with Lamp Lighting & Saraswati Vandana
	Welcome Address Shri Pragnesh Shah, Director – ATIRA
	Brief on Key Initiatives and Contributions of TRAs Shri Punit Lalbhai, Chairman, ATIRA Council of Administration
	Address by Chief Guest Ms Mamta Verma, Additional Chief Secretary, IAS, Govt of Gujarat
	Vote of Thanks Dr. Prakash Vasudevan, Director, SITRA
11:30 – 12:00 PM	Tea Break and Expo Visit
12:00 – 1:30 PM	Session 1: Functional Fabrics
1:30 – 2:30 PM	Networking Lunch
2:30 – 3:30 PM	Session 2: Fiber and Process Innovation for Technical Textiles
3:30 - 4:30 PM	Panel discussion: Building Future-Ready Textile Businesses: Leadership Perspectives on Sustainability
4:30 – 5:45 PM	Session 3: Sustainability
5:45 PM onwards	High Tea

Time	Day 2: 17 Feb 2026
9:30 - 10:30 AM	Panel Discussion: From Conventional to Technical Textiles: Diversification Strategies, Skills and Market Opportunities
10:30 - 11:00 AM	Tea Break
11:00 - 11:30 AM	Guest Address
11:30 - 1:00 PM	Panel Discussion: Cotton at a Crossroads: Balancing Sustainability, Performance and Global Competitiveness
1:00 – 2:00 PM	Networking Lunch
2:00 - 3:00 PM	Session 4: Protech
3:00 - 4:30 PM	Session 5: Agro and Geotextiles
2:00 - 4:30 PM	Session 6: Parallel Session Conventional Textiles (Cotton quality, Spinning and Processing)
4:30 - 5:00 PM	Valedictory Session and Vote of Thanks
5:00 PM onwards	High Tea

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1. Dr. Kameswara Rao PV

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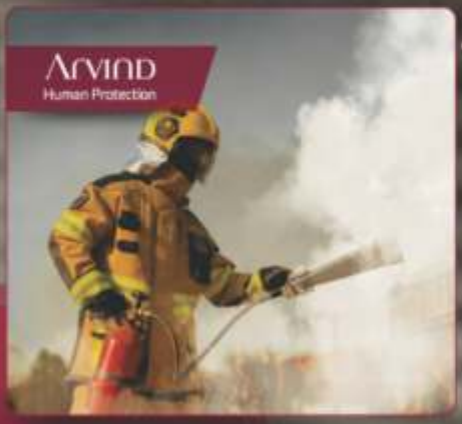

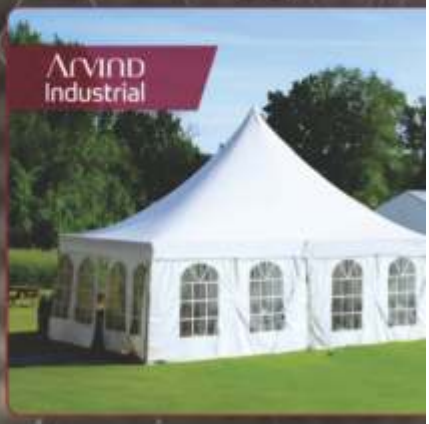

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63rd Joint Technological Conference (JTC)

The Joint Technological Conference has long been regarded as one of the most enduring and respected knowledge-sharing platforms within India's textile and fibre science community. Over the decades, it has evolved into a unique confluence of academia, research institutions, industry leaders, policymakers, technologists, and students, all united by a shared commitment to advancing the textile sector. The significance of JTC lies not merely in its continuity, but in its ability to consistently reflect the changing priorities of the textile ecosystem — from traditional manufacturing excellence to modern concerns of sustainability, innovation, and global competitiveness.

The 63rd JTC, being conducted at ATIRA, carries particular significance due to both its venue and its theme. ATIRA has been a cornerstone institution in India's textile research landscape, known for its contributions to testing, standardization, innovation, and industry support. Hosting the 63rd edition at ATIRA symbolizes continuity with legacy while simultaneously embracing forward-looking research and technology-driven growth. The institution's infrastructure, expertise, and industry linkages make it an ideal setting for discussions that aim to shape the future of the sector.

The theme, “Envisioning a Self-Reliant Textile Ecosystem with Technical Textiles: Pathways to Innovation and Sustainability,” resonates strongly with contemporary national and global priorities. Technical textiles have emerged as a transformative segment with applications in healthcare, infrastructure, mobility, defence, agriculture, environmental protection, and filtration. By centering the conference on self-reliance, the 63rd JTC aligns with the broader national vision of strengthening indigenous capabilities, reducing import dependency, and building resilient supply chains through research-led innovation. At the same time, the emphasis on sustainability highlights the growing responsibility of the textile sector to adopt resource-efficient processes, eco-friendly materials, and circular economy principles.

Textile Research Associations in India

Textile Research Associations (TRAs) in India form an integral part of the institutional framework supporting the growth, modernization, and global competitiveness of the textile and apparel sector. Functioning under the aegis of the Ministry of Textiles, TRAs have been established to provide industry-focused research and development, testing and certification services, standardisation support, technology transfer, and human resource development across the textile value chain.

TRAs operate as interface institutions between industry, academia, and government, enabling the translation of research outcomes into practical and scalable industrial solutions. Their close engagement with industry ensures that technological interventions are aligned with manufacturing requirements, quality benchmarks, regulatory compliance, and evolving domestic and global market needs. Over the years, TRAs have played a critical role in enhancing productivity, improving product quality, promoting process efficiency, and supporting the adoption of new technologies.

TRAs support the sector through applied research, pilot-scale development, performance evaluation, and advisory services. In recent years, their scope has expanded to include technical textiles, advanced fibres, nonwovens, composites, functional textiles, and sustainable processing technologies, in line with emerging national and global priorities.
In alignment with flagship initiatives such as Atmanirbhar Bharat, Make in India, the National Technical Textiles Mission (NTTM), and the Viksit Bharat Vision @2047, TRAs contribute to import substitution, value addition, export competitiveness, and self-reliance. By facilitating validation, benchmarking, and standardisation, they help reduce the risks associated with technology adoption and accelerate industry uptake, particularly among MSMEs.

TRAs also play a significant role in capacity building and skilling through structured training programs, faculty development initiatives, and industry-oriented human resource development.
Collectively, Textile Research Associations continue to support the transformation of India's textile sector towards a technology-driven, sustainable, and globally competitive industry, contributing meaningfully to national economic growth and long-term industrial development.

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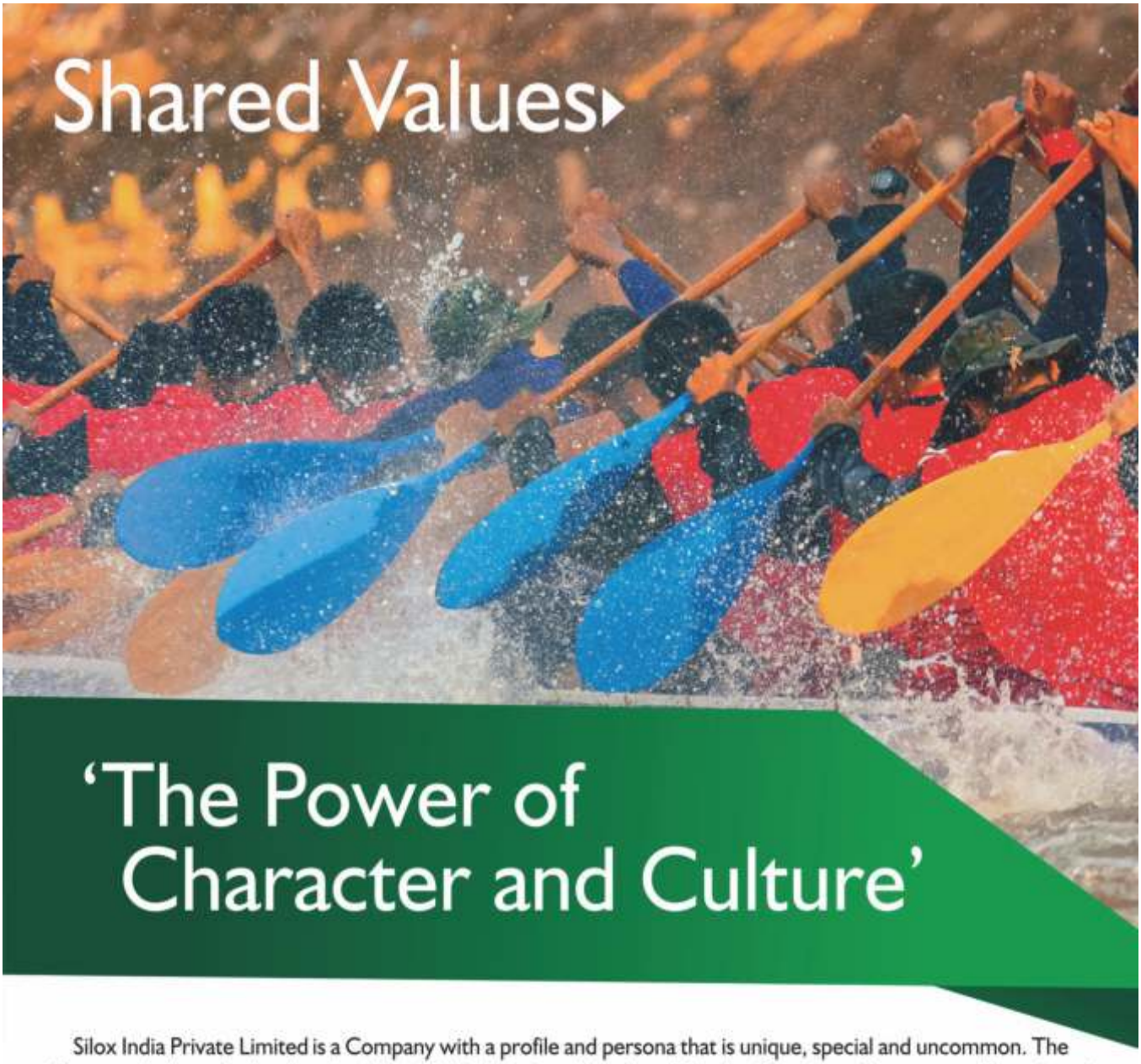

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Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad

Recent Activities Highlights & Achievements

For over 75 years, ATIRA has driven India-born innovations in textiles and allied industries, meeting global benchmarks under the visionary leadership of Dr. Vikram Sarabhai, Shri Kasturbhai Lalbhai, and Shri Shanti Swaroop Bhatnagar. Today, ATIRA stands as a leading independent, non-profit R&D institution, supporting India's transition toward high-value and technical textiles.

Last one year, ATIRA made significant progress on two NTTM-approved development projects focused on HEPA filters using electrospinning and CFRP composite slotted waveguide antennas for space and ground applications. ATIRA strengthened its engagement with the aerospace and defence sectors by developing reflectors and antennas for SAC–ISRO and extending similar collaborative models to Defence PSUs for critical composite components. In the area of sustainable materials, ATIRA developed jute composite prosthetic limbs and eco-composites from textile waste, enabling cost-effective and environmentally responsible solutions. Additionally, hybrid jute composite porta cabins developed by ATIRA demonstrated superior thermal insulation performance during Indian Army field trials conducted above 15,000 ft under extreme cold conditions.

ATIRA expanded applications of nanofibre technology through the development of a collagen-based melting nano mask and the successful commercialisation of nanofibre-based cosmetic masks using electrospinning, with over 75,000 products exported through an industry partner. Advanced textile and composite capabilities were further strengthened by developing glass fabrics (105–750 GSM) for filtration and insulation, and nine radially braided products (3”–12”) with biaxial and triaxial architectures using glass, carbon, and polyester yarns for aerospace and defence applications. ATIRA also developed meta-aramid yarn with a glass core, achieving export-scale success with over one tonne shipped to the USA. The Centre of Excellence – Composites Design Cell showcased precision engineering through the development of over ten specialised mould systems for radomes, reflectors, and waveguide applications supporting defence and space programmes.

In FY 2024-25, ATIRA expanded its NABL-accredited testing capabilities by adding 265 new test parameters across Textile, Technical Textile, Composites, and Ecology laboratories. Four start-ups incubated at ATIRA secured project approvals and grants from the Ministry of Textiles under the GREAT Scheme of NTTM. The Environment Engineering Department delivered 109 environmental audit and feasibility reports and supported 15 textile units through its Indore Centre.

ATIRA continued to build future-ready talent by hosting 43 student interns from institutions across Punjab, Delhi, Gujarat, and Telangana under the GIST scheme of NTTM, and by training 144 participants through specialised programmes covering FMEA, RCA, weaving, cotton quality, textile processing, and pultrusion technology. During the year, ATIRA signed nine MoUs and one NDA with leading national and international academic and industry partners and, in collaboration with Ahmedabad University, launched one of India's first M.Tech programmes in Composites in October 2024. ATIRA also led three high-impact flagship symposiums aligned with national missions such as Make in India and Viksit Bharat 2047.

ATIRA published **20 research papers** and **filed two patents** in the field of **technical textiles** during the last year.

Bombay Textile Research Association (BTRA), Mumbai, Maharashtra
Recent Activities Highlights & Achievements

BTRA has successfully developed the PAN based precursor suitable for T700 grade carbon fiber through the NTTM funded project. Carbonisation furnace line will be installed soon for converting the developed precursor into the carbon fiber.

Focus of BTRA is now on High Performance Fibres and Materials Including carbon Fibre, UHMWPE, aramid fibres which are a few examples.

Our present research work includes alkaline resistance polyester, plasma assistance waterless dyeing, new and long-lasting pavement development, Manufacturing of Aircraft interior material and creating aircraft interior testing facilities first of its kind in India and so on. Few are in verge of completion.

BTRA has other projects from other government organisation like DRDO, BRNS, RGST, BIS etc other than NTTM. and some in-house project is also ongoing.

BTRA has completed 4 projects in the year of 2024-2025.

We also filled 3 patents in the duration of 2024-2025 and contributed to scientific literature by publishing 21 research papers in high impact peer reviewed national and international journals.

BTRA also provides valuable services to the industry, educational institution, research organisation in terms of testing, training, consultancy, customer satisfaction.

Our Soil Mechanics and Asphalt laboratory is now fully working and open to industry and academic it has now become a revenue creating entity.

BTRA has signed MOUs with several educational institutes like IIT (Jammu), ICT, IIT (Mumbai), Maharashtra Government, Thermax (Pune), ARCI (Hyderabad), IFBEC and so on.

In 2025, BTRA has commercialised one of its developed technologies for making conductive yarn.

Northern India Textile Research Association (NITRA), Ghaziabad

Recent Activities Highlights & Achievements

NITRA had a productive year in research, development, and industry engagement, actively pursuing nine R&D projects during the period October 2024 to December 2025. These projects were supported by various Government of India agencies, including five sanctioned under NTTM (GoI) and two each by BIS and DST (GoI). Out of these, two projects have been successfully completed and submitted. The major focus areas of the R&D initiatives included protective textiles, development of test instruments, and exploration of the potential application of milkweed floss as a new-age textile fibre. Key achievements under these projects include the cultivation of milkweed fibre, development of advanced heat protection testing instruments such as Convective Heat Tester (ISO 9151), Radiant Heat Tester (ISO 6942), and Contact (Conductive) Heat Tester (IS 12127), as well as the development of Fire Entry Suits.

In addition to R&D, NITRA remained actively involved in product development across multiple domains of technical textiles and continued to provide extensive testing and consultancy services to the textile industry. During January 2025 to December 2025, a total of 16,880 samples were tested across NITRA's seven NABL-accredited laboratories, including Physical Quality Evaluation (8,603 samples), Heat & Flame and Chemical Quality Evaluation (5,783), Polymer & Technical Textile Laboratory (1,593), Microbiology (522), and Eco & Environmental Laboratories (379). Further strengthening its testing infrastructure, NITRA commissioned a state-of-the-art Fire Manikin Testing Facility under the Centre of Excellence – Protech. NITRA also extended consultancy services to 135 industrial units in areas such as inspection of textile and allied products, energy audits, manpower rationalization, and assessment of machine ageing and health. During the reported period, 71 research papers were published in reputed national and international journals, and 24 Memoranda of Understanding (MoUs) / Non-Disclosure Agreements (NDAs) were signed. For the stated period the organization secured 1 patent granted, 7 patent applications filed in 2025. Training and skill development remained a key focus, with more than 658 personnel trained through various programs. In the area of intellectual property, NITRA secured one patent grant, filed seven patent applications in 2025, and obtained one trademark registration. The trademark “CLOCell (device)” was granted under Indian Trademark Application No. 7102666 dated July 7, 2025, in Class 22, in the name of Northern India Textile Research Association.

South India Textile Research Association (SITRA), Coimbatore

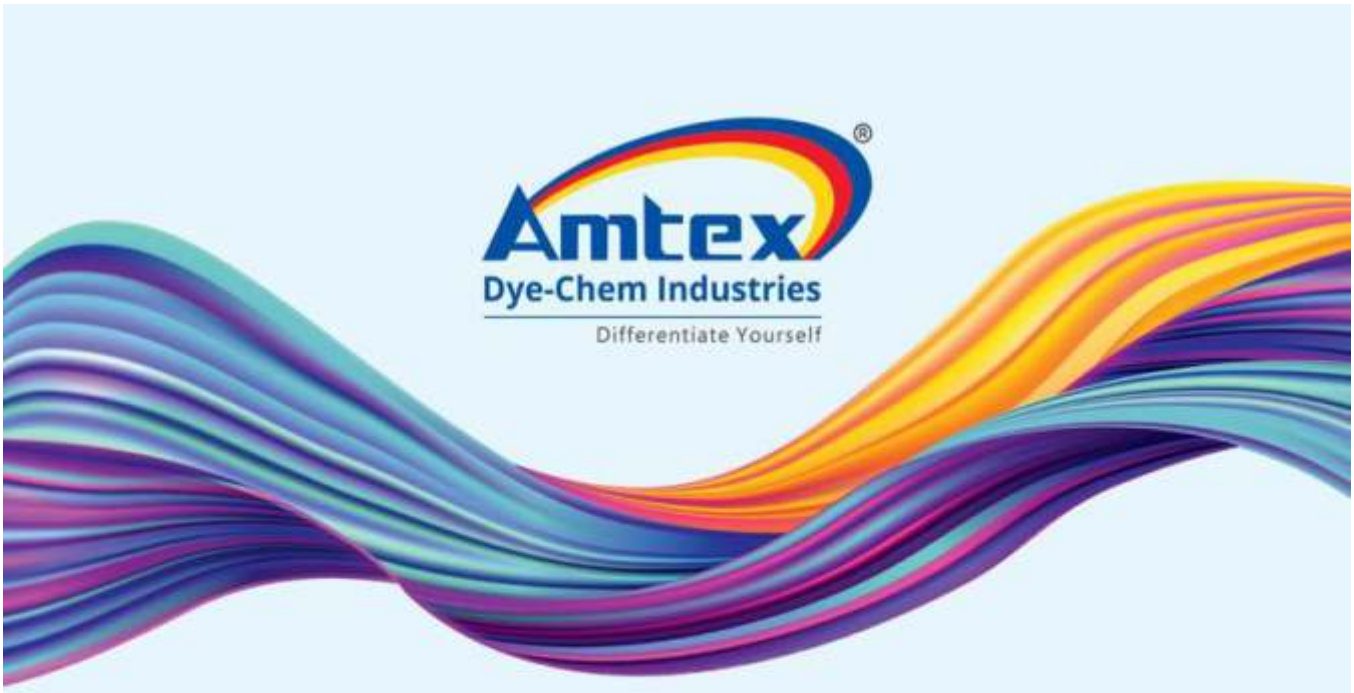
Recent Activities Highlights & Achievements

SITRA remained a trusted technology partner to the textile industry for nearly seven decades, and its contribution continued in the last year, with a clear focus on three fundamental pillars: research excellence, industry relevance, and technology translation. SITRA has strengthened its collaborative ecosystem through MoUs and NDAs with leading global and national organizations, including Archroma and Mercedes-Benz R&D, enabling joint research, pilot trials, and technology transfer.

Under medical textiles, SITRA has made significant strides through the development of a high-throughput needle-less electrospinning system for nanofibre production, natural antimicrobial-coated textiles for hospital wear under the GREAT scheme, biodegradable antimicrobial packaging, and other translational research initiatives. The Textile Chemistry Division has expanded its NABL and FSSAI-accredited infrastructure, supported thousands of industrial tests, and advanced several impactful projects. These include NTTM-supported development of natural fibre-based, herbal extract-coated seed protection bags, consultancy projects on advanced multifunctional shirting, phytochemical red–orange dye synthesis, and cottonization of banana fibre for blended yarn applications.

In the area of weaving and knitting, SITRA has made remarkable advances in developing high-performance structures for aerospace and medical applications, such as para-aramid and carbon fibre preforms, specialised sewing threads for semi-cryogenic engines, haemostatic fabrics, heart patches, tubular woven fabrics, and metal braided structures, demonstrating growing strength in mission-critical textile applications.

SITRA also continued to strengthen the conventional textile industry through focused interventions in spinning, testing, training, engineering, and benchmarking. Looking ahead, SITRA is embarking on a new phase of growth with plans to establish additional Centres of Excellence in specialised domains. The emphasis will be on translational research, faster industry adoption, digitalisation, sustainability, and future-ready textile technologies.



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Session-wise Papers Details

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1	Development of Graphene-Functionalised Natural Fibers for Wearable Technology and Advanced Composites	ATIRA	Dr. Partha Bairi, Dharmesh Rizwani, and Dr. Kameswara Rao
2	Durable Conductive Graphene Polypropylene Hybrid Fabrics by Plasma Enhanced Vinyltrimethoxysilane Grafting	BTRA	M. Amarnath, Shreyash Mohite, Shital Palaskar
3	Nano-Finishing of Fabrics: Assessing Antimicrobial Potential of Copper and Zinc Nanoparticles	MANTRA	Murtuza Z Channiwala, Sejal Shirsath
4	A Case Study on the processing of Bamboo Viscose/ Spandex Knitted Fabric by Continuous Process	SITRA	Mr. Sivakumar Subramaniam
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3	Electrospun Wound Dressings - ATIRA's Capability Expansion for Translational Medical Textiles	ATIRA	Yogeshwar Chakrapani, Ankit Darji & Deepali Plawat
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3	Development of sustainable hygiene products from sugarcane bagasse	BTRA	Shraddha Gaonkar, M P Sathianarayanan
4	Development of Insecticide-Free Moth Repellent for Woollen Textiles as a Sustainable Alternative to Toxic Chemical Pesticides	WRA	Chaitali Parab Mhamunkar, Sharan Uday Shetty & Dr. Mrinal Rajesh Choudhari
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8	Impact of Phytohormones on the Yield & Quality of Cotton Fibres	SITRA	Dr. R. Radhai, Dr. S. Lakshmi Subramanian, L. S. Kumar and V. Vijayajothi

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Development of Graphene-Functionalised Natural Fibers for Wearable Technology and Advanced Composites

Partha Bairi, Dharmesh Rizwani, and Kameswara Rao

Abstract

Natural fibers possess unique properties that make them attractive for conventional wear and apparel applications. However, the modern era demands advanced materials capable of addressing critical technological challenges posed by abundantly available natural fibers. Natural fibers offer several advantages, including biodegradability, renewable sources and low cost, but suffer from limitations such as lack of electrical conductivity, poor mechanical strength, and high-water absorption. Over the last two decades, scientists have turned to nanomaterials to overcome these challenges due to their exceptional properties compared to conventional materials. Graphene is one of the most promising nanomaterials, offering high electrical conductivity, antibacterial and antimicrobial properties, excellent mechanical strength, and good thermal stability. Moreover, its zero-bandgap semiconducting nature makes it suitable for electronic applications.

At ATIRA, we are integrating graphene onto the surface of natural fibers to enhance their properties, making them suitable for wearable technologies and advanced sustainable composite products. We have successfully developed graphene-coated natural fibers such as jute, cotton, coir, and banana. We demonstrated the development of a strain sensor for wearable technology applications, as well as the enhancement of high-strength polymer composites for lightweight structural applications. Currently, we are scaling up the coating process and developing new products.

Figure 1: Photograph of graphene-coated natural fibres

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Durable Conductive Graphene Polypropylene Hybrid Fabrics by Plasma Enhanced Vinyltrimethoxysilane Grafting

M. Amarnath, Shreyash Mohite & Shital Palaskar

Abstract

Achieving stable conductive coatings for antistatic polypropylene (PP) fabrics is challenging due to the polymer's hydrophobicity, low surface energy, and propensity for static charge, which reduces uniform deposition of nanomaterials. To address these limitations, we developed a hybrid functionalization strategy combining atmospheric plasma activation, vinyltrimethoxysilane (VTMS) grafting, and nitrene-functionalized graphene deposition to fabricate robust conductive PP fabrics. To enhance the adhesion of the conductive graphene layer to the PP surface, VTMS introducing covalently bound vinyl groups that act as chemical anchors. Atmospheric plasma treatment was employed prior to grafting to generate reactive polar groups on the PP surface, improving surface energy and promoting strong interfacial bonding. The functionalized fabrics were systematically characterized using scanning electron microscopy to assess surface morphology and coating uniformity, X-ray photoelectron spectroscopy (XPS) to confirm chemical composition of N-graphene, contact angle measurements to evaluate wettability, and surface volume resistivity measurements to quantify electrical conductivity. The nitrene-functionalized graphene formed uniform, conformal coatings, achieving sheet resistances below 10^6 □. sq^{-1} at 0.2 wt. % graphene loading. This study focuses on the effect of plasma-assisted VTMS functionalization on the washing durability and retention of electrical conductivity, quick charge dissipation of the graphene coating after repeated laundering Importantly, the electrical performance remained stable after 10 home-laundry cycles following AATCC standards, demonstrating excellent washing durability. The resulting nitrene-functionalized graphene–polypropylene hybrid fabrics exhibited promising characteristics for wearable electronics, including lightweight structure, excellent flexibility, and long-term stable conductivity. These results highlight the potential of plasma-assisted silane functionalization as a scalable and versatile approach for fabricating multifunctional smart textiles with enhanced durability and performance.

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Nano-Finishing of Fabrics: Assessing Antimicrobial Potential of Copper and Zinc Nanoparticles

Murtuza Z Channiwala & Sejal Shirsath

Abstract

This study investigates the antimicrobial activity of fabrics treated with copper and zinc nanoparticles derived from selected plant extracts. Initially, cotton and polyester fabrics were chosen for their widespread use in textiles. Medicinal plants, known for their antimicrobial properties, were selected for the extraction of copper and zinc nanoparticles using green synthesis methods. Following extraction, nanoparticles were characterized using UV-Vis spectroscopy to confirm their formation and determine their absorbance peaks. The application of the copper and zinc nanoparticles to the fabrics was achieved through cold batch pad method. The antimicrobial efficacy of the synthesized copper and zinc nanoparticles biosynthesized from medicinal plants was first assessed using the Agar well diffusion method, revealing significant inhibitory effects against pathogenic microorganisms, including Staphylococcus aureus and Escherichia coli. Subsequently, the treated fabrics were tested for antimicrobial activity through the Disc Diffusion method, demonstrating a reduction in microbial growth. Results indicated that the plant-derived copper and zinc nanoparticles not only enhanced the antimicrobial properties of the fabrics but also maintained effectiveness post-treatment. This study highlights the potential of using environmentally friendly copper and zinc nanoparticle treatments in textiles, paving the way for the development of multifunctional fabrics for healthcare and hygiene applications. Future work will focus on the long-term stability of these antimicrobial effects and their practical applications in various industries.

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A Case Study on the processing of Bamboo Viscose/ Spandex Knitted Fabric by Continuous Process

S. Sivakumar, P. Arumugam and A. Krishnan

Abstract

SITRA was requested by one of its clients to assist them in achieving the desired stretch and minimise the pilling tendency while processing Bamboo Viscose / Spandex knitted fabric. It was reported that the fabric processed by the mill failed in pilling, bursting strength, and stretch & recovery, leading to the rejection of the lot by the buyer. The mill has previously followed the conventional process of Dry heat setting, pre-treatment, and biopolishing in a soft flow dyeing machine, followed by Compaction. It is also noted that the processed fabric did not meet the requirements with regard to pilling due to the longer contact time and abrasion within the soft-flow dyeing machine.
Hence, SITRA suggested an alternate process route, thereby adopting continuous processing of Bamboo Viscose / Spandex knitted fabric. The process route followed by SITRA involved Dry-on-wet heat setting, Gas Singeing, Continuous bleaching and Cold-pad-batch dyeing process followed by finishing and compacting.

Knitted fabric of 35s Ne Count yarn made from 95% Bamboo Viscose and 5% Lycra was used for the trials. The process route adopted by SITRA yielded improved results (i.e.) ICI pilling rating improved by 1 grade, bursting strength improved by 25%, balanced stretch and recovery between course and wales directions, improved thermal conductivity under compression and recovery, and brilliant shade. Further, it has also resulted about 34% reduction in water consumption. More importantly, the fabric processed through the process route adopted by SITRA has met or exceeded all the stipulated requirements and has been approved by the buyer.

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Bast Fiber Innovation: Exploring Ramie and Industrial Hemp in Technical Textiles

Nidhi Sisodia & M.S Parmar

Abstract

This study investigates the potential of bast fibres—specifically ramie (Boehmeria nivea) and hemp (Cannabis sativa)—as sustainable alternatives to synthetic fibres in technical textiles. Known for their exceptional mechanical strength, breathability, moisture management, UV resistance, thermal insulation, antimicrobial properties, these fibres offer significant environmental advantages, including biodegradability, low carbon emissions, minimal water usage, and soil regeneration benefits. Life Cycle Assessment (LCA) comparisons reveal that ramie and hemp emit 60–70% less CO_2 and consume substantially less energy and water than cotton and polyester. The research standardizes commercial-scale fibre extraction processes and evaluates physical, chemical, and functional properties using standard methods, including TGA, FTIR, and microbial resistance tests. Ramie (Boehmeria nivea) and industrial hemp (Cannabis sativa) fibres exhibit excellent chemical and physical properties suitable for technical textiles. Ramie contains 91–93% cellulose, 5–7% hemicellulose, and 0.6–0.7% lignin, while hemp has 68–74% cellulose, 15–20% hemicellulose, and 3–5% lignin. Both fibres show a moisture regain of 8–12% and a partially hollow structure enhancing oil sorption and insulation. Ramie is finer (8–12 denier) with bundle strength 40–45 g/tex, whereas hemp is coarser (15–30 denier) with bundle strength 35–40 g/tex. Their high cellulose content, strength, and biodegradability make them sustainable alternatives for nonwovens, filtration, and protective textiles. Applications explored include nonwoven sorbent mats and filter media for oil–water separation, with oil absorption tested per ASTM F726. Needle-punched nonwovens and yarns were developed using 100% ramie and hemp or blended with wool, FR viscose, and assessed for thermal resistance and FR properties. The findings support the integration of ramie and hemp into Indu-Tech, Pro-Tech, and Meditech sectors, offering biodegradable, renewable, and high-performance solutions for filtration, composites, and protective fabrics.

Keywords: Antimicrobial properties; Bast fibres; Biodegradable materials; Industrial hemp (Cannabis sativa); Ramie (Boehmeria nivea); Sustainability; Technical textiles

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From Fibres to Functional Structures: Radial braiding technology at ATIRA for Aerospace, Automotive and Industrial Applications

Dhananjay Shah & Deepali Plawat

Abstract

The increasing demand for lightweight, high-strength, and reliable composite structures in aerospace, automotive, and industrial sectors has intensified the need for advanced preforming technologies. Radial braiding has emerged as a versatile solution for manufacturing with superior mechanical and structural properties, damage tolerance, and design adaptability. At the Ahmedabad Textile Industry's Research Association (ATIRA), a state-of-the-art radial braiding machine has been commissioned to develop complex braided architectures. The braiding process is classified as either two-dimensional or three-dimensional braiding. The 3-D braiding at ATIRA has the special advantage of having the ability to develop a variety of symmetrical and non-symmetrical complex shapes without the need of cutting, joints and splices. On the same machine, however, 2 dimensional structures can also be produced. This unique setup enables the production of braided preforms with tunable braid angles, fibre architectures, and hybrid material combinations. The system allows precise control of axial and radial yarn placements, thereby achieving optimized fibre orientations critical for load-bearing aerospace components, energy-absorbing automotive structures, and durable industrial reinforcements.

This paper presents the technical capabilities of the radial braider at ATIRA, Ability to form a variety of complex structural designs and shapes using different high functional fibers such as carbon, aramid, glass, & hybrids and developing products for various end applications with an objective of light weighting, improving abrasion resistance, vibration damping, and thermal protection and so on.

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Electrospun Wound Dressings - ATIRA's Capability Expansion for Translational Medical Textiles

Yogeshwar Chakrapani, Ankit Darji & Deepali Plawat

Abstract

Any wound basically implies a disruption in the skin which makes the human body prone to attack by microorganisms leading to infections. A wound dressing is a crucial component in wound management, designed to protect the wound, promote healing, and prevent infection. Various wound dressings are available in the market, each designed to meet specific healing requirements. Selection of the wound dressings depends on multiple factors which include but not limited to: wound type and severity, exudate levels, infection risk, patient comfort and cost. Among these, fibrous dressings have shown to have better moisture absorbency and swelling, properties crucial for any type of wound dressing. Due to their unique physicochemical characteristics, nanofibres are increasingly regarded as superior alternatives to traditional wound care products

At ATIRA, it is our constant endeavour to push the boundaries in large scale electrospinning of nanofibres for various applications. The current study explores the large-scale production of biodegradable nanofibre mats suitable to be used in wound healing applications. Promising results obtained through physicochemical and biological characterizations opens up a variety of options for producing nanofibre based wound dressing products.

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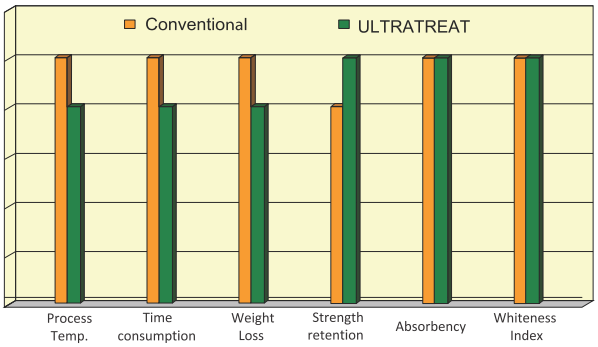

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Comparative Environmental Impact Assessment of Milkweed and Cotton Cultivation for Textile Applications: A Life Cycle Assessment Approach

M.S. Parmar, Preeti Kaur Sachdeva & Annu Kumari

Abstract

Environmental challenges, particularly those resulting from the overuse of natural resources, are driving the urgent search for sustainable alternatives. This shift is focused on sustainably sourced raw materials, eco-conscious production processes, greener consumption practices, and the promotion of secondary raw materials to replace conventional ones. In the textile industry, this transformation is accelerating the adoption of new cotton alternatives—among which milkweed is emerging as a strong contender. Commonly known as a weed across Asia, Europe, and the USA, the milkweed plant bears pods containing a soft, silky, cellulosic floss. This floss has an exceptionally low density (0.89 g/cc) and a 70% hollowness, lending it remarkable thermal insulation properties. Often referred to as "vegan wool," milkweed is already gaining traction in extreme cold-climate protective clothing.

To evaluate its environmental viability, a Life Cycle Assessment (LCA) was conducted comparing milkweed and cotton cultivation over a one-hectare plot. The assessment included key variables such as soil type, climate, water and fuel consumption, and inputs like seeds and fertilizers across five phases: soil preparation, sowing, growth, harvesting, and post-treatment. While cultivation contributes less to total lifecycle impacts than textile processing and consumer use, it significantly affects water usage and eutrophication. As part of the study, the Air Pollution Tolerance Index (APTI) was also calculated for both plants. APTI is a key indicator of a plant's resilience to air pollution. Notably, milkweed's APTI value was found to be three times higher than that of cotton—highlighting its superior environmental stress tolerance. These findings strongly support milkweed as a sustainable, low-carbon-footprint alternative to cotton. However, to fully validate its potential, further research across all stages of fibre production and processing is not only necessary—it is critical to shaping a more sustainable textile future.

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Development of Jute Fiber Reinforced Thermoplastic Composites for Sustainable Application

Ankush Sharma, Shreeom Godewar, Bhushan Chaudhary & S M Poojari

Abstract

Sustainable fiber reinforced polymer (FRP) composites from renewable and biodegradable fibrous materials and polymer matrices are of great interest, as they can potentially reduce environmental impacts. Addressing the imperative for environmentally responsible materials, this research develops jute-fiber-reinforced polypropylene (PP) thermoplastic composites as sustainable alternatives to glass-fiber-reinforced polymers in non-structural automotive interiors, such as instrument panels and door trim. Composites were produced by hot-press consolidation of non-woven jute mats with PP sheets under precisely controlled temperature and pressure parameters to achieve optimal melt infiltration, fiber wetting, and interfacial adhesion. Jute, a renewable lignocellulose fibre with rapid growth cycles, confers low density and partial biodegradability, while PP ensures complete recyclability within established thermoplastic reprocessing infrastructures. Mechanical properties, evaluated through standardized tensile, flexural, and impact testing, revealed enhanced tensile strength relative to unreinforced PP, with modulus and toughness meeting performance benchmarks for automotive interior specifications. The jute–PP composite system minimizes reliance on non-renewable resources, reduces lifecycle carbon emissions, and supports closed-loop material cycles, establishing it as a technically viable and ecologically superior substitute for conventional composites in sustainable automotive engineering.

Keywords: Jute fiber, Polypropylene, Compression molding, Automotive interiors, Sustainable composites

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Development of sustainable hygiene products from sugarcane bagasse

Shraddha Gaonkar & M P Sathianarayanan

Abstract

Conventional sanitary napkins typically consist of three to four distinct layers, each performing a specialized function. Commercial products predominantly utilize a permeable top layer made of polypropylene to facilitate fluid transfer, an absorbent core composed of super absorbent polymers or cotton fibers, and an impermeable polyethylene back sheet to prevent leakage. However, these synthetic materials are non-biodegradable and contribute significantly to environmental pollution. The current study addresses the ecological concerns posed by such personal hygiene products and proposes a sustainable alternative. This research focuses on the development of an eco-friendly sanitary napkin utilizing sugarcane bagasse (SCB)—an abundant lignocellulosic waste byproduct of the sugar industry—as the primary absorbent material. The bagasse was processed into a fine cellulosic pulp and incorporated as the absorbent core in the prototype design. The laboratory-scale prototype comprises a permeable inner layer of absorbent cotton gauze, three layers of SCB pulp as the core, and a hydrophobic cotton fabric serving as the outer barrier. This study aims to replace petroleum-based components in sanitary napkins with biodegradable alternatives without compromising functionality. Preliminary results demonstrate that the SCB-based napkin exhibits enhanced absorbency and fluid retention characteristics, while being completely biodegradable, thereby offering a promising solution for sustainable menstrual hygiene.

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Development of Insecticide-Free Moth Repellent for Woollen Textiles as a Sustainable Alternative to Toxic Chemical Pesticides

Chaitali Parab Mhamunkar, Sharan Uday Shetty & Mrinal Rajesh Choudhari

Abstract

Wool, a premium natural protein fibre valued for its warmth, comfort, and resilience, is inherently vulnerable to damage by keratin-feeding pests such as cloth moths (Tineola bisselliella) and carpet beetles (Anthrenus flavipus). Infestations typically develop under poorly ventilated, dark, and humid storage conditions, where the larvae of these insects degrade the fibre structure, leading to substantial deterioration in quality and commercial value of woollen products. Conventional control measures rely heavily on synthetic chemical based mothproofing agents inclusive permithrin/mittin FF/Dieldrin based insecticides. These are effective but present serious toxicological and environmental concerns. The persistence in the environment contributes to air, water, and soil contamination, posing potential risks to both ecosystem and human health. With growing global emphasis on eco-safety and sustainability, there is a pressing need for the development of insecticide-free, herbal-based moth repellent finishes that ensure effective fibre protection without ecological compromise.

The project "Development, Application and Benchmarking of Eco-friendly Moth Repellent and Moth Proofing Finish for Woollen Textiles" undertaken by the Wool Research Association (WRA), Thane focused on formulating sustainable, insecticide-free finishes to protect wool against moth damage. This aimed at development of effective herbal formulations, optimising and benchmarking the application of formulation and evaluation of other natural, biodegradable, and non-toxic alternatives for moth protection in woollen textiles, offering a sustainable pathway to replace conventional chemical pesticides.

The methodology involved the development of microencapsulated based herbal formulations as well as their standardization of dosages on woollen fabrics using various techniques. The treated samples were evaluated for moth repellency using test method ISO 3998 (Determination of resistance to certain insect pests) and fastness to washing, dry cleaning, durability was evaluated followed by benchmarking against commercial synthetic products. Industrial-scale trials were conducted to validate performance and scalability.

The outcome of project includes the creation of environmentally benign moth repellent finishes demonstrating effective protection without compromising fibre quality. The initiative contributes to sustainable textile innovation, enabling eco-labelling of wool products, reducing pollution, and promoting safer production practices. The developed technology also holds potential for commercialization and patenting, strengthening India's position in the field of eco-friendly textile finishing.

Keywords: Wool, Moth Repellent, Microencapsulation & Eco friendly

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Firefighters' Hoods in India: Pioneering Materials and Design Strategies for Comfort and Safety

Shweta Saxena, M.S. Parmar & Swami Sharan

Abstract

As firefighting operations grow more demanding, the traditional hood—firefighters' first line of defence against heat, flame, and contaminants—must evolve. With the rising frequency of fire incidents in urban and industrial India, the demand for advanced protective gear intensifies. Fire hoods are critical for safeguarding firefighters' heads, necks, and parts of the face, while balancing thermal protection with wearer comfort.

This paper reviews current hood technologies, surveys cutting-edge materials, explores innovative design paradigms, and outlines a testing framework to evaluate thermal performance, breathability, and fit. By highlighting the need for advanced materials and demonstrating how performance and design advances can synergize, it proposes new performance requirements that set a benchmark in India's protective-equipment landscape. Adoption of these performance parameters promises to elevate firefighter safety, reduce heat-stress injuries, and catalyse a domestic protective-equipment industry.

Keywords :
Fire hood; thermal protective performance; ergonomic design & fit; NFPA 1971; IS standards

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Tailoring Flame Retardant Properties in Cotton Fabrics through Plasma Assisted Chemical Treatment

Shreyasi Nandy & TV Sreekumar

Abstract

Cotton fabric was treated using commercially available 3-hydroxyphenyl phosphinyl propanoic acid (3HPP) as a flame-retardant agent, in combination with 1,2,3,4-butanetetracarboxylic acid (BTCA) as a cross-linking agent and dicyandiamide (DCDA) as an esterification catalyst. The phosphorus-containing moiety formed effective covalent bonds with both the cotton fibers and the cross-linking matrix, as confirmed through Fourier-transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). The concentration of 3HPP in the padding solution was varied between 1% and 10%. A marked increase in the limiting oxygen index (LOI) was observed—from 17.4% in untreated cotton to 29.5% in samples treated with higher concentrations of 3HPP—further improving to 31.5% upon application of atmospheric plasma treatment. Thermogravimetric analysis revealed enhanced thermal stability, with untreated cotton exhibiting approximately 80% weight loss at 350□°C, compared to only 40% in the treated samples. Cone calorimetry results demonstrated a substantial reduction in both peak heat release rate and total heat release, along with a delayed ignition time. Notably, the treatment exhibited excellent durability, maintaining an LOI of 28.1% even after 20 laundering cycles. This study addresses the critical challenge of flame-retardant durability in cotton textiles and highlights the efficacy of the 3HPP/BTCA system—augmented by plasma treatment—as a promising strategy for enhancing fire safety and performance in cellulose-based materials.

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Development Of The Flame-retardant Polyamide 66 Fabric

Sundaramoorthy Palanisamy, C. P. Bansal & M. S. Parmar

Abstract

Polyamide 66 (PA 66), commonly known as nylon 66, is one of the most widely used engineering polymers because of its excellent mechanical strength, wear resistance, heat stability, and chemical resistance. These attributes make it an indispensable material in sectors such as automotive, aerospace, textiles, and protective equipment.

In this work, the PA 66 polymer is synthesized through a condensation polymerization reaction. In the polymerization of PA 66, the adipic acid and hexamethylenediamine react in equimolar quantities to form AH salt. Then, the salt concentration is reduced to 75-85% in the condensation reactor, and the polymerization reaction takes place at a higher temperature and high pressure under an inert atmosphere. After the polymerization reaction, the molten polymer is decompressed to atmospheric pressure and heated up to remove the volatile substances and water molecules. At last, the product was removed from the reactor, cut into pellets, and dried in a vacuum oven at 110 °C for 24 h.

The PA 66 pellets and flame retardant (FR) master batch (which is halogen-free) were added together in the melt spinning to manufacture the FR PA 66 filament yarn. FR master batch is added at three different ratios to find out the optimal range for FR applications. The properties of PA66 yarns were investigated by intrinsic viscosity, relative viscosity, melt flow index (MFI), differential scanning calorimetry (DSC), and tensile test. The woven fabric is developed through the FR PA 66 yarn to analyze the flammability as per IS 11871 method A. The melting points of AH salt and PA 66 granule are 205 °C and 256 °C, respectively. The pure PA 66 filament sample was completely burnt during the vertical flammability test, and melt dripping was also noticed.

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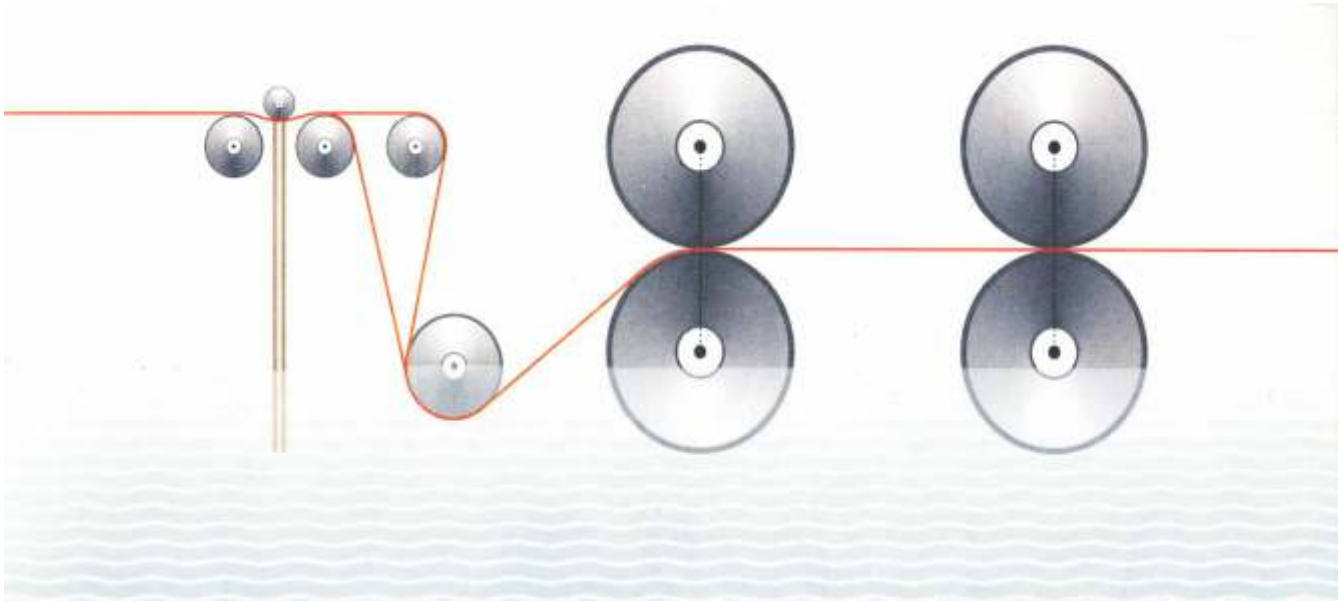

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Development of Alkaline-Resistant Polyester via PVA-Based Coating for Geosynthetic Applications

Prasanta K. Panda, Shyambabu K. Sainik

Abstract

Polyester-based Geosynthetics are widely employed in civil engineering applications due to their excellent mechanical properties and cost-effectiveness. However, their susceptibility to alkaline hydrolysis in aggressive environments, such as soil and groundwater with elevated pH, significantly limits their long-term durability. In this work, we explored two approaches to impart alkaline resistance to polyester: (i) surface modification via chemical treatment, plasma, and electron beam, and (ii) surface coating with alkaline-resistant polymers. While surface modification routes exhibited challenges related to high energy demand, complex chemistries, and cost feasibility, the surface coating approach was identified as a more practical and scalable solution.

Poly vinyl alcohol (PVA) is selected as the coating material owing to its intrinsic alkaline resistance and water solubility, which reduces reliance on organic solvents and enhances environmental sustainability. To overcome the inherent water solubility of PVA, extensive trials were conducted using acid- and aldehyde-based crosslinkers, glutaraldehyde identified as the most effective. Optimization of the PVA–glutaraldehyde ratio enabled the formation of a robust, crosslinked coating on polyester substrates. Initial studies revealed some degree of water diffusion despite complete crosslinking, which was subsequently mitigated through the incorporation of selected additives. The final coating demonstrated excellent resistance to alkaline conditions up to pH 12.5 at 60°C, establishing its suitability for harsh geosynthetic environments.

The developed method requires no modifications to current machinery and can be seamlessly integrated into the production line with minimal additional processing time. Ongoing studies are focused on evaluating the long-term durability of the coated materials. This work demonstrates a cost-effective, environmentally considerate, and industrially compatible approach for enhancing the alkaline resistance of polyester-based Geosynthetics, thereby extending their functional lifespan in critical infrastructure applications.

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Evaluating Agrotextile Ground Cover Impact on Purple Cauliflower: Microclimate Modulation and Yield Enhancement

R. P. Singh, P. R. Surwase & P. R. Salunkhe

Abstract

A Climate Smart Agrotextile Demonstration Center has been established by SASMIRA at Navsari Agricultural University (NAU)Under National Technical Textile Mission (NTTM), Ministry of Textiles, GoI, to promote climate-smart applications of agrotextile products through field demonstrations and training. This study evaluates the impact of a commercially available woven polypropylene ground cover installed at the centre on the growth and yield of purple cauliflower (Brassica oleracea var. botrytis). The ground cover was applied to designated plots and compared against open field (control) under identical agronomic conditions.

Key parameters such as soil temperature, moisture retention, weed suppression, and crop yield were monitored throughout the crop cycle. Soil temperature and moisture dynamics were continuously monitored using IoT-enabled sensors deployed across both plots. These sensors provided real-time data throughout the crop cycle, enabling precise assessment of microclimatic changes induced by the ground cover. Results revealed that the agrotextile ground cover effectively moderated soil temperature, maintaining it within the optimal range for cauliflower root and curd development. IoT sensor data showed improved soil moisture retention by 30–42% compared to the control, contributing to reduced irrigation frequency and better water use efficiency. Weed incidence was suppressed by over 80%, significantly lowering labour input for manual weeding. Most notably, purple cauliflower grown under the agrotextile ground cover exhibited a 38% increase in marketable yield compared to the open field. Improvements in curd uniformity, pigmentation, and size were also observed, indicating enhanced physiological conditions and reduced abiotic stress.

These findings validate the agronomic benefits of agrotextile ground covers in high-value horticultural crops. By improving soil health, conserving moisture, and suppressing weeds, the ground cover contributes to better crop performance while supporting sustainable resource management. The integration of IoT-based monitoring further strengthens the evidence base, offering a scalable model for precision agriculture.
This study reinforces the role of demonstration centre in bridging the gap between innovation and adoption. The Climate Smart Agrotextile Demonstration Center at NAU provides a live interface for farmers, researchers, and extension personnel to witness the practical benefits of agrotextile technologies.

Keywords: Agrotextile ground cover, purple cauliflower, climate-smart agriculture, soil moisture retention, weed suppression, yield enhancement, NTTM.

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Functionalization of Rootball Agro-Packaging Nets with Nutrient-Rich Bentonite for Soil Improvement

Mayur Basuk, Sharan Shetty & Atharvan Deshpande

Abstract

Rootball nets, also known as root wrapping nets, are mesh coverings used in Agro and horticultural applications to securely wrap the root balls of plants, trees, and shrubs during transplantation. Biodegradable Rootball nets have emerged as an innovative solution for the transportation and storage of shrubs, saplings, and plants. Designed as a sustainable alternative, these nets aim to replace conventional synthetic storage bags that contribute to microplastic pollution. The introduction of Bentonite-enriched Rootball nets offers additional benefits, including enhanced moisture retention, improved soil texture, and a boost in nutrient content. This combination creates optimal growth conditions, supporting healthier plant development and promoting sustainable agricultural practices. In this study, both Bentonite-treated and untreated Rootball nets were filled with soil and lemon saplings (Citrus limon) and monitored over a six-month period. The impact of Bentonite on soil moisture retention and nutrient levels (NPK) was assessed using standardized testing methods. The primary objective was to evaluate how the Bentonite finish influences soil health and plant growth. Ultimately, the results aim to demonstrate the potential of Bentonite-treated Rootball nets as a viable, eco-friendly solution for sustainable nursery Agro-packaging.

Keywords: Agro Packaging, Rootball Net, Nutrient, Eco-friendly, Soil Enhancement.

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Energy-Modulating Agrotextile Shade-Net: Development, Characterization and Field Trials on Marigold and Chilli

R. P. Singh, P. R. Surwase, P. R. Salunkhe & B. N. Ghag

Abstract

An energy-modulating HDPE/LLDPE based Agrotextile shade-net incorporating metal-oxide and Hindered Amine Light Stabilizer (HALS) functional materials was developed to modulate incoming solar energy while preserving photosynthetically active radiation (PAR), creating a cooler, more stable microclimate for low-cost protected cultivation. Functional Films and Shade-net using slit-knit process were developed with optimized functional material loadings and characterised for thermal, optical and mechanical performance. Laboratory results showed PAR transmission consistently in the range of 80-92%, increased modulation of longer-wavelength solar energy with functional material loading, and tensile-strength retention of 85–91% after accelerated UV exposure. Field validation at ICAR-KVK, Dindigul, Tamil Nadu compared open field, a conventional shade-net and the developed energy-modulating shade-net on Marigold and Chilli under standard agronomic management. Microclimate monitoring demonstrated that the developed net reduced average internal temperature by 1.5–3.5°C and 0.5-2.0°C relative to the open field and conventional shade-net respectively. It also facilitated a more stable relative humidity (70–78%). Agronomic outcomes showed substantial productivity gains: Marigold yield increased by 49%, 25.2% and Chilli by 33% and 15.8% compared with open field and conventional shade-net respectively. The combined laboratory and on-farm results indicate that selective modulation of incoming solar energy, coupled with high PAR transmission and HALS-enabled UV stability, translates into significant microclimate improvement and crop productivity benefits. The technology offers a practical, low-cost option for off-season horticulture. This Proof of Concept (PoC) research work was supported by the National Technical Textile Mission (NTTM), Ministry of Textiles, Government of India.

Keywords: Energy-modulating Agrotextile, HDPE/LLDPE shade-net, Hindered Amine Light Stabilizer (HALS), Solar energy modulation, PAR transmission, microclimate, Marigold, Chilli, UV stability, protected cultivation.

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Indian Spinning Industry – A Decadal Review of Market Performance, Cost Pressure & Sustainability

J.Sreenivasan

Abstract

The Indian spinning industry occupies a critical position in the textile value chain; however, over the past decade, it has been operating under increasing stress due to market volatility, sharp fluctuations in raw material prices, and sustained escalation in labour and energy costs. This paper presents a decadal review of the commercial performance, cost pressures, and sustainability of the Indian spinning industry using data generated through SITRA's Monthly Online Surveys and CPQ (Costs, Operational Performance and Yarn Quality) studies.

The MPEI trend from 2013 to 2025 shows sustained subdued commercial performance, interrupted only by a brief boom during 2020–22, driven by post-Covid demand–supply imbalance. An analysis of Net Output Value against labour and power costs highlights that rising conversion costs have not been matched by commensurate improvements in commercial efficiency. Further, CPQ-based analysis shows a clear disconnect between steady improvements in productivity and value addition, and highly volatile contribution levels, largely due to adverse price–cost relationships.

The study concludes that long-term sustainability of spinning mills will depend on an integrated strategy encompassing productivity-led cost control, selective value addition, effective raw material price risk management, energy efficiency, and strong financial discipline.

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Effect of Top Roller Diameter used in Ring Frame Drafting System on Yarn Quality

L. S. Kumar & V. Vijayajothi

Abstract

The drafting system in ring spinning plays a critical role in determining yarn quality, with top roller cots significantly influencing fibre control and drafting stability. While cot hardness has been extensively studied, the effect of cot diameter remains less explored. This study evaluates the influence of three top roller diameters - 28.5 mm, 30 mm, and 32 mm - on yarn quality parameters in compact ring-spun cotton yarns (60s combed compact).

Trials were conducted on a LMW LR6 ring frame equipped with a Suessen compact attachment, under controlled machine and process conditions. Yarn irregularity, imperfections, hairiness, and tensile properties were systematically analyzed. Results showed that increasing cot diameter led to improved yarn evenness, reduced imperfections, lower hairiness, and superior tensile properties compared to smaller diameters.

The findings demonstrate that larger top roller diameters contribute to better yarn quality by improving fibre strand control. However, limitations arise when using larger diameters along with standard pin spacers. Future work will extend the study to finer cotton counts, synthetic fibres, and alternative compact spinning systems to validate the broader applicability of the results.

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Impact of Parameters of Top Roller Cots Buffing & Berkolisation Treatment on Yarn Quality

L. S. Kumar & V. Vijayajothi

Abstract

In spinning mills, the surface condition of top roller cots plays a critical role in fibre control, drafting stability, and yarn quality. While cot hardness and rubber composition have received much attention, the influence of buffing parameters and post-buffing treatments is often underestimated. This study investigates the effect of buffing time, stone grit, and berkolisation treatment on yarn performance in ring spinning.

Trials were conducted in a 60s combed compact yarn spinning machine (LMW LR J9 AXL with Spinpact attachment), where cot buffing time (2–7 seconds) and stone grit (60° and 80°) were varied. Online yarn faults (NSLT clearer cuts, H1 faults) and offline evenness (U%, thin places) were systematically evaluated. Results show that longer buffing durations (6–7 seconds) consistently improved yarn quality across all parameters, with 80° grit yielding slightly superior results at shorter buffing times. Shorter buffing durations (2–3 seconds) were insufficient, leading to higher imperfections.

A comparative study across three mills further revealed that berkolisation treatment after buffing stabilises the cot surface and enhances yarn quality during the first five days post-buffing, demonstrating both technical and economic benefits.

The findings highlight the importance of optimising buffing duration and adopting berkolisation to improve yarn evenness, reduce faults, and enhance spinning performance. Future work will extend to cot surface roughness analysis, temperature effects during buffing, and correlations with cot hardness and stone characteristics.

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Achieving Pre-treatment Excellence in Cotton & Cotton Blends: Practical Strategies to overcome preparation barriers

Nitin Shah

Abstract

Ideal desizing conditions are rarely achieved in practical wet processing, and complete removal of size at the desizing stage occurs only in limited cases. During singeing, cotton waxes and residual warp waxes may melt and re-deposit as a hydrophobic film on the fibre surface, thereby restricting water penetration and inhibiting proper swelling and removal of size materials. Under such conditions, the efficiency of size removal is largely governed by mechanical parameters and the overall production setup rather than chemical action alone.

Furthermore, critical process controls such as residual peroxide removal, oft water & iron contamination management, and effective neutralization present significant operational challenges, frequently necessitating additional processing steps and chemical auxiliaries. Preservation of the degree of polymerization (DP) of cellulose under these demanding conditions cannot be ensured merely by reducing chemical dosages; rather, it requires the systematic application of result-oriented process techniques. Establishing and adhering to fundamental control rules governing these parameters is essential for enabling a realistic and practical understanding of non-performance issues in wet finishing (pre-treatment) operations.

Failure to achieve adequate performance at intermediate wet-processing stages often results in non-performing goods, causing significant processing dissatisfaction for bleachers and introducing substantial value-loss risks up to the final finished product stage.

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Development of Advanced Shirting Fabric with Multi-functional Finishes

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Abstract

The consultancy project aimed to develop a multifunctional shirting fabric incorporating odour control, stain resistance, and a phase change material (PCM)–based thermal regulation within a single textile system. The study involved careful selection of compatible functional chemicals, optimization of finishing formulations, and stepwise scale-up from laboratory padding trials to bulk and pilot-scale production. Finished fabrics were evaluated for stain repellence using the AATCC 22 method, odour resistance according to ISO 17299-3, and thermal behaviour through differential scanning calorimetry (DSC) as per ISO 11357-3. The treated fabric exhibited excellent stain resistance (Grade 10), complete odour suppression (Grade 0), and a clear PCM phase transition near 26.7 °C with latent heat values reaching approximately 4.7 J/g, indicating effective thermal regulation suitable for apparel use. Wash durability studies showed strong retention of stain resistance and partial preservation of PCM functionality, with a gradual reduction in latent heat after repeated laundering. A 500-m pilot-scale industrial trial has been successfully completed, and further work includes detailed fabric characterization and garment-level wearer trials to confirm comfort and performance under real-use conditions.

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Fabric to suit the Aspirational Lifestyle (Wash-Dry-Go)

Nitin Shah

Abstract

Liquid ammonia mercerization (LAM) is an advanced fibre modification technique employed to enhance the structural, functional, and aesthetic properties of cellulosic textiles. In contrast to conventional caustic soda mercerization, liquid ammonia rapidly penetrates the amorphous regions of cellulose, inducing controlled fibre swelling with minimal chemical degradation. This treatment promotes molecular realignment, reduces internal stresses, and improves fibre uniformity at the microstructural level.

LAM-treated cotton fabrics demonstrate significant value addition, including improved dimensional stability, enhanced tensile and tear strength, increased fabric lustre, and superior wet and dry crease recovery performance, reflected by high barium activity numbers. The process enables effective crosslinking with approximately 40% lower resin consumption while minimizing strength loss, thereby offering a comparatively safer and more efficient finishing route. Preservation of cellulose integrity allows retention of higher degrees of polymerization, supporting durable wash-and-wear performance above 3.5 DP. Additionally, reduced moisture retention contributes to faster drying behavior.

Improved dye diffusion and shade uniformity, particularly in medium to dark shades, are attributed to the more homogeneous fibre morphology and reduced fibrillation achieved through LAM. Despite challenges associated with ammonia handling and recovery, precise process control enables the production of high-performance cellulosic textiles with superior functional and aesthetic characteristics.

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Assessment of Water, Chemical and Energy Saving in Textile Wet Processing Units in the Panipat Textile Cluster, India

M.S.Parmar, Pankaj Kumar & Jeeshan

Abstract

Wastewater pollution control is a significant area of scientific research today, particularly in industries with high environmental impact, such as textile processing. The textile processing industry is one of the major contributors to pollution in Panipat district. With growing awareness about environmental preservation, efforts are being made to reduce the consumption of fresh water, chemicals, and energy in these industries. Textile processing requires substantial amounts of fresh water and chemicals during various wet processing stages. A series of studies were conducted in the textile processing industry in Northern India to analyze the specific consumption of water, chemicals, and energy needed to process 1 kg of material. These studies also aimed to identify opportunities to reduce consumption, thereby decreasing the load on effluent treatment plants and minimizing water pollution while saving energy and time. Environmental issues in the textile industry are primarily caused by the discharge of wastewater. This paper presents a critical review of water, chemical, and energy consumption practices in textile processing units in Panipat. The findings are based on a detailed, face-to-face, questionnaire-based survey conducted in 19 textile processing factories, mostly MSMEs, where modified processing methods were implemented. These improvements were possible by slightly changing the methods and chemicals without major investments from the factories. As a success story, a brief case study of two processing industries (Code: PT-011 and PT-001) is presented here.

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Impact of Phytohormones on the Yield & Quality of Cotton Fibres

R. Radhai, S. Lakshmi Subramanian, L. S. Kumar & V. Vijayajothi

Abstract

Cotton, the world's most important renewable fibre, faces persistent challenges in India due to low productivity, fibre quality deterioration, and pest infestations. Despite India's large cultivation area, average yields remain below global standards, leading farmers to shift to alternative crops. Phytohormones, even in small concentrations, play a critical role in regulating plant growth and fibre development. Foliar application of phytohormones has emerged as a promising strategy to improve both yield and fibre quality.

This study evaluated the impact of foliar sprays containing a customised phytohormone blend and herbal insect-repellent extract across multiple cotton varieties and irrigation regimes. Over three years of trials, results consistently showed increased yield (up to 41% in high-density planting) and improved fibre properties including length, strength, and uniformity. The herbal component reduced pest infestation, contributing to healthier plants and higher boll retention. Farmers reported dual benefits: greater yields with superior fibre quality commanding premium prices.

These findings demonstrate the potential of phytohormone-based foliar sprays as a cost-effective and scalable intervention for enhancing cotton productivity and fibre quality in diverse field conditions. Future work will include multilocation and state-level coordinated trials under ICAR CICR, along with farmer outreach and technology protection through patenting.

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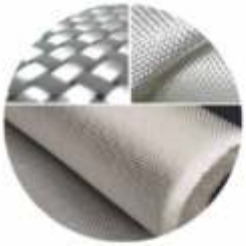

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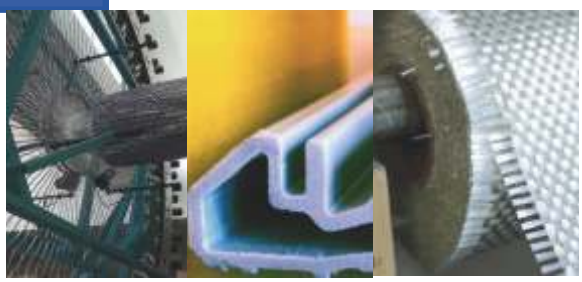

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- Launched **Skill development** program for Pultrusion Operators
- Internship programme **under GIST**

वस्त्र मंत्रालय
MINISTRY OF TEXTILES

OTHER SERVICES

Environmental Audit & Consulting Services (GPCB Schedule 1 Auditor)

Training and Skill development

Consultation

Lonsen-Kiri

Creating Colors of Joy

Manufacturer and Exporter of High Quality Dyestuff:

- All Range of Reactive Dyes
- Reduced Indigo 30% Solution

GLOBAL ORGANIC TEXTILE STANDARD - GOTS -

ZDHC

ISO 9001:2015
ISO 14001:2015
ISO 45001:2018
BUREAU VERITAS
Certification

BUREAU VERITAS 1828

UKAS
0008

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