7th International Conference on
Technical Textiles and Nonwovens

Sustainable Technologies and Entrepreneurship: Pioneering the Future of Technical Textiles

12-14 December 2023

IIT Delhi, New Delhi, India

Organized by

Department of Textile and Fibre Engineering
IIT Delhi

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SOUVENIR

Dr. R ALAGIRUSAMY
Professor & Head
Department of Textile & Fibre Engineering
IIT Delhi

Message

Dear Esteemed Participants and Distinguished Guests,

It is my honour and privilege to welcome you to the 7th International Conference on Technical Textiles and Nonwovens (ICTN2023) as the Head of the Department of Textile and Fibre Engineering, which is organizing the conference.

ICTN2023 serves as a pivotal platform for professionals, researchers, and industry experts to converge and deliberate on the latest advancements in the dynamic field of technical textiles and nonwovens. Our conference theme, "Sustainable Technologies and Entrepreneurship: Pioneering the Future of Technical Textile" underscores our commitment to fostering innovation, collaboration, and sustainable practices within our industry. In the ever-evolving landscape of technical textiles, this conference provides an unparalleled opportunity to share knowledge, engage in meaningful discussions, and explore new possibilities. The diverse range of sessions, workshops, and exhibitions curated for ICTN2023 aims to encapsulate the richness and breadth of the industry.

As we gather to exchange ideas and insights, let us seize this occasion to build bridges, establish collaborations, and collectively contribute to the growth and development of the technical textiles and nonwovens sector. The challenges we face demand creative solutions, and the synergy generated at ICTN2023 will undoubtedly pave the way for future innovations.

I extend my sincere gratitude to the organizing committee, speakers, sponsors, and participants who have dedicated their time and expertise to make this conference a reality. Your contributions are instrumental in making ICTN2023 a cornerstone event in our industry's calendar. I encourage each of you to actively participate, connect with fellow professionals, and absorb the wealth of knowledge that this conference has to offer. May ICTN2023 be a source of inspiration, collaboration, and lasting memories.

Thank you for being part of this remarkable journey, and I wish you a rewarding and enriching experience at ICTN2023.

Dr. R ALAGIRUSAMY

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Conference Chair, India
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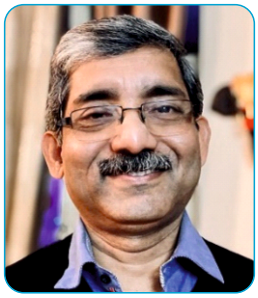


Message

Dear Beloved Colleagues and Distinguished Participants,

You are cordially invited to the 7th International Conference on Technical Textiles and Nonwovens 2023 (ICTN 2023) - Sustainable Technologies and Entrepreneurship: Pioneering the Future of Technical Textiles. The event will take place at the Lecture Hall Complex (LHC), Indian Institute of Technology Delhi, India, on December 12–14, 2023. I am really happy to be extending this invitation as the Conference Chair. As we gather here to explore and exchange ground breaking ideas in the area of Technical Textiles and Nonwovens, I am honoured to witness the convergence of brilliant minds from around the world. Distinguished scientists, researchers, industry professionals, and students can come together, share their wealth of knowledge, and learn about the latest developments in the area of technical textiles and nonwovens at this conference. The gathering is expected to spark lively debates, new ideas, and establish crucial relationships among fellow technocrats and academicians. We hope that your participation at this conference is both encouraging and rewarding. Your presence, participation, efforts and contributions will surely benefit this collaborative knowledge-creation effort. At this historic occasion, I look forward to your active participation and developing of interesting talks. I would like to express my gratitude to our sponsors, speakers, organizing committee, and all those who have played a pivotal role in making this event possible. May the 7th International Conference on Technical Textiles and Nonwovens 2023 (ICTN 2023) be a source of inspiration, a catalyst for positive change, and a stepping stone towards a brighter and more interconnected future. I am excited to witness the wealth of knowledge and ideas that will unfold in the coming days.

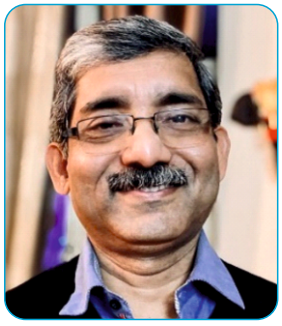
Welcome again to the 7th International Conference on Technical Textiles and Nonwovens 2023 (ICTN 2023), Indian Institute of Technology Delhi, and let us work together to make this event a huge success!

Warm Regards,

Prof. Apurba Das
Conference Chair

Organizing Committee

Prof. R Alagirusamy
Dept. of Textile & Fibre Engineering
Indian Institute of Technology Delhi



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Plenary Talk

High-throughput electrospinning methods and their combination with additive manufacturing techniques

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Abstract

Electrospinning and the resulting nanofiber mats have many unique features including high porosity, high surface area, lightweight nature and low material consumption, ease of doping, and surface functionalization, just to name a few. They have a wide variety of potential applications detailed in the literature, but most of these have not emerged in real-life applications. One of the main drawbacks of the technology is that it is difficult to scale it up, even though there are numerous successful attempts and commercial nanofiber-producing machines available on the market. The application of highly volatile, sometimes harmful, and sometimes highly flammable solvents is also a technical difficulty to consider at the scale-up of the technology.

Our research team was working on making nanofiber production more efficient, and we developed several unique electrospinning setups. These novel setups include rotation, shear forces, vibration, and air while operating, and apply those as auxiliary forces to reach higher throughputs and better control over the fiber morphology. The solution properties, including their rheological characteristics, play a key role in improving the process itself.

Recently, we tried to combine layers of either electrospun nanofibers or melt-blown sub-micron fibers with layers deposed by additive manufacturing. If the 3D-printed layers are not completely filled, i.e., they are macroporous, then we can build hierarchical structures from 3D-printed patterned structures and micro/nanoporous webs. They can even be made of the same biopolymer material and can show good biocompatibility. The key features of these simple, but high-throughput methods developed, and our recent achievements of nanofiber/3D printed hierarchical structures will be introduced.

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Acknowledgment

The research reported in this paper was supported by the National Research, Development and Innovation Office (FK 138501) and the National Research, Development, and Innovation Fund of Hungary under Grant TKP2021-EGA-02 and by H2020-MSCA RISE No. 872152 -GREEN-MAP project of the European Union.

Keynote Talks

High performance yarns for advance textile applications

Olivier Boubeaud
Innovarte, Singapore

Abstract

In the dynamic landscape of advanced textiles, high-performance yarns play a pivotal role, shaping various sectors with their remarkable characteristics. The evolution of textiles is evident in trends where durability, strength, and versatility are paramount. High-performance yarns contribute significantly to this paradigm shift. Their high cut resistance makes them indispensable in applications such as protective textiles, while their high strength ensures better safety and reliability in the maritime and aqua industry. In the medical field, these yarns enable the development of innovative materials for implants and surgical procedures, while in the military, they enhance the performance of protective gear. Non-woven fabrics benefit from their advanced properties, providing new possibilities in industrial applications. Beyond performance, high-performance yarns contribute to sustainability, aligning with the global shift towards eco-conscious practices. In conclusion, the multifaceted applications of high-performance yarns exemplify their pivotal role in advancing textile technologies, driving innovation, and addressing contemporary challenges across diverse industries.

Advanced Fibres for Thermal Protection

Manoj Jhaver
Dupont India Pvt Ltd, Mumbai

Abstract

Thermal Hazard is present for the workforce in Oil & Gas, Utilities, Defense, Fire-Fighters and many more industries. A textile solution which can minimize the impact of these thermal hazard is utilized as PPE in these industry verticals. Several PPE's (textile & non-textile) have to work in synergy to provide a 360° protection to people working in such environments. With the enhancement of our learnings about additional risk present in an burning environment, presents new challenges to find solutions to protect the folks. The paper dwells on the additional risk for Fire Fighters and how new materials and different textile structures are utilized to address these challenges.

Navigating the Nonwoven Landscape: Decoding Market Trends, Identifying Opportunities, and Shaping the Future

Kanav Gupta
Associate Director, BCH

Abstract

Titled "Navigating the Nonwoven Landscape: Decoding Market Trends, Identifying Opportunities, and Shaping the Future," this presentation illuminates the transformative journey of India's nonwoven sector within the context of the country's remarkable economic growth and demographic dividend. This presentation delves into key facets, commencing with an exploration of the domestic market size of nonwovens, coupled with insightful analyses of export-import dynamics. Shedding light on emerging trends and drivers specific to various applications within the nonwoven sector constitutes the second focal point. Thirdly it outlines a comparison of the potential of the Indian market with other countries, showcasing the opportunities of India to become one of the largest players in the nonwoven sector, globally. This analysis is a valuable step to guide the stakeholders to anticipate market shifts and capitalize on new opportunities. Additionally, the presentation addresses the profound impact of the COVID-19 pandemic on the technical textile industry, underlining the sector's adaptability and resilience in the face of challenges. In conclusion, this presentation not only dissects the present state of the nonwoven sector but also strategically points towards future directions. This holistic approach, coupled with a keen understanding of market dynamics will provide important directions to the

Nonwoven Applications and Technology Solutions from Oerlikon

Shridhar Dhumal
Oerlikon Textile India Pvt Ltd, Mumbai

Nonwoven Applications and Technology Solutions from Oerlikon

Ingo Maehlmann
Oerlikon Nonwoven, Neumunster, Germany

Airlaid Nonwovens - The Nonwovens of the future

Marko Mäntylä
ANPAP OY, Valkeakoski, Finland

Oral Presentations

Protective Textiles: Market Opportunities & Challenges

Nandan Kumar (PhD)
Managing Director, High Performance Textiles Pvt Ltd., Panipat, Haryana

Abstract

Protective textiles play a pivotal role in ensuring safety across various industries such as automotive, healthcare, military, metal processing, electronics, construction, and firefighting. The demand for these specialized fabrics has witnessed substantial growth both in domestic and export market due to increasing awareness of occupational hazards, stringent safety regulations, and a growing emphasis on personal protective equipment (PPE) globally. With India aiming to become manufacturing powerhouse, we can foresee exponential growth in the domestic market. Keeping pace with rapidly evolving technologies is a challenge for the Indian protective textiles industry where we not only need collaborative and continuous research on development of high-performance fibres but also need to incorporate cutting-edge materials, such as smart textiles and nanotechnology, into protective garments. The 'National Technical Textiles Mission – NTTM' is an excellent initiative by the Ministry of Textiles where many innovative products, machines and processes are being developed which would help protective textile manufactures in India. We also need stringent regulations and standards for protective textiles across industries and regions so that sub-standard products are not imported and supplied to our manufacturing companies.

In summary, the protective textiles market presents significant opportunities driven by increasing safety awareness across industries. However, addressing challenges related to local availability of high-performance fibres, technology, regulations, cost, and testing as per global standards is crucial for sustained growth and market leadership in this dynamic and evolving sector.

Our company HPT is a government recognized 'One Star Export House' and specializes in the spinning of technical composite yarns (using para-aramid, meta-aramid, modacrylic, UHMWPE, FR Nylon, FR viscose, stainless steel and other high-performance fibres) using innovative spinning technologies for protection against thermal, mechanical, and electrostatic hazards. Recently, we have incorporated 'Institute of Technical Textiles' to promote commercial developments related to protective textiles in India.

Development of Molten Metal Splash Resistant Jute-Cotton Based Union Fabric

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Abstract

In this study, 13 woven fabrics of 100% Jute (7 samples), 100% cotton (3 samples), and Jute-cotton union compositions (3 samples) with different weaves have been manufactured and treated with durable organo- phosphorous based flame-retardant finishing. The DSC study carried out on untreated (Fig 1a) and FR-treated fabric samples (Fig. 1b) showed a lower thermal decomposition temperature in the case of FR-treated fabric. The TGA study (Fig, 1c and Fig, 1d) also revealed a higher residue remained at 400oC of FR-treated fabric. The FR-treated fabric samples were studied for their molten metal splash resistance (iron and aluminium metals before and after 5 wash cycles. The 100% jute fabric samples, passed the molten metal splash (iron) up to the E2 level (Fig 2a and Fig. 2b) and did not pass the molten metal splash (Aluminium) even level D1. On the other hand, out of 3 samples of 100% cotton of different weaves- plain, twill, and mock leno, only the twill weave sample passed the E3 level, rest two samples passed up to level E2. These all samples passed level D1 of the molten metal splash(Aluminum) test. In the case of the Jute-cotton union fabric sample, 2/2 twill fabric passed the E3 level, while the other two passed the E2 level. These samples passed only the D1 level in the case of the molten metal splash (Aluminium) test.

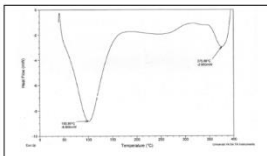
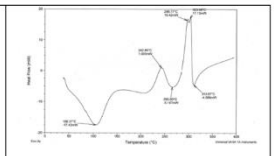


Fig. 1a DSC study on Untreated Jute Fabric



Fig, 1b DSC study on Treated Jute Fabric

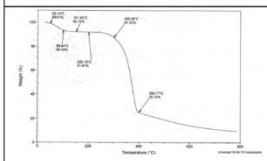


Fig. 1c TGA study on Untreated Jute Fabric

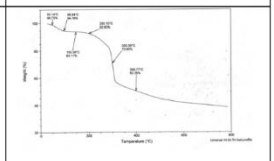


Fig. 1d TGA study on Treated Jute Fabric

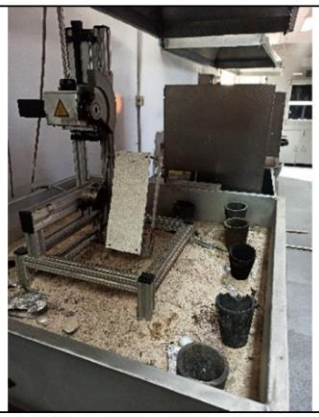


Fig. 2a Molten Metal Testing Machine

Fi.g 2b Tested sample

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Advancements and Applications of Fire Protective Textiles

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Abstract

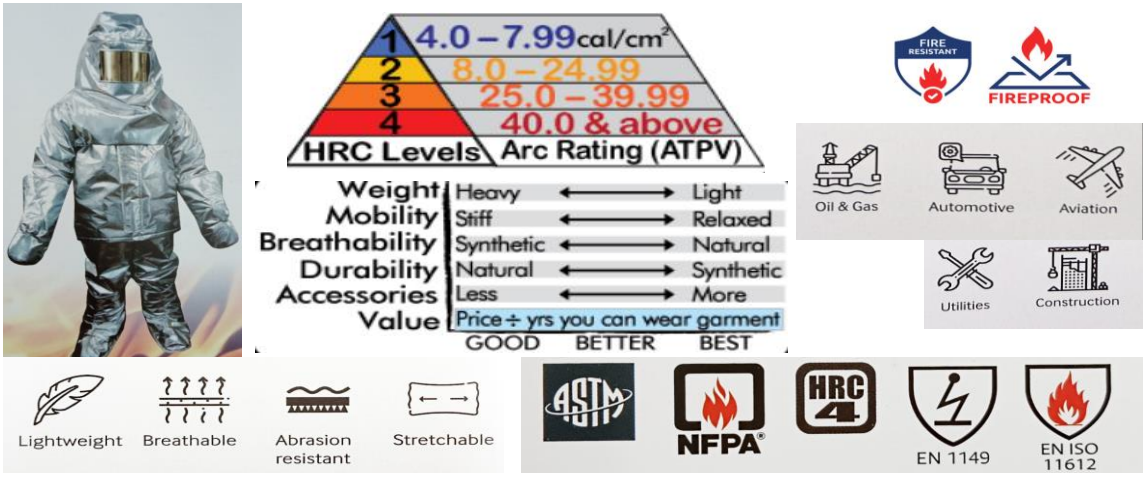
India being a net exporter of overall 207 technical textile products is 5th largest in the world. Technical textiles, a dynamic subset of the textile industry, have catalysed innovations across diverse sectors. Among them, industrial textiles hold a pivotal role, contributing significantly to safety and protection solutions. Fire hazards pose substantial threats, causing extensive damage to property and life. Understanding and addressing these hazards are vital to enhancing safety measures. The paper examines fire hazards, their destructive impact, and the theoretical underpinnings of fire retardancy. Furthermore, the study investigates the market dynamics of fire-resistant textiles, profiling manufacturers, technical specifications, and a comprehensive range of applications. The discourse encompasses various fibres, fabrics, and finishes used in production, including inherently flame-resistant fibres and textiles treated with fire-retardant coatings or sprays.

A visit to the international exhibition Fire India 2022, held at Gandhinagar had influenced the present study in reviewing recent research investigations, technological advancements, and global views on the future perspectives and development in the field. The contribution of industry giants like Arvind, Hi-care and Shinde fire safety products in human protection are noteworthy. Several manufacturers invest in research, leading to innovative textiles with precise technical specifications. These textiles find application across a wide spectrum, from personal protective equipment to various industrial contexts.

The essential components of a fire protection costume, equipment and machinery involved in the production of fire protective garments, care and maintenance guidelines add to the technical information on textiles used for fire safety. Comfort properties, cost considerations, and accessory integration are explored, along with guidelines for care labels. It overviews simulation testing methods and quality control measures for evaluating the performance of protective garments in controlled conditions that mimic real-world fire and heat exposures. The paper also addresses fire safety regulations, recent developments, research gaps, and the promising future prospects of fire-resistant technical textiles. Use of eco-friendly recycling and disposal systems guide the industry toward sustainable practices, fostering safer textiles while protecting natural resources and ecosystems.

Graphical Abstract:

Fig. 1 Human Protection, Fire Safety Standards & Applications



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Acknowledgment

The authors of the paper acknowledge the exhibitors, Arvind Limited, Hi-Care and Shinde Fire Safety Products at International Fire India 2022 Industrial Exhibition; Safe Pro Fire held at Gandhinagar for their support in explaining and providing all the necessary information and material which formed the ground for the study.

Development and Characterization of Cut-resistance Gloves using Cotton: Recycled Para-Aramid Fibre blended yarns

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Abstract

High-performance fibers are widely used in various technical textile products owing to their physical and chemical properties. The processing of these fibers generates pre- and post-consumer waste, which can be utilized for conversion into value-added products. India is the largest producer of cotton fiber, and its utilization in the technical textile sector is minimal. Blending cotton and recycled para-aramid fiber will aid in the value addition of cotton fiber and improve the interfacial bonding and performance properties of the final products. In this work, we attempt to develop protective gloves by blending cotton fiber with recycled para-aramid fiber with blend proportions of 70/30 and 50/50, and the results were compared with those of 100% cotton. The cotton/recycled para-aramid fiber blends were spun into 20s Ne using the ring spinning method, and their single yarn strength was tested. The single yarn strength of 70/30 was 19.89cN/tex, whereas that of the 50/50 blend yarns was 21cN/tex. The developed yarns were converted into seamless gloves using knitting technology. The developed gloves were tested according to EN 388 standards for puncture resistance, tear strength, abrasion resistance, and cut-resistance properties.

Advancing Impact Protection in Sports Textile: Microgel Integration on 3D Knitted Fabrics for Enhanced Athlete Safety

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Abstract

Within the realm of competitive sports such as football, baseball, and cricket, the escalating prevalence of impact injuries poses a significant challenge to athletes' careers. The spectrum of these injuries encompasses spinal trauma, ligament and tendon damage, fractures, and head injuries. Shoulder injuries following knee injuries are one of the most common occurrences in sports (Funk, 2016).

In a bid to mitigate these risks, regulatory bodies have established guidelines permitting the usage of shoulder pads, as long as they are composed of soft and thin materials, integrating seamlessly with undergarments or jerseys while effectively covering the shoulder and collarbone. Conventional protective materials, notably composed of polyurethane foam, have historically addressed this need but often fall short in terms of optimal comfort (Harris & Spears, 2010).

In alignment with this imperative, our research advances the state-of-the-art by proposing the integration of microgels onto intricate three-dimensional knitted textiles, aiming to revolutionize protective padding. Our study meticulously optimizes the incorporation process of microgels on 3D-knitted fabrics. Furthermore, we comprehensively evaluate the impact resistance properties intrinsic to these innovatively designed protective fabric. The outcomes of our research hold substantial promise for elevating both the comfort and efficacy of protective gear, offering athletes an advanced solution to mitigate impact-related risks, thereby nurturing their careers in the face of these challenges.

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Lightweight Multilayered Filter Material for NBC Protective Clothing

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Abstract

Over the years, NBC Protective clothing is used by services however, some limitations in terms of weight, comfort properties and limited biological protection was associated with this. To overcome these limitations, herein, lightweight multilayered chemical and biological protective ensemble has been developed which can provide enhanced biological protection without compromising chemical protection level. During NBC scenario, NBC protective clothing provides full body protection to the first responders. It comprises of three layers i.e outer, middle and inner layer. The outer layer is basically FR polyester or aramid based multifunctional fabric consisting of flame retardancy, oil repellency, water repellency and antistatic properties. Inner or next to skin layer provides comfort to the wearer during physiological exercises. The most crucial middle layer is activated carbon-based adsorbent material in form of granules, spheres or fabric which is used as an adsorbent layer for deadly toxic chemicals. To develop this novel filter layer, Activated Carbon Spheres (ACS) having high surface area and crushing strength, was used as a filter layer for chemical protection. In case of biological protection, breathable nonwoven (Melt-blown and Spun-bond) based five different configurations along with ACS coated laminated fabric were developed using breathable polyurethane adhesive. To check the chemical and biological protection efficiency, the developed different configurations were subjected to various tests including Sulfur Mustard (which is one of the most toxic chemical warfare agents because of its high penetration capability through dermal route) breakthrough test (HD-BTT) as per IS 17377 (Part 1), and Synthetic Blood Penetration Test as per IS 16546. Out of five configurations, two of them have shown desired level of chemical and biological protection. The finalized two configurations were further evaluated against Moisture Vapor Transmission Rate as per ASTM E-96, Water Vapor Resistance test as per ISO 11092, Mandrel Test, Expulsion Test, Inverted expulsion test for confirmation of desired level of comfort and chemical protection level along with enhanced biological protection during NBC scenario. This novel ACS based lightweight filter layer will set a paradigm for development of next generation NBC protective clothing.

Figure 1. Construction of NBC protective clothing material

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Smart Textiles for Advanced Energy Harvesting and Storage Applications

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Abstract

Smart textiles have wide range of applications in energy sectors to improve the safety and electrochemical performance of energy storage devices and harvesters. Electrospinning is a simple and versatile method which is gaining importance in recent years as the textile prepared by employing this method have controlled properties. The electrospun polymer nonwoven textile consist of thin fibers of micron/sub-micron diameters with high specific surface area. The interlaying of fibers generates large porosity with fully interconnected pore structure that facilitates easy transport of ions, and serves as flexible and stretchable electrolyte and electrode in batteries and supercapacitor for the advanced energy storage solutions especially for electric vehicles and stationary power source applications. Due to the high porosity and robustness these smart textiles also explored for the harvesting energy which is outperform than other electrodes. The smart textiles prepared from different polymers such as PAN, PVdF and their blend with other polymers such as PMMA or their nanocomposite are employed in different energy storage devices such as lithium ion batteries, sodium ion batteries and super capacitors and energy generator such as triboelectric nanogenerators. The smart textiles are explored for flexible and stretchable textile/fiber supercapacitors, the next generation energy storage solutions. The schematic illustration on the fabrication of smart textile based energy storage device is displayed in Figure 1. The employment of these smart textiles not only enhanced the electrochemical properties and charge discharge cycling orate capability of the batteries but also significantly improved the thermal stability and safety of the batteries, which can safely operate at very high temperature above 200 ℃.

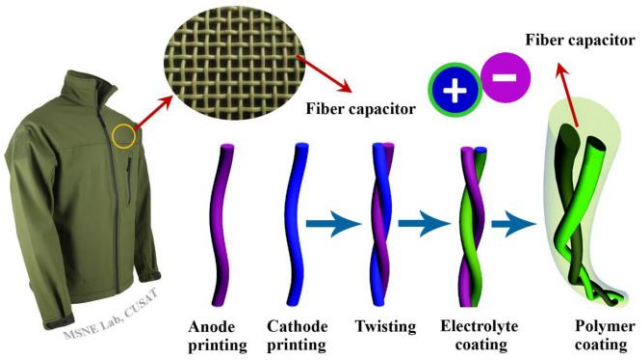

Figure 1: *Schematic illustration on the fabrication of smart textile based energy storage device*

Textile based Triboelectric Nanogenerator Composed of Electrospun Nylon 66 Nanofibres on Silk and PVDF on Polyester

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Abstract

In recent years, renewable energy harvesting has drawn great attention for supplying power to portable or wearable electronics. At present, battery is the main power source for portable and wearable electronics, but battery has disadvantages like limited life span and also not environmentally friendly. Therefore, it is desirable if the wearable power problem can be solved using sustainable and renewable sources. There are many mechanical energy sources in our surroundings such as wind, water waves, machine vibrations, and everyday human body motion, etc. Mechanical energy can be harvested either by piezoelectric technology or triboelectric technology. In this present study, a high-performance textile triboelectric nanogenerator has been prepared by using commercial silk and polyester fabrics (Fig. 1). Herein, electrospun nylon 66 nanofibrous web was deposited on the silk fabric to boost the tribo-positivity of the silk, whereas PVDF polymer solution was coated on the polyester fabric to enhance the tribo-negativity of the polyester fabric. The surface modified textile based triboelectric nanogenerator shows a significantly high electrical outputs (output voltage: 100 V and current density: 24.5 mA/m2) than the unmodified textile based triboelectric nanogenerator (output voltage: 5.85 V and current density: 1.6 mA/m2). In addition, the as developed modified textile based triboelectric nanogenerator has shown a maximum power density of 280 mW/m2 at 4 MΩ resistance. The enhancement in electrical outputs of the surface modified textile based triboelectric nanogenerator is mainly due to the boosting of the electro positivity/ electro negativity of the contact layers and increased contact area facilitated by the electrospun nanofibres. The capacitors charging and LEDs glowing were demonstrated to check practical ability of the developed triboelectric nanogenerator.

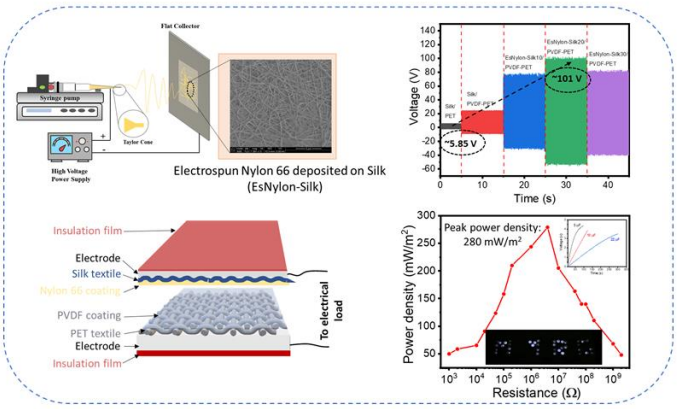

Fig. 1: Textile based triboelectric nanogenerator: electrospinning setup, output voltage, schematic line diagram of the device, and power density.

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Acknowledgment

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Prototype development of smart vest for search & rescue dogs

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Abstract

Dogs play a crucial role in maintaining law and security in a country, particularly in search and rescue (SAR) and detection operations. However, working dogs often face health challenges in extreme climates, such as hypothermia and fatigue. Considering their significance in police and military forces, it is essential to prioritize their comfort, safety, and situational awareness during field operations. Existing solutions fall short of meeting these requirements, relying solely on the dog-handler relationship and training. To address these limitations, this research focuses on the development of a smart vest (Figure 1). It incorporates microencapsulated phase change material (PCM) that regulates a dog's body temperature in both hot and cold environments. Additionally, advanced features like heart rate sensors, temperature sensors, GPS, and cameras are integrated to monitor the dog's well-being comprehensively. By providing an effective solution that caters to the specific needs of working dogs, this research aims to enhance their performance and ensure their overall welfare in demanding operational scenarios.

Figure 1. Developed Smart Vest worn on Government service Labrador

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Studies on vapor phase polymerization of pyrrole over polyester fabric for wearable sensors

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Abstract

Due to the ease with which their properties may be tailored using various compositions and synthesis techniques, polymeric materials have opened up a wide range of application possibilities. Out of these, inherently conducting polymers present a novel family of polymers that might close the gap between polymers and metals. Researchers working on the development of wearable sensors have always been interested in how electrical energy can conduct as well in polymers as it does in metals while maintaining the flexibility and robustness of polymers. If textiles can be combined with such material, sensors could be simply integrated into our apparel.

Polymerization of monomers over the surface of textile material for the synthesis of conductive polymer coated textiles has been the easiest and most effective method for manufacturing the electrically conducting textiles. Out of different methods of synthesizing the conducting polymers, vapor phase polymerization results in smooth and durable coating over the fabric surface with surface resistance less than 200 Ω. The effect of process parameters largely affects the type of deposition and the surface resistance (Figure 1). The effect of oxidant was found to be one of the decisive factors during polymerization whereas, the presence of dopant has a negative effect over the surface resistance. The conductive fabric thus formed was used for preparation of flexible capacitive sensor for measurement of environmental humidity. Such materials could open up new horizons for development of wearable biomedical sensors, detection of life threatening gases, chemicals, and could be easily integrated in our daily clothing due to the flexibility they offer.

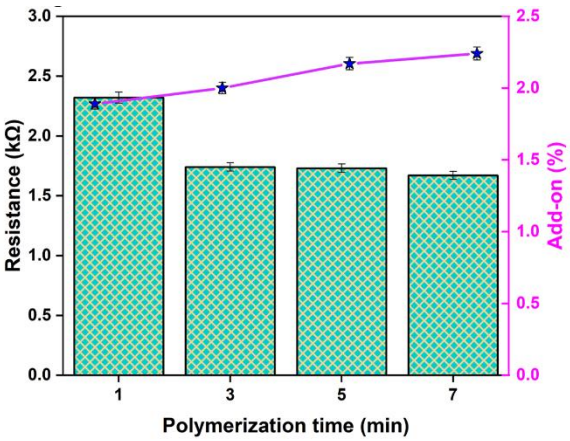

Figure 1 Decrease in resistance with polymerization time.

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An Innovative Technique for Aligned PVDF/TMDs Piezo-Polymers with High Piezoelectric Performance Suitable for Large-Area Wearable Electronics

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Abstract

Researchers are required to develop lightweight, flexible, biocompatible wearables that are self-powered due to the massive consumption of fossil fuels, environmental contamination from chemical batteries, and the rapid expansion of different wearable gadgets and IoT-enabled devices. Research on smart textiles and wearable electronics is always exploring for material systems that are very effective against physical incentives. Such applications necessitate the use of responsive piezoelectric-polymers and their preparation method which is totally activation-free method, which might potentially result in a continuous big area film. The approach presented in this work may allow not only facile, economical, and sustainable production but also improve the piezo electric performance of the polymer without using any activation step. Due to the very effective piezo property polyvinylidene fluoride (PVDF) and its copolymer (PVDF-TrFE) are currently the only cutting-edge piezo materials that are acknowledged by the commercial world. But there are certain benefits and drawbacks to these polymeric piezoelectric materials. i.e., despite their high manufacturing costs, low dielectric constant, low electromechanical coupling, and high flexibility, they have several drawbacks. PVDF has five crystalline phases, among them the β-phase has strong electroactive and piezoelectric properties. For use in wearable applications, several attempts have been made to improve the β phase of PVDF by introducing various nanofillers. accordingly, 2D TMDs are viewed as promising candidates for wearable electronics devices in the post-silicon era because of its broad band gap. So here, a smart choice of a semiconducting filler and a novel spin coating technique that doesn't need activation, improve the device's piezo responsiveness. The centrifugal force produced by the rotating directed field during the spin coating process greatly increases the piezoelectric capabilities without the need for an additional activation step. This is the method used to improve the piezo responsiveness of the polymeric material which can be further improve by a wise choice of filler material in this present work.

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Haptics in textile for Deafblind

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Abstract

The use of electronically or mechanically generated movement that a user experiences through the sense of touch as part of an interface can be incorporated with textile. These interfaces can provide reliable, intuitive, and clear feedback. As the technology has improved the components/ actuators miniaturized, the mobility of these interfaces has become more fluid. The actuators used help in other aspects rather than just performing motor tasks better. Sensors and Interpreters can be added to apparel for people who are deafblind, from which they can get feedbacks for their activity-based interactions; for example, guidance required to move towards the desired direction when they reach the zebra crossing, if the road crossing light is green and safe to cross. This information could be synthesized by the user faster with haptics.

Textile haptic devices	Year	Feedback type	Power source	Wearable type	Tethering
Bianchi et al.[30]	2017	Tactile	Electric motors	Wrist sleeve	Tethered
Low et al.[22]	2017	Kinesthetic	Pneumatics	Glove	Tethered
Culbertson et al.[31]	2018	Tactile	Magnetics	Forearm sleeve	Tethered
Ramachandran et al.[32]	2018	Kinesthetic	Electrostatics	Elbow joint	Untethered
Park et al.[33]	2019	Tactile	Electrostatics	n/a	Tethered
Wu et al.[34]	2019	Tactile	Pneumatics	Forearm sleeve	Tethered
Carpenter et al.[35]	2019	Kinesthetic	Thermoelectrics	Finger	Tethered
Hinchet et al.[36]	2020	Kinesthetic	Electrostatics	Glove	Untethered
Lee et al.[37]	2020	Tactile	Thermoelectrics	Wrist joint	Tethered
Zhu et al.[38]	2020	Tactile	Pneumatics	Forearm sleeve	Tethered

Figure 1: Comparison of existing textile-based haptic devices

In another scenario if a deafblind person is approaching something which is a hot vessel or iron box, they can receive haptic feedback to make them cautious, keep them safe and protect them from danger. Information received from wearable haptic communication devices about visual and environmental or social feedback such as Facial expressions, directional information, actions, layout of room/area can make the deafblind people more aware of their surroundings through feedback from garments and a sense of direction. The haptics can convey confirmation or negation or prompting. With the already existing wearable haptic sensors and interpreter with feedback devices the feedback received by the deafblind are on the fingers, palms or on the feet; multiple real time received stimuli often tend to confuse or are wrongly interpreted by the deafblind user. Wearable Artificial technology based haptic garment which has sensor and interpreter fixated in specified regions of the wearable garment as center back, shoulders, sleeves with longer cuffs, around the front pocket in pants, around the knees and under the feet will provide a real moment based tactile feedback as the requirement of action to be taken in the space, scene, people, and environment. This research will be on the placement of the haptics for real, quick and clutter free feedback-based decision making and interact with non-impaired people.

Keywords
haptics, deafblind, feedback, smart garment, textile actuators, interaction

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Copper-Infused Viscose Fibre for Medical Textile

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Abstract

Copper ions, either alone or in complex form have been used for centuries to disinfect liquids and solids. Today, copper is used as a water purifier, algaecide, fungicide, antibacterial and antifouling agent. Copper is an approved biocide to make medical claims internationally. Copper-infused technology refers to fabrics and yarns, which have been impregnated with minute copper compounds, making them self-sterilizing.1

Copper-infused viscose fibres have the potential to revolutionize the field of medical textiles. Viscose fibres are soft, flexible, and absorbent, making them well-suited for use in medical textiles. By combining the natural properties of viscose with the antimicrobial power of copper, it is possible to create medical textiles that are both functional and sustainable.1,2,3 When infused into viscose fibres, copper can help prevent the growth of harmful bacteria and other microorganisms on textiles used in healthcare settings. Particularly, as hospital linens, such as patient gowns (regular), sheets (top sheet, draw sheet, ICU sheet), blankets, pillowcases, towels, and also as bandages for wound healing, etc. This can help to reduce the risk of infection and improve patient outcomes.

These textiles can also be used in a variety of other applications. Further research is needed to fully explore the full potential of Cu-infused viscose fibres in medical applications.

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What affects stromal cell - resultant surface charge or surface charge composition!!!

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Abstract

Biocompatibility of any material is a multifactor governed phenomenon, which decides the fate of the material and application site. In many instances, nanoparticles in biomedical research, come in direct vicinity of cells and govern cell responses. In this research, gelatin nano/ submicron structures were synthesized by binary nonsolvent aided coacervation (BNAC) method for skin tissue regeneration purposes. Synthesis pH was varied from 3 to 11. Further, those structures and ionic composition of their surfaces were scrutinized to assess their impact on stromal cells like fibroblast cells. Primary toxicity against peripheral blood mononuclear cells (PBMC) was assessed. Synthesis pH 7 yielded gelatin nanoparticles (GNPs) with minimum particle size and positive cell viability of more than 100%. Minimum cumulative negative and positive charge (CNCP) ratio of GNPs synthesized at pH 7 (GNPs-pH 7) may be one of the cues for this. Also, GNPs-pH 7 more than 100% cell viability for L929 mouse fibroblast cells.

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Development of Antimicrobial Silk Sutures Treated with Natural Coating Agents

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Abstract

Sutures are widely used for wound dressing. Silk, a natural non-absorbable suture material has been used as biomedical suture for centuries due to its advantageous characteristics. However, one of the major problems associated with the silk is its poor microbe resistance characteristics. We can overcome this by making a study of peel off property, antimicrobial property, bulk density and strength analysis. Sik have been used for making sutures ever since 1900s owing to the presence of Kangaroo cut and Cat gut. The silk sutures have great tenacity and knotting strength. In order to increase the microbial resistant property, coating agents such as treatment with Thermomyces, silver doped bioactive glass powder and tetracycline coating on silk. The only substance being used for impregnance is Triclosan but since its harmful for humans, chitosan, a biopolymer is used for coating. Along with that, some naturals components like aloe vera powder and curcumin powder are used. This coating showed a better strength and bending rigidity.

Depending on the layer of natural coating given to the braided silk structure, the level of optimum distance between the skin and silk suture varies. These sutures are non-implantable in nature. Non absorbable sutures are used in dermatology because of the time taken for degradation. We can enhance the property using the natural coating agents which we have used in this paper. Properties like high tensile strength, high knot strength, less memory, less stiffness and high coefficient of friction. The inflammatory response will be peak during the different intervals of the treatment. The test analysis such as tenacity, knot pull strength, bending rigidity, coefficient of friction, anti-bacterial activity was made. The scanning electron microscope was used to compare the results.

Design of Woven Fabric Inspired 3D Printed Bone Implants

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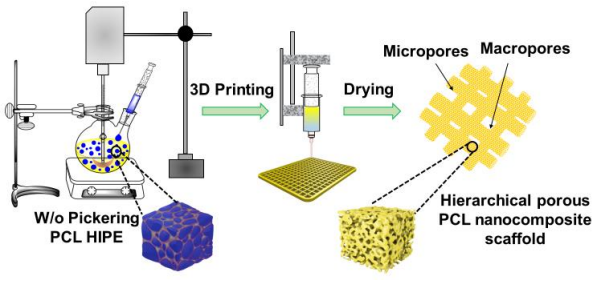
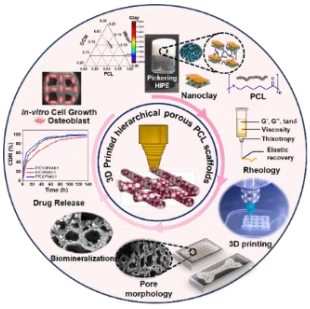
Abstract

Although bone tissue can heal itself, it cannot fully cure large-volume bone defects or damage to the articular cartilage brought on by trauma, infection, or aging. The regeneration of bone is complex because it involves a number of molecular, cellular, biochemical, and mechanical cues. Hierarchical porous 3D scaffolds of biodegradable polymers play a crucial role in damaged tissue repair through simultaneous mimicking and regulation of cellular response. Commercially, these are typically prepared by using porogenic materials within polymeric matrices, but they lack interconnectivity, limited control over design architecture, become tissue specific and so on. Among the numerous scaffold construction processes, textile technology has demonstrated its distinct benefits in imitating the features of human tissues such as hierarchical, anisotropic, and strain-stiffening capabilities. Textile patterns, as fundamental components in textile technology, influence the porosity, architecture, and mechanical properties of textile-based scaffolds. However, the potential of varied textile patterns in the fabrication of textile-based scaffolds has not been substantially explored, and the effect of different textile patterns on scaffold qualities has not been thoroughly researched. Herein, we have mimicked a 3D woven fabric architecture through printing a biopolymer (poly(ε-caprolactone), PCL) ink. Combination of the high internal phase emulsion (HIPE, with the disperse phase volume fraction higher than 0.74) templating and 3D printing technology is utilized where emulsion droplets act as the sacrificial template for micropores and macropores which form upon subsequent solvent and disperse phase evaporation. Thus, it leads to the formation of microporous architecture within the 3D printed macroporous fabric architecture. These bio mimicked fabric mats demonstrated bone like morphology and mimicked mechanical strength of human cartilage. The pore morphology resembling the natural extracellular matrix and the mechanical properties of scaffolds are customizable by tuning the emulsion composition and 3D printing parameters. In-vitro cytocompatibility tests using osteoblast cells, In-vivo studies, biodegradation, anti-inflammatory drug release profile and bio-mineralization experiments reflected the potential of such architectures in the field of bone tissue engineering.





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Cantharis Q Incorporated Polyvinyl Alcohol Nanofibrous Mat for Burn Wound Healing: Preparation, Characterization, and In Vitro Release

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Abstract

In the realm of medical textiles incorporating nanofibers have emerged as a promising avenue in the development of transdermal drug delivery systems for burn wound scaffolds. Cantharis Mother Tincture Q (CMT) is a crude alcoholic extract of blister beetle Lytta vesicatoria commonly known as Spanish fly having cantharidin. This study investigates the potential of Cantharis Mother Tincture Q (CMT) a traditional medicine incorporating Polyvinyl Alcohol (PVA) at different ratios PVA/CMT- 70:30 (CMT-30), 60:40 (CMT-40), and 50:50 (CMT-50) to produce nanofibrous mats using the solution electrospinning process. The investigation encompassed an analysis of fiber morphology, moisture management properties, bonding behavior, and in vitro drug release profiles by scanning electron microscopy (SEM), moisture management tester (MMT), Fourier transforms infrared spectroscopy (FTIR), and in vitro drug release respectively. SEM revealed that the diameter of PVA/CMT blend fibers was found to be 136 nm, 222 nm, and 226 nm for CMT contents of 30%, 40%, and 50%, respectively. Notably, the MMT results demonstrated optimal moisture management properties for the CMT-30 nanofibrous mat eclipsing the performance of CMT-40 and CMT-50 and consistently aligning with the AATCC-195-2009 standard. The characteristic peaks of PVA and CMT constituents in FTIR spectra of the developed mat confirmed the presence of both components. The in vitro drug release tests disclosed distinct release patterns, with CMT-30 exhibiting a burst release commencing at 40 minutes, CMT-40 at 4.40 hours, and CMT-50 at 10 hours. These findings underscore the potential of PVA nanofibrous mat incorporating CMT for enhanced transdermal drug delivery in burn wound healing applications.

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Acknowledgment

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Effect of Flow Media in RTM Process

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Abstract

Resin Transfer Molding is one of the popular techniques to make fiber reinforced composites (FRC) in metro industry. The layers of glass fibers are impregnated with phenolic resin to make the composite with RTM process. The process has many advantages like it is out of autoclave process, both side part finish is possible, no human intervention as it is being done with molds and machines, no hazardous fumes generates as it is closed mold process and uniform part thickness is possible. However, the process being close molding process it is very important to ensure parts are properly impregnated with the resin. Sometimes dry patches are observed after opening the mound. To overcome this problem a special flow media between the layers is used to help the impregnation of resin throughout the part. In this paper various methods of impregnating resin with two different flow media and one with special weaved mat for RTM process has been used. The mechanical properties with both different flow media and special mat have been studied and it was observed that the one of the flow medias gave proper flow, parts without defects and better mechanical properties using phenolic resin system than the other two methods for manufacturing FRC parts with RTM process.

Acknowledgment
The author acknowledges the overall support received from the Mass Transport Department of Reliance Composites Solutions, Vadodara.

A Study on the Creep Behaviour of Ozone Treated Jute Fabric/Epoxy Composites Filled with Ozonized and Pulverized Cornhusk Fibres

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Abstract

In present work, the creep performance of ozone treated jute fabric/epoxy composites was studied at different environment temperatures after incorporation of 1, 3 and 5 wt % of ozonized and pulverized cornhusk particles. The ozone treatment of jute fabric as well as cornhusk fibres was found successful in removal of non-cellulosic contents. Furthermore, the ozone treatment of cornhusk fibres was observed beneficial during ball milling as it easily pulverized them into particles due to decrease in strength. When the creep behaviour of composites was investigated using several creep models (i.e., Findley's power law model, Burger's model, and Coupling Model), the incorporation 3 wt % cornhusk particles was found to reduce the creep deformation and strain rate of composites to greater extent especially at higher temperatures. The 3 wt % cornhusk particles were found to restrict the segmental mobility of epoxy matrix in extended temperature range of 100°C–140°C. Nevertheless, the microbead pull out and nanoindentation tests indicated that the interfacial shear strength properties of composites increased after the incorporation of 5 wt % of cornhusk particles. Among various creep models, the coupling model predicted the creep behaviour of composites more accurately in addition to explanation on the creep mechanism.

Keywords
Cellulose; Jute fabric; Cornhusk fibres; Oxidation; Creep Modelling.

Advancements in Single Fibre Testing for Technical Textiles and Composites

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Abstract

Single fibre testing stands as a foundational method for gaining insights into the intrinsic material properties of fibres, particularly tensile strength and modulus. The single fiber approach becomes even more enlightening when paired with linear density measurements for each individual fibre. While well-established for common synthetic fibres like cellulose, polyester, and polyamide, the application of single fibre testing extends its efficacy to less common fibres such as UHMWPE, Aramide, as well as glass or carbon fibres and can ultimately be applied to any kind of fibre.

In light of the ever-increasing demand for expediting research and development across all fibre types, there is a growing desire for automation in testing procedures. Automation not only conserves valuable operator time but also enables the generation of a wealth of analysable testing data.

Furthermore, recent years have witnessed the emergence of new single fibre testing techniques. The first example is the single fibre pull-out test, which provides insights into the adhesion between fibres and their surrounding matrix, offering valuable information about bonding types in fibre reinforced composites. The second example involves concurrent measurement of single fibre conductivity during tensile or alternating load tests. This dynamic measurement of conductivity as a function of fibre stretch and the subsequent loss of conductivity after cyclic loading holds significant relevance for applications such as smart textiles, textile sensors, conductor fibres, and antistatic materials.

In our presentation, we will share the latest developments in single fibre testing techniques, their automation, and their practical applications through a series of case studies.

Exploring The Impact of Jute Fabric Reinforcement on the Mechanical Characteristics of Poly Lactic Acid Composites: A Research Study

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Abstract

The pressing need for sustainable materials has driven considerable research into bio-composites that marry natural fibers and biodegradable polymers. This study focuses on an eco-conscious solution by combining jute fabric and Poly Lactic Acid (PLA) via the compression molding technique. Unique to this work is the evaluation of three distinct jute fabric weave patterns—plain 1/1, twill 2/2, and sateen 1/4—as reinforcement in the PLA matrix. This study encompasses an exhaustive methodology, including the production of jute fabric on a hand loom machine, yarn and fabric property assessments, alkali treatment protocols, and crimp percentage evaluations.

Mechanical characterization of the composites revealed significant enhancements in tensile, flexural, and compressive strength upon the inclusion of jute fabric. Alkali treatment served as a catalyst for further improvements. Distinctive findings were made regarding the impact of weave patterns on mechanical performance. Specifically, the plain 1/1 weave exhibited the highest crimp percentage but yielded lower mechanical properties. In contrast, the sateen 1/4 weave emerged superior in mechanical evaluations, even outperforming neat PLA samples. This superior mechanical integrity is attributed to sateen's weave architecture, which distributes tensile loading across multiple yarns, enhancing its resistance to failure.

The twill 2/2 weave also demonstrated increased mechanical properties over the plain 1/1 weave, establishing the critical role of weave pattern and fabric density in dictating composite performance. Given these results, the study suggests a hierarchy in mechanical performance among the tested weaves, potentially guiding future research and applications in sustainable composite materials.

Overall, this research study focuses on critical insights into how natural fibers, when adequately processed and woven, can dramatically elevate the mechanical properties of biodegradable polymers, thereby leading the way toward a new generation of eco-friendly, yet mechanically robust, composite materials.

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Effect of Operating Pressure And Processing Time on Physico Mechanical Properties of Compression Moulded Nettle/Pla Biocomposites

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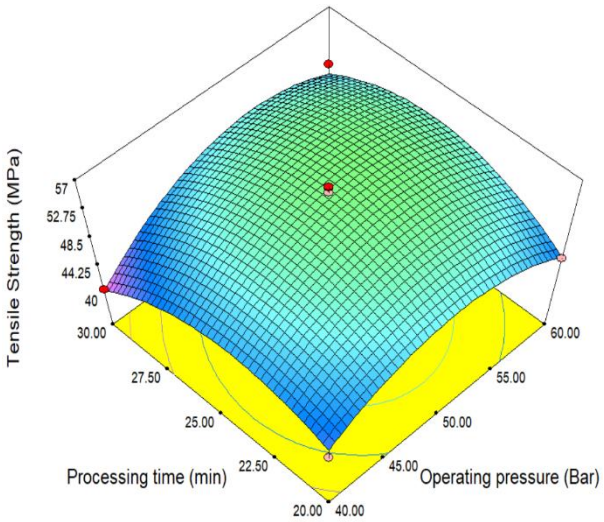
Abstract

Recent studies say structural form of reinforcement (yarn or fabric) influences physico-mechanical properties of the biocomposite. Making a unidirectional (UD) nettle/PLA biocomposite shows an improvement in the results of static and dynamic mechanical properties of UD biocomposite, as compared to the biocomposite having short fibre as reinforcement. But maintaining integrity of orientation of yarn-preform is difficult job, especially during fabrication through compression moulding, whereas maintaining integrity of tightly woven fabric is easy. Additionally, this woven reinforcement can give us a bidirectional biocomposite. Literature mentioned multi-ply biocomposite from successive layers of reinforcement and matrix can perform well as integral-structural-element. Consequently, it gives us an open opportunity to developed isotropic biocomposite by angle-ply layup of reinforcement. So, in this study authors tried to optimize process parameters for biocomposite having multilayers of reinforcement.

The combined effect of operating pressure and processing time for a biocomposites having multilayered reinforcement is illustrated in the figure. At the both low and high level of operating pressure, the tensile stress increases then decreases with the increase in processing time. This refers to the concepts of better impregnation of reinforcement within the matrix with increasing dwell time to the optimum extent; and consequent partially degraded matrix for long exposure time. At a higher level of operating pressure higher magnitude in the value of tensile strength is observed, which specifies biocomposite having higher number of reinforcing layers perform well after consolidated with higher pressure. This theory strongly get validation once at a higher level of processing time, the tensile strength increases with the increasing processing pressure. At lower level of processing time with increasing pressure tensile strength increases, although to a very poor extent. Though a slight drop of mechanical strength is monitored at very high processing pressure, that suggests effect of pressure on the polymer melt which may leads to the degradation of matrix.



Enhancing UV Protection, Antimicrobial Properties, and Flame Retardancy of Cotton Fabrics Coated with MgO-Al2O3 Nanocomposites

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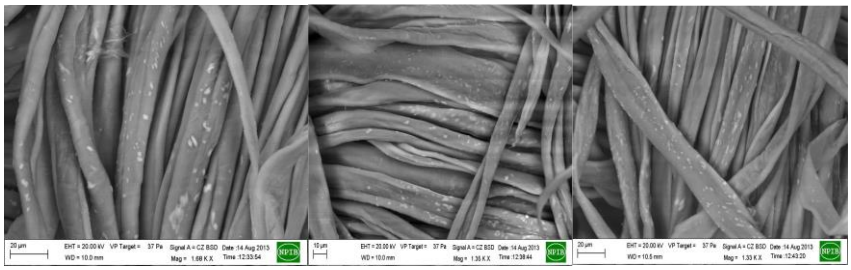
Abstract

Metal oxide nanoparticles have been very popular to enhance some specific properties of fabrics when these are applied on fabrics. Multiple nanoparticles can be blended to form nanocomposites and can be used for the enhancement of multiple properties as per their inherent properties. The Magnesium Oxide nanoparticles are mostly known to impart fire retardancy whereas the Aluminum Oxide nanoparticles are known for their antibacterial and UV protection. The objective of this research is to assess the effectiveness of MgO-Al2O3 nanocomposite-coated plain-woven cotton fabrics in terms of ultraviolet protection factor, antibacterial characteristics, and enhancing fire retardant properties. This nanocomposite with three different concentrations was coated on the fabric samples by pad-dry-cure method. The uniform deposition of the nanocomposite on the coated fabric surface was ensured from the images captured from the Scanning Electron Microscope (SEM). The ultraviolet protection factor, antibacterial and the flame retardance property of the



c b a

Figure 1: Scanning electron microscopy images of Al_2O_3 nanocomposite coated fabrics: a-0.5%; b-1% and c-1.05% nanocomposites on the weight of the fabric.

nanocomposite coated fabrics are improved as compared with the untreated fabrics. These properties also improved with the increase of the concentration of nano composites. The performance of the fire retardance property of the nanocomposite coated fabric was evaluated against that of a commercially successful fire-retardant finish namely Pyrovatex CP. The limiting oxygen index (LOI) and burning time of the 1.5% concentration nanocomposite coated fabrics found to be slightly better as compared to the Pyrovatex CP treated fabrics. Hence, MgO-Al2O3 nanocomposite can be used for the enhancement of multiple properties like ultraviolet protection, antimicrobial and flame retardancy.

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MOF Nanoparticles based highly effective, durable Antiodor and Antimicrobial Finish for Polyester Fabrics

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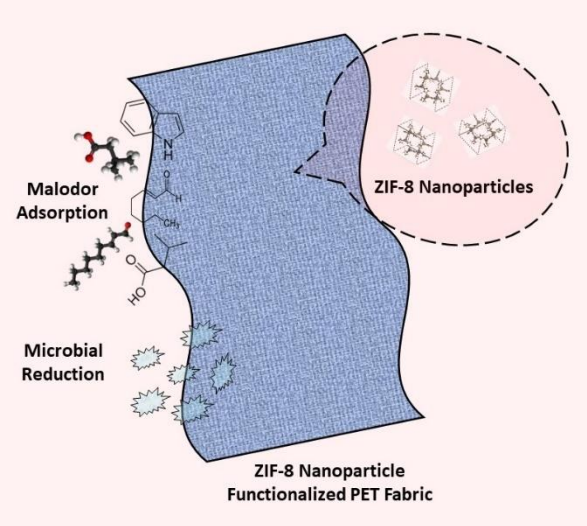
Abstract

To achieve effective odor control in textiles, it is necessary to simultaneously employ two approaches. The first involves the capacity to absorb body odors and volatile organic compounds (VOCs) found within the microenvironment between the skin and the textile layer. The second entails the textile's ability to eliminate and prevent the proliferation of odor-causing bacteria. Unfortunately, many existing finishes rely on only one of these methods, which diminishes their overall effectiveness. In our research, we have introduced the use of Zeolitic Imidazolate Frameworks, specifically ZIF-8 nanoparticles (NPs). When applied to polyester fabrics, these nanoparticles serve a dual purpose by both adsorbing odors and conferring antimicrobial properties. ZIF-8 NPs, with an average size of approximately 60 nm, were synthesized using a water-based method at room temperature. They were subsequently applied in small quantities to PET fabric using a commercial binder. The resulting polyester fabric functionalized with ZIF-8 (referred to as ZIF-8@PET Fabric) was subject to characterization to assess its morphology and functionality. These fabrics demonstrated the capacity to adsorb substantial amounts of three odor-causing model compounds: isovaleric acid, indole, and nonenal. Additionally, they exhibited effective inhibition of bacterial growth, specifically against E. coli and S. aureus. Furthermore, the fabric's functionality remained intact even after undergoing multiple washing cycles, and it could be reused multiple times.



Keywords
Antiodor, Malodor Adsorption, Antibacterial, multifunctional, metal-organic frameworks (MOF)

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Advancement of the Performance of Dyed Textiles Via Colorless Biobased Multifunctional Finishing Agent

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Abstract

Nowadays, research community is highly engaged in reducing the catastrophic impact of synthetic chemicals and working in this line for prevention, reduction, recycling, and reuse of the biobased textile finishing agents. This abstract explores the application of colorless multifunctional finishing agents as a novel approach to improve the quality and durability of dyed materials. Traditional textile finishing processes primarily aim to impart desired functionalities and appearance through the application of various chemicals and treatments. However, these processes often involve the use of colored agents, which can affect the original hue of dyed materials. In contrast, colorless multifunctional finishing agents offer a compelling solution by providing functional benefits while preserving the intended color and appearance of the fabric. This study investigates the application of colorless multifunctional finishing agents to improve the functional performances of dyed materials such as antimicrobial, ultraviolet resistance, and oxidative stress resistant. The finishing process involves the application of eco-friendly, non-coloring polyphenolic secondary metabolites to achieve desired functional characteristics. The finished fabric has shown exceptional ultraviolet protection (50+ rating) and more than 90% oxidative stress resistant and antimicrobial properties without compromising the basis physical and aesthetic attributes of the fabric, expanding its potential in the global marketplace. Moreover, the study discusses the ecological and economic benefits of utilizing colorless multifunctional finishing. By reducing the need for color-altering finishing agents, manufacturers can streamline their processes, conserve resources, and minimize environmental impacts. This research contributes to the ongoing efforts to improve the textile industry's sustainability, all while ensuring that the original beauty and color of dyed fabrics are preserved.

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Development and Evaluation of Mosquito Repellent and Antibacterial Microcapsules Containing Catnip Essential Oil Using Complex Coacervation Approach

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Abstract

In recent years, protective textile materials have captured a lot of attention on a global scale. The textile sector is increasingly focusing on natural raw materials which are economically and environmentally safe and are eco-friendly agents in the manufacturing process, with the potential of recycling.

In the present investigation, gelatin-gum arabic microcapsules filled with catnip oil were prepared using complex coacervation technique of microencapsulation. The treated cotton fabric was investigated for mosquito repellent and antibacterial properties using standard tests methods. Since ancient times, people have used plant-based repellents as a form of personal protection against mosquitoes and bacterial infestations. Therefore, catnip oil was used in this study for the development of novel natural-based finish for cotton as an alternative to chemical repellents. Catnip essential oil is generally dominated by nepetalactone isomers and has many medicinal properties along with the potential to repel mosquitoes, bacteria and other insects.

The characterization of the prepared microcapsules and the treated fabric was evaluated using scanning electron microscopy (SEM) and Fourier transform infrared (FTIR) spectroscopy. The encapsulation yield percentage was also calculated to optimize the concentration and ratio of wall material and core material. Also the microcapsules provided a controlled release system which delivered excellent wash durability up to 10 washes. It was found that the gelatin-gum arabic microcapsules with catnip essential oil showed yield percentage of 75.43%. The results also revealed that the encapsulated cotton fabric displayed antibacterial percentage of 99.9% and 99.9% against Staphylococcus aureus and Klebsiella pneumoniae respectively and after 10 washes it retained the properties with 98.6% and 96.5% antibacterial efficacy against Staphylococcus aureus and Klebsiella pneumoniae respectively. The excito chamber mosquito repellency test showed 100% and 90% repellency before wash and after 10 washes respectively. The results showed that the finished fabric developed from eco-friendly wall and core materials was durable against both the properties, suggesting that the catnip essential oil containing components such as nepetalactones can effectively repel mosquitoes and inhibit bacteria.

Keywords
Catnip, Microencapsulation, Antibacterial clothing, Mosquito repellent textiles, Complex Coacervation

Isolation And Production of Crude Cellulase Enzyme from Cellulolytic Bacteria and Biopolishing of Cotton Knitted Fabric

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Abstract

The adoption of biological treatment of textiles has gained popularity recently. The bio-polishing process targets the removal of the small fiber ends protruding from the yarn surface and thereby reduces the hairiness or fuzz of the fabrics. The purpose of this study was to produce a crude cellulase enzyme from cellulolytic bacteria and apply it on cotton knitted fabrics for the biopolishing treatment.

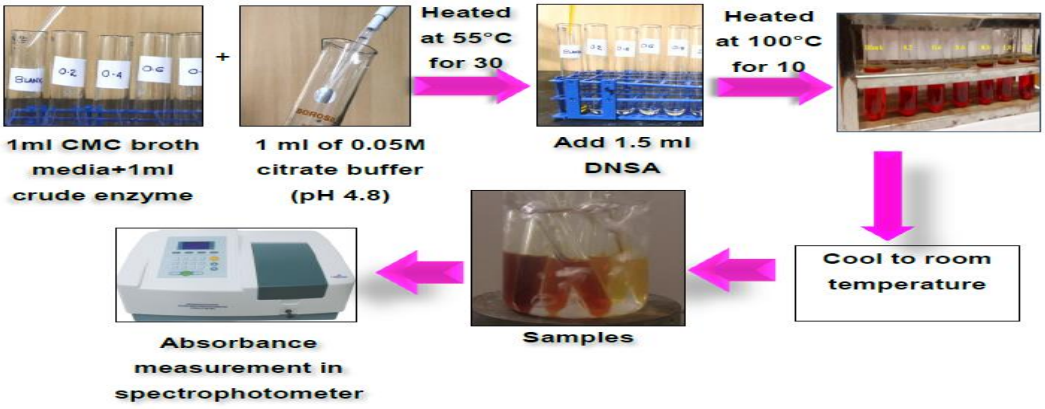

Figure 1: Enzyme activity determination by DNSA method

In this study, biopolishing was carried out on scoured-bleached fabric using crude cellulase enzyme considering three factors like concentrations (6 mL/L, 8 mL/L, and 10 mL/L), treatment duration (40, 50 and 60 minutes), and temperature 55℃. The properties such as weight loss, strength loss, pilling resistance, abrasion resistance of biopolished fabrics were measured. Fourier Transform Infrared spectroscopy (FTIR), Scanning Electron Microscope (SEM), Energy Dispersive Spectroscopy (EDS), and Thermogravimetric Analysis (TGA) were also analyzed. It was observed that crude cellulase enzymes exhibit optimum activity at 55℃ using 10 mL/L enzyme concentration and pH 4.5 for 60 minutes. All these results support that the crude cellulase enzyme produced from cellulolytic bacteria was a good biopolishing agent for textiles.

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Omyafiber® solutions for Fibers and Nonwovens

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Abstract

Omyafiber® is a calcium carbonate solution specifically designed for fiber spinning applications. Its tailored particle size distribution and proprietary treatment enable excellent dispersion during the compounding and fiber extrusion process. Omyafiber® proprietary treatment also offers excellent temperature stability and compatibility with polyolefins as well as polyester, PLA and polyamide. To round up the product design, Omyafiber®'s tight quality control secures smooth and stable processing with no concerns about pressure rise. Being a renewable raw material with low carbon footprint, Omyafiber® reduces the overall green house emissions of the final fibre or nonwoven and its addition improves the sustainability of the final application. Studies have also demonstrated that Omyafiber® is not causing skin irritation, nor skin sensitization, making it a suitable solution for sensitive applications like textiles, personal care and hygiene. Its food contact compliance and no impact on organoleptics also open the possibility to participate in this growing market segment.

During the presentation, data from filament spinning, spunbond thermal bonded as well as spunbond + spunlacing will be shared and the impact of Omyafiber® on the process and the final properties will be discussed. To conclude, it will be shown that Omyafiber® can improve the haptics and optical appearance of the final fibers and nonwovens.

Utilizing Soybean Protein Fibre as a Means of Sustainable Development

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Abstract

The awareness for menstrual hygiene have become more and more important for both physical and psychological health of a woman. Various unsafe and unhygienic materials like rags, leaves etc., were utilized earlier for menstrual management that caused several harmful effects. Sanitary pads were introduced in the early 19th century, which are made of synthetic, non-biodegradable materials, the continued use of which causes skin irritation, itching, rashes, and complex disorders including cervical cancer. Moreover, the environment is currently struggling severely as the atmosphere is exposed to hazardous gases because there is a significant volume of non-biodegradable waste dumped in landfills. Several efforts are being given in order to protect the environment by the use of various biodegradable and sustainable fibres providing great potential for creating sustainable textiles.

In this paper, efforts are made for a sustainable step by utilizing alternative materials to develop reusable absorbent of menstrual fluid replacing synthetic materials used in commercially produced sanitary napkins. The materials used to develop the washable sanitary pads includes two significantly efficient functional property bearing fibre producing fabrics namely, soybean fabric and bamboo terry as a surface layer and an absorbent layer respectively along with a leak-proof layer to develop a skin-friendly, biocompatible product.The developed pad was tested for absorbency, wicking, retention, strike through and antimicrobial properties. The results of all the tests performed on the developed product shows significant difference than that on commercial products.This approach can be considered to contribute for the betterment of a healthy environmental scenario from the perspective of woman health, sustainability and environmental health concerns.

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Fabric Waste Minimization in Readymade Garment Units: A Step towards Sustainability in Textile Industry

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Abstract

The textile industry is one of the most important categories in the consumer products sector. However, the textile sector is accused of being one of the most polluting industries. Apparel sector is one of the major sectors competing for natural resources and is gaining awareness of hazards to environment. The growing cost and diminishing availability of landfill space, as well as the depletion of natural resources, drive the need for efficient clothing waste management. Efforts must be made to preserve our environment and control the waste generation in apparel. The initial step for the industries is to assess their environmental impacts and identify areas for improvement in order to take a sustainable approach. Companies in the fashion and textile industries are looking for innovative sustainable solutions right now to lessen their environmental effect. The readymade garment industry generates a significant amount of fabric waste, which includes cutting scraps, leftover fabric pieces, and faulty garments. Managing this waste is essential for achieving sustainability in the industry. The study conducted gave insight into the industrial overview of fabric waste generated. Readymade garment industries of Kolkata were surveyed to know about the generation of waste, waste management policies employed and their willingness to incorporate this new concept in their organization or not. More than seventy per cent of the total waste was that of fabric waste in all the micro, small, medium and large industries surveyed. The micro and small industries majorly being unorganized, had greater amount of mixed waste generation. The goal of the study was to introduce and illustrate the notion of zero waste fashion as a sustainable way towards fabric waste minimization. Pre-consumer zero waste and post-consumer zero waste fashion are the two main strategies for waste management. The pre-consumer method, which eliminates waste during manufacture, is the main objective of this study. The goal of zero-waste fashion is to eliminate manufacturing waste by using a holistic approach to many components like designing, drawing, pattern cutting, and draping. Certain points were considered while designing the zero waste garments to cope with changing fashion trends keeping in mind the target group, market suitability and current trends. In this study, women's garments were created with the idea of zero waste and sustainability in mind. The last phase was to determine whether potential customers and manufacturers would accept these designs. Manufacturers responded far more favourably to zero waste concepts in the built clothing than did potential customers.

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Acknowledgment

The author acknowledges the support received from the readymade garment units surveyed in Kolkata for sharing their information and giving their valuable feedback.

Textile waste as sustainable substrate for seed germination and plant growing

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Abstract

Textile waste is playing a major role in increasing environmental pollution. Increasing waste on land and growing population, decreasing land for farming and plantations, attract new methods of agriculture. Vertical farming is one of the suggested solutions for producing food for a growing population. Concentrating the cultivation of plantations and managing the textile waste in growing herbs, shrubs, and small plants. This study investigates the replacement of soil with textile waste for different plants in a vertical planting system and the suitability of textile waste as a sustainable substrate in a natural outdoor environment. To find out if plants require specific lighting conditions or added fertilizer in the process. This study aims to investigate whether textile waste can be used as a replacement for soil for planting and to examine the degradation of textile waste as a substrate for plant growth. To this end, seed germination, seedling growth, and planting of moss, herbs, shrubs, and small plants with dicot roots and monocot roots were observed on woven and non-woven textile waste in a natural outdoor environment near a roadside with no specific lighting and no added fertilizers. The developed plants on textile waste in this ecosystem have attracted insects and become natural habitats for insects like honeybees, ants, and earthworms. The textile waste also absorbed the fine dust pollution from the roadside area. This fine dust with given regular water decomposes the textile waste. To this end, the result showed that moss, herbs, shrubs, and small plants with taproots (dicot) and fibrous roots (monocot) on textile waste are indeed possible and allow for growing a platform for plant species, suggesting recycling of textile waste for growing plants to increase the greenland and saving land to be filled with textile waste.

Acknowledgment
The author acknowledges the project is self-funded.

Investigating the Environmental Sustainability of Military Combat Uniforms: An Integrated Analysis of Material Sourcing, Production Processes, and Disposal Practices

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Abstract

Combat uniforms play an essential role in military operations, yet their environmental impact is a high concern in today's era of raising environmental awareness. This research endeavours to comprehensively examine the environmental sustainability of combat uniforms by scrutinizing three pivotal dimensions: material sourcing, production processes, and disposal practices through literature, and journals. The study offers insights into the environmental footprint of military apparel and illuminates avenues for eco-conscious enhancements.

This research offers a holistic perspective on the environmental sustainability of combat uniforms by synthesizing findings from each lifecycle phase of material from fibre to disposals of the uniform. The insights gained herein align with global efforts to address climate change and safeguard natural resources, rendering military operations more ecologically sustainable.

In conclusion, this research contributes to the broader discourse on sustainable military practices by shedding light on the environmental implications of combat uniforms. Through an analysis encompassing material sourcing, production processes, and disposal practices, this study lays the foundation for more eco-conscious decision-making within the defense sector.

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Sustainable Chemical-Free Reactive Dyeing on Chemical-Free Pretreated Cotton

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Abstract

The textile industry is one of the main industries for ingestion of both surface and groundwater, along with the usage of chemicals and synthetic dyes. Numerous initiatives attempted to address the most popular synthetic dyes' sustainability concern, where investigations have discovered cationization-based, salt-free reactive dyeing, process alternation by using polyacrylonitrile, cationic acrylic polymer, methylamine, trisodium nitrilotriacetate (TNA), etc. Many of the chemicals used to create cationic sites in cotton are neither eco-friendly nor sustainable [1]. Nevertheless, all the alteration or critical process adaptation options could not open a real cost-effective, energy-saving, and eco-friendly window. In this context, researchers investigated less chemical-consumed pretreatment and even chemical-free pretreatment on cotton knit fabric [2]. According to their research, chemical-free pretreated cotton has a higher dye uptake capacity than conventionally pretreated ones. This can be a hint for higher dye uptake by the cotton fabric. Auto-ionization can assist cellulose in turning into cellulosate ions (Cell-O-), which then can react with the reactive dye cation (C+). By dint of this encouraging hint, the present work was carried out by applying bi-functional reactive dye on chemical-free pretreated cotton knit fabric where the auxiliaries were not present. A significant level of depth of shade (K/S ≈ 2.0) was achieved for 3% shade; then four to five times repeated dyeing was also conducted for the maximum dye pick up as a whole by the fabric. The color fastness to wash rating was almost 4 to 4/5 for all the cases. Ether linkage at 1190-1210 cm-1 was detected at FTIR, which indicates successful dye-fiber bonding. Because of the absence of all types of chemicals during dyeing, the effluent load was highly reduced. At the pretreatment stage, less amount of wax was reduced, so further use of softener was avoided. Still, the smoothness, softness, and touch-feel properties were the same as the conventionally softener-applied fabric. The overall cost dropped at a remarkable level. The detailed CIE Lab values along with CMC DE color differences were revealed.

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Acknowledgment

The authors acknowledge the processing trial support received from the factory Texurop BD Ltd., Vogra, Gazipur, Bangladesh.

Optimization by statistical and unitary methods of dyeing cotton khadi fabric with African tulip flower

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Abstract

India's textile manufacturing industry heavily relies on khadi, a 100% biodegradable, carbon-free material. In the current study, African tulip (Spathodea campanulate) aqueous extract was used for fabric dyeing of cotton khadi in hues ranging from medium to dark brown with African tulip using copper sulphateas a pre-mordant. Excellent rubbing (dry) and wash fastness to staining resulted together with good light fastness on the dyed fabricwith optimised dyeing parameters. The LC-MS and UV-VIS spectral analysis revealed caffeic acid as the primary colouring component in African tulip blossoms.pH - 12, 60 min, 100 °C and 1:20 MLR were identified as the ideal conditions for aqueous extraction of the dye.Similarly, pH - 10, mordant concentration - 10% (owf), 15 min and 60 °C were determined to be the ideal set of parameters for pre-mordanting the fabric using CuSO4 before dyeing with the African tulip flowers. The fabricdyeing process parameters standardized by the unitary method matched with the predicted values of the statistical approaches using the Box-Behnken model of experimental design. The best dyeing conditions were determined to be pH-2, temperature-100 °C, time-60 minutes and 100% owf for African tulip-dyed cotton khadi fabric.For this fibre-mordant-dye combination, pH and dye concentration were found to be the most sensitive dyeing process variables as identified by the higher RCR values indicating that these variables must be managed strictly to provide consistent and uniform results. The undyed and dyed fabric's FT-IR examination revealed the development of giant adduct of caffeic acid (one of the major colour component of African tulip) with copper sulphate mordant and cotton fibre substantiating good fastness property of the dyed fabric. The fabric samples that were dyed under optimized conditions provided good antimicrobial property and good UV protection.

Activated Carbon Precursors from Jute Fiber

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Abstract

Carbon fiber are one of the emerging and high performance fiber materials which are practically of great importance for various applications. In general, carbon fiber precursors are derived from fossil fuel based sources like poly-acrylonitrile (PAN) and mesophase pitch as a raw material1. The preparation of carbon fiber from ubiquitous, renewable and low-cost biomass is very attractive and sustainable growing approach in green chemistry. This study explores the systematic and facile synthesis of activated carbon precursors from low-cost and eco-friendly jute fiber as an alternative approach. The jute fiber was collected from local market and pretreated with alkaline solution. The pretreated jute fiber was carbonized at 500℃ in inert condition. The carbonized material was activated with H3PO4 and KOH. The as prepared carbon precursors were characterized with field emission scanning electron microscopy (FE-SEM), TGA and X-RD). The FE-SEM images confirmed the hollow and porous carbon precursors from jute fiber. It was observed that KOH activated carbon precursors exhibited higher porosity than the H3PO4 counterpart. The EDX analysis revealed that more than 90% atomic carbon was found in H3PO4 activated carbon precursors. The TGA analysis depicted the thermal properties of pristine jute fiber, carbonized and activated carbon precursors from jute fiber. It was observed that activated carbon fiber precursor showed much higher thermal resistance than the jute fiber. The H3PO4 activated carbon precursors exhibited highest thermal resistance showing more than 80% residual mass even at 500℃. The high thermal resistance of this carbon precursor was originated from the phosphorus (P) element whose elemental composition was 0.56% in the activated carbon fiber precursor. This attribute of activated carbon fiber precursors from jute fiber attesting the suitability of this material for thermal insulation and flame retardant applications.

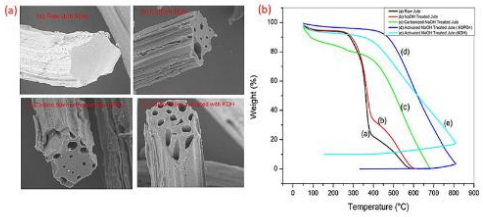

Figure 1. Cross-sectional FE-SEM images of activated carbon precursors attesting hollow and porous structure (a) and TGA thermograph of different carbons showing high thermal resistance at elevated temperatures.

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Acrylic colours: A sustainable alternative for direct dyes

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Abstract

The process of Tie and Dye traditionally uses direct dyes and is a prevalent practice across the world. However, usage of direct dyes poses sustainability challenges due to discharge of chemicals and alkaline pH. The current study is an attempt to explore acrylic colours on textiles as a potential source and a sustainable alternative to direct dyes on cotton fabric. Figure 1 shows the research design employed for the study.

Box and Behnken design of experiments was employed to optimize the dyeing parameters viz. M.L.R, time and temperature. Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) of the effluent dye liquor was also assessed and compared with that obtained after the usage of direct dyes. The optimum parameters that produced the maximum dye uptake were 500C, M.L.R 1:10, 60 minutes. Analysis of COD and BOD of the effluent liquor showed significant reduction in values as compared to that of direct dyes. Therefore, acrylic colours can be a sustainable alternative to direct dyes.

Keywords
Acrylic Colours, Direct Dye , Box and Behnken , M.L.R , Time ,Temperature.

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Sustainable Approach Towards Natural Dyeing of Leather Developed from Reishi Mushrooms

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Abstract

Natural leather replacements are a new class of morally and environmentally responsible materials that are becoming famous as an alternative to synthetic and bovine leathers since they meet the practical and aesthetic needs of consumers. Leather production, which also contributes to climate change, environmental degradation, pollution, and water poisoning, causes millions of animals to suffer and die every year [1]. In contrast to this leather which is being developed from mushroom is sustainable and have the potential to replace the animal skin. Mushroom leather is produced by using mycelium and does not go through the same processes as animal skins or have the same problems. Mycelium is a network of fungal roots that contains mycelial cells and is cultured in a controlled environment in an incubation chamber. A trail has been carried out to culture mycelium samples that were subjected to computerized tensile and impact testing. Mostly leather is colored using alcohol- or spirit-based dyes, which soon bleed into the saturated leather. In this study leather was successfully dyed using natural dye and properties were compared with acid dyed mushroom leather as well [2]. The natural dyed mushroom leather will help in reducing the carbon footprints leading to sustainable production. Keeping in view the production of mushroom leather from cultured mycelium and it dyeability with natural dyes, it can be a better alternate to animal skin for various end use applications.

Keywords
Resihi Mushroom, Mycelium, Incubation, Turmeric Dyeing, Cultured Leather

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Design and Development of 3D printed PLA blocks for Textile Printing

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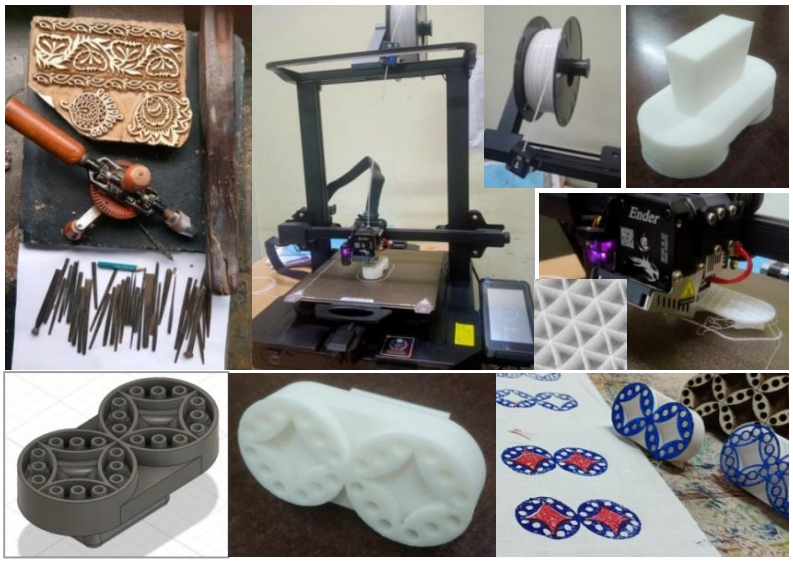
Abstract

Undoubtedly, the beauty of handmade fashion textiles comes from their human element. The age-old techniques reveal a mastery of skill and a result full of life and history. While there has always been a market for handmade goods, the present market always challenges local artisans with respect to globalisation. Adapting to the requirements of huge international customers without the infrastructure of large scale production is highly challenging. In today's world of business, application of technology is already bringing new business to old crafts. The main purpose of the study is to examine the intervention of 3D technology as a means of changing players in the practice of handmade fashion from Baby boomers to Millennials.

Graphical Abstract



A field survey based on personal interviews and observation of master block printers, new generation craftsmen and master block makers of the craft Kalamkari of Machilipatnam, Andhra Pradesh, India revealed the laborious process involved in wood block making using various mechanical devises and tools. In addition to wood, conventional block printing generally uses copper strip inlay blocks and felted blocks for printing.

Block Printing - Hand carved Wooden blocks Vs 3D printed PLA blocks

The recent technology of 3d printing has been very rapid, supported by new software for designs, new materials and digital interface, which encourages printing scaled models quickly and in detail. Three-dimensional printing is an additive manufacturing process that creates a physical object from a digital design. Hence, the experiment was designed to compare the outcome of block printing using blocks made of two different materials such as wood and PLA, made of hand carving and 3D printing techniques respectively. Desktop modeling software and a 3D printing machine ENDER was used for 3D printing of blocks in

the same pattern using PLA polymer filament of 1.75mm. Further, the performance of the blocks is assessed comparing the fabrics printed using three different print mediums; pigments, reactive dyes and selected natural mordents on cotton fabrics.

The research paper describes 3D modeling and various technical parameters of 3D printer used in the 3D printing technology; the technology of Fused Deposition Modeling (FDM) using a biopolymer Poly Lactic Acid (PLA) that is renewable and biodegradable material, used for 3D printing of blocks and the aspects of sustainability involved in the present study.

Although wood is seen as a sustainable material for various applications at present and also foreseen as a future material, continuous cutting down of the trees and using the heart wood of perennial trees may not be sustainable in today's context. Combining the technology of 3D manufacturing and block making for textile printing could incorporate modernity while still respecting tradition. The PLA block printing tends to be safer, easier to use and has minimal ergonomic risks of neck, shoulder and wrist joint pains which are otherwise caused due to handling of heavy blocks. Comparison of some of the visual and technical aspects of block printing such as design compatibility, time taken for block making, level of craftsmanship needed, weight and impact of blocks needed, material wastage, cost, quality of prints, texture, clarity of background, ease of cleaning and drying revealed that the PLA blocks made of 3D printing has the potential to be used in block printing techniques.

Keywords
Block Printing, PLA, 3D Printing, Desktop Modeling, Sustainable, Digital Transformation, Recycling

Subtheme
Product Development

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The authors of the paper acknowledge the master block makers and printers of the craft Kalamkari of Machilipatnam of AP for providing insights necessary for this research and also the technical staff of Weavers Service Center, Hyderabad for their support in experimentation, which formed the ground for the study.

Effects of various natural mordants on Babool based dyeing of recycled cotton fibre for sustainable textile coloration: An Investigation

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Abstract

This paper investigates the utilization of babool natural dye extract on recycled cotton fibers, employing a range of natural mordants. This innovative amalgamation not only addresses pressing ecological concerns but also resonates with evolving consumer preferences for ethically produced and eco-friendly products. Through meticulous experimentation and analysis, this paper addresses on the feasibility and potential benefits of employing Acacia nilotica-based natural dyes in enhancing the value and eco-friendliness of recycled yarn, thereby contributing to the ongoing discourse on sustainable textile practices. Employing various natural mordants viz., salt, vinegar, coconut husk, banana stem, myrobalan [(Figure 3.a) represents the shade produced with babool bark extract with salt as a mordant b) vinegar as a mordant c) natural dye extract)] on recycled cotton yarn dyed with natural dye extract obtained from barks of acacia nilotica are conducted and the characterization will be carried out on the samples. The study aims to assess the effects of diverse natural mordants on color vibrancy, wash-fastness, color strength and functional properties of dyed recycled cotton fiber will be characterized by colorimetric analysis, K/S Vs. wavelength spectra of dyed samples, and UV–visible spectroscopic analysis of mordant and dye extracts. and overall sustainability of the dyeing process. It is anticipated that by employing natural dyes and recycled fibers, the textile industry reduces its ecological footprint, mitigating the environmental harm caused by conventional dyeing processes.


Figure 1: Barks of Acacia Nilotica / powder form


Figure 2: Extraction of dye


Figure 3: a

Figure 3: b


Figure 3: c

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Financial support provided by All India Council of Technical Education-Indian Knowledge System (AICTE-IKS); New Delhi is thankfully acknowledged. We thank Kumaraguru Institutions, Coimbatore for their support and guidance

Keynote Talks

Chemically Treated Fibrous Air Filters for Automotive Engine Closing the Loop: Sustainable Sourcing and Textile Recycling for a Circular Economy

Anurag Gupta

Abstract

Integration of Disciplines
- Circular economy principles applied to textile recycling harmonize economy, management, engineering, technology, and societal impact.

-Interdisciplinary Synergy
- Collaborative approaches among various disciplines are essential for addressing environmental challenges in textile recycling and achieving sustainable development goals.

Policy Frameworks
- Implementation of innovative policies, including market-based instruments and circular public procurement, is imperative for advancing circular economy practices in textile recycling.
- Emerging policies like the EU eco design for sustainable products and the EU Product Environmental Footprint guide are becoming pivotal in addressing the profound effects of climate change.

Technological Advancements
- Embracing technical cycle solutions is crucial for achieving circular economy objectives in textile recycling, focusing on efficient waste management, 3R strategies, and renewable energy.
- Diverse circular practices, such as reuse, upcycling, mechanical recycling, and chemical recycling, are integral components of technological advancements in textile recycling.
- Areas of technology intervention range from collection, sorting, preprocessing to recycling based on fiber composition.

Environmental Engineering Practices
- Efficient waste management, 3R strategies, water recycling, wastewater treatment, and renewable energy practices contribute to sustainability in textile recycling.
- Chemical recycling, particularly stabilizing post-consumer usage, is vital in the context of India's ample feedstock and regulated workplace environment.

Business Innovation
- Circular business models and innovations in the textile industry foster a more sustainable and interconnected economic landscape.

Effective Management
- Circular management solutions tailored to textile recycling and understanding consumer behavior within a circular economy are key focus areas.
- EU Textile Regulations, especially those enforcing Extended Producer Responsibility (EPR), play a crucial role in effective management practices.

Consumer Awareness
- Introducing circular economy product labels and building social acceptance are integral components of promoting sustainable practices in textile recycling.

Multilevel Classification
- Micro-level considerations involve firm-level engineering and managerial aspects in textile recycling.
- Meso-level focuses on industrial ecology, eco-industrial parks, and eco-clusters.
- Macro-level encompasses general policies, plans, and support for green and sustainable entrepreneurship in the textile industry.

The need for responsible social practices in the textile industry becomes evident. Embracing circular practices should not only address environmental concerns but also prioritize ethical and socially responsible practices. This involves fair labor practices, ensuring the well-being of workers, and promoting inclusivity

Protective Wear: Market Dynamics, Growth and Advancements

Aastha Kalsi
Arvind Lt

Abstract

The global market for protective wear is experiencing unprecedented growth due to heightened awareness of safety measures across industries. Market trends indicate a surge in demand for multifunctional, breathable, and sustainable protective wear. Let's delve into key markets, regulatory influences, and future projections, shedding light on the dynamic landscape of this evolving industry.

Nonwoven Innovation for Medical and Hygiene Applications

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Abstract

The innovation process of today's non-woven textile world is extremely dynamic. The innovation is mainly driven by the market demand for new products with added values, higher component products segmentation and by legislation. Spun melt and Spun bond mono- and bicomponent technologies cover the range of special products where the properties cannot be met by any other economically viable technologies available on current medical and hygiene segments.

The main requirements for today's medical and hygiene products are safety and comfort. The lecture discusses the features of the medical and hygiene components and the innovation trends to satisfy such requirements.

Chemically Treated Fibrous Air Filters for Automotive Engine Intake Application

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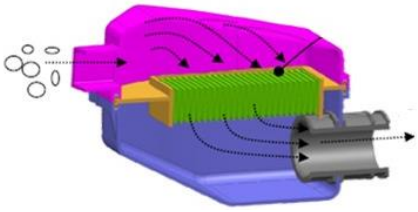
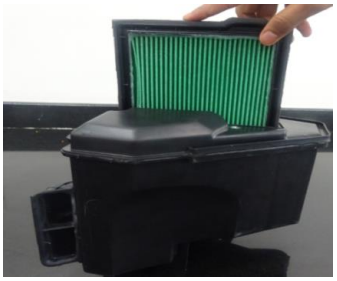
Abstract

It is quite logical to think that as the velocity of a particle increases, its momentum makes it more vulnerable to get captured by the fibres. This is, however, not always the case as found in the current research work. The filtration efficiency of a fibrous air filter can decrease at a high velocity especially for large particles. This happens due to high kinetic energy of large particles facilitating them to bounce back from the filter surface and reentrain into the airstream before passing through the filter media. This phenomenon poses a serious challenge to achieve high filtration efficiency while downsizing the automotive engines (Fig. 1a). The current research demonstrates a solution to suppress particle bounce by means of a suitable chemical treatment. As a result, no sooner do the particles touch the fibre surfaces than they are adhered to the filter media. Further, the chemically treated filter media is pleated, and the filter element is installed in a commercial air intake system (Fig. 1b) and its filtration performance is assessed and compared with that of a commercially available filter. As compared to the commercial one, the chemically treated filter exhibits higher gravimetric as well as fractional filtration efficiency, delayed rise of pressure drop and higher dust holding capacity, leading to much higher service life, more savings of energy, lower greenhouse gas emission, and less fuel consumption. Overall, the chemical treatment to fibrous air filters is found to be highly advantageous for automotive engine intake application.



(a)



(b)

Fig. 1: (a) Schematic of an engine intake air filter assembly; (b) Photograph of a prototype assembly developed in this work

Acknowledgment
The financial support received from Council of Scientific & Industrial Research (CSIR) under Project Number 22 (0838)/20/EMR-II is gratefully acknowledged.

Impact of Fiber Blend and Finishing Processes on Filtration and Related Properties of Needle Punched Composite Nonwoven

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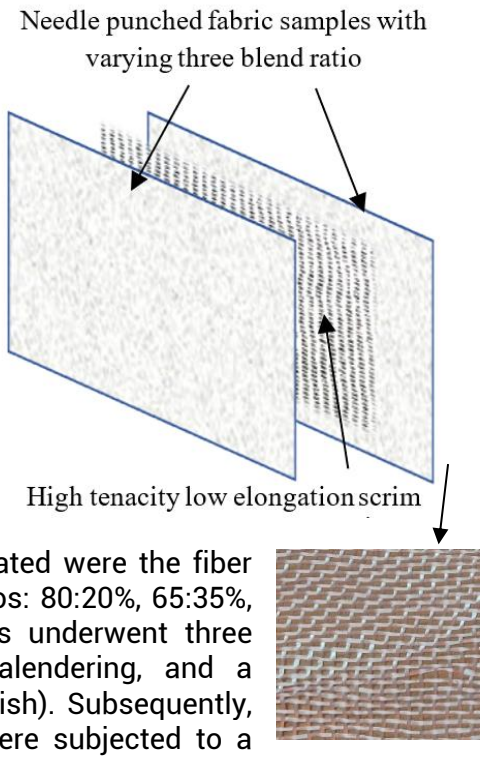
Abstract

Composite nonwovens, characterized by their versatility and multifunctional capabilities, are produced by combining disparate components using various technologies and substrates, making them cost-effective materials for a wide range of applications. This study aimed to investigate the impact of different levels of fiber blend and processing methods on the properties of needle-punched composite nonwoven fabrics. To achieve this objective, we introduced a 1000 D polyester multifilament high-strength, low-shrinkage scrim between the top and bottom layers of needle-punched nonwoven fabric during the manufacturing process. Twelve samples were meticulously prepared using the SAMHWA needle-punched non-woven machine line, with machine parameters held constant. The key variable manipulated were the fiber blend composition, which included three distinct ratios: 80:20%, 65:35%, and 50:50% of 3 denier (D):1.4 (D). These samples underwent three different processing methods: singe treatment, calendering, and a combination of calendering and singe treatment (Finish). Subsequently, the needle-punched composite nonwoven fabrics were subjected to a series of tests to evaluate their essential properties, including air permeability, pore size, filtration efficiency, thickness, bursting strength, tensile strength, elongation, and shrinkage. Statistical analysis, specifically Two-way ANOVA without replication, was employed to know the effects of fiber blend and processing on the fabric properties. The results revealed significant influences of both fiber blend composition and processing method on filtration efficiency, air permeability, pore size. Notably, as the proportion of fine denier in the blend increased, filtration efficiency improved with a reduced pressure drop, demonstrating the importance of fiber composition in achieving efficient filtration performance. Furthermore, the study highlighted the considerable impact of the processing of grey fabric on these critical fabric properties, emphasizing the need for careful consideration of processing methods in fabric development for specific applications. In conclusion, this research underscores the critical importance of a customized approach in selecting the right fiber blend ratios and processing techniques to tailor needle-punched composite nonwoven fabrics to meet specific application requirements.



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- *Acknowledgment*

- *The author acknowledges the support received from the Khosla Profil Pvt, Ltd, Kudus and DKTE TEI, Ichalkaranji for sample production, and testing received.*

Thermo-acoustic insulation behaviour of the stacked fibrous automotive-insulation materials under compression

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Abstract

Fibrous materials have traditionally been relied upon as primary sound-absorption solutions, extensively employed in various industrial contexts, including aircraft engine liners, automobiles, ships, power generators, and industrial insulation, where the demand for both thermal and acoustic insulation is prevalent. In automobiles, engine bay and exhaust systems are the most potential application areas for thermos-acoustic insulation.

In automobile engine compartments, specialized materials and components are crucial for heat management and noise reduction. Heat shields, typically made of heat-resistant materials like ceramics or fibre-glass mats, safeguard sensitive areas near high-temperature components such as the exhaust manifold. They serve to protect nearby parts from extreme heat and minimize the outward radiation of heat into the engine bay. Additionally, heat-resistant insulation blankets and wraps are used to envelop exhaust components, like the exhaust manifold and catalytic converter, effectively trapping heat within the exhaust system for improved thermal efficiency while preventing excessive heat dispersion[1].

In the exhaust system, various strategies are employed for heat and noise control. Sound-absorbing materials like fiberglass or perforated baffles are integrated into mufflers and silencers to reduce exhaust noise. Heat shields are also used to limit heat transfer to surrounding structures. Furthermore, heat-resistant wraps on exhaust pipes minimize the emission of radiant heat. Collectively, these materials and components in the engine compartment and exhaust system ensure effective heat management and noise reduction, contributing to vehicle safety and a quieter driving experience [1].

The insulation properties of materials are subject to multiple factors, among which the stacking arrangement assumes a significant role [2]. Stacked materials may or may not experience compression in places like muffler, engine room etc., which significantly impacts their behaviour.

This study reports the influence of compression on the sound absorption and thermal insulation characteristics of stacked materials. It was witnessed from the experimental study that the application of compression to stacked materials has an adverse effect on both their sound absorption and thermal insulation properties. This may be because of the reduction in the thickness of the air cavity present between the stacks due to the compression, causing less sound energy loss and high direct heat transfer.

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Particle Filtration Performance of Tribo-Charged Electrets

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Abstract

With increasing road traffic, residential emission, and industrialization, air pollution has become a serious threat to mankind. Fibrous air filters are used to capture the particles causing air pollution. Among the several mechanisms of particle capture, electrostatic attraction has been the most dominant one because of its high efficiency of capturing extremely small particles. In this work, the role of fibre mixture in deciding the filtration performance of electrostatically charged filter media has been studied systematically. The commonly available polyester and polypropylene fibres were blended in different weight fractions by employing carding and needlepunching processes to prepare a set of tribo-electrically charged filter media. The prepared filter media were tested for surface potential and filtration efficiency. The roles of fibre materials and manufacturing processes in deciding the surface potential and filtration efficiency of the filter media were investigated. It was observed that the filter medium prepared with equal weight fraction of polyester and polypropylene fibres recorded the highest filtration efficiency.

Keywords
Nonwoven, carding, needlepunching, tribo-electric, surface potential, filtration efficiency.

New Possibilities in Spunlace Nonwovens

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Abstract

Currently, over 1.8 million tons per year of spunlace is produced worldwide. The main end use is wipes of various categories. In this paper we propose tweaking existing processes, raw materials and process technology (on current machines) to make new products to meet different end-use requirements. This will increase the market breadth and usage of this unique technology for many end uses other than commodity products like wipes. The techniques and achievements in different product parameters will be discussed in detail.

References

- *Industry experience and trials*

Impact & Advantages of X Ray Gauges in Machinery for manufacturing Nonwoven, Technical Textile & Textile

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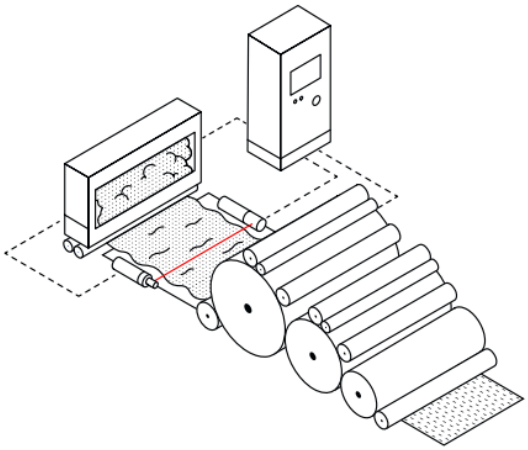
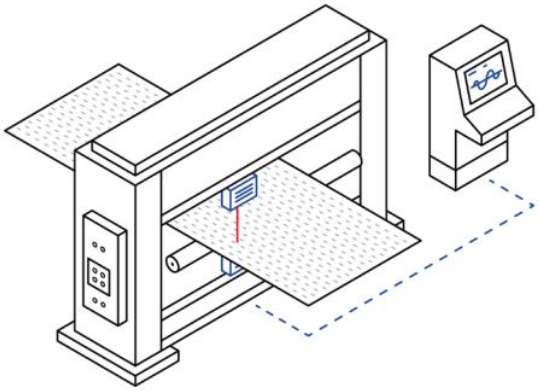
Abstract

This abstract focuses on the solutions to the following needs in textile industry to: (1) to achieve precision in evenness of mass / density of natural or man-made fibres at carding stage, (2) to maintain consistent throughput into the line, while managing too high vs too low input, proactive vs reactive management of line settings, (3) to remember optimized parameters for recurring production batches while enabling quick & efficient creation of optimized parameters for new production batches, (4) to achieve a maintenance free solution, without mechanical parts responsible for measurement making contact with fibres or finished goods, (5) to manage data & ability to communicate via different communication protocols

Drawing 1



Drawing 2



The ICTN 2023 from Dec 12 – 14th will provide my principal Serel Industrie Belgium and myself an opportunity to present effective solutions to above needs (1) – (5). Serel Belgium has pioneered in design, development, testing, manufacturing and service of this technology since 1980.

References

- *Data provided by Serel Industrie Belgium – via Managing Director – Mr Sebastien Michel*

Coaxially Electrospun Nanofibers Comprising Block Copolymer Templated Yolk-Shell Nanoparticles for Photocatalysis

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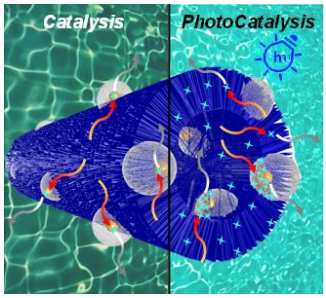
Abstract

In response to the escalating severity of environmental issues, the imperative for highly efficient pollutant mitigation methods has grown exponentially. Photocatalytic degradation, an eco-friendly treatment avenue, emerges as a potent solution, dismantling organic pollutants into benign substances devoid of secondary contamination. Herein, we unveil the fabrication of hybrid nanofibrous photocatalysts, achieved through the combination of block copolymer (BCP) templates, sol-gel processes, and coaxial electrospinning techniques. The application of coaxial electrospinning yields core-shell nanofibers (NFs), subsequently transformed into porous hollow TiO2 NFs via oxidative calcination. Hybrid BCP micelles encapsulating plasmonic nanoparticles within their cores, leading to silica-coated core-shell particles, serve as precursors to generate yolk-shell particulate inclusions within photocatalytically active electrospun nanofibers (NFs).



Remarkably, calcined NFs integrating silica-coated yolk-shell particles exhibit enhanced catalytic performance, a phenomenon attributable to localized surface plasmon resonance and confinement effects within porous TiO2 NFs housing silica-encased yolk-shells. The integration of metal oxide coaxial electrospun nanofibers alongside yolk-shell nanoparticles emerges as a potent stratagem for effecting the photocatalytic disintegration of diverse pollutants. In sum, this approach charts a promising course toward addressing pollutant challenges effectively.

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Acknowledgment

The author acknowledges the financial support received from the Deutsche Forschungsgemeinschaft , (HO 5526/2-1), Department of Science and Technology of India, (INT/FRG/DFG/P-02/2017), Volkswagen Foundation through a Freigeist Fellowship to TAFK.

Development of electrospun polyvinylidene fluoride (PVDF)/ doped potassium sodium niobate (KNN) based nanofibers as soft piezoelectric energy material

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Abstract

With the awareness of energy crisis spreading around, the quest for alternative non-conventional energy sources has been astir since the last few decades. The availability, abundance and reliability of the mechanical sources of energy has attracted the attention of the research community. Piezoelectric energy materials are emerging as one of the promising solutions to the apprehended energy crisis. Keeping environmental and toxicity issues in mind, the search for eco-friendly low toxic piezoelectric materials has led to the development of numerous novel lead free alternatives with appreciable piezoelectric properties. Potassium sodium niobate (KNN), a member of the alkali niobate family has emerged as the forerunner of such lead free piezoelectric materials. However, its properties are still inferior compared to its lead based counterparts. This work seeks to enhance the piezoelectric property of KNN by chemically doping it with metal ions i.e. zinc and tin. The doping of these foreign elements have increased the piezoelectric coefficient of the modified material to 95pC/N from 13pC/N of the pristine KNN samples. Further, the incorporation of these modified KNN nanorods into electrospun polyvinylidene fluoride (PVDF) nanofibres stabilized the electroactive β phase of this polymer. A comparison drawn between the PVDF/KNN and PVDF/doped KNN showed a significant increase in electrical output in case of doped KNN samples owing to higher piezoelectric coefficient of doped KNN. This study gives a detailed analysis of the nanocomposite material in terms of its structural, morphological, and electrical properties. It further hints at the possible ways of harvesting and utilizing energy from such material composites to cater to our energy needs.

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Acknowledgement

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Application of Polyethylenimne based Shape Memory Polymers on Textiles for Body Responsive Smart Clothing

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Abstract

Smart clothing could be utilized for wrinkle-free apparel, maintaining dimension stability, pattern keeping, and smart actuation in textile applications. The crease resistance in cotton fabric is achieved by various crosslinking finishes such as DMDHEU and BTCA conventionally. However, they lead to reduced fabric comfort and mechanical properties. The primary cause for low crease resistance in cotton fabric is the intermolecular hydrogen bonding rearrangement between the cellulose chains and inter-yarn slippage. In this study, the crease recovery angle (CRA) of cotton fabric is enhanced by utilizing the shape memory effect of the shape memory polyurethane (SMPU). The SMPU are synthesized based on polyethylenimine (PEI-SMPU) and 1,4 Butanediol (BDO-SMPU). The SMPU was coated on cotton fabric via a simple dip-coating method. The effect of curing and thermomechanical variables - load and temperature on the shape memory performance of SMPU-coated fabric is analyzed.

The PEI-SMPU/Cotton showed excellent memory performance with shape recovery of 90.2 % when coated using 1 % concentration of PEI-SMPU, solution temperature of 30 °C and dwell time 10 min. While the BDO-SMPU showed 75.8 % shape recovery at 10 % SMPU concentration and 50 °C solution temperature. Also, the shape recovery varied with the programming temperature and load. At 10 N load, and programming temperature 35 °C, the PEI-SMPU/Cotton showed better shape memory performance as compared to the BDO-SMPU/Cotton with ~20 % improvement in shape recovery. Therefore, the modification of SMPU from BDO-SMPU to PEI-SMPU has improved the shape recovery performance at 35 °C in the coated fabric.

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Acknowledgment

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Application of Jute Knitted Fabric for Desert Cooler

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Abstract

This study focuses on replaced of wooden wool by the Jute yarn knitted structure which is produced by hand loom knitting. Desert coolers are 80-85% cheaper as compare to air conditioners (AC). In existing cooler wooden wool is used for manufacture the water pads. For manufacturing the water pads of normal size cooler, we require around 1Kg of wooden wool. The wooden wool is extracted for the trees. We required 60 lakh Kg of wooden wool for manufacturing the 6 million units of desert cooler and replacement of wooden wool for existing coolers. If we consider the weight of wooden wool extracted from 1 tree is 50 Kg then we need to cut 1,20,000 trees. So, this is not ecofriendly to cut huge number of trees for fulfilling the requirement of wooden wool. Also, the life of wooden wool is hardly 1-2 seasons. To save the environment and stop the deforestation, we replaced wooden wool by the Jute yarn knitted fabric. Jute is one of the most important natural fibers after cotton in terms of cultivation and usage. It is most affordable and readily available natural bast fiber. The jute yarn knitted fabric is used for because of its high moisture regain (13.75%). All the drawbacks and problems of wooden wool pads can be eliminated by the jute knitted fabric. For present study, crossed stockinette knitting structure is prepared by hand loom knitting. Knitted fabric of 1000 GSM is manufactured using 82 jute count yarn. This structure gives sufficient openings as well as bulk which helps in better cooling efficiency of the desert cooler. In the existing cooler, wooden wool is kept in between two metallic mesh which has problem of corrosion. To overcome this problem, we used synthetic mesh and nylon filament outside and inside respectively instead of metallic net. We can reduce environmental pollution, support farmers and local artisans, and promote traditional crafts, which can also improv the cooling efficiency of desert cooler. Thus, desert coolers which are manufactured using knitted fabric instead of wooden wool are ecofriendly, long lasting, and gives better cooling efficiency as compared to existing wooden wool based coolers.

Crossed Stockinette Structure

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Development of Smart Gloves for Parkinson's Disease Patients

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Abstract

The present study aims to improve Parkinson's disease symptoms with designing of wearable gloves for elderly. Smart E-textile gloves were designed with the concept of treating Parkinson disease patients with vibration therapy. All the movements of an elderly person using a sensory system for real time monitoring were developed. Their physical movements were monitored with E-textiles. This was most exciting part of research that vibration therapy has minimal to no side effects. For the present study market analysis was first done for .Type of smart gloves available in market for Parkinson's on disease patients. The target group comprised of elderly of age group between 70yrs and above. The sample size was 30.Standard questionnaire /interview tool was developed with panel of experts from medical field and scientist .The 6 designs of vibratory gloves were developed .These were shown to team of doctors, scientist and professionals from electronics field. Also preferences were taken by target respondents. Then out of six, three designs were converted into prototypes. These prototypes (vibrating gloves) were given to patients with Parkinson's disease. In the clinical trial, patients wore gloves on each hand for several hours a day. It was found that smart gloves developed reduce tremor, stiffness and slowness in Parkinson's symptoms. The results of trials with vibration therapy through E-gloves showed improvement in movements and balance. No conclusions could be made regarding localized vibrations. As results were too varied across different trials. It was concluded that majority of patients were relieved from Parkinson disease symptoms to some extent .Also smart gloves were accepted by the majority of respondents .Thus vibratory gloves is a part of a larger research effort to maximize the use of technology to help diagnose and treat neurological illness. The study will reduce side effects from medication and risk from brain surgery and also Parkinson disease patients could manage their life better.

Keywords
Parkinson's disease, E-textile, wearable gloves.

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Effect of Temperature and Humidity on triboelectric performance of Textile triboelectric nanogenerator.

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Abstract

Triboelectric nanogenerators (TENGs) have gained significant attention in recent years as a promising technology for harvesting mechanical energy from everyday activities. In this study, we investigate the impact of temperature (20°C to 70°C) and humidity on the triboelectric performance of a textile-based TENG employing a ridge knitted structure fabricated from polypropylene (PP) and nylon materials. The TENG's output voltage and current characteristics were systematically examined as relative humidity (RH) varied from 90% to 20% at different temperatures within the specified range.

Our experimental results reveal a notable influence of RH and temperature on the TENG's performance. As RH decreased from 90% to 20%, the generated output voltage increased from 8V to 73V, while the output current exhibited a corresponding enhancement. This behavior can be attributed to the changes in surface charge density and frictional properties of the PP and nylon materials under different humidity levels. Additionally, temperature fluctuations were found to interact with RH variations, influencing the TENG's performance.

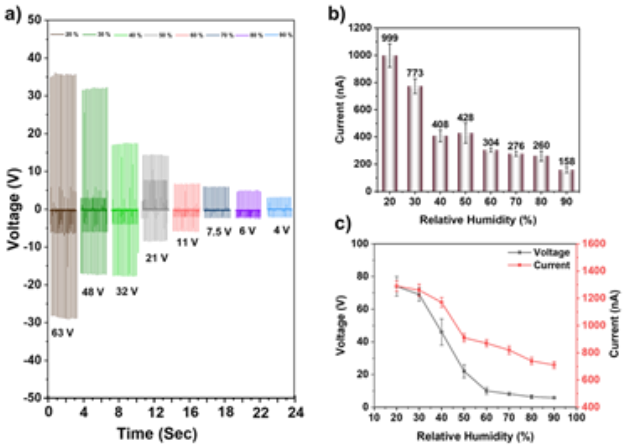

Figure 1. Effect of relative humidity on a) voltage, b) current in tapping mode and c) voltage and current in sliding mode.

Acknowledgment
The author acknowledges the financial support received from National Technical Textiles Mission, Ministry of Textiles India (Project no.- RP04310G).

Scope of circular economy in the Indian T-shirt industry: A study on T-shirt consumption and disposal patterns

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Abstract

Circular economy refers to practices and technologies that decrease leakage or loss of materials in a system. On average, it increases a product's lifespan by 2 times and usage by 100 times, which in turn decreases its climate impact by 47% as mentioned by Svensson, 2020. In the apparel industry, it especially applies to consumption and disposal which are crucial to re-introducing materials in a closed-loop economy. As there are limited studies in India on the consumption and disposal practices of apparel or designing for a circular economy by Indian apparel brands, the study aims to map patterns of consumption and disposal of one of the widely used apparel (T-shirts) in urban India. Additionally, as there are no systematic channels for the disposal of T-shirts to aid circularity this study was deemed important.

It focuses on 2 challenges prevalent in the consumption of apparel: extrinsic value system, and cognitive dissonance. The extrinsic value system influences external achievements such as attractive appearance, financial success, and social recognition as it leads to fast fashion consumption. Cognitive dissonance is the gap between what one says one will do and what one actually does i.e., attitude-behaviour gap. There is also a need to understand mental models to design products in a circular fashion. Therefore, this study seeks to document localized and socio-culturally relevant insights to see the scope of the circular economy in the Indian T-shirt sector.

The study utilizes the grounding theory which analyses people's lived experiences to induce a conceptual understanding (Charmaz, 2001). An ethnographic research method was used to collect data through wardrobe audits, day in the life, accompanied shopping trips, structured interviews with industry experts, structured questionnaires with consumers, journal entries' study, and upcycling ideation workshop. The data was collected from 102 individuals from different urban setups in India. Analyses data via design thinking frameworks such as AEIOU, causal loop diagram, and DPSIR. The data collected provided insights into consumers' daily behavior related to T-shirts, which can be a starting point for designing practices and technologies for a consumer-centric circular economy. The survey found that 56.86% of respondents bought 1-10 T-shirts on average both before and after the Covid-19 pandemic. E-commerce has risen in popularity with 50% of respondents mentioning that they were likely to buy impulsively online. 72.2% of respondents had 50-75 T-shirts on average in their household, with no clear channel for disposal to aid circularity. The survey study found that consumers would prefer to donate, repurpose into a dusting cloth, lend or swap (10.8%), throw in trash (8.8%), and lease or resell (2.9%). Therefore, design and technological interventions for the introduction of circularity in the T-shirt sector are important areas for research and development.

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A sustainable high fashioned futuristic blend

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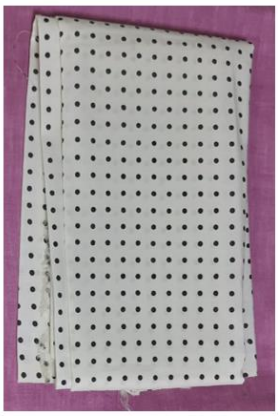
Abstract

Mulberry silk fibre waste generated during reeling process in silk industry has been used for blending with flax fibre in linen wet spinning system. The developed yarn has been used for development of fabric using 100% linen warp/ 100% silk warp. The developed fabrics have been subjected for dyeing and printing process, followed by garment preparation. The developed fabrics have been subjected for testing of mechanical, aesthetic and thermophysiologial comfort properties. Linen- Mulberry silk blended products provide an excellent strength, absorbency, air and water vapour permeability, drape, pilling and abrasion resistance, luster and smoothness. The fabrics and products developed are a new series of products to be used for niche application.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- *Behera B K and Mishra R: Ind Jr Fibre & Text Res 32, 72-79 (2007).*

Acknowledgment
The authors acknowledge Central Silk Board, Govt. of India, Bangalore for funding this project work. clothing that facilitated independence and self-confidence for people with locomotor disabilities. The design idea holds promise for assisting many more individuals facing similar limitations in the future.

Extraction of Bast Fibre from Calotropis Gigantea and Its Potential in the Textile Industry

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Abstract

Calotropis gigantea is a tropical shrub belonging to the Apocynaceae family which primarily grows as a robust weed in arid and semi-arid environments. It is a multipurpose plant, which can be utilized for pharmacological applications, the paper industry, fabricating reinforced composites, as well as for fodder and fuel purposes. It has also been widely used in traditional medicine systems across Asia and North Africa. Some pieces of evidence of the use of Bast and Seed hair fibres from the plant to make textiles have been found in historical documents. Although, the process for extraction and the properties of the extracted fibres or the textile made from it has not been recorded.

This paper aims to optimize conditions of extraction of bast fibres from Calotropis gigantea stems using Biological and Chemical Methods and explore the suitability of the extracted fibres for use in the textile industry. Sodium Hydroxide and Sodium Carbonate have been used in varying concentrations and time durations for Alkali-based extraction. The chemical composition, as well as Physio mechanical properties of the extracted fibres, will be investigated and compared with other Ligno-cellulosic fibres.

Since Calotropis gigantea is a wildly growing shrub in many regions of India, using it as a source of high-quality cellulose fibres might have significant economic implications.

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Acknowledgment

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Transforming waste Polyester Bottles into Ultrafine Nanofibers: An Eco-Friendly Method for Crafting High-Efficiency Face Masks

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Abstract

The usage of polyester bottles gives rise to significant challenges that extend to both environmental and social domains. These challenges primarily encompass their non-biodegradable nature, contribution to overwhelming landfills, and the generation of microplastic pollutants. Resolving these issues necessitates the identification of a viable solution that not only curbs microplastic production but also eases the burden on landfills. Furthermore, the prevalence of particulate matter (PM) pollution poses substantial health hazards to humans. While high-efficiency face masks offer an effective remedy to this quandary, they frequently carry a drawback - a notable increase in breathing resistance, rendering them unsuitable for extended wear. Our study has undertaken the successful conversion of discarded polyester bottles into ultrafine nanofibers, boasting a diameter of under 100 nm (to be precise, an average fiber diameter ranging from 82 to 86 nm). Our endeavor has led to the creation of pristine as well as silver-infused polyester nanofibrous matrices, designed specifically for air filtration applications. By embedding these matrices between two spunbonded nonwoven fabrics, we have achieved a remarkable enhancement in particle filtration efficiency, elevating it from a mere 10% to an impressive 98-99%. Moreover, our innovative approach has enabled us to maintain the pressure drop at a minimal level, peaking at 62 Pa. The inclusion of silver within the nanofibers has concurrently engendered an antibacterial coating on the filter media, augmenting its utility in personal protection scenarios. In summation, our research delineates an uncomplicated yet efficacious methodology for repurposing waste polyester bottles into dependable, high-efficiency filter media, thereby contributing to a more sustainable and healthier environment.

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Sustainable Fibre Extraction Methods for Himalayan Nettle

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Abstract

The bast fibre bundles are enveloped within the phloem beneath the bark and are characterised by their extraordinary length and strength. A bast fibre of significant interest is the Himalayan Giant Nettle (Girardinia diversifolia L.), an herbaceous plant that thrives from 1,000 to 2,500 meters above sea level, reaching 1 to 3 meters. It is predominantly cultivated in Uttarakhand, Jammu and Kashmir, and Himachal Pradesh. The extraction of fibres from Himalayan nettle presents a formidable challenge. The fibres separated are often termed "crude fibre," comprising bundles of individual fibres adhered together. Moreover, the inherent nature of tangling propensity makes the removal of shives a daunting task. The traditional extraction process involves sun-drying the collected bark for 2-3 days, then boiling it with ash for 3 hrs. The obtained fibres are then rigorously washed with water and beaten with a mallet. The entire process is executed manually, a labour-intensive, painstaking crude procedure that lacks scientific precision. Consequently, the extracted fibres exhibit inconsistent properties after each treatment, resulting in variations in the final products. Chemical methods have been studied by various researchers and have been employed commercially that quote the utilisation of higher concentrations of sodium hydroxide (NaOH) up to 8%. This chemical-intensive method has repercussions that can lead to total dissolved solids (TDS), which pose health risks and result in toxic discharge into water bodies. Complexities of extraction, the need for reduction in chemical usage and emphasis on environmental consciousness have pressed the need for sustainable alternative methods.

This research explores and advocates methods such as Ultrasonication, Infrared radiation (IR) and HTHP (High Temperature and High Pressure) in conjunction with reduced alkali usage. The ultrasonication and IR were used as pre, simultaneous and post-treatment with alkali, while for HTHP, extraction was carried out with alkali in a pressure cooker. All the alkalisation involved the utilisation of 1% NaOH. The fibres were characterised in terms of yield and mechanical properties.

The findings revealed that among all the methods, pre-sonication with alkali yielded fibres with a tenacity of 5.82 g/den, comparable to the chemical method (6.5 g/den). Thus, providing a significant result in reducing the NaOH concentration from 8% to 1%. Simultaneous and post-treatment fibres showed lower strength, signifying partial delignification, making them suitable for applications where strength compromise is acceptable, like composites in construction, automotive, and aerospace industries. In contrast, the IR-extraction method was ineffective in removing non-cellulosic constituents at the experimental conditions selected. The fibre extracted from the HTHP method resulted in a tenacity of 4.82g/den. This method is techno-economically feasible to the cottage industries, which follow a crude extraction method with limited access to advanced equipment. However, for laboratory and pilot scale purposes, ultrasonication is a suitable method. Thus, as the world grapples with the imperative to transition towards sustainability, lowering the concentration of NaOH in the

process may result in reduced chemical usage, lower production costs and environmental considerations.

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Advancing Sustainability with 3D Printed Auxetic Textile Structures: Design and Simulation for Technical Applications

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Abstract

The research aims to investigate the deformation properties of auxetic textile structure using Ansys software . Auxetic structures exhibit unique mechanical behavior, including negative Poisson's ratio, which makes them promising for various technical textile and engineering applications. This study explores the deformation characteristics under different loading conditions. A 3D model of the re-entrant auxetic structure with a thickness of 3mm is created and meshed using Ansys software. Material properties of Polylactic Acid (PLA) and boundary conditions are defined. Various loading scenarios, including bending and compression, are simulated by applying forces at specific distances from reference points, that is the centre of the structure for synclastic curvature and from the centre of side walls for compressive Strength. Ansys Software is utilized to perform structural analysis, capturing total deformation and stress distribution. Synclastic curvature for bending and compressive strength for compression are the primary focus which are worked on Ansys workbench. The analysis reveals that when subjected to bending forces, auxetic textile structure exhibits a significant synclastic curvature, making it viable for 3D printing. This behavior suggests its potential for applications requiring flexibility and adaptability. Under compressive loading, the auxetic structure demonstrates remarkable compressive strength, with minimal deformation. This characteristic makes it suitable for applications where load-bearing capabilities are critical. The auxetic textile structure with a 3mm thickness exhibits pronounced synclastic curvature during bending, indicating its suitability for applications that require flexibility and shape adaptation suitable to be developed as 3D printed auxetic textile structure. The structure displays impressive compressive strength with minimal deformation under load, making it a promising candidate for load-bearing applications in engineering and textiles.

Muscular simulations and sweat capillary as critical attributes of Sports apparels

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Abstract

Keywords *PQI – process quality index, EQI – equipment quality index, CQI – consolidated quality index, Abrasion resistance, flexural rigidity, muscle peaks simulation, sweat capillary, MFI – molten flow index*

Muscular simulation and sweat capillary effects have always been subject of high end research in the realm of functional textiles. This is a treatise drawn in from the intellectual property initiatives of the author within the consulting ecosystem of the company. Extensive research in detailed process engineering for cotton blends with spandex as the core of the spun yarn have founded a series of functional apparels that closely simulate the muscular spasmodic movements during competitive sport, prevent hamstring pulls or muscle injuries by providing a therapeutic recovery forces to rehabilitate the muscular strains through a combination of stressed work done coordinates and a garment profiling to contour the unique muscle contraction profiles as well as spatial bone density of the athlete to simulate peaks of athletic activities. The paper has potentially seven patentable designs built into the garment models for field sports and swim wear. Sweat capillaries are unmatched differentials of the products.

COMPREHENDING THE CRITICAL DIFFERENTIALS IN THE REALM OF SPORTS APPARELS

TABLE -1:KEY BRAND DYNAMICS @ 1.0 - benchmark values

PRODUCT DIFFERENTIAL	Global brands - Adidas, Nike, Puma	Blackstone Synergy
Flexural rigidity@ patent -1	1.0	1.45
Abrasion resistance@ patent -2	1.0	1.55
Sweat capillary@patent -3	1.0	1.62
Air ventilation and aerodynamic flow with minimal resistance in the fabric structure@patent -4	1.0	1.65
Aesthetics @patent-5	1.0	1.55
Functionality @patent -6	1.0	1.48
PRICE NTIAL	**1**	**0.38**

Thermo-physiological comfort of cut protective workwear

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Abstract

Comfort is the burning issue during the use of protective workwear against the cut, and slash protection. When worn normally, clothing integrates with the body's thermoregulatory system and aids in maintaining and gradually releasing the heat and moisture vapour fluxes that are produced. The skin-contacting cloth needs to be able to control skin sweat. High-performance woven fabrics are treated as prominent cut protective workwear. Thermo-physiological comfort properties are greatly influenced by the weaving pattern. This study is designed to explore the effect of weaving patterns on thermo-regulation attributes of cut protective workwear. In this regard, three distinct weave patterns were employed to fabricate the specimen, including plain, 2/2 twill, and 6-end satin. The total number of nine sets of hybrid woven fabric samples was made by using para-aramid/modacrylic/stainless steel core spun yarn, ultrahigh molecular weight polyethene (UHMWPE)/polyester/ stainless core spun yarn and para-aramid staple spun yarn. The thermo-physiological comfort properties including air permeability, thermal resistance, thermal conductivity, water vapour transmission rate, and moisture wicking were evaluated to assess the comfort property of the cut protective textiles. The fabric with 6-end satin weave performs better regarding thermo-physiological comfort attributes than other weaves due to longer floating yarn and the loose structure.

Keywords
Cut protective fabric, Weave design, Thermal comfort, Water vapour transfer rate, Moisture Wicking

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Comparative Analysis of Thermo-Physiological Comfort Properties on Multilayered Fabric Assembly with Sweat and Water

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Abstract

Thermo-physiological comfort, focusing on the attainment of a comfortable thermal and moisture state, is a pivotal aspect of human well-being. This study focuses on examining how clothing interacts with and influences the regulation of heat and moisture within the human body. The management of heat and moisture is important because it plays a critical role in ensuring that an individual maintains a comfortable and stable internal temperature. This comfort level needs to be sustained across different scenarios, including variations in physical activity levels and changing environmental conditions. The investigation involves the analysis of three distinct combinations of multilayered fabrics, with a particular emphasis on their moisture and thermal properties, assessed through exposure to both simulated sweat solution and water. The multilayer assembly comprises of inner layer (polyester knit) middle layer (polyester spacer/polyester hollow/polyester fleece) and outer layer (PU coated nylon). It was observed that there is a significant difference in the thermal and moisture properties of fabric when tested with sweat solution and water. The spacer fabric exhibits better moisture properties than hollow wadding and fleece fabric when tested individually. For sweat solution, absorption rate is higher for both inner and outer surface as compared to water for single layer. However, in case of multilayered fabric the absorption rate at outer surface of fabric is zero due to the presence of PU coated nylon as the outer layer. While testing the thermal comfort in case of multilayered assembly the thermal resistance of multilayer clothing with hollow polyester wadding as a middle layer is found to be higher for both dry and wet conditions than other two assemblies. The optimization of multilayer clothing holds the potential to significantly enhance comfort and safety across diverse industrial sectors, encompassing outdoor labor, military applications, and sports.

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Balancing Durability and Comfort: Challenges in Military Uniform Design

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Abstract

In the area of modern warfare, military uniforms stand as the first and last defence for soldiers. The military forces engage in a wide range of activities such as running, jumping, climbing, falling, and crawling during defence and physical training in various environmental conditions. These activities demand uniforms that are highly durable, comfortable, lightweight, and offer protection (Figure 1). The durability or serviceability of military garments is primarily determined by the fabric's ability to withstand various stresses. Uniform integrity depends on fabric mechanics, including tensile, tearing, and abrasion strength, along with seam durability. Uneven stress distribution can cause fabric wear and compromise the uniform's structure. Comfort is another major requirement for military uniforms as the soldiers have to wear their uniforms for longer periods, and discomfort can hinder their performance. The soldier's survivability, mobility and stamina are closely linked with thermophysiological comfort and fit of the clothing [1]. If the garment's design, fit, and construction are inadequate, the wearer may experience discomfort, which could lead to issues such as chafing. Additionally, failure to manage heat and moisture transfer through the clothing during physical activities could cause heat stress, which could be potentially life- threatening.

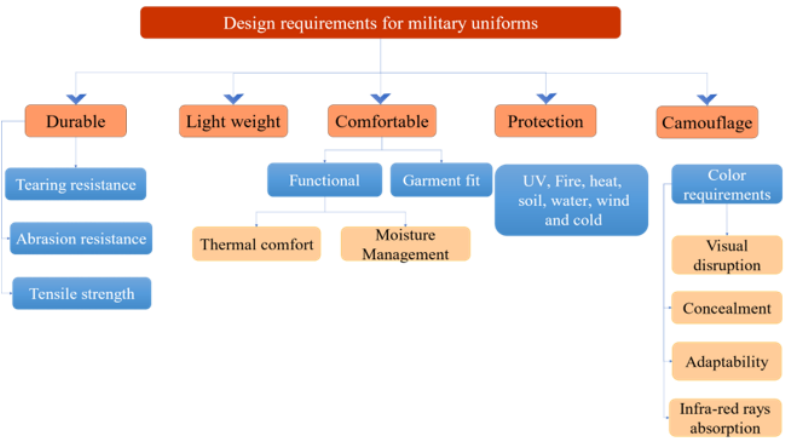

Figure 1 Requirements of military uniforms

Designing military clothing is challenging, especially in terms of durability and comfort. However, achieving both simultaneously can be difficult, as various studies have shown that efforts to enhance the durability of military clothing often result in compromised comfort, often necessitating high-performance materials and finishes that may reduce the overall comfort. Additionally, the application of camouflage prints and the dyeing process itself can also diminish the tearing strength of military clothing, creating additional challenges that must be addressed during the design phase [2]. The selection of the seam and stitch at high stress areas (such as crotch, inseam, seat seam) reduces garment failure during peak activity sessions [3]. This review article provides an overview of the mechanical and comfort behaviour of military uniforms. The contribution of all the factors toward the mechanical and comfort properties, the current trends, and advancements in the field of military uniform design and development are also discussed, including the use of advanced materials, such

as high-strength fibres to improve durability and functionality. The importance of human factors in military uniform design, including ergonomics and comfort, is also highlighted.

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Development of Blended Yarn using Himalayan Nettle (Girardinia diversifolia) and Polyester Fibres

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Abstract

Himalayan nettle (Girardinia diversifolia) is locally known as Dolan, Nilgiri, Bichhu Buti and Kandali. It is found in the moist Himalayan region from Jammu Kashmir to Sikkim at the altitude of 1200-3000 m. The fibres extracted from the barks of nettle are presently used for the application of ropes, bags, carpets, fishing nets and bio composites etc. The nettle fibres are known to be the longest fibres, to have excellent mechanical properties and insulating properties. Due to these distinct properties, fibres can be used for value added application, which depends on quality and quantity of fibres. Currently fibres are extracted using traditional method which is not only time, water, labor and energy intensive, but the method also yield poor quality fibres.

The Himalayan nettle ribbons procured from Uttarakhand were alkali treated to extract the fibres. The extracted fibres possess better physical and mechanical properties than the fibres extracted using traditional methods. The fibres were opened and cleaned using miniature carding machine various times and then passed through trash analyzer to clean fibres. The obtained fibres were mixed with polyester in the ratio of 60:40 and passed through miniature carding to obtain the lap. The lap was converted to yarn by passing through a draw frame, roving frame and ring spinning machine in sequence. The blended yarn developed was characterized for physical and mechanical properties, twist, hairiness, and unevenness. The result shows good physical and mechanical properties of the yarn.

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Inclusive Sportswear Design for Mobility-Impaired Tennis Player: A User-Centered Approach

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Abstract:

This study focuses on designing sportswear, for tennis players with mobility impairments. These individuals face challenges during play due to neurological conditions like amputation, paralysis, cerebral palsy, stroke, multiple sclerosis, muscular dystrophy, arthritis, and spinal cord injuries. Astonishingly 56% of wheelchair tennis players struggle to find sportswear that hinders their participation in the sport. This research aimed to address three issues identified: strain on garments during tennis strokes, difficulties in dressing and undressing for wheelchair users, and limited accessibility for storing balls. This research aimed to develop stylish sportswear that not only caters to the functional requirements of wheelchair tennis players but also empowers them to pursue their dreams and aspirations in sports despite life-altering setbacks.

Keywords
Inclusive sportswear, mobility disorders, adaptive clothing, user-centered design, functionality.

Recent advancements and Futuristic Technologies for NBC Protective Textiles

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Abstract

Over the years, technological advancements in the field of chemical, biological and nuclear threats have made it possible to create extremely toxic and deadly chemical and biological agents.The rising threats and unpredictable use of NBC (Nuclear, Biological, Chemical) agents to global security and peace urge to develop efficient and versatile technological solutions in particular for the development of smart and intelligent NBC protective textiles to protect the first responder and combatant in a high-risk environment. The quest to integrate functionality within the fabric itself has encouraged researchers to explore new dimensions of technical textiles because of the advantages in the warfare field. A wide range of adsorbent materials including active carbon granules, spheres, fabric and various hybrid materials incorporated in textiles are reported to achieve the desired level of chemical as well as biological protection. Recent advancement includes the utilization of reactive material for greater filtration, smart fabrics with sensor capabilities for real-time threat detection and innovative design approaches for improved comfort and mobility for the first responders. Futuristic technologies may involve self-healing material, adaptive camouflage and advanced bio-sensing fabrics that can detect and neutralize chemical threats when come in contact. Coupling of the self-decontaminating properties, electro-spun nanofibers-based textiles, molecularly imprinted polymers(MIP) with high surface area carbon-based materials, Metal Organic Framework(MOF), covalent organic frameworks (COF) and selectively permeable membranes-based textile materials integrated through coating, impregnation, lamination or in-situ deposition techniques will increase the design options significantly. These new materials pave the way for the development of next-generation, lightweight, breathable, comfortable NBC protective textiles to enhance the effectiveness, usability in terms of breathability, comfort and sustainability of NBC protective textiles in evolving threat scenarios which holds a considerable promise for diverse defense and environmental applications.

Estimation of Durability of Outer Shell Fabric

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Abstract

Durability (Service-life / Shelf-life) is an important criterion for the development of advanced protective textiles and efforts were made for evaluation of the durability of the outer shell fabric for ballistic protective textiles. The advanced grade outer shell fabrics (OSFs) were developed in Nylon 6, Nylon 6,6 and Polyester of weight 153 g/m2, 162 g/m2and 170 g/m2 respectively. Nylon 6, Nylon 6,6 and Polyester fabrics were coated with specialized grade thermoplastic polyurethane (TPU) with add-on of 10%, 15% and 20% respectively, along with additives of titanium dioxide nanoparticle of size 20-50 nm.

The Shelf-life & Service-life of developed TPU coated fabrics was predicted by assessing the strength degradation of the materials in terms of tensile, tear and bursting strength, when subjected to natural and accelerated weathering conditions for two months and 100 hours respectively. In natural weathering test, the fabric was exposed to outdoor environmental conditions, whereas accelerated weathering was carried out in Q-SUN xenon test chamber as per ISO 105: B02:2014 and thereafter, the change in breaking strength, tear strength and bursting strength were evaluated to assess the extent of deterioration. Also, Abrasion resistance was tested at Martindale Abrasion tester for 6,000 abrasion cycles at 12 KPa pressure with 400 grade emery paper as abradant for assessment of material durability.

Among these, the TPU coated Nylon 6, 6 fabric showed the best results, when subjected to both natural and accelerated weathering, as change in the tear and bursting strength before and after weathering was found to be unaffected. However, in case of breaking strength, the degradation was noticed to be very low (4% strength loss). The material showed excellent abrasion resistance with negligible weight loss and no fibre damage on the surface of the fabric. The fabric showed no signs of blocking and no apparent change from the original sample after accelerated ageing (70°C ± 1°C for 168 hours). Also, no cracking was observed due to flexing after 1, 00,000 cycles. However, in case of Nylon 6 and Polyester fabric the weathering degradation was comparatively higher (9-10 % strength loss) as compared to the Nylon 6, 6 fabric. Also, Nylon 6 fabric showed slight sticking properties due to TPU coating adhesion. Hence, based on the evaluated characteristics, it was predicted that the Nylon 6,6 fabric with similar areal density 162 g/m2 would show higher durability of minimum 4 years Service life and 5 years Shelf life as against the 2 years service life/ shelf life of existing version IS:17051 & GSQR1438 of Nylon 6 160 g/m2 OSF.

Keywords
ageing; blocking; flexing; nylon; outer shell; polyester; service-life; shelf-life

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Development of UHMWPE/Para-aramid based anti-vandal textiles

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Abstract

Metallic wires are being knitted and weaved to serve various purposes such as filtration, shielding, protection, construction etc. These knitted and weaved products can be used in oil & gas, automotive, food processing, farming and chemical industries to name a few. Similar concept was utilized to develop the textile product which are having high performance yarns such as UHMWPE (Ultra high molecular weight polyethylene) and para-aramid along with the steel wire. The UHMWPE have lower density than steel thus utilizing some ends of UHMWPE yarn along with steel wire, made product lighter compared to 100% steel wire based product. Likewise, the inherent property of flame retardancy of para-aramid was utilized to develop a product with steel wire that can have an application in cut and flame resistant anti-vandal curtain and seat cover as shown in figure 1.

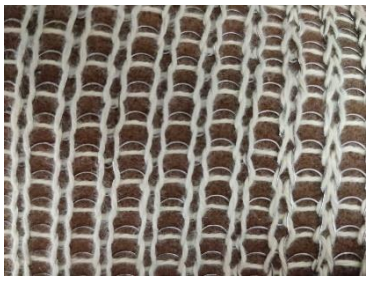

Figure 1: Anti-vandal seat cover for automotive.

Single or multiple ends of these high performance yarns can be utilized with steel wire to develop the products of specific use. Along with the high end application of these products, the flexibility introduced by using high performance yarns make them suitable in safeguarding military weapons, vehicles etc. There are ways to reduce the percentage of steel wire in these products such as multiple ends of high performance yarn can be used while developing these products and twisting the high performance yarn over steel wire before making final products. An example of twisted yarn over steel wire is shown in figure 2.

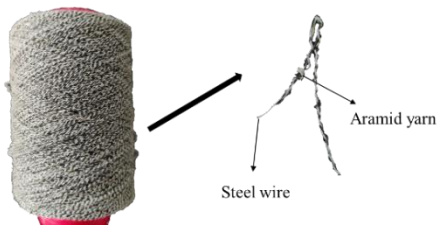

Figure 1: Aramid yarn twisted over steel wire.

Development of inherent flame-retardant textiles for protection against molten metal

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Abstract

In foundries and other related industries dealing with molten metals, burn injuries are commonplace among workers. The spectrum of thermal hazards in these industries can be extreme molten metal splash, fire, high temperature flame, steam burn to radiant heat exposure. For protection against such thermal hazards, many commercial fabrics are used which include FR cotton, cotton denim, 100% para-aramid, Savesplash®, meta-aramid, aluminized aramid, Nomex, Kevlar, FR viscose-wool-polyaramid and leather with varying performances and properties. Primary protective clothing is the first line of defence against molten metal splash and other foundry hazards. The performance of molten metal protective clothing against large splashes of molten aluminium and iron is assessed using ISO 9185:1990 and EN 373:1995 respectively. The present study investigates the uses and effects of new technologies of surface coatings like nano clay coatings, intumescent coatings to enhance the fire- and flame-retardant properties of different fabrics. It has been observed that the coated fabrics shows excellent fire- and flame-retardant properties. The analysis of flame retardancy and thermal decomposition behaviour of 100% cotton fabrics using commercial nano clay (Cloisite 20A), clay-basedmontmorillonite shows that even at low nano clay concentration, is enough to have a considerable flame-retardant effect. The study of intumescent coating of pentaerythritol phytate ethylenediaminetetraacetic ester (PPEDTE) prepared by the esterification of phytic acid, pentaerythritol and ethylenediaminetetraacetic acid on silk fabric shows remarkable decrease in release of heat and smoke during burning and possesses high FR performance and washing durability during vertical burning and LOI tests. In this study, molten metal splash protection test was conducted on samples of 100% para-aramid fabric (325 g/m2) and Savesplash® fabric (550 g/m2) - a blend of FR viscose, para-aramid with 80 gm molten aluminium using PVC skin stimulant. The fabrics were coated with neoprene on one side using knife roller coating method. The result shows that the performance of 100% para-amid fabric was better than Savesplash® fabric. The coating side of both the fabrics performed better as the molten alumina slide instantly on the coating.
Keywords: Molten metal splash protection, flame retardancy, nano clay coatings, intumescent coating.

Light weight multilayer structural fire protective suit

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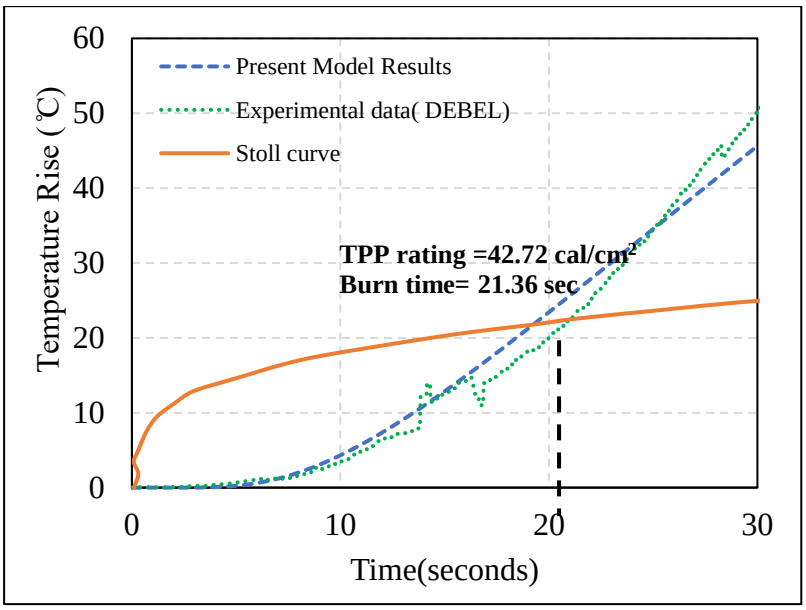
Abstract

Firefighters are frequently dealing with intense heat flux, hot liquids, gases, hot surfaces, and molten metals while fighting fires. Because of the numerous physical and environmental factors involved, it is difficult to characterize and define thermal hazards. These thermal environmental conditions are divided into three categories: routine, hazardous, and emergency. Heat energy can be transmitted from these thermal environments to the wearer's body via radiation, conduction, convection, or a combination of these methods. During this process, both the wearer's body temperature and the temperature of the clothing rise. As a result, thermal protective clothing is required to protect firefighters from this hazardous situation. The design of this fully indigenous, low-cost structural fire protective suit is multi-layered, with an outer shell, moisture barrier, thermal liner, and face fabric. Honeycomb meta-aramid woven fabric at the outer shell provides high flame retardancy, heat resistance, high breaking strength, high tear strength and durability. PU coated PTFE laminated meta-aramid nonwoven fabric is used as moisture barrier for the jacket. Meta-aramid needle punched multi-layered nonwoven fabric is used as thermal liner in the jacket. The thermal liner is divided into various layers of different areal density in order to achieve better insulation. The design is optimized through in-house developed and validated software simulation tool. A face fabric made up of woven cotton fabric is also placed after thermal liner order to provide tactile comfort to the wearer. The jacket provides a TPP rating of more than 38 cal/cm2 ×sec as per NFPA standard. The weight of the jacket is 2 kg.



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Effect of test orientation on the thermal protective performance of the outer layer of multiple layer thermal protective gear

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Abstract

The fabric's structural properties, the air gap, and the testing orientation all have a significant impact on the thermal protective performance of protective apparel. This study employs a Box-Behnken experimental design to examine the effects of shell layer pick density, air gap, and test orientation on thermal protective performance. The testing is conducted with a steady stream of radiant heat. Utilizing Stoll's curve, thermal protective performance is calculated in terms of second degree burn duration. The model's F value is 72.98 and its p-value is 0.0001, indicating its significance. Additionally, it is discovered that the pick density, air gap, and orientation angle all significantly affect RPP. Pick density and air gap have a beneficial impact, whereas orientation angle has a negative impact. Additionally, it has been found that as the air gap widens, the effect of pick density rises. The findings may aid in the creation of thermal protective garments for various body sections.

Effect of Different Working Conditions and Fitting of Garment on the Radiant Heat Transfer Index (Rhti24) of a Thermal Liner

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Abstract

To better comprehend the impact of the fitting of protective clothing and working conditions on its thermal protection and the safety of occupational workers, the current study analyses the effect of microclimate thickness (the distance between the wearer's skin and clothing) and compressive stress on thermal liners on thermal protection. 33 Box-Behnken design was utilized to carry out this study. Compressive stress on the thermal liner, thickness of the microclimate, and heat flux were the independent variables. Three levels of incident radiant heat flux were employed to evaluate the thermal liner's radiant heat transfer index (RHTI24). Compressive stress on the thermal liner, microclimate thickness, and heat flux were examined individually and in combination with the dependent variable RHTI24 using an analysis of variance study. At each heat flux level, the RHTI24 value is seen to rise in tandem with increasing microclimate thickness. As thermal liner compressive stress and heat flux increase, so does the RHTI24 value. The results of this investigation show that the user is more protected from heat when they are dressed in loose-fitting, microclimate-enhancing apparel. When the incident heat flux is modest, thermal liner performs exceptionally well. Protective gear is more effective at keeping employees safe from harm when there is less compressive stress applied to the thermal lining.

Advances in Testing Methods for Recycled Fibre Materials

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Abstract

Textile recycling is among the fastest growing textile sectors of the current decade. When textiles are mechanically recycling back into fibres, various techniques can be applied, resulting in very different fibre properties. Likewise, using established or also novel processes for regenerative fibres in combination with alternative feedstock requires tight control of the fibre properties to truly achieve circularity. Finally, chemical, and thermo-chemical processes also open possibilities to recycle technical textiles, where the quality of the recycled fibres needs to be tightly monitored to meet the desired specifications and built trust for use in demanding applications.

In all cases, the knowledge of the properties of the recycled fibres are key for a high-quality final product. Relevant fibre characteristics certainly include the tenacity and – depending on the process – the wet-tenacity, the fibre length distribution, and the level of contaminations, e.g., from yarn remnants.

When developing testing instruments for fibres and yarns, Textechno paid close attention to the flexibility and versatility of the instruments. These instruments are now well suited to characterize various aspects of recycled fibres and specialized techniques have been implemented that are uniquely required for recycled fibres. In several studies and by practical use the testers have proven to be well suited to support recycling processes of all kinds. This includes fibres from post-industrial as well as post-consumer waste, regardless of material, colour, or chemical treatment.

In our talk, we will present the latest advances in testing techniques for recycled and technical fibres and highlight their usefulness in several case studies.

Electrothermal Characterization of Knitted based Joule Heating Textile

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Abstract

In the realm of wearable technology, e-textiles are gaining prominence for their utilization of textile structures like knitting, weaving, and nonwoven fabrics. Knitted fabric has unique properties such as stretchability, flexibility, and comfort among these textile structures. However, traditional knitted heating pads are manufactured by employing a straightforward three-structure design comprised of a plain, rib, and interlock with yarn that is entirely conductive. The usage of fully conductive materials in industrial applications has been restricted primarily as a result of their more expensive price tag and higher power requirements. In this study, we delve into how various knitting structural parameters, such as knit, float, and tuck, along with different environmental conditions, affect the efficiency of joule heating pad with localized conductive yarn. Rib and its derivative based heating pads were fabricated using stainless steel (SS) and low twisted cotton yarn. It is observed that the 3F and FTF knitted heating pads exhibited a notable increase in surface temperature compared to the 3R structure. The 3F knitted structure demonstrated the least temperature fluctuation due to the float in the structure. Furthermore, the effect of relative humidity and ambient temperature, both with and without airflow, impacted the efficiency of the 3F heating pad. Additionally, a laboratory-based prototype heating pad designed for alleviating neck and wrist pain.

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Analysis of the mechanical properties of agro-waste derived carded pineapple leaf fibre and polypropylene composites

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Abstract

The pineapple plant is grown all across the nation, and after the fruit harvesting, its leaves are typically burned as waste, used in land filling, or piled in the middle of the plantation land. Pineapple agro-waste management must be considered from the beginning of the cultivation process. Without the right management, pineapple leaf wastes can have a negative effect on the environment, which requires development of innovative methods to turn them into value-added materials. A portion of the long fibrous material extracted manually and mechanically from pineapple leaves is known as pineapple leaf fibre (PALF). In this work, a greener approach was used to process PALF instead of any chemical treatment for fabricating polypropylene (PP) matrix composites. Carding process was used for individualization of PALF as well as for removal of dust and sticky fibres. The high melt viscosity of PP hinders its penetration into the composite reinforcement. To overcome this difficulty, the carded PALF and PP fibres (50%/50% by weight) were blended in the carding process to ensure homogeneous distribution of reinforcement and matrix phases within composites. The blended carded silver was further parallelized through a gill-drawing process, and subsequently, unidirectional composites were fabricated using compression moulding. The highest tensile strength, tensile modulus, bending strength, bending modulus, and impact strength values obtained were 124.60 MPa, 6.24 GPa, 103.27 MPa, 6.16 GPa, and 104.28 kJ/m2, respectively. However, more than four carding passages did not further improve the mechanical properties of composites. Good impregnation of PALF with PP matrix was achieved due to superior distribution of PALF and PP fibres and fibre parallelization through carding and subsequent drawing process, leading to improved mechanical properties of composites. Therefore, agro-waste PALF fibre reinforced PP composites can be used for the development of various value-added products for several technical applications.

Keywords
Agro-waste, pineapple leaf fibre, fibrillation, carding, thermoplastic composites.

Acknowledgment
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Performance Evaluation of the Parachute Canopy under Small-Scale Tensile Impact and Quasi-Static Load Conditions

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Abstract

A parachute is a device that slows down a person's vertical descent through the sky. The parachute canopies experience different forces during their practical application and the most important is opening shock force which is developed during parachute deployment. In this study, the three levels of the maximum sustainable tensile impact load for a small rectangular ripstop parachute canopy specimen stitched at a 45° seam angle have been determined manually. Using a scale-up approach, the corresponding peak sustainable opening shock force for low porosity canopies, specifically T10, C9, and G11 has been calculated subsequently.

This study also involved the characterization of both unseamed and seamed small rectangular specimens at 0° and 45° seam angles under three levels of maximum sustainable tensile impact and quasi-static loads applied. The ANOVA results revealed that the fabric joining has a more significant effect on the specimen's performance compared to the seam angle and the applied load. It is observed that the specimen experienced greater degradation under impact load compared to the corresponding quasi-static load. When subjected to both types of loads, the seamed specimen showed more substantial losses in strength and elongation compared to the unseamed specimen. Moreover, the loss of strength was for specimens with a 0° seam angle as compared to the specimen with a 45° seam angle.

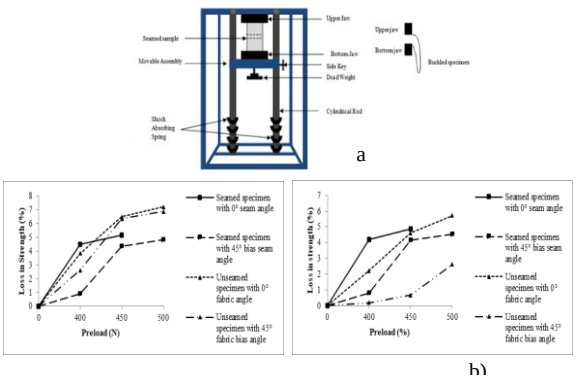

Figure 1- a) Impact Tester b) Effect of impact load on loss in strength (%) c) Effect of Quasi-static load on loss in strength (%)

Interestingly, specimens with a 45° seam angle demonstrated better performance under both impact and quasi-static loads. Although they exhibited higher elongation loss, they still possessed a greater breaking elongation than specimens stitched with a 0° seam angle at the same load level.

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Recycled Colored Yarn Manufacturing: Transforming Cotton Fabric Waste into Quality Yarn

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Abstract

Because of the high level of resource consumption and broad environmental impacts of the textile, the close loop and recycled textiles are seen as crucial environmental improvement potential. The textile and fashion sector produce a huge quantity of used garment/ clothes and remanent waste. Both pre-production and post-production hard waste cause landfills and pollution. Mechanical recycling of fabric waste provides enormous opportunities for the circular textile economy as it helps reduce dependence on conventional fibres and reduce waste. However, the recycled spinning industry is expected to produce quality recycled yarn although the input materials (fabric) are from diverse sources with different shades, structures, and quality. For fabric waste recycling, the recycled spinning factories collect the pre-consumer single jersey knit fabric waste obtained from the cutting department of garment factories. The fabric waste is segregated colour-wise and shade-wise. The impurities are removed. The fabric is transformed into regenerated/reclaimed fiber with the help of processes such as cleaning, cutting, shade mixing, conditioning, tearing, and bailing. Further, these regenerated fibres pass through various stages of mixing, blending with dyed recycled polyester, blow room, carding, draw frame, and rotor spinning machines. The shades are mixed at various stages, such as cutting and tearing, blow room, and draw-frame.

In this paper, author has discussed the processes, spinning, quality control, advantages, and disadvantages of rotor-spun melange recycled yarn. Further, the author suggested feasible technological interventions to address the key issues.

Tensile properties evaluation of high-performance dual sheath single core hybrid yarn

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Abstract

High-performance fibers are showing an emerging intensity for the growing market of protective textiles. For converting fiber into fabric, it generally needs to convert high-performance fibers into yarns first. Apart from other spinning processes, the concept of hybrid yarn is gaining popularity for its potential to use several protective aspects, such as protection from sharp forced action. Moreover, the dual sheath feature with single-core yarn can provide options to protect the subject from multiple types of adverse undesired surroundings. Herein, a total of twelve different types of hybrid yarns were spun with a core and two continuous filament sheaths. These twelve yarns were mainly categorized into two sub-divisions with steel wire (SW) and glass fiber (GF) in the core respectively. For the outer sheath layer, polyester yarn (PET) was considered the first sheath, and ultra-high molecular weight polyethylene (HPPE) was considered the second sheath. The twist direction of the sheath layers was also kept in consideration with different directions of twist like Z twist in the first sheath and S twist in the second sheath for a total of six samples of SW and GF core yarns. Similarly, the same direction of twist for both sheaths was also kept for the rest of the six yarns, which was S twist for both the first and second sheaths. The count of core yarn and second sheath yarn were varied to observe the final hybrid yarn tensile properties where twist per meter was retained the same at 400. The tensile strength of the yarns was evaluated using the ASTM D2256 Method on the Instron universal tensile strength tester. Maximum load and tenacity for S and Z twisted hybrid yarns were higher than for S and S twisted yarns. At the same time, being finer than GF core yarns, SW core yarns showed higher tenacity and load-bearing capacity than GF core. Likewise, Young's modulus of SW core yarns also witnessed higher values than GF core yarns. Conversely, the strain percentage at maximum load was higher for GF core yarns than for SW yarns. While analyzing the breaking points of the yarns, multiple breaking points were observed for coarser hybrid yarns, whereas for finer hybrid yarns, this phenomenon was rarely present. These multiple yarn-breaking phases were seen more in GF core than SW core yarns. The presence of this breaking tendency in GF core yarns mostly originated from their lower load-bearing capacity and tenacity with a higher strain percentage than SS core yarn.

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Thermal & Mechanical Characterization of Knitted based Cut-resistant Textile Materials

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Abstract

Now a days, protection from cut has become essential aspect of everyone lives as it may happen in construction sites, industrial sites or everyday activity, the risk of cut performance makes a significant presence, Hence the development and characterization of effective cut resistant fabric has become very important. This paper presents the development and analysis of high-performance yarn based cut resistant knitted fabrics. In this study, three types of knitted fabric were prepared on 7-gauge, 10-gauge, 13-gauge shimaseiki gloves knitting machine by using 100% ultra-high molecular weight polyethylene (UHMWPE), steel reinforced UHMWPE and glass reinforced UHMWPE yarn. The effect of core reinforcement such as stainless steel and glass fibre into UHMWPE yarn as well as impact of knitting variable such as stitch density and machine gauge on cut performance were investigated by using cut testing instrument named tomodynamometer and it was found that steel reinforced UHMWPE fabric knitted on 13-gauge shimaseiki gloves knitting machine which have stitch density of 150 loops/inch2 were showing highest cut resistant value. The structural contribution of core reinforced yarns in cut performance of knitted fabrics was illustrated from the scanning electron microscopy images. The results of this study can be used in the development of cut resistant fabrics with superior performance.

Himalayan Nettle Plant for Applications in Textile, Paper and Composite

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Abstract

Nettle plants are grown naturally as forest weeds in Himalayan region without much explored economic value. The plant remains under-explored as far as extraction of fibre for textile and other industrial applications are concerned. Present study highlights a complete value-chain of nettle plant starting from fibre extraction & retting, detailed fibre quality evaluation, production of blended yarns & fabrics, yarn colouration, fabric development and apparel products manufacturing along with cost analysis. Himalayan nettle plant considered for fibre extraction through microbial retting yielded 1.25% dry fibre. Extracted fibre was characterized in terms of physical, morphological, mechanical, thermal and chemical properties. Nettle fibre of fineness of 2.2 -2.4 tex, tenacity of 10-16 cN/tex and elongation of 3%, was blended with viscose fibre in 75/25, 50/50 and 25/75 proportion to produce blended yarns along with development of 100% nettle yarn of count. These yarns were utilized as weft to produce union fabric in handloom, keeping the cotton yarn as warp. Yarn and fabric properties were also evaluated in details. Apparel textile products, like female fashion wear (cost $ 13) and 'shawl' (cost $ 39) were produced from the as-prepared, bleached and dyed yarns. The developed apparel products are not only fashionable, but also fully biodegradable. During the yarn spinning, fibres get wasted as carding, drawing and spinning droppage, were utilized to produce pulp and paper. The develop paper of 260 g/m2 exhibits the breaking load of 59 N, tear strength of 700 mN and initial modulus of 395 N/mm2. Furthermore, after extraction of fibre, nettle plant could yield 19.3% dry stick that has been used in making particle board in combination with jute stick using synthetic resin. Research findings advocate that complete nettle plant can be considered as an untapped potential raw material for industrial applications in value added Textiles, Pulp & paper and Composite board.

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Acknowledgment

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Development of Silk Cosmetics – Exploring New Horizons

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Abstract

Silk– the Queen of Textiles is the most elegant sought-after fabric in the world.However, with its remarkable eco-friendly, bio-compatible,bio-degradable qualities silk is also fast gaining grounds in the field of non-textile uses also. In fact, in the recent times, its use beyond textiles has opened new vistas not only in the fields like pharmaceutical, nutraceutical, bio-medical but also cosmetics. Like other beauty boosters, silk cosmetics are also used as beauty aids tohelp build up the self-esteem and confidence of an individual but with more natural, soothing,silky qualities. Sericin- a protein extracted during silk degumming process-treated as a waste sofar is now being utilized as an active ingredient for these silk cosmetics. In the recent times, Sericin is the most sought-after bio- material in cosmetic industry. With the increasing awareness about the eco-friendly products worldwide, consumer attention is gradually turning to all-natural organic cosmetics. Even multi-national cosmetic companies are leaning towards natural ingredients like Sericin in their products to be in race with the global go green agenda. Hence, the importance of Sericin based cosmetics.Sericin consists of 18 amino acids of which ten are similar to the amino acids already present in the skin. When silk nutrients enter the body, they are organically bound to skin cells and absorbed. Sericin is beneficial for maintaining the normal function of the skin's surface film. This film on the outermost layer of the epidermis prevents external factors from irritating it, helps evaporation of water and protects the skin; Sericin can maintain water content of the skin and has the function of natural humidity-regulating factor.Sericin has the function of preventing ultraviolet radiation. It inhibits the formation of excess melanin in the skin thus preventing the formation of dark spots and freckles.Keeping in view the above facts, CSTRI, CSB, Bengaluru and M/s Bregma science LLP have successfully developed few products like body lotion, hair conditioner, moisturizer with Sericin as an ingredient to begin with. Since India is in a continent of silk, there appears to be a great scope for this unique industry to span its wings wider. And, yes, silk is quite expensive and unique. As such even its waste and by products are also expected to carry forward its royal precedence through value addition in the niche market and beyond! The saga of Cocoons to cosmetics is nothing but transformation of waste to wealth in other terms. It means, it is yet another step towards the universally driven eco-friendly movement.

Keywords
Amino acids, bio compatible, cosmetics, non-textile uses, Sericin

Acknowledgment
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Development of Denim Clothing Using Natural and High-performance Fiber (UHMWPE) for Bike Riders

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Abstract

Motorcycling is an activity of pleasure in most part of the world. In India, it is a regular mode of commuting. These days, large numbers of vehicles on road are bike riders. The accidents on road involving bike riders are also higher. According to a report published by the Ministry of Road Transport and Highways, the number of fatal accidents involving pedestrians and 2-wheeler riders has increased consistently over the past few years. As per the report, 56,136 people died in 2-wheeler accidents in 2019. In 2021, this figure rose to 69,635 deaths [1]. It therefore becomes necessary to develop some provision to protect human body due to road accidents.

Road accidents are unavoidable. However, the injuries to bike riders can be reduced/minimized through the wearing of helmet and the use of high protective clothing which may act as a barrier between the bike rider's body and road surface. As we know bike riders are mostly youngsters or teenagers who prefer clothing made of denim which, in turn, is made up of cotton fiber [2]. The reason being comfort properties of cotton clothing during hot climate. However, such clothing cannot prevent the rider from serious high impact injuries during road accidents [3]. To improve the protection and minimize the injuries to rider's body, a high protective denim fabric was developed in this study through blending of high performance (UHMWPE) fiber with cotton fiber.

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Development of Silk Yoga Mats form Recycled Silk Yarn.

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Abstract

Yoga is a means to relax mind and body and connect back to nature. While yoga is gaining popularity, yoga mats made of natural materials are disappearing from the market due to influx of cheaper synthetic mats. Synthetic mats create a physical barrier between man and nature, diluting the very purpose of yoga. They often have poor durability and are disposed off creating an environmental hazard, as they do not biodegrade within a reasonable time. Hence, the need for yoga mats made from natural materials like cotton, jute, hemp, straw and silk. Amongst the natural materials, silk is unique because it is a protein fibre and most compatible with the skin. It is soft, smooth and hygroscopic. However, silk is scarce and expensive and a yoga mat made of silk would be a luxury item, unaffordable to the common man. Hence, we made yoga mats from 500 Tex recycled silk yarn developed from discarded silk material waste and selvedge waste. The yarn was coloured using natural dyes. The mats were woven on handlooms with cotton yarn in the warp and recycled silk yarn in the weft, with different constructions. Ten desirable characteristics for yoga mats were identified and the mats were evaluated for compliance. Laboratory tests were supported by actual field trials. The quality was compared vis-à-vis 100% cotton yoga mat of the same construction and also non-woven (needle punched) yoga mat made from silk waste. The many advantages of recycled silk yoga mats, including promoting the concept of recycling, are discussed in detail.

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An Attempt on Impact of 3D Printing on Haute Couture Fashion

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Abstract

The fashion industry is a lucrative global enterprise with a significant economic impact, focused on the production and commercialization of clothing. Certain analysts make a distinction between the fashion industry, which produces high-end fashion, and the apparel industry, which manufactures everyday clothing or mass fashion. However, from the 1970s, the demarcation between these two sectors became increasingly indistinct. Haute couture, derived from the French language, refers to the practice of producing bespoke and luxurious fashion designs that are tailored to individual clients. The phrase "Haute couture" originates from the French language, with "Haute" denoting "high" or "elegant," and "couture" signifying "sewing" or "dressmaking." Haute couture refers to the production of bespoke, luxury fashion designs that are tailored to individual clients. Haute couture refers to a form of fashion that is not commercially accessible in the traditional market. Instead, it entails the production of bespoke garments and fashion accessories that are tailored to individual clients. Typically, individuals of high socioeconomic status provide precise bodily measurements, which serve as the foundation for fashion designers to build bespoke garments tailored to their unique specifications. The textile utilized in the production of these garments is characterized by its superior quality and substantial cost.

The recent progress in materials and technology has generated significant interest among fashion enthusiasts in the field of 3D printing. The process involves depositing successive layers of different materials to construct three-dimensional objects. Numerous brands have embraced this technology in order to undergo transformation by exploring a wider array of its uses. As to the ISO/ASTM 52900:2015 standard, additive manufacturing is a process that involves the sequential addition of materials with regulated thickness, facilitated by software, to produce physical objects through supplement manufacturing. The technology in question deviates from traditional manufacturing methods. Currently, prototype development and manufacture of diverse things have gained significant popularity. The utilization of this technology has enabled the capturing of diverse trimmings and materials, generating automated shapes that serve as the foundation for the intricate sewing and embellishment techniques employed in Haute Couture fashion. The advent of 3D printing has raised concerns regarding its potential impact on artistic endeavours involving various materials. This study examines the effects of 3D printing on the Avant-garde fashion style within the Fashion Industry. The present study adopts a qualitative and exploratory approach, incorporating recent references for the purpose of debate.

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AI(Artificial Intelligence): Emerging Future Prospects in Fashion Industry

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Abstract

AI has revolutionized the fashion industry by transforming manufacturing and design processes. In manufacturing, AI optimizes operations, predicts maintenance needs, and enhances quality control. Real-time data analysis enables pattern recognition, defect detection, and process adjustments, while AI-driven robots and automation systems streamline tasks like material handling and fabric inspection.

In design, AI algorithms generate unique patterns, colors, and textures based on input parameters, empowering designers to explore new creative avenues. Additionally, AI aids trend forecasting by analyzing vast amounts of data from social media and sales records. The impact of AI on textile manufacturing and design is evident in increased productivity, creativity, and sustainability, propelling the industry forward.

This research work is related to AI-enabled AR (Augmented Reality) allows users to virtually try on clothes and accessories on online platforms. This technology enhances the online shopping experience by providing a realistic representation of how the items will look on the user's body. It helps users to make more informed purchasing decisions and reduces the need for returns, ultimately leading to reduced shipping costs. Consumers can see themselves virtually on online platforms, allowing them to assess the look of silhouettes, fall, and design on them. They can also try different fabrics, saving time, cost, and promoting sustainability. This technology is a game-changer for the fashion industry, bringing convenience and confidence to online shoppers.

Keywords
AI, real-time data, defect detection, productivity, creativity, sustainability, virtual, try-on, augmented reality (AR), game-changer.

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Cellulose based HIPE scaffolds for efficient and eco-friendly oil sorption

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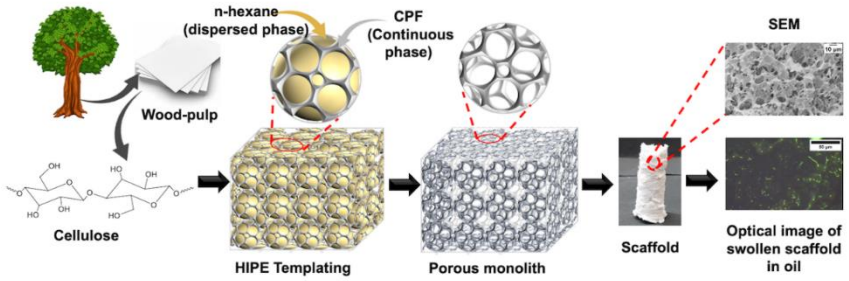
Abstract

Addressing oil spills and their associated environmental challenges has historically involved a range of strategies. One prominent method has been the utilization of hydrophobic adsorbents derived from synthetic polymers, offering practical viability, and yielding an array of superabsorbent materials tailored for oil absorption. Despite their significant effectiveness, these polymeric superabsorbent presents a substantial problem– their non-biodegradable composition raises concerns regarding disposal and secondary contamination. To avoid the problems linked with synthetic polymers, this study focuses on crafting an oleophilic porous scaffold for oil absorption using a natural polymer, specifically cellulose. The procedure involves emulsion templating, wherein pre-treated wood pulp cellulose (WPC) is employed to create an oil-in-water high internal phase emulsion (HIPE). Critical factors such as solvent selection for WPC, choice of emulsifiers, and properties of the dispersed phase are carefully optimized to engineer the emulsion. The cellulose within the continuous phase is crosslinked during scaffold fabrication, enhancing its durability and stability throughout cyclic oil absorption and desorption tests. The scaffold exhibits a remarkably interconnected porous structure, enabling it to achieve an oil sorption capacity of up to 8.8 g/g for automotive engine oil, accompanied by a volumetric swelling of 30 ml/ml. This capacity aligns with findings from prior studies involving hydrophobically modified cellulosic materials. Remarkably, the scaffold withstands repeated absorption and desorption cycles without structural deterioration or diminishing sorption efficiency over five cycles. These findings can be attributed to the scaffold's oleophilic attributes, stopping from its substantial surface area and intricate macropores that serve as microchannels and oil reservoirs, all while obviating any interaction between the hydrophilic cellulose and the oil. Future endeavours could explore hydrophobic functionalization to enhance the effectiveness of this natural polymer-based porous scaffold for oil absorption. This advancement holds promise for diverse applications beyond its current scope.



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A Perspective on Biomimicry for Medical Textiles

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Abstract

Humans have always sought to comprehend and imitate biological systems; Otto Schmitt first used the term "biomimetics" in the 1950s to refer to the "transfer of ideas and analogues from biology to technology." Technical textiles have had a significant impact on society and have profoundly altered the framework of daily living. However, nature has produced amazing inventions all around us and serves as humanity's primary creative and technological mentor. Innovations in medical textiles have produced a wide variety of wound-healing devices. The main applications of biomimicry in enhancing health and wellbeing in medical textiles are examined in this research.

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Smart Textiles for Health Monitoring

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Abstract

Smart textiles play an indispensable role in myriad of medical applications owing to their inherent capability of responding to external stimuli and adapting their behavior accordingly. Furthermore, the prime requirements of agility, comfort, breathability, nontoxicity, bio compatibility and non-carcinogenic attributes can be well achieved by utilization of textiles in medical domains. Smart textile is a fibre-based flexible system that can accommodate complex and severe deformations with high stability. Medical professionals and health care providers having experienced several health care challenges in pandemic era have been advocating the necessity and benefits of mobile health care as a means to ensure improvised contactless communication among patients and physicians. The integration of mobile computing and health monitoring through smart textile clothing can serve as best of both worlds for medical staff as well as anyone who wishes to integrate heath care to mundane routine and can have handy access of physiological parameters to decide workout schedule or planning a visit to physician in case of some abnormal parameters being tracked and recorded by smart wearable devices. Mobile health monitoring can be achieved by integration of sensors, low-power ic, and wireless communications into wireless personal or body area networks for sensing, processing and communication of vital body parameters. A complete monitoring system entails an effective communication protocol, reliable data management and processing to ensue long term monitoring of patient without any space or time constriction. Textile sensors are expected to meet technological challenges and requirements. Therefore, the manufacturing process, the technology, and materials must be pragmatically selected as per the application areas. Undoubtedly, the future belongs to the new generation of wearable devices put to use in a gamut of applications apart from health monitoring. The present paper shall review application of smart textiles in health monitoring.
Keywords: Monitor, Physiological, Sensing, Sensor, Smart, Health, Wireless.

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Exploring the Potential of Non-Woven Wet wipes in Advancing Hygiene Practices

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Abstract

Non-woven wet wipes have gained significant popularity in recent years as a convenient and effective solution for personal hygiene, cleaning and various other applications. However widespread use of non-woven wet wipes has raised concerns about their environmental impact and sustainability. This research aims to investigates the potential of non-woven wet wipes in sustainable hygiene practices by examining their production, designing patterns, disposal methods, and potential alternatives. By examining their production, design patterns, disposal methods, and alternative solutions, the study aims to shed light on their role in advancing sustainability. Through a mixed-methods approach involving literature review and environmental impact assessment, this research provides insights into the characteristics of non-woven wet wipes, their environmental implications. The findings contribute to understanding the opportunities and challenges associated with non-woven wet wipes, informing policymakers, manufacturers, and consumers about sustainable hygiene practices.

Keywords
Non-woven wet wipes, raw material potential, designing patterns, sustainability

References
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Acknowledgment
Provide the brief acknowledgement (Font 10 pt., Time New Roman)

Sustainable Absorbents from Lignocellulosic Materials for Hygiene Applications

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Abstract

Absorbent polymers are used extensively in contemporary hygiene products like diapers, adult incontinence aids, and feminine hygiene solutions. Besides hygiene applications, absorbent polymers have also found utility in the agricultural sector. Superabsorbent hydrogels, a category of absorbent polymers, have demonstrated potential as reservoirs, capturing excessive irrigation water and vital nutrients. Absorbent polymers have traditionally been derived from petrochemical feedstocks. This raises environmental concerns due to the inherent ecological footprint of petrochemicals. Shifting the narrative, researchers are now trying to develop absorbent polymers from lignocellulosic biomass, an abundant plant resource comprising cellulose, hemicellulose, and lignin. When juxtaposed against conventional acrylic acid-based absorbent polymers, lignocellulosic-derived polymers exhibit pronounced advantages, notably their inherent biodegradability, potential economic feasibility, and environmental compatibility.

This paper outlines the applications of absorbent polymers, lignocellulosic materials used for producing absorbent polymers, techniques utilized for the extraction, refinement, and cross-linking of lignocellulosic constituents, and testing and characterization of the same. The challenges and future prospects of lignocellulosic absorbent polymers will also be discussed.

Keywords
Sustainable; Absorbents; Lignocellulosic materials; Hygiene applications.

Antiviral, Antimicrobial & Anti Fungal Sustainable Mask Finished With Plant Extract Proposed For Cancer Patients

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Abstract

The growth of medical textiles in recent times has taken a new dimension with advanced development of technology that seamlessly weaves together innovation, science and healthcare. Comfortable healthcare textiles were created for its well-known protection, prevention and healing wand with its advanced innovation and performances. Essentially masks and gowns played a vital role recently and prevented the spread of infections. Infections are the incursions of microorganism such as viruses, bacteria and fungus. Cancer patients are prone to infection than a healthy normal person due to the cancer therapy that suppress the immune in the patients. A neutropenia patient gets rapidly infected with common microbes that affects them precariously with severe side effects and put their life at risk. A mask is very essential for a cancer therapy patient with more recommended herbal finish which will offer several advantages that cater to both the wearer's comfort and the environment. Bamboo knitted fabric, which is known for its unique properties and sustainability, has been taken for the study and coated with the plant extract. The plant named as "A" has a property of Anti-viral Anti-Microbial and Anti-fungal properties. The ethanol extracted of 1ml plant A was tested for Anti-Viral with the Bacteriophage MS2 ATCC 15597-B1 for 24 hrs. The same was tested for Anti-microbial activity with three different bacteria of Staphylococcus, E.coli and Pseudomonas aeruginosa. Also, it was tested for anti-fungal activity with candida albican. The plant A ethanol extracted solution was added with the natural mordant and coated through padding mangle on the fabric. After coating the fabric was tested with the anti-microbial, anti-fungal, anti-viral activity and further tested with the filtration test. As a result, the bamboo fabric is claimed with the better performance on antiviral, anti-microbial & anti-fungal for mask.

Keywords
Medical textiles, Anti-viral, Cancer patients, Masks, Bamboo fabrics, Herbal finish, functional clothing.

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Application of Antimicrobial and Blood Repellant Finish on Polyester/Cotton Blend

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Abstract

Increasing global competition in textiles has created many challenges for textile researchers and industrialists. The rapid growth in technical textile and their end uses have generated many opportunities for the application of innovation in finishes. Antimicrobe and blood carry a host of diseases. Therefore, there is a need for the development of a textile product of anti-microbial and blood repellency properties. Thus, by developing the product with anti-microbial and blood repellency properties the cross infections due to the use of bed linens and wound dressings which in contact with the blood of the wound can be reduced. Methanol extract of clove herb was examined using a standard antimicrobial agar diffusion method. Clove extract was tested against Gram negative (Escherichia Coli) bacteria. The result showed antimicrobial properties on polyester/ cotton blend. Critic acid at different M: L: R (1:50, 1:70 and 1:90) was used for the post treatment of clove extract treated fabric. The union dyed fabric showed excellent antimicrobial activity and reactive dye minimum antimicrobial activity. Blood repellency was examined at different time intervals (5, 10 and 30 mins). The finished fabric when treated with blood repellant finish showed excellent results. Various physical properties (tensile strength, bending length and crease recovery) of finished sample were also increased.

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The authors acknowledge the anti-microbial and blood repellency properties on polyester cotton blend by researchers.

kriAntimicrobial Textiles Based on Vanillin and Its Derivatives

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Abstract

Multifunctional finishing agents are the primary need for the current scenario. To provide multifunctional effect to textile one or more finishing agents are required which have generally compatibility issue. Natural based finishing agents having disadvantage of reproducibility and higher add on was required which hamper the basic useful properties of textile. Synthetic material based multifunctional agents having problem of biocompatibility and having adverse effect on environment. Recently vanillin explored exponentially in pharmaceuticals industries. Vanillin is a small magical molecule having very interesting properties. In this research, comparative studies of vanillin and its derivatives have been summarized and discussed in details. Vanillin is a small molecule which is safe to explore and having excellent biocompatibility and eco-friendly in nature. Synthesis of other derivatives of vanillin have been discussed. Further vanillin and its derivatives integrated on textile and their functional properties have been studied in details. It was observed that vanillin derivatives having good wash durability and having excellent functional properties as comparison to vanillin alone. But copper complex of vanillin and derivatives having excellent functional properties and having potential to explore in various sector such as hospitals, sport textile, hotels etc. The main advantage of these finishing agents is that they required very low add on which do not hamper basic physical properties textile and provide excellent functional properties such as antimicrobial activity, antioxidant activity, fragrance ,UV resistance, and having attractive colouration.

Acknowledgment
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Poster Presentations

Enhancing Clothing Accessibility: Customized Garment Patterns for Individuals with Locomotor Disabilities

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Abstract

Disability encompasses difficulties arising from activity limitations, impairments, and participation restrictions. It results from interactions between personal, environmental, and health factors. The disabled population faces various medical, economic, social, and psychological challenges, necessitating a focus on their needs. For people with locomotor disabilities, dressing can be particularly problematic due to physical limitations. Adaptive clothing can significantly improve their quality of life and address body deformities. Key attributes for such clothing include using natural fibers to manage body odor, accommodating individual needs like sensitive skin and thermal comfort, and providing ease of care and donning/doffing. Clothing-related issues can limit independence and social participation for disabled individuals. The lack of adaptive clothing options hinders their ability to engage in various activities and negatively impacts their social life. Designing adaptive clothing requires considering aesthetics, comfort, protection, ease of movement, access, quality, and proper fit to improve their overall quality of life. To achieve a good fit, garment patterns should be tailored to body measurements and proportions. Clothing should not only accommodate disabilities but also promote self-expression and independence. Creating appropriate basic blocks based on body dimensions or simple manipulations can achieve the desired fit. The study used a two-phase approach, involving problem identification through interviews and observations, and prototype development addressing specific needs. The research revealed the significance of physical comfort, individual expression, and social acceptance through clothing for people with disabilities. The prototype development process considered factors like warmth, comfort, and ease of movement. The results led to the design of adaptive

Parali: Unfolding New Horizons in Paper Development

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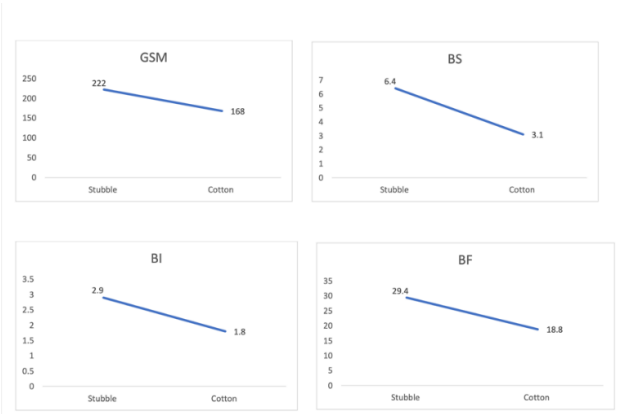
Abstract

During rice crop harvesting in October-November, residue is left on the ground as harvest machines cannot cut close to the ground. The only way to get to quickly get rid of this "useless" residue without wasting manpower remains burning which releases toxic gases, leading to air pollution, smog formation, and health issues.

However, by converting crop residues into paper, we can mitigate these problems. The fibrous nature of the crops allows them to be used as raw materials for paper production. The project revealed that paper sheets made from wheat stubble had greater burst strength compared to cotton-based sheets, suggesting its potential for primary packaging.Apart from the environmental benefits, using crop residues for paper production has positive economic impacts. Farmers can generate additional income by selling stubble and straw to paper mills instead of burning them. This boosts rural economies and provides economic opportunities.



The sustainable approach of using agricultural residues also helps conserve forests and natural habitats. By reducing the need for wood pulp from trees, we contribute to environmental preservation. Overall, the project's observations are valuable and encourage further research and development. Optimizing the paper-making process and exploring various applications for agricultural residues will lead to even more significant benefits. This innovative solution fosters resourcefulness and offers a win-win situation for the environment, farmers, and industries. By implementing these findings, we can contribute to reducing air pollution, promoting sustainable practices, and improving livelihoods.

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Sports-Eco: Exploring the Ways to Create Cellulosic Activewear

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Abstract

Sportswear and athleisure materials have advanced in recent years to accomplish high functions and attain comfort. The comfort of a person wearing activewear can be broken down into four categories: thermo-physiological comfort, sensory/tactile comfort, mobility/dexterity comfort, and psychological comfort. There are numerous natural and synthetic textile fibers used in sportswear at the moment, however, the sportswear market is dominated mainly by polyester. Active wears form an important part of functional textiles. These textiles are designed to transport moisture away from the skin, promoting quick evaporation and keeping the wearer dry and comfortable. They are commonly used in activewear, sportswear, and performance apparel.

Single jersey fabrics of 100% dope-dyed viscose with a hydrophobic finish at one side along with viscose/excel (70:30) blended yarn were used for developing active wear. The fabric developed was compared with the commercial activewear available in the market. The moisture management properties of both fabrics have been compared. The wicking values and heat flux values are greatly influenced by the knitting structures. The more the air gets entrapped in the structures the less the Qmax values. The developed fabric shows higher air permeability, heat flux, and wicking height as compared to the commercial sample. The absorption rate and spreading speed are slightly lower than the commercial fabric used in active wear. It may be due to the knitted structure. The dope dyeing technology is more effective than the two-step dyeing of polyester and modal with disperse and reactive, which requires an enormous amount of water and energy. The dope dyed or the spun dye technology adds up to the sustainability factor and saves water and dyeing cost. Printing of polyester or polyester blended fabrics also requires different types of machinery and methods. The fabric developed for activewear from dope dyed 100% viscose can be printed using a digital printer with reactive ink.

Keywords
Activewear, Dope dyed, Excel, Finishing, Hydrophobic, Viscose

Marbling: An Unconventional Way of Surface Design

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Abstract

Marbling is an unconventional technique of surface ornamentation on textiles to add value and also enhancing the aesthetic appeal of the final product. The naturally flowing colors produce through this technique are responsible for eye-catching and vibrant effects on the fabric. This innovative way of printing is comparatively very fast and effective, and printing long lengths of fabric can also be possible. It is one of the cheapest methods of surface ornamentation since the preparatory cost of block-making, screen-making, etc. can be avoided. The marbling bath can be effectively reused several times to get the marbled effect. Thus, marbling can be used to achieve varieties of textures, patterns, and shade ranges, for producing fashionable garments. Marbling is a process that is appreciated by different luxurious brands that use this technique in their collection. The objectives of the present study are to use natural/semi-synthetic gum as a thickener to avoid certain drawbacks associated with the use of popularly used chemicals viz., carrageenan and methocel in the marbling process. The risk of mixing pigments is avoided by using hydrophobic substances like turpentine oil, kerosene, etc. In the present study, various methods have been tried to create a variety of textures on different fabric surfaces, that can be further converted into garments in Indian style, Indo-western style as well as Western style.

Keywords
Carrageenan, Gum, Marbling, Methocel, Pigments.

To Develop Defensive wear with Photochromic Pigments by using Cotton and P/C Blended Fabric

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Abstract

In recent years, the smart textile section has opened new ways to functionalize photochromism. This research work chronicles a product development of defensive wear made up of cotton fabric, using photochromic Strontium aluminate pigment by the chameleon effect. The product gives the utmost protection to military applications with respect to clothing. A chameleon's capacity to change the tone to match its current circumstance is its approach to safeguard itself when a hunter is close by; the same phenomenon can be applied to a soldier's defensive wear using colouring pigment. The specified compound (SrAl2O4) for the defensive wear is comprised of photochromic and fluorescent materials that change tone with light. The photochromic pigments change in colour when exposed to sunlight or UV, and revert to their original colour. The photochromic pigment can be applied on fabric surfaces by screen printing. The P/C blended fabric was taken as the second variable. The dye concentrations of 10,15 and 20 percentages respectively with varying wavelengths of light sources are investigated. The products were tested for toxicity, air permeability, UV protection factor, colour fastness to washing and light. The factors that influenced the degree of photo-coloration are dye concentration, type of fibre and UV irradiation wavelength profile. The cotton fabric has a superior colourisation effect than the P/C blended fabric. The concentration of dye is directly proportional to the colouring effect. As a result, the wavelength has increased colour changes from mild to intense shade. The air permeability is better in cotton fabric, as it ensures more comfort. The fastness properties are at acceptable level that confirms the serviceability and durability of both the fabrics. The UV factor and toxicity are at acceptable level. This specially designed defensive wear is capable of satisfying the military application with respect to colour and comfort properties alone.

Keywords
photochromic Strontium aluminate pigment, chameleon effect, cotton & P/C blended fabric, air permeability and UV protection factor

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Transparent jute fibre-based composite for sustainable packaging

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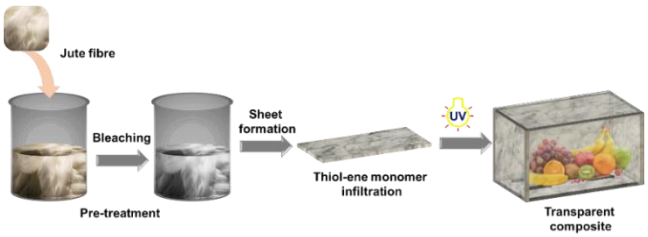
Abstract



The growing global awareness of the significance of sustainability and the urgent need to address the problem of plastic waste has led to an increasing demand for ecologically sound packaging materials. This demand is particularly pronounced in the fruit packaging sector, where there is a strong inclination towards finding alternatives to conventional materials. These alternatives should ensure adequate product protection and reflect a commitment to environmental consciousness. This study investigates the potential of jute-based fiber composites as a sustainable solution for fruit packaging. To achieve this, a UV photopolymerization method was utilized to fabricate transparent bio composites composed of solvent-free thiol and ene monomers reinforced with bleached jute fibers. SEM image describes the very good interaction between fiber and polymer. This investigation provides insights into polymerization and the production of transparent jute (TJ) films, achieved through variations in the fiber weight percentage, providing to packaging applications. The research also investigates the optical characteristics like transmittance and haze while adjusting the jute fiber weight proportion within the biocomposite. Transparency plays significant role in evaluating and validating specific packaging materials, allowing consumers to observe the products conveniently. Moreover, the mechanical performance was compared against commonly accessible commercial PET packaging alternatives. The TJ composite displayed remarkable mechanical strength, revealing an impressive 500% enhancement in flexural strength than Commercial PET packaging boxes. By presenting the findings, this research aims to contribute to the development of environmentally friendly materials for fruit packaging, thereby fostering a sustainable approach to packaging within the food industry. The utilization of jute-based fibre composites exhibits significant potential in substantially reducing plastic waste and facilitating a more environmentally conscious future for fruit packaging.

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Printing by Natural Minerals

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Abstract

In olden days fabrics is dyed by natural color from root, stem, and flower of plants, fabric can also be dyed by mineral oxides. The mineral khaki is dyed by the mixture salts. It is deposition of iron oxide and chromium oxide on cloth. But the dyed cloth facing problem like washing fastness and rubbing fastness. This problem can eliminated by using new methodology. The mineral means clay of different color available on land i.e. soil of different colors. This soil on land is in final state. It contain salt like sulfates, carbonates, chromates, of different metals. These acts as coloring matter. But we know the idea of printing of cotton and blends with pigments. Pigments are inert coloring matter in micro form. Here pigments are fixed to cloth by binder. We put an effort to use different colored naturally available minerals of on earth as yellow ocher, lime, minerals of mines etc.

Figure 1. Printing on Different Soil with Cotton material (Photographical Images of Printed Samples)

1. Amminagad Soil

2.Bagalkot Soil

3. Kamatagi Soil

4.Badami Soil

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Testing of NBC Protective Textiles

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Abstract

Nuclear Biological Chemical (NBC) Protective textiles provide full body protection to the first responders during NBC Scenario. Over the years, various type of adsorbent materials like granular activated carbon (GAC), Powder activated carbon (PAC), Activated Carbon spheres (ACS) and activated carbon fabric (ACF), are used to develop this type of protective textiles. The main challenges associated with development of NBC protective textiles are the testing and validation against toxic Chemical Warfare Agents (CWA). In order to achieve the quality, reliability and safety parameters, testing against CWAs are required at component level and full system level. In India, no laboratory except DRDE, Gwalior, is having these type of testing facilities as this requires authorization from strategic governing bodies of Government of India. DRDE, Gwalior has developed testing facility for textile materials against CWAs as per IS 17377: 2020 (Part 1). This facility includes Sulphur Mustard Breakthrough Test, Mandrel Test, Expulsion and Inverted Expulsion test.Development of these types of indigenous test facilities against CWA leads our nation towards "Atmanibhar Bharat". In order to achieve quality, and safety of protective ensembles/ clothing /material; new test methods / approaches, customised test assemblies as per international level need to be developed which will include integration of robotic mannequins and Artificial Intelligence based approach.

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Dyeing Of Cotton Fabric with Natural Dye Extracted from Parthenium Weed

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Abstract

The current study aims at dyeing of cotton fabric with natural dye extracted from leaves of parthenium hysterophorus. This would give scope for utilisation of unwanted terrestrial weeds. Parthenium hysterophorus is a commonly occurring annual herbaceous weed and aggressively colonized all over the places. This paper describes extraction of dyes from its matured leaves and also colorfastness properties. Pre-mordanting method was used for dyeing. Alum and Tin -chloride was used as mordants for fixation of natural dye. The results showed eye-cooling shades and color fastness to light, washing ,ironing, crocking was found to be good to excellent. It was concluded that leaves of parthenium weed can be utilised for cost effective cotton fabric dyeing with variety of shades with average to good fastness properties. Problem of weed management will be rectified and cost-effective dyed cotton fabric will be produced.

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Investigation of Thermal Insulation and Sound Absorption Properties for Composites made of Cotton/Polyester Recycled Non-woven and Polypropylene

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Abstract

Thermal and acoustic insulation in buildings and transport vehicles from recycled textiles can play an important role in energy savings and the reduction of environmental pollution. Textiles contribute a significant amount to the waste stream since most of these valuable fibre products are discarded after use. These discarded but valuable textiles can be recycled to produce several products including thermal and acoustic insulation materials. The cotton and polyester fabric selvedge wastes from specific lots are collected in the weaving mill. The selvedge wastes are converted into fibre form. Three different blends (50% Polyester & 50% cotton, 75% polyester and 25% cotton, 25 % polyester and 75% cotton) are taken to produce non-woven fabric using a needle punching technique, with a needle punching density of 350/inch is used as reinforcement material. Polypropylene resin is taken as matrix material. The compression moulding technique is used to convert composite materials, with a reinforcement ratio of 80:20 (Recycled material: Polypropylene). The variables are taken as temperature (900C, 1100C, 1200C) and moulding time (10, 20, 30 minutes) respectively. In the compression moulding process, pressure is taken at a constant rate of 120 Pascal to produce 15 mm thickness as standard with an area of 30 X 30 cm. The mechanical properties (tensile, flexural and impact), thermal insulation and sound absorption properties of natural /synthetic fibre reinforced with polypropylene matrix composites were reported. The fractured materials are analysed by scanning electron microscope (SEM).

Keywords
Polyester-Cotton, Non- woven, recycled material, Polypropylene, Compression moulding technique, Thermal insulation and Sound absorption)

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Merging fashion and technology seamlessly: an in-depth analysis of virtual clothing try on platform

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Abstract

This Project is entitled with "Merging Fashion and Technology Seamlessly: An In-Depth Analysis of Virtual Clothing Try-On Platform" is developed in PYTHON as a front end and back end.

In the Virtual Fashionista software, users can upload their clothing collections and a personal video. The platform allows users to virtually try on the uploaded clothing collections in their own video. The process involves using augmented reality and computer vision technology to overlay the virtual clothing items onto the user's video. By accurately tracking the user's body movements and aligning the virtual clothes, the system creates a lifelike try-on experience. Users can view themselves wearing their chosen virtual outfits in their own video, giving them a realistic impression of how the clothes fit and look. This interactive and personalized try-on process enhances the online shopping experience, allowing users to make informed fashion decisions and find the perfect outfits that suit their style and preferences. With Virtual Fashionista, users can confidently explore different clothing collections and virtually try on various outfits in their own videos, providing an engaging and enjoyable way to shop for fashion online.

Keywords
PYTHON, Virtual Fashionista software, augmented reality, computer vision technology, virtual clothing, online shopping experience.

Protective Textiles: Advancements and Applications

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Abstract

Protective textiles have emerged as a vital and rapidly evolving field, driven by the growing demand for innovative solutions that enhance human safety and well-being in a wide range of environments and scenarios. This paper provides an overview of recent advancements and applications in the realm of protective textiles. The paper begins by introducing the fundamental concepts of protective textiles, highlighting their importance in safeguarding individuals from various hazards such as thermal, chemical, biological, mechanical, and radiological threats. It outlines the key characteristics that protective textiles need to possess, including comfort, durability, breathability, and flexibility, while effectively mitigating risks. Subsequently, the paper delves into the technological progress that has significantly contributed to the development of protective textiles. It explores the utilization of advanced materials such as high-performance fibres, nanomaterials, and smart textiles. The integration of these materials not only enhances protection but also allows for tailored solutions for specific applications. The applications of protective textiles span a multitude of sectors, including but not limited to military, healthcare, emergency response, industrial workwear, sports, and aerospace. Each application area demands unique attributes from the protective textiles, leading to a diverse range of specialized designs. The paper provides case studies and examples that showcase how protective textiles are being employed to address challenges in various domains. In conclusion, the paper underscores the interdisciplinary nature of protective textiles, where material science, engineering, design, and human factors converge to create effective solutions. It also highlights the ongoing research endeavours aimed at pushing the boundaries of protection and comfort. As protective textiles continue to evolve, their potential to save lives and improve overall quality of life remains a driving force for innovation.

Acknowledgment
Dr. Preeti Singh is thankfull to the UGC D.S.Kothari Postdoctoral fellowship and Indian Institute of Technology, Delhi.

Exploring Hylocereus Polyrhizus (Dragon Fruit) Wastage as a Natural Colorant for Eco-Friendly Dyeing of Wool Fabric: Extraction, Absorption, and Fastness Analysis

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Abstract

The use of synthetic dyes in textile industries has been a significant contributor to environmental pollution. The discharge of these dyes into water bodies poses a considerable threat to aquatic ecosystems. In response to this concern, there has been a growing trend towards utilizing natural colourants for textile dyeing due to increased consumer awareness about environmental sustainability.

Hylocereuspolyrhizus, commonly known as Dragon Fruit, offers a promising source of natural colourant in the form of Betacyanin. This research aims to explore the feasibility of using the wastage of Hylocereuspolyrhizus as a substitute for synthetic dyes in dyeing wool fabric.The primary objectives of this research are to extract Betacyanin-based dye from the wastage of Hylocereuspolyrhizus (Dragon Fruit) juice, to assess the absorption and fastness properties of the extracted natural dye on wool fabric,to investigate the impact of different mordants and dyeing temperatures on the colour retention and stability of the dyed wool fabric and to identify the optimal combination of dyeing parameters to achieve the best color fastness on wool fabric.

The expected outcome is the identification of the effective extraction method for Betacyanin-based dye from Dragon Fruit wastage. Evaluation of the absorption and color fastness properties of the natural dye on wool fabric. Determination of the impact of different mordants and dyeing temperatures on color stability. The utilization of Hylocereuspolyrhizus wastage as a natural colorant has the potential to reduce the environmental impact of textile dyeing. The findings will provide valuable insights for textile industries aiming to adopt eco-friendly dyeing processes,by utilizing Hylocereuspolyrhizus wastage. The investigation into the absorption and fastness properties of the natural dye on wool fabric, along with the optimization of dyeing parameters, will offer practical solutions for sustainable textile coloration.

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Development of Wound Healing Material Using Sericin and Tridax Procumbens

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Abstract

Small accidents and injuries often takes part even once in everyone's life. Those injuries or wound takes quite a long time for healing. The purpose of this study is to heal those scars or wounds in simple and economic way that heals the wound in a shorter period of time. This study is an idea to make a wound healing component, by combining a various components which has a same chemical composition and its reaction to a wound has to be similar, and definitely in a quick and effective way. This study aims to develop a wound dressing material with sericin and extract from tridax orocumbens as active ingredients for surface wounds. Sericin is a globular protein present in silk. It is often discarded as waste during processing of silk and can be easily procured from local industries. Sericin is found to have wound healing, antioxidant, antimicrobial properties. It is found to improve the proliferation of new cells in the injured site. Tridax procumbens is an abundantly available plant that has many medicinal values. The extract from the leaves of the plant is known to remove scars while healing wound. Wound dressing materials with varying concentrations of the active ingredients have been developed and the properties are studied in this work.

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Study of Protein Based Flame Retardant Coating on Cellulosic Textile Fibre Derived From Marine Collagen Peptide

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Abstract

Cotton fibre is the most widely known and popular in the Indian subcontinent for its availability and comfort. But cotton being a non-thermoplastic fibre shows a complete lack of glass transition temperature as well as melting temperatures. It directly undergoes pyrolysis and combustion at 350 C and the resulting LOI is also found to be as low as 18.4% as a result it catches fire easily. This possess a serious threat to the consumer as well as the environment regarding fire hazards. Significant research has been conducted in the earlier century contributing many successful outcomes. But, research is mainly concentrated in commercially available fire retardants which can be broadly classified into Halogen based, Phosphorus-Nitrogen based and inorganic salt based. Apart from these intumescent based fire retardants were developed which are eco-friendly but their durability is in question. Recently, scientists have used plasma treatment with different polymerization gases to give cellulosic fabric fire retardancy properties. Although the plasma process is water-free and environmentally benign, it is quite expensive and the flame-retardant feature it imparts is not washable or age-resistant. Now, scientists are looking for completely natural and non-toxic alternatives which are eco-friendly and sustainable. Many natural alternatives like banana pseudostem sap, spinach juice, pomegranate rind, plant derived phytic acid and tannin-based compounds have shown positive results in regards to exhibiting fire retardant properties when applied directly on cotton fabric as surface coatings. Other protein-based substances like caseins, hydrophobins, whey proteins, collagen from cattle skin and egg shell membranes have also shown positive results. Therefore, a hunt for effective natural alternative is underway. The present research paper focuses on the possibilities of another potential substance, Marine Collagen Peptide. Marine collagen is already known for its striking benefits in cosmetic and pharmaceutical fields. Marine collagen peptide, a protein-based bio-macromolecule was added as a coating on cotton textile using pad batch method consisting of 4 dips & nips. The solution was applied in three different concentrations (15%, 20% & 25%) and two different padding expressions (80% & 100%) to enzymatically desized, scoured and bleached cotton fabric samples. Fire retardant characteristics of both the control and the treated fabrics were analyzed in terms of limiting oxygen index (LOI) and vertical flammability. The surface morphology was also studied with scanning electron microscope images. Later the results from the tests and characterizations were statistically analyzed revealing the best possible outcome and the optimum parameters to achieve the same.

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Development of Cold Weather Protective Clothing Using Knitted Fabric

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Abstract

Clothing made for cold weather clothing should suffice minimum heat loss and good sweat evaporation. Initially people tried with wool which gave better results. As the technology started to develop, researchers and academicians tried to come up with more alternatives in respect to raw materials, methodology. Generally, the protective clothing appears to be bulkier and it will have three layers. In that, the outermost layer is used for protection, the middle layer being the reason for insulation and perspiration and the innermost layer accounts for wicking action. The design complications, raw material cost and ease of productivity in respect to three layers production is critical. To avoid design complications, we are moving with single layer fabric with aim of reducing weight. Also, bulkier fabrics tend to give less comfort.

knitting is a process of intermeshing the loops of yarn where we can achieve our key properties like thermal conductivity, thermal resistance, water vapour permeability and air permeability just by reducing the loop length. knitting also stands as the solution for comfortableness. As the loop length being increased, the thickness increases. To achieve reduction in thickness, we are using EKS (polyacrylate) fibre. Though polyester and EKS have good insulating properties, EKS is generally preferred as it returns the lost body temperature back to body. The methodology is to use bicomponent fibre (acrylic and hollow polyester) with knitting technology and test results such as thickness test, air permeability, tearing test, abrasion test, pilling test, water spray test, thermal conductivity test, fabric dry time are being evaluated and compared with wool fabric.

Infused with Pipli Appliqué Charm: Shaping a Multifunctional Reversible Clothing Design Process based on the Eco-Fashion Framework

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Abstract

This study aimed to develop Pipli Applique's design of multifunctional revisable clothing that supports sustainability goals. This paper proposes multifunctional clothing that can be recycled and decomposed at the end of the clothing's lifespan. In particular, the Eco-fashion design model was adopted in this project. After analyzing fashion consumption and problems in multifunctional revisable product design, two items of multifunctional unisex clothing were developed out of the best five designs. Multifunctional revisable clothing design focuses on Pipli Applique, material selection, zero-waste techniques, and design for reversible. Thus, the minimization of material diversity as well as the application of zero-waste design techniques and multifunctional design guidelines for revisable clothing design can be implemented towards sustainability to preserve the environment by selecting recyclable materials, promoting profit and human health concerning multifunctional purposes and international standards for revisable clothing design. The findings can be used in various apparel products to help mitigate problems related to excessive clothing consumption as well as increasing fabric waste cause environmental concerns and resource depletion in the apparel industry.

Keywords
multifunctional clothing; design for reversible; eco-fashion design; zero-waste design, Pipli Applique art

Impact of Synthetic Textile Waste on the Environment and Assessment of Measures Available to Tackle It

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Abstract

The fast fashion industry is one of the major sources of environmental degradation and resource depletion in the world. According to the World-Population Clock 2019, the global population is over seven billion and growing by 200,000 people every day. This means that the demand for material goods, especially clothing, is increasing rapidly. However, the supply of natural resources is limited and declining, creating a serious imbalance between consumption and production. The fast fashion system relies on cheap and synthetic materials, such as polyester, nylon, and acrylic, that have a low life cycle assessment (LCA) and a high environmental impact. These materials are often embellished with metal studs, buttons, prints, and embroidery that make them difficult to recycle. As a result, most of the fast fashion garments end up in landfills, where they release toxic chemicals into the soil and water as they do not biodegrade. This poses a threat to the health of humans and other living beings.

Therefore, this study aims to explore the existing ways in practice to reduce the synthetic textile waste generated by the fast fashion industry and to promote more sustainable practices among consumers and producers. The study will focus on the design development of garments that can inspire sustainable behaviour in customers, such as reuse, repair, and upcycling. The study will also examine the potential of experimental fashion techniques that can lower the environmental impact of clothing production, such as natural dyeing, organic cotton, and hemp fabrics.

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Innovative Approaches to Sustainable Textile Treatments: Advanced Dyes and Coatings

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Abstract

The textile industry is known to be one of the major polluting sectors, with an estimated 20% of all water pollution caused by textile treatments such as coloration processes. Synthetic dyes, which are commonly used in the industry, contribute to this pollution and pose a serious environmental problem. To address this challenge, advanced dyes are being developed to treat materials and package coatings to sustain the environment and control the pollution caused by normal dyes. These advanced dyes are more biodegradable and environmentally friendly than synthetic dyes.

The use of natural dyes is also being explored as a sustainable alternative to synthetic dyes. Innovative companies are driving progress in coating technologies to meet the ambitious packaging requirements of the future. These advanced coatings ensure product safety and reduce the negative impact of consumer products on the environment. The development of green technologies and the application of Industrial Revolution 4.0 are also being explored to create a sustainable future. The use of eco-friendly sustainable dyeing of cotton fabric using reactive violet 05 and direct violet 09 dyes is also being studied.

Sustainable dyeing methods are being explored to reduce the environmental impact of the textile industry. Some of the sustainable dyeing methods include foam dyeing, bio-based dyeing, and the use of azo-free dyes. The use of natural dyes made from plants, marine invertebrates, algae, bacteria, and fungi is also being explored. However, the isolated use of natural dyes is not sufficient to establish the process as sustainable. It is necessary to consider the process in a global way, taking into account all the products that will be added during each stage, as well as the amounts of water

The implementation of these advanced dyes and technologies can help reduce the environmental impact of the textile industry and promote sustainable practices. The textile industry can adopt sustainable dyeing methods such as exhaust dyeing, continuous dyeing, and semi-continuous dyeing to reduce the amount of water used in the dyeing process and minimize the release of toxic chemicals into the environment. The implementation of green technology in the textile industry requires a holistic approach that involves adopting sustainable practices throughout the entire value chain. The use of green technology in the textile industry can help reduce the environmental impact of the industry and promote sustainable practices.

Keywords
Sustainability, advanced dyes, natural dyes, pollution, environment.

Smart Clothing-Based Healthcare Application System with Embedded Electrocardiogram Sensor

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Abstract

The combination of advancements in textile technology and smart wearable has culminated in an entire revolution, leading to the transformation of the garment industry and revolutionizing the way we engage with technology. Wearable textiles combine innovative materials with ergonomic design, providing individuals with enhanced comfort, durability, and practicality. Concurrently, the integration of smart clothing incorporates sensors, microprocessors, and wireless networking to transform clothes into interactive platforms, enabling the capture of real-time data and facilitating tailored experiences.

In this study, we will be discussing smart clothing based healthcare application systems that integrate various micro sensors for physical signals collection. The wearable electrocardiogram (ECG) electrodes are embedded into the smart clothing. With the assistance of the cloud resource manager, a dynamic allocation mechanism can be applied to access cloud resources for monitoring the smart clothing-based healthcare application. The paper will take you through a information flow system of how the patient health details are transferred from sensors, analysing the data, transforming the data signals into information and cloud system presenting it on monitor. It would also deal with how the ECG sensors would be integrated into the patient gowns/ aprons/ uniforms to keep a 24/7 eye on the ECG levels of the patient. This study aims to cater for Intensive care units (ICU) in hospitals by making a centralized monitoring system of all patients through these sensors attached in clothing. This study will also look into the primary study of collecting data from various hospitals to assess the current problems faced in monitoring the patients and stating why this kind of technology has a need in the market and a comparative analysis on how this will make the system more efficient and easy to monitor.

Keywords
Wearable Technology, Smart clothing, Healthcare, Sensors, AI

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Exploring the Impact of Length-scale on the Efficacy of Particulate Matter Removal from Air via Electrospun PVDF Nanofibers

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Abstract

Human health is seriously threatened by particulate matter (PM) pollution, demanding effective mitigation measures. High efficiency face masks are one option; however, they are ineffective for prolonged usage due to significant pressure drop. Here, in this work, we demonstrate how tweaking of length scale in a fibrous media can enhance the efficiency, yet keeping the pressure drop in a comfortable breathing domain, when used as a facemask filter media. The fibrous layer is made out of electros spun polyvinylidene fluoride (PVDF) nanofibers, varying in four different fibre diameter ranges (about 150, 475, 615, and 950 nm).

The data suggests that the filter medium with 150 nm fibre diameter exhibit remarkable particle filtration efficiency (PFE) for PM0.2-0.5 m while maintaining an incredibly low pressure drop (P) in Fig. a. Among different basis weights,1.5 GSM with fiber diameter of 150 nm showed best results in terms of PFE and pressure drop.

This media was capable of capturing sub-micron PMs beyond 98.5% for all the chosen sizes. Interestingly, this pattern holds true throughout a broad range of face velocities (0.05 to 0.4 m/s) and lengthy filtering cycles (21 cycles). Here, the observations suggested that the ultrafine fibers allow a transition flow that enhances slip to negate tortuous path that adds resistance to flow; thus, not allowing drastic pressure drop. At the same time, a high number of ultrafine fibers practically stops the particle trajectory efficiently, increasing interception-diffusion interaction. This study shows an effective method for creating reliable, reusable high efficiency filter media.

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Revolutionizing Textiles: Ayurvastra, Lotus Fabric and Cocona Fibers for Health and Sustainability

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Abstract

The textile industry is transforming remarkably, driven by a growing demand for sustainable and health-conscious products. This abstract explores three innovative textiles—Ayurvastra, Samatoa Lotus Fabric, and Cocona Fibers—that are revolutionizing the way we think about clothing and textiles.

Ayurvastra, derived from Sanskrit, translates to "life cloth." This textile branch is rooted in Ayurveda and prioritizes health, sustainability, and organic materials. Ayurvastra garments are crafted from 100% pure organic materials such as cotton, silk, wool, jute, and coir. What sets them apart is their unique dyeing process using Ayurvedic herbs, imbuing the fabric with medicinal properties. These fabrics are free from synthetic chemicals, making them environmentally friendly and beneficial for the wearer. They have been found to alleviate various skin conditions and even aid in treating ailments like diabetes, asthma, and insomnia. Ayurvastra represents a significant step towards healthier and more sustainable clothing choices. Samatoa Lotus Fabric, on the other hand, embraces the healing properties of the sacred lotus plant. This fabric, made entirely from lotus fibers, is believed to induce a sense of calmness and peace in those who wear it. It also carries the potential to alleviate headaches, heart ailments, asthma, and lung issues. Beyond its health benefits, Samatoa Lotus Fabric adheres to eco-friendly practices, reflecting the innate purity of the lotus plant. Handmade meticulously, it is a testament to the harmony between nature and textile production.

Cocona Fibers represent yet another paradigm shift in textiles. These fibers incorporate activated carbon derived from coconut shells, enhancing fabric performance in numerous ways. Cocona fabrics excel in quick drying, odour control, and UV protection. The activation process creates a surface area within the fibers, enabling moisture to evaporate rapidly, making them ideal for sportswear and outdoor activities. Their ability to trap odours and provide a durable solution for eco-conscious consumers sets Cocona Fibres apart. By upcycling waste from the food industry, Cocona sets a sustainable standard for the industry. These innovative textiles—Ayurvastra, Samatoa Lotus Fabric, and Cocona Fibers cater to consumers who prioritize well-being and environmental responsibility. As the textile industry evolves to meet these demands, these textiles stand as exemplars of a brighter, more conscientious future for fashion and textiles.

Keywords
Herbal, Upcycling, Organic, Eco-friendly, textiles, Sustainability, UV protection

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Blockchain to enhance transparency of supply chain in fashion industry

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Abstract

The fashion industry faces numerous challenges related to transparency, authenticity, and sustainability. Use of blockchain technology provides the platform to ensure security of these aspects of the supply chain and foster sustainability within the industry. Companies aim to build the trust with consumers, labour advocates, and investors by publishing supply chain information, showing accountability. The current supply chain is as shown in Figure 1 and after integration of Blockchain technology to enhance transparency the supply chain will look like as in Figure 2. There are four crucial components of blockchain technology for supply chain transparency i.e., distributed shared ledger, smart contract, permissions, and consensus. At system level, the blockchain would require recording and securing essential data to ensure traceability. Each transaction is verified against the rules before recording on the shared ledger. The safeguarding of critical data is necessary and can be done using The Internet of Things (IoT), which facilitates real-time monitoring of logistics data to enhance collaboration among supply chain stakeholders. IoT device tag, location system, location engine and wireless communication with the cloud platform are the four main components of a IoT tracking system. It is important to address the challenges that accompany the use of blockchain in supply chain - technical limitations, regulatory issues, and concerns over data privacy etc. Therefore, there is a need for experimentation to demonstrate application of blockchain in the supply chain to enhance transparency and promote sustainability.

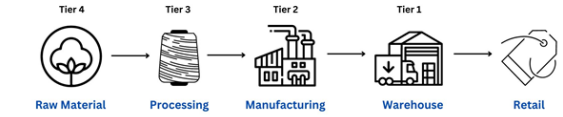

Figure 1: Supply chain process of fashion industry

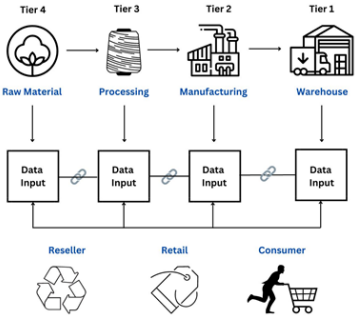

Figure 2: Supply chain after integration of blockchain

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Acknowledgment

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Experimental Demonstration of Memristor

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Abstract

In addition to the fundamental circuit elements of resistors, capacitors, and inductors, there exists a fourth essential component known as the Memristor. The Memristor is a two-terminal, non-linear device with the remarkable ability to retain information regarding the magnitude of electric current traversing through it.

In this study, we have designed a simple apparatus to elucidate the behaviour of a Write-Once-Read-Many (WORM) Memristor. Our selected sample material is an electronic textile (e-textile) fabricated from e-yarn. This e-yarn is specifically composed of a blend of Polyethylene Terephthalate (PET) and stainless-steel fibres, with a composition ratio of 80:20.

This educational kit (as shown in the Fig. 1. and Fig. 2.) serves as a pedagogical tool for illustrating Memristor operation at various educational levels. Initially, the Memristor resides in a High Resistive State (HRS) with an approximate resistance of 'k' ohms or 'M' megaohms. Upon the application of a voltage or current bias, it undergoes a transition to a Low Resistive State (LRS). Notably, this LRS state exhibits stability, showcasing its non-volatile characteristics, thereby exemplifying the WORM process. The device can be reverted to the HRS state through mechanical perturbation, thereby rendering it primed for another cycle of the WORM process, which is termed the Reset Write-Once-Read-Many (ReWORM) operation.

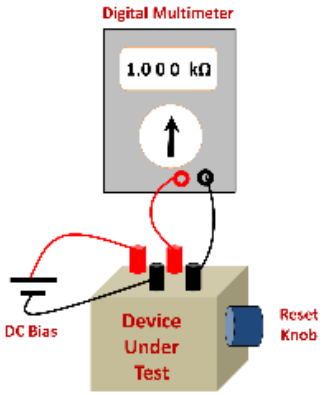

Fig. 1. Block diagram of the setup

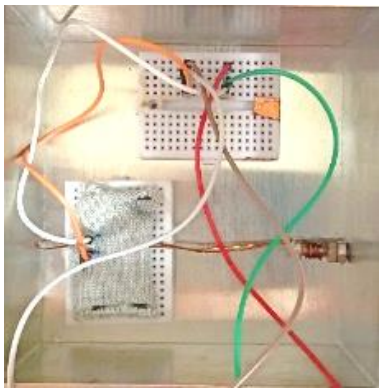

Fig.2. E-textile, connecting wires housed in a metal box

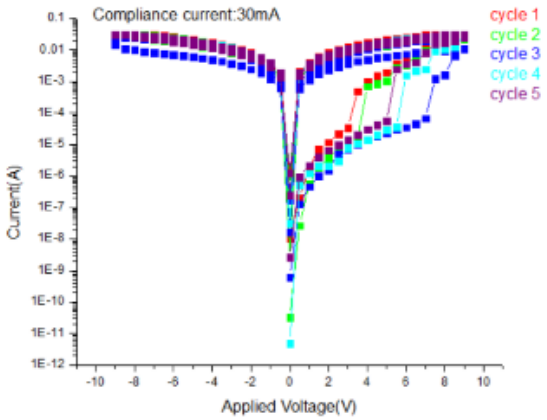

Fig. 3. The current-voltage (I-V) characteristics of the device under test

The charge conduction mechanisms encompass various phases, including thermionic emission, Space Charge Limited Conduction (SCLC), and ohmic conduction during the High Resistive State (HRS), the transition state, and the Low Resistive State (LRS), respectively. The current-voltage (I-V) characteristics are graphically depicted in the accompanying figure (Fig. 3) for visual reference.

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Revolutionizing Sustainability: Innovative Utilization of Fabric Waste in Eco-Friendly Brick Production

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Abstract

In today's world, sustainability has transcended being merely a buzzword; it has become an urgent call to action. The essence of sustainability lies in utilizing resources in a manner that fulfils the needs of the present without compromising the prospects of future generations. As the world grapples with escalating concerns surrounding climate change, resource depletion, and environmental degradation, industries are under immense pressure to adapt. Among these, the construction and textile sectors loom large as major contributors to environmental deterioration.

Traditional brick manufacturing, a cornerstone of the construction industry, is responsible for its substantial greenhouse gas emissions, primarily in the form of carbon dioxide, contributing significantly to climate change. In parallel, the textile industry, while fueling the world of fashion, stands as the second most polluting sector, with garments boasting an average lifespan of a mere three years. Astonishingly, the fashion industry churns out a staggering 92 million tons of textile waste annually. Confronting these pressing environmental issues necessitates a radical shift towards sustainable alternatives.

The present research explored the innovative utilization of textile waste and agricultural by-products in the cutting-edge domain of Eco-friendly brick production. In this pioneering initiative, both pre- consumer and post-consumer textile waste, in conjunction with agricultural by-products, were harnessed to fashion conventional bricks. Extensive research has been conducted, rigorously examining the mechanical and thermal characteristics of these eco-friendly bricks. The researcher fashioned a range of interior items from these environmentally friendly bricks, blending functionality with aesthetic appeal, all while prioritizing sustainability. Further, these eco-fab bricks present a wide array of opportunities for creating sustainable solutions that replace conventional, environmentally detrimental practices with products derived from these waste materials. This innovative approach tackles two crucial challenges: efficient waste management and the advancement of eco-friendly development strategies.

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A Review of High Compression Clothing for Sportswear

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Abstract

This review comprehensively explores the intricate relationship between high compression sportswear and athlete physiological well-being. This review focus on performance optimization and technological integration. Compression garments known for calibrated tightness for potentially improving exercise efficiency and comfort. Inconclusive research necessitates thorough investigation for a solid knowledge foundation. The present review critically defines commercially available compression garments through diverse lenses and wearer perceptions which unravels the complex dynamics of garment performance. In the evaluation of compression garment brands, assessment of textile parameters including durability and comfort contributes to understand the garment effectiveness. Initial findings reveal performance differences between professional grade and standard compression garments. The review underscores diverse factors affecting compression garment efficacy, such as materials, design nuances, athlete-specific traits, and athletic demands. This helps to understand and execute the need of product developments. The review extends to technology in sports textiles, encompassing performance enhancement and aesthetics. Which discusses the advance fabrics regulating temperature, minimizing drag, reducing muscle oscillation boost performance, Integrating microprocessors and sensors into sportswear. There are challenges persist in integrating technology and launderable garments in organic fiber transistors and solar cell-imbued fibers. In present time material innovations are extended in to the traditional fabrics. Polyester's evolution from moisture accumulation to moisture-wicking exemplifies progress. Bamboo's transformation into antimicrobial rayon is noteworthy. Synergy between merino wool and spandex yields adaptable ensembles for varied climates. Compression attire's resurgence, aided by technology, aids injury prevention and recovery while regulating temperature. In conclusion, this review helps in understanding the compression garment complexities for athletic performance and well-being. It uncovers the evolving fusion of scientific inquiry and technological innovation which transforms sports textiles into a realm where science, technology and human potential harmoniously converges.

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Application of Multi-Criteria Decision-making technique for Selection of the Best Nonwoven fabric in Biocomposites

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Abstract

Dhaincha (Sesbania aculeta) and Sunnhemp (Crotalaria juncea) are the green manuring crops mainly employed for the improvement of soil health and its stabilization in agricultural fields. Rather than being used in green manuring, these crops also yield quality lignocellulosic fibres, which can be applied to various technical textiles. Since these fibres are coarser, the realization through spinning is low for apparel textiles, so these fibres fit into the technical textile arena, particularly for fabricating bio-composite due to their stiffness. In this study, nine needle-punched nonwoven fabrics from Dhaincha and Sunnhemp fibres with varying areal densities (200, 300, and 400 g/m2) of the fabric and blend proportions of fibres (100% Dhaincha; 50:50 Sunnhemp: Dhaincha; 100% Sunnhemp fibre) were produced. A multi-criteria decision-making (MCDM) statistical algorithm, i.e., the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method, was utilized to select the suitable nonwoven fabric for the reinforcement based on their performance parameters like tensile strength, puncture strength, compressibility, packing density, and resin sinking time (in unsaturated polyester resin) of the nonwoven fabrics. The TOPSIS method helped in selecting and ranking the best nonwoven fabrics suitable for fabricating bio- and green-composite materials. According to this technique, the best alternative would be the one that is nearest to the positive ideal solution and farthest from the negative ideal solution. In this MCDM problem, there were nine alternatives and five criteria or attributes. By comparing the relative closeness values, the ranking of the alternatives was determined using TOPSIS scores (Figure 1). Among nine alternatives, the TOPSIS algorithm identified 100 percent Sunnhemp nonwoven fabric with 400 g/m2 as ideal for the construction of sustainable biocomposites with high strength and durability.

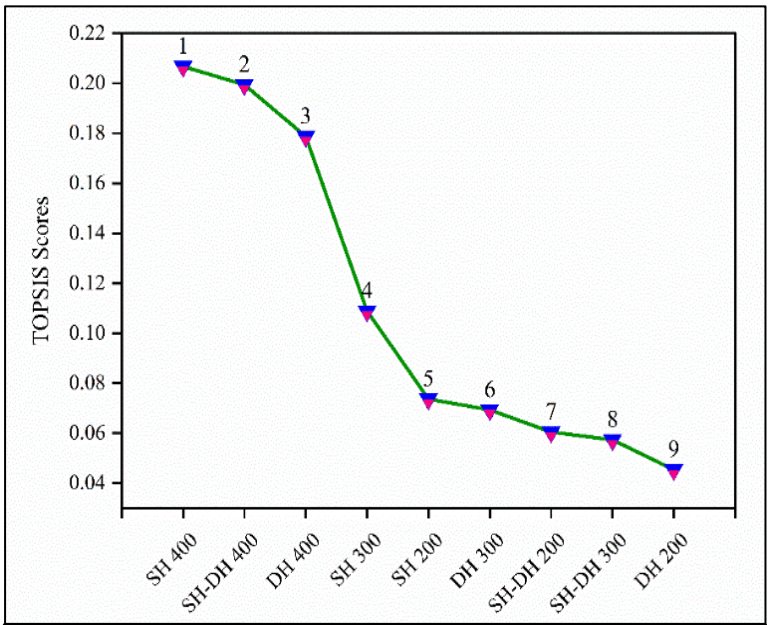

Figure 1. TOPSIS scores of nonwoven fabrics

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A Review on Recycling in Natural and Synthetic Fibre Cotton, Polyester, and Wool Blends of Apparel

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Abstract

This review explores the contemporary approaches and challenges associated with recycling natural and synthetic fibers, focusing primarily on cotton, polyester, wool, and silk. With the growing environmental concerns associated with the textile industry, the need for sustainable and eco-friendly practices has become imperative. Regarding natural fibers, cotton, one of the most widely used materials in the textile industry, poses challenges in recycling due to the complexity of separating cotton from other blended fabrics. However, advancements in mechanical and chemical recycling techniques, including enzymatic processes, offer promising avenues for the efficient recycling of cotton fibers. Similarly, the recycling of wool and silk, owing to their unique structures and characteristics, demands innovative methodologies such as solvolysis and biotechnological processes, to ensure the preservation of their intrinsic properties. Synthetic fibers, such as polyester, contribute significantly to environmental pollution due to their non-biodegradable nature. Consequently, the exploration of various recycling methods, including mechanical recycling, chemical depolymerization, and upcycling, has gained traction in mitigating the adverse environmental impact caused by polyester waste. The challenges in recycling polyester include maintaining its quality and ensuring cost-effective procedures.

Keywords
Recycling natural & Synthetic fibre, Sustainable garments

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Effect of Soil Particles on Wicking Properties of Natural Fibre Yarns for Geotextile Application

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Abstract

The wicking and drainage properties of geotextile play a significant role in geotextile products, such as prefabricated vertical drains (PVD). The accumulation of soil particles on the sheath and core of the PVD can reduce its drainage properties. The effect of soil clogging on the hydraulic properties of jute yarn and coir yarns was studied. A vertical wicking test of the yarn was conducted using tap water and slurries made from Delhi silt and Kaolinite clay. The soil slurries were prepared at 5%, 10%, and 20% concentrations. The maximum wicking heights of the yarns were determined. It was observed that the maximum wicking height of both jute and coir yarns decreases when soil slurries are used instead of tap water. Furthermore, the maximum wicking heights of both yarns are significantly reduced as the concentration of soil slurries increases. This reduction can be attributed to the intrusion of soil particles into the capillaries of the yarns due to the capillary clogging phenomenon.

Review on Design and Development of Woven Textiles for Anti-Gravity/Micro-gravity Explorations

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Abstract

Research works are an endeavor to discover answers to intellectual and practical problems through the application of scientific methods. It is believed that the fashion industry must reconsider their approach to design if it is to succeed in clothing for the demands of new-generation. A new field of fashion notifies to dress for the changing environment, which seeks the creativity of the designers with specialist knowledge, and will able to apply their knowledge in the development of designs for the micrograviy and variable gravity environments.

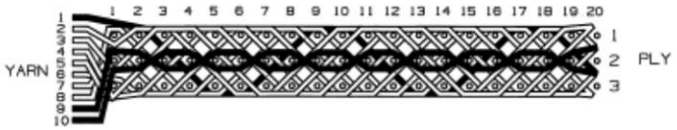

Image 1: Unique Glass Layer Construction for AO Resistance
Source: NEED (nasa.gov)

The variety of missions to explore the anti-gravity/microgravity adventures have determined that with minimal resupply opportunity in long-duration missions, the amount of logistics needed for minimum four astronauts will stand unpredictable, if supplies are continued to be provided in the same way as today. Clothing forms one of these logistical elements, which reflects the capacity to be addressed differently. The emergence of the Smart Textiles field opens possibilities for designers to combine traditional surface fabrication techniques with advanced technology in the design process. Relatively innovative collaboration of Schoeller Textiles, with Jan Beringer, workout apparel for astronauts to wear while exercising from the sportswear apparel defines the similar usage of targeted clothing usage.

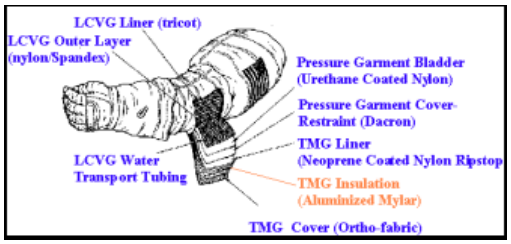

Image 2: Multi-layer Assessment of Space Clothing System
Source: NEED (nasa.gov)

The purpose of this work is to develop knowledge on interactive textiles as materials for specific performance through the review of practice-based design researches. The proposal formulates a review in order to frame the design explorations, in which material expression and design are major placeholders.

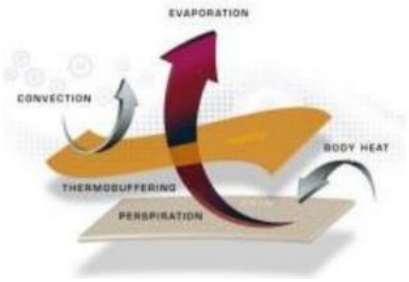

Image 3:
Moisture Management Fabric
Source: (PDF) Active knit fabrics - functional needs of sportswear application (researchgate.net)

Relating the development of woven textiles for performance apparel to existing methodology in sports-tech and space suits gives rise to new issues that need to be addressed. Finally, the research would reflect on the role of relative textiles for possible methods of prototyping.

The study aims to establish a collaborative design language based on woven textiles and the expression of smart textiles as a new design material for the performance apparel. It could also guide the reusability of such wearable technologies and commercialization of the product for the masses. It Influences the task of designing in observance of the effects of microgravity and in response to expectations of adventure and travel enthusiast audiences.

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Performance analysis of the outer layer of extreme fire-retardant fabric at different angle of exposure using numerical modelling

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Abstract

Many extreme fire-relevant accidents and burning of human physiological or wealth damage are happening due to willingly or unwillingly creating fire worldwide. It is a great challenge to simultaneously meet the properties of fire protection and physiological comfort. Sometimes fire rescuers need to face and stay for a long duration inside the extreme heat exposure. They need to sustain themselves against extreme flame exposure including radiant heat exposure as well as convective exposure from different distances which is considered as the air gap or distance between the heat source and the body of the rescuers. The type of material of the outer layer of extreme heat protective clothing, and the heat flux generated from the source of the fire in different directions. In this study, the outer layer was weaved in a honeycomb design. The para-aramid fibres of different content percentages (from 0% to 100%) of multilayered extreme fire protective clothing were examined concerning the impact of several factors, including heat flux expansion at different angles. A model presented for the combined radiative and conductive heat transportation was developed and solved numerically by a self-developed code to evaluate the protective performance of the outer layer of clothing subjected to a higher heat flux. In this study, we examined the rating of thermal protective performance (TPP) for the outer layer of extreme heat protective fabrics that were tested by taking 50 percent radiant heat exposure and 50 percent flame exposure combined and individually. The experimental data extracted by applying laboratory testing (Vertical Protective Performance (TPP) Tester) using reduced heat flux has been utilized to validate the model and code. Finally, analyzing the model results, flame exposure makes the protective ensemble's burn time the highest, and radiant exposure drives it to be least for different Kevlar fibre content percentages for the honeycomb weave structure.

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Dyeing and eco-printing of cotton fabric with guava leaves (Psidium guajava)

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Abstract

The current study aims to accomplish a number of objectives, including the efficient recycling of agricultural waste, simplification of the natural dye process through direct application without extraction in the form of prints, increased value addition through the use of natural colourants in printing, and both dyeing and printing of cotton-hemp blended fabric using a natural dye. Abundantly and easily available leaves of guava tree (Psidium Guajava) were used to dye 100% cotton and cotton-hemp blended fabrics. Low-toxicity metal mordant, such as aluminium sulphate, was utilized in the process making it environmentally friendly. The extraction of colours from guava leaves, mordant concentration and dyeing conditions for guava leaf-aluminium mordant-100% cotton/cotton-hemp (50:50) blended fabric combination were optimized. Additionally, the leaves were printed on the fabrics using the rolling and hammering methods, both with and without steaming for varying durations. Phenolic substances including ellagic acid and myricetin-3-O-b-D-glucoside, an anthocyanidin compound in addition to some flavonoid-based compounds were identified in guava leaves through phytochemical, LC-MS, and UV-VIS spectral analysis. 100% cotton and cotton-hemp (50:50) blended fabrics were exhaust-dyed in brown hues using guava leaf aqueous extract, and the results showed good fastness. The resulting prints were clear, sharp and distinct, with good to outstanding fastness to light and rub, but moderate to washing. In general colours developed by guava leaves on 100% cotton/cotton-hemp (50:50) blended by eco-printing using pounding technique are darker than when it is used as a dye to the fabrics by the exhaust method. The results of FT-IR spectrum analysis show that the phenolic structure of ellagic acid and catechin in guava leaves forms complexes with aluminium mordant through Al–O coordinated covalent bonds, and hydrogen bonds may also form between the dye molecules and cellulose. UVF and antimicrobial property of the dyed fabrics were identified to be good. The leaves were printed as a product-end usage on tote bags, t-shirts, and scarves.

Keywords
Aluminium sulphate, aqueous dyeing, extraction, contact printing, cotton, cotton-hemp blend, eco-printing, guava leaves, natural dyes, Psidium guajava, surface colour strength, fastness.

Title: Water repellent finishing treatment for different types of blended suiting fabrics

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Abstract

Five different types of blended suiting fabrics have been collected from BSL Suiting Bhilwara (Raj.). The compositions of suiting fabrics were 100% polyester, Polyester/Viscose (65:35, 80:20) & Polyester/Wool (55:45, 70:30). Different structural mechanical properties of the blended fabric have been examined in detail. All fabrics are having plain weave structure and areal density was in the range of 160-190 g/m2. The polyester filament of 1.2-1.5 denier was used for 100% polyester fabric. The polyester-viscose blended fabrics were made of 1.4D Polyester and 1.2D Viscose staple fibre, however, polyester -wool blended fabrics were developed using yarn of 2/48-56S. The polyester and wool were used 2.2-2.5 D and 22-24µm respectively. The breaking strength and elongation of fabrics were found in the range of 63-102 kgf. 100% polyester fabric has highest strength followed by polyester-viscose and polyester wool fabrics. The young modulus of polyester-wool blended fabric was lowest followed by polyester-viscose and 100% polyester fabrics. Water repellent finishing was imparted on all blended fabrics. Henceforth contact angle, absorbency time and wicking property of the finished fabrics were evaluated for these blended suiting fabrics. 100% polyester cot-look and P/V (70:30) suiting fabric found higher water wicking (absorbance) than other blended fabrics. It may be due to higher capillary action between polyester fibres. The P: W (55:45) and P/V (65/35) exhibited higher water repellent behavior (lower wicking behavior) than other suiting fabrics. It may be due to higher proportion of wool and viscose fibres and its water absorbency in the blended fabrics. The structure of yarn and its fabric is also affect for the higher water repellent behavior of the fabrics. Mechanical and physical properties of finished fabrics have been examined in terms of tear, tensile strength, fabrics thickness, weight and its cover factor. Fabric handle properties after finishing were also measured and compared with the unfinished fabrics. No significant difference was observed for handle and aesthetic values of the finished fabrics.

Keywords
100% Polyester, P/V & P/W blended finished suiting fabrics, Water absorbency and repellent. Tensile and tear strength, Cover factor, Fabric weight & thickness. Low-stress mechanical properties

Silk Sericin: Biowaste Transformation to Functional Materials – Structure, Properties, Extraction, and Promising Applications

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Abstract

Silk sericin, a proteinaceous substance derived from the waste generated during silk processing, has garnered attention for its promising applications in various fields. The aim of this paper is to provide a comprehensive overview of the sericin extraction process and explore its diverse functional applications. This review starts with a brief introduction of silk and silk sericin, then deals with various extraction processes where traditional methods such as chemical and physical processes are discussed as well as comparatively new techniques such as enzyme, microwave-assisted, and ultra-sound extraction.

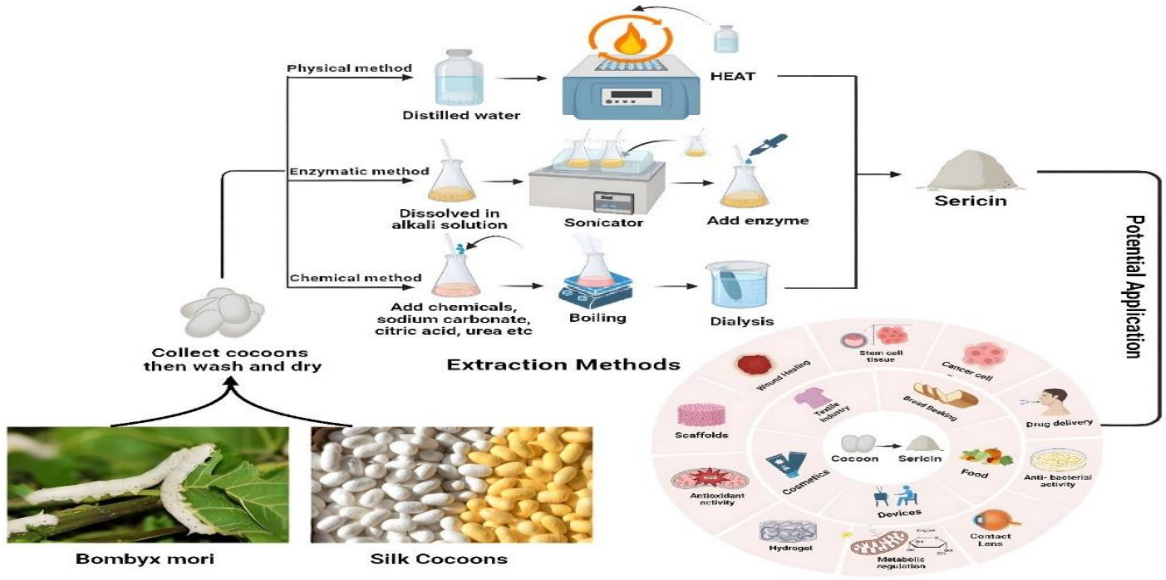

Fig 1: Extraction of silk sericin and potential applications of sericin.

The advantages, limitations, and optimization strategies associated with each extraction method are also discussed. Furthermore, this review explores the wide range of functional applications of silk sericin across various industries. In the field of biomedical sciences, silk sericin has shown promise as a wound healing agent, a scaffold for tissue engineering, a carrier for drug delivery, and a biomaterial for regenerative medicine. Additionally, silk sericin finds application in the cosmetic industry, where it is used in skincare products due to its moisturizing, antioxidant, and anti-aging properties. Finally, the challenges, limitations, and future prospects of sericin are intensively discussed. The comprehensive understanding of extraction techniques and the range of applications discussed in this review contribute to the growing body of knowledge surrounding silk sericin, fostering further research and development in this field.

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Designing a biomimetic chemically modified silk fibroin gelatin-based bioink for 3D bioprinting of cartilage tissue

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Abstract

Designing a suitable bioink for articular cartilage regeneration using 3D bioprinting still stands as a major roadblock. Here in our study, we have attempted to covalently conjugate three chondrogenic signaling morphogens: LDN193189 (BMP pathway inhibitor), Transforming growth factor β three (TGF-β3) and Interleukin 1 receptor antagonist (IL-1Ra) to our silk fibroin gelatin (SF-G) bioink prior to 3D bioprinting. The chemical modification of SF biomaterial with cyanuric chloride (CyCl) to conjugate TGF-β3 and LDN193189 and diazonium coupling for IL1Ra conjugation was confirmed using the ATR-FTIR analysis. The covalent conjugation of these small molecules allowed for a sustained release profile, thereby increasing their overall bioavailability to the cells. An in silico-based molecular modelling approach was adopted to further validate the conjugation. The Autodock vina and Chimera tools were used to predict the protein-ligand interactions where our chosen conjugation strategy displayed the minimum C-score and Root mean square deviation (RMSD) value. The hydrophobic interactions between the respective protein and small molecules were predicted using PyMol and Ramachandran plots, respectively. Detailed rheological characterization revealed that both the chemically modified SF-G bioinks displayed a shear-thinning behavior with an approximate gelation time of 10 minutes, similar to untreated SF-G. The printability analysis also demonstrated a spreading ratio and printability score equal to 1. Therefore, the chemical modification of the SF-G bioink did not interfere with the rheological and printability characteristics of the SF-G bioink. When 3D bioprinted with human bone marrow-derived mesenchymal stem cells, the chemically decorated SF-G bioink displayed adequate chondrogenic properties required for cartilage tissue development. Therefore, the covalent conjugation of these small molecule regulators to our SF-G biomaterial rendered biomimetic characteristics required to develop a 3D bioprinted cartilage graft.

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Generation of Pantone Numbers of disruptive printed Outer Shell Fabrics (OSFs)

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Abstract

Pantone Number is a specific colour code used for colour matching system using Spectrophotometer to ensure accurate and consistent colour identification. In the present work, attempts have been made to evaluate the Pantone colour code of the printed advanced grade outer carrier fabric dyed & printed with disperse dyes (Polyester) and acid dyes (Nylon 6/ Nylon 6,6) in disruptive camouflage pattern as per the Indian Army print Combat Suit. The Pantone numbers of the Combat Suit were found to be 17-0618 TCX (khaki), 19-4008 TCX (black), 19-0307 TCX (olive green) and 19-1116 TCX (dark brown). The RGB image processing was done using colour space conversion (HEX, HSV, RGB and LAB values). The different CIE LAB values for each colour are 51.31, -1.02 and 12.48 with HEX code 817a65 for khaki, 16.78, 0.91 and 0.32 with HEX code 2b2929 for black, 30.31, -4.01, 4.69 with HEX code 444940 for olive green and 32.12, 7.34, 11.42 with HEX code 5d473a for dark brown. The obtained colour values vary with change in temperature, humidity conditions and light sources (D65, TL84, UV, D50). These were converted into prepress by spot colour and process colour by digital printing machine. Also, the colour depth (K/S) & colour difference (ΔE) values were compared with the Pantone colour guide to find the colour tolerance limit and their closest possible match in CMYK four-color process for evaluation of JAD (just acceptable difference) and JND (just noticeable difference). The CIE LAB values of four colour disruptive printed fabrics of Nylon 6, Nylon 6, 6 and Polyester were measured using Spectrophotometer for mapping the acceptable tolerance range (lower limit & upper limit). The results obtained were within the acceptable limit with the standard digital camouflage pattern (ΔE < 2) in case of Polyester and Nylon 6,6 fabric, while in case of Nylon 6, there was slight deviation in the obtained colour characteristics so further optimization in colour values needs to be done.

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Acknowledgment

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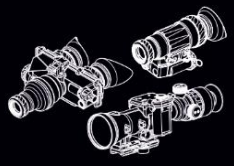

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