BOOK OF ABSTRACTS

2nd International Symposium

IGNITING INNOVATION FOR SUSTAINABLE TEXTILES

Ahsanullah University of Science and Technology

Dhaka, Bangladesh

19-21 November, 2024

Message from the Vice-Chancellor

It is my profound honor to welcome you to the Second International Symposium titled "Igniting Innovation for Sustainable Textiles," organized by Ahsanullah University of Science and Technology (AUST) under Phase 2 of 'Chair for Sustainability and Textile Innovation project' This symposium, originally envisioned as a physical gathering at our campus in Dhaka, Bangladesh, has been rescheduled as an online event due to student-led quota reform movement across the country. The event will now take place on the Zoom platform from November 19 to 21, 2024.

While the transition to a virtual format was necessitated by unforeseen circumstances, we remain steadfast in our commitment to providing a vibrant platform for intellectual exchange. This symposium builds on the resounding success of the first edition, hosted by UNU-FLORES in Dresden, Germany, in 2023, and continues to serve as a conduit for global collaboration among academicians, researchers, industry experts, and policymakers.

The symposium's primary objective is to foster meaningful dialogue and the exchange of innovative ideas that address the pressing challenges in textile engineering, sustainability, and technological advancement. We are confident that this virtual format will maintain the same rigor and depth of engagement, ensuring the seamless dissemination of groundbreaking research and creative insights. I am particularly inspired by the enthusiastic participation of scholars and professionals worldwide who are contributing through research papers, case studies, and creative works.

On behalf of AUST, I extend my deepest appreciation to the steering committee, organizing committee, judge and technical committee, contributors, and participants for their adaptability, dedication, and resilience in ensuring the success of this symposium despite many challenges. Your active engagement of all participants and stakeholders will undoubtedly enrich the discourse and inspire actionable outcomes. I believe that it will shape the future of our industry.

Let us seize this opportunity to forge new collaborations, share transformative ideas, and collectively strive for a more sustainable and innovative textile future. I look forward to a stimulating and impactful symposium, one that transcends geographical boundaries and exemplifies the power of global academic cooperation.

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Chair for Sustainability and Textile Innovation (CSTI)

The goal of modern civilization is to act and practice responsibly with the resources present and already have in circulation, while not ignoring the environment and people. The key is sustainability, where the environment and society are in harmony with a balanced and resilient economy. In 1987, sustainability was defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” by the United Nations Brundtland Commission. As the world recognizes the imperative of sustainability, and one effective approach is integrating it into educational curricula. As part of this effort, the German-Bangladesh Higher Education Network for Sustainable Textiles (HEST) was initiated to address the inadequacy of sustainability-related topics in the existing textile engineering syllabus.

Through a collaborative effort involving Technische Universität Dresden (TUD) with expertise in sustainability, Ahsanullah University of Science and Technology (AUST) with expertise in textile engineering, and Notre Dame University Bangladesh (NDUB) with expertise in value-based management, the HEST project surveyed the current curriculum. The findings revealed that the inclusion of sustainability-related topics in the textile engineering syllabus was unsatisfactory. At the conclusion of the HEST project, it was determined that additional collaborative initiatives were necessary to enhance education and awareness of sustainable practices in the textile industry with an aim to foster a more responsible and forward-thinking approach among future professionals. Consequently, the recommendation emerged to establish sustainability as a stream within the B.Sc. in Textile Engineering program.

The urgency of sustainability in Bangladesh is underscored by increasing consumer knowledge, evolving governmental and international policies, and mounting buyer pressure. This pressing issue requires continuous innovation and development. The ongoing shift towards a significant "Sustainability Transition" in companies and industries is particularly advantageous for Bangladesh. It is noteworthy that every country is mandated to comply with the 17 Sustainable Development Goals (SDGs) by 2030. In response to this global trend, different fashion brands worldwide adhere to the guidelines and regulations of the UN Fashion Charter, particularly in manufacturing facilities located in Bangladesh. The Bangladesh Garment Manufacturers and Exporters Association (BGMEA) comprises a total of 3796 members. The growing emphasis on sustainability has led buyers to demand the appointment of at least two sustainability-responsible professionals at each step of the supply chain. Additionally, at the buyer level, there is a trend towards establishing a separate department dedicated to sustainability. Given these developments, numerous factories now require qualified graduates possessing extensive knowledge of sustainability and its various implications to drive this transition further. Introducing a sustainability stream in the Textile Engineering program becomes crucial. If such a stream were implemented, producing 50 graduates annually (25 in each semester), it would still take more than 10 years to meet the

substantial demand for skilled employees in the field of sustainability in the textiles of Bangladesh.

As part of its sustainability initiatives, Engelbert Strauss GmbH & Co. KG from Germany is actively contributing to the enhancement of higher education in Bangladesh. Specifically, Strauss aims to elevate the capabilities of future university graduates entering the workforce. Engelbert Strauss generously funded the Chair for Sustainability and Textile Innovation project through GIZ in collaboration with TUD and the United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES). As a result, the Chair for Sustainability and Textile Innovation was established under the Department of Textile Engineering, AUST. AUST would be the pioneer in introducing sustainability as a new stream in the undergraduate Textile Engineering program, both domestically and internationally.

The project's goals include faculty development, curricular refinement, and the establishment of a new stream on Sustainability and Textile Innovation within the B.Sc. in Textile Engineering program. This budget covers all costs related to establishing the new stream, including faculty salaries and laboratory setups. Within the project, since 2020 new course modules have been developed, and academics were trained for the preparation of a successful implementation of the course modules of the newly established Chair for Sustainability and Textile Innovation.

Project Partners

United Nations University
FLORES, Germany

Deutsche Gesellschaft für
Internationale Zusammenarbeit

Engelbert Strauss, Germany

Activities of CSTI

CSTI team organized a seminar on sustainability at AUST campus.

CSTI team visited a weaving museum Braunsdorf in Saxony,

CSTI team participated in the International Textile Symposium in Dresden, Germany

CSTI team organized a 3-day long workshop at AUST campus

CSTI team participated in the country planning workshop at Bhawal

CSTI team visited Pacific Jeans at Chittagong to conduct LCA study

Committees for the Symposium

Chief Patron

Prof. Dr. Md. Ashraful Hoque

Vice-Chancellor, AUST

1. Steering Committee

- Prof. Dr. Mohammed Mahbubur Rahman, Pro-Vice- Chancellor, AUST
- Prof. Dr. Sharmin Reza Chowdhury, Treasurer, AUST
- Prof. Dr. Md. Mahmudur Rahman, Dean, Faculty of Engineering, AUST
- Prof. Dr. Lal Mohan Baral, AUST-GIZ-ES Project Coordinator, CSTI, Department of Textile Engineering, AUST
- Mr. Emdadul Haque, Head, Department of Textile Engineering, AUST
- Prof. Dr. S.M.A. Al-Mamun, Director, ICT, AUST
- Prof. Dr. Dewan Hasan Ahmed, Director, Research and Publication, AUST
- Prof. Dr. Md. Ashrafur Rahman, Proctor, AUST
- Prof. Dr. Md. Meganur Rahman, Advisor of Students' Welfare, AUST
- Mr. Md. Muniruzzaman, Registrar (Acting), AUST

Chair of the Committee: Prof. Dr. Mohammed Mahbubur Rahman, Pro-Vice-Chancellor, AUST

2. Organizing Committee

- Prof Dr. Lal Mohan Baral, AUST-GIZ-ES Project Coordinator, CSTI, Department of Textile Engineering, AUST
- Mr. Md. Ruhul Amin, Associate Professor, Department of Textile Engineering, AUST
- Mr. Emdadul Haque, Head, Department of Textile Engineering, AUST
- Mr. Mohammad Faizur Rahman, Associate Professor, Department of Textile Engineering, AUST
- Dr. Mohammad Tajul Islam, Associate Professor and Chairholder, Chair for Sustainability and Textile Innovation, Department of Textile Engineering, AUST
- Mr. Subrata Kumar Saha, Associate Professor, Department of Textile Engineering, AUST
- Mr. Siyam Quddus Khan, Assistant Professor, Department of Textile Engineering, AUST
- Mr. Amit Chakrabortty, Assistant Professor, Department of Textile Engineering, AUST
- Mr. Kazi Rezwan Hossain, Lecturer Grade-I, Department of Textile Engineering, AUST

• Ms. Noor-E-Farzana Annesha, Lecturer Grade-II, Chair for Sustainability and Textile Innovation, Department of Textile Engineering, AUST

• Mr. Md. Mazharul Haque, Lecturer Grade-II, Chair for Sustainability and Textile Innovation, Department of Textile Engineering, AUST

• Ms. Tamjida Islam, Lecturer Grade-II, Chair for Sustainability and Textile Innovation, Department of Textile Engineering, AUST

• Ms. Iffat Ara Anannya, Lecturer Grade-II, Chair for Sustainability and Textile Innovation, Department of Textile Engineering, AUST

Chair of the committee: Prof. Dr. Lal Mohan Baral, AUST-GIZ-ES Project Coordinator, CSTI, Department of Textile Engineering, AUST.

3. Judges and Technical Committee

• Prof. Dr. Jasmin Ara Begum, Dean, Faculty of Architecture and Planning, AUST

• Mr. Md. Ruhul Amin, Associate Professor, Department of Textile Engineering, AUST

• Dr. Mohammad Tajul Islam, Associate Professor and Chairholder, CSTI, Department of Textile Engineering, AUST

• Mr. Mohammad Rukanuddin, Assistant Professor, Department of Arts and Science, AUST.

• Prof. Dr. Ummul Khair Fatema, Dean, Faculty of Textile Chemical Engineering, BUTEX

• Dr. Mohammad Abbas Uddin Shiyak, Assistant Professor, BUTEX

• Dr. Md. Abdullahil Kafi, Associate Professor, Department of Textile Engineering, DUET

• Prof. Dr. Engr. Abu Bakr Siddique, Professor, Faculty of Textile Engineering (FTE), BUFT

• Dr. Arun Kanti Guha, Professor, Department of Textile Engineering, SEU

• Dr. Syed Atiqur Rahman, Associate Professor, Department of Textile Engineering, SEU

Chair of the committee: Prof. Dr. Jasmin Ara Begum, Dean, Faculty of Architecture and Planning, AUST

Program Schedule

The whole program is split into three themes namely "Resources and Their Nexuses in Textile Industry", "Special Sustainable Tools for Sustainability Assessment in Textile Industry", and "Water and Waste Management in Textile Industry" aligned with the name of the courses offered by CSTI that explores the latest innovation, challenges, and solutions in these segments to create a sustainable textile industry. Moreover, there will be two panel discussions on textile sustainability with the prominent experts. As creativity, technology, and know-how are necessary, these three sessions will play a role in achieving a sustainable future of the textile industry along with SDGs through the interdisciplinary engagement of world-class personnel.

Theme 1: Resource Nexus in Textile Industry

Related SDG Goals

Theme 2: Sustainability Assessment

Related SDG Goals

Theme 3: Water and Waste Management

Related SDG Goals

Day 1: 19th November, 2024

Session 1: Inauguration of the Symposium & Keynote Lecture

Zoom Link: Inauguration of the Ceremony
Moderator: Noor-E-Farzana Annesha, Iffat Ara Anannya

Recitation of Quran: Sahaf Estiaz Ratul, Student, DTE, AUST
Time: 2.00–2.05 PM

Activity	Resource Person	Time
Inauguration Speech	Prof. Dr. Lal Mohan Baral, Project Coordinator, CSTI, DTE, AUST	2.05–2.15 PM
Overview of CSTI Project	Dr. Mohammad Tajul Islam, Chair Holder, CSTI, DTE, AUST	2.15–2.25 PM
Overview of AUST & Department	Engr. Emdadul Haque, Project Administrator (CSTI) & Head, DTE, AUST	2.25–2.35 PM
Welcome Speech and Keynote	Prof. Edeltraud Guenther, Director, UNU–FLORES, Germany Title: Sustainability transformation in the textile industry:Aresource nexus pers pective	2:35–3:15 PM
Speech of Special Guest	Mr. Johannes Froester, PM, International Service, GIZ, Germany.	3.15–3.30 PM
Speech of Special Guest	Dr. Christian Bochmann, Head, HELD Project, GIZ	3:30- 3.45 PM
Speech of Special Guest	Prof. Dr. Mustafizur Rahman, Ex-Treasurer, and Founding Head, DTE, AUST	3:45–4:00 PM

Chief guest	Prof. Dr. M. Shamsher Ali, Member, Board of Trustees, AUST Ex-VC of Open University and Southeast University	4:00- 4:15 PM
Speech of Chair of the Program	Prof. Dr. Md. Ashraful Hoque, Vice–Chancellor, AUST	4:15- 4: 30 PM

Day 2: 20th November, 2024

Session 1: Technical Paper Presentation based on Theme 1 & 2

Zoom Link: International Textile Symposium Day 2

Moderator: Noor-E-Farzana Annesha

Session Chair: Dr. Lal Mohan Baral, Professor, DTE, AUST

Presentation Title	Presenter	Time
Renewable Energy Integration in Bangladesh's Textile Industry: Analyzing Opportunities Amidst Challenges	Mst. Nadiya Noor, American International University Bangladesh (AIUB)	9.00 – 9.15 AM
Hydrogen Cells in Bangladesh's Textile Sector: A Comprehensive Examination of Opportunities and Challenges	Sunipun Seemanta, American International University Bangladesh (AIUB)	9.15–9.30 AM
Enhanced Safety and Monitoring for Special Needs Children Through Smart Textiles with Integrated GPS and Camera Systems.	Md. Rafiqul Islam, Bangladesh University of Textiles (BUTEX), Bangladesh	9.30–9.45 AM
Valorizing of Post-Consumer PET Bottles into Functional Fabrics: Preparation and Characterizations	Md. Tanvir Hossain, Dhaka University of Engineering and Technology (DUET)	9.45–10.00 AM
Physicochemical Properties and Applications of Alginate in Smart Materials and Cosmetic Textiles	Md. Tanvir Hossain , Dhaka University of Engineering and Technology (DUET)	10.00–10.15AM
Integration of Hydro Power in Bangladesh's Textile Industry:	Tanisha Fairooz, American International	10.15-10.30 A.M

Challenges and Opportunities for Sustainability	University Bangladesh (AIUB)	
Progress in conductive materials for smart textiles	Md. Mostafizur Rahman, Dhaka University of Engineering and Technology (DUET)	10.30-10.45 A.M
Correlation of Air Gaps and Dynamic Postures in Human Body-Clothing System: A Numerical Approach	Rashed Al Mizan, DTE, AUST and PhD fellow, TUD, Germany	10.45-11.00 A.M

Session 2: Panel Discussion

Moderator: Dr. Mohammad Tajul Islam, Chair Holder, CSTI

Title	Resource Person	Time
Challenges and Opportunities of Sustainability Certifications in Apparel Industries	**Presenter: Ms. Rabeya Sultana**, Sustainability Manager, Hohenstein Institute Bangladesh	11.00–11.20 AM
	Panelists: **Mr. Kamal Hossain**, GM, GSCS, Bangladesh **Mr. Rafiqul Islam**, Manager, SGS, Bangladesh **Mr. Auyan Biswas**, Manager, Control Union Certifications B.V. **Nur E Alam Anik**, Country Manager, GCL Assessment Service Ltd.	11.20–11.40 AM

Session 3: Invited Talk

Session chair: Dr. Md. Saifur Rahman, Professor, Daffodil International University, Bangladesh

Title of the Talk	Invited Speakers	Time
Eco Costs / Value Ratio (EVR)	**Dr. Natasha van der Velden**, Independent Researcher, The Netherlands	12.00–12.15 PM
Social Sustainability in the Textile Supply Chains	**Dr. Enrico Fontana**, Cranfield University, UK	12.15–12.30 PM

Lunch & Prayer Break: 12.30–1.30 PM

Session 4: Keynote Speech

Session Chair: Professor Dr. Ayub Nabi Khan, Pro-VC, BGMEA University of Fashion and Technology, Bangladesh

Keynote title	Resource Person	Time
Sustainable Textiles and Waste Management in RMG Industries	**Dr. Mubarak Ahmad Khan** Scientific Advisor, Bangladesh Jute Mills Corporation	1.30–2.00 PM 2.00–2.10PM(Q&A)

Session 5: Session on Resource Nexus approach by UNU-FLORES

Special Session		Time
Session Title	**Presenter**	
A Resource Nexus approach in the textile sector	Asha Verma/ Prof. Serena Coetzee, UNU FLORES, Germany	**2.30–3.00 PM**

Session 6: Poster Presentation

Session Chair: Prof. Dr. Ummul Khair Fatema, BUTEX, Bangladesh

Judges: Dr. Ummul Khair Fatema, Prof. BUTEX, Rashed Al Mizan, TUD, Germany, Md. Ruhul Amin, Asso. Prof. AUST, Dr. Arun Kanti Guha, Prof. SEU

Poster Presentation		Time
Poster Title	**Presenter**	
Exploration & Innovation of Potato-based Natural Flame-Retardant Textiles	Nure Arfi, AUST	**3.00–3.10 PM**
Study of Adsorption & Equilibrium Isotherm of Reactive Dye Removal from Aqueous Solution Using Eggshell Biomass Adsorbent	Yousuf Mahmud, AUST	**3.10–3.20 PM**
Study on the Effect of Natural Rubber as Binder on Pigment Printing in Combination with Synthetic Binder	Sayef Ahmed, AUST	**3.20–3.30 PM**

QR Code Printing on Apparel as an Alternative to Product Labels	Humayra Salam Arshi, AUST	**3.30–3.40 PM**
Towards Sustainable Consumption and Production: A Focus on Bangladesh's Leather Tanning Industry	Mongsathowai Marma, AUST	**3.40–3.50 PM**

Session 7: Application of Photovoltaic in Agriculture

Session Chair: Dr. Mohammad Sarwar Morshed, Prof, AUST

Special Session		**Time**
Session Title	**Presenter**	
Feasibility and Economic Viability of Horticulture	Dr. Max Trommsdorff, Head of Group Agrivoltaics; Fraunhofer Institute for Solar Energy Systems ISE, Germany	**4:00 - 6.00 pm**

Day 3: 21st November, 2024

Session 1: Technical Paper Presentation based on Theme 3

Zoom Link: International Textile Symposium Day 3

Moderator: Iffat Ara Anannya

Session Chair: Dr. Mohammad Abbas Uddin Shiyak, Asst. Prof., BuTex

Presentation Title	Presenter	Time
Characterization of Benzoyl peroxide treated and polymer-coated sustainable jute fabric for the use of Geo-Technical purposes	Ms. Nasrin Akter, DTE, AUST	9.00 – 9.15 AM
Identifying and Overcoming Critical Barriers to Circular Economy Transition in the Textile Industry	Md. Abidur Rahman Asif, Hameem Group	9.15–9.30 AM
Fabric Waste Reinforced Bio-Composite: A Sustainable Flame Retardant using Banana Peel	Abdullah Al Fariz, Northern University of Bangladesh	9.30–9.45 AM
Sustainable Bleaching of Juton Fabric	Md. Monowar Hossen, BUTEX	9.45–10.00 AM
Predicting the Stitch Density of Finished Fabrics Using Weft Blended Grey Knit Fabrics	K. M. Elias, Jahangirnagar University, and DBL	10.00–10.15 AM
Cotton Knit Fabric Coloration with Tamarind using Bio mordants as a Greener Alternative to Metallic Mordanting	Sadia Afrin, Port City International University,	10.15– 10.30 AM

Building a Sustainable Supply Chain: The Role of Sustainable Supplier Selection in Bangladesh's Apparel Industry	Md. Mahfujul Haq, AUST	10.30– 10.45 AM
A Statistical Expedition on the Characteristics of Textile Wastewater Assessing the Aftermath on Environment and Urban Civilization	Md. Jubairul Alam, American International University Bangladesh (AIUB)	10.45– 11.00 AM

Session 2: Panel Discussion

Moderator: Dr. Mohammad Tajul Islam, Chairholder, CSTI

Title	Resource Person	Time
Sustainability Expectations of Global Fashion Brands: How to Meet Them	**Presenter: Mr. Moyeen Chowdhury,** Country Manager, PUMA	11.00–11.20 AM
	Panelists: **Mr. Moyeen Chowdhury**, Country Manager, PUMA; **Biplob Barua**, GM, Strategic HR, Urmi Group; **Mr. A.B.M Faqrul Alam**, Head of Sustainability Department, Urmi Group; **Mr. Syful Alam Mallick**; Sustainability Expert; **Mr. Zakir Hossen**, DGM, Sustainability, Noman Group; **Mr. Mashook Chowdhury**, Senior Manager, Sustainability, DBL Group	11.20–11.40 AM

Session 3: Invited Talks

Session Chair: Dr. Nitai Chandra Sutradhar, Prof. Green University and Ex-VC, BuTex

Title of the Talk	Invited Speakers	Time
Sustainability transformation in the textile industry: A policy briefing for environmental resource practices	**Mr. Komol Gomes**, UNU–FLORES, Germany	12.00 - 12:15 P.M
Cost Benefit Analysis Green Chemistry	**Mr. Shamsul Arefin**, GIZ, Bangladesh	12.15–12.30 PM

Lunch & Prayer Break: 12.30–1.30 PM

Session 4: Keynote Lecture

Session Chair: Prof. Dr. Mustafizur Rahman, Ex-Treasurer and Founding Head, DTE, AUST

Keynote title	Presenter	Time
Sustainability is the Future of the Textile Business	**Dr. Michael Rauch**, Professor, Hof University, Germany	1.30–2.00 PM 2.00–2.10PM (Q&A)

Session 5: Presentation on Englebert Strauss

Keynote title	Presenter	Time
Presentation on Englebert Strauss	Representative from Englebert Strauss	2.10–2.30 PM 2.30–2.40PM(Q&A)

Session 6: Closing of the Symposium

Moderator: Noor-E-Farzana Annesha, Iffat Ara Anannya

Activity	Resource Person	Time
Opening Speech	Dr. Mohammad Tajul Islam, Chairholder, CSTI, AUST	3.00- 3.10 PM
Speech of Special Guest 1	Prof. Dr. Engr. Ayub Nabi Khan Pro-Vice-Chancellor, BUFT	3.10- 3.20 PM
Speech of Special Guest 2	Prof. Dr. Mohammed Mahbubur Rahman, Pro-Vice–Chancellor, AUST	3.20- 3.30 PM
Announcement of Best Poster Presentation Award	By Moderator	3.30- 3.40 PM
Speech of Chief Guest	Dr. S.M. Khalilur Rahman, Member, Board of Trustees, AUST and Ex-Member Director, Bangladesh Agricultural Research Council	3.40–4.00 PM
Closing Remarks	Prof. Dr. Lal Mohan Baral Project Coordinator, CSTI, AUST	4.00–4.10 PM
Vote of Thanks/ Session chair	Head, Department of Textile Engineering, AUST	4.10–4.20 PM

Abstracts

Renewable Energy Integration in Bangladesh's Textile Industry: Analyzing Opportunities Amidst Challenges

Mst. Nadiya Noor*, Shams Pahlowan Soad, Md. Mortuza Ahmmed

American International University – Bangladesh (AIUB), Dhaka 1229, Bangladesh.

Abstract

The textile industry in Bangladesh is a vital engine of the national economy, significantly boosting gross domestic product GDP and employment while establishing the country as a top global exporter of garments. The keystone of the nation's economy faces increasing pressure to adopt sustainable practices due to global environmental concerns and regulatory demands. This study aims to explore the integration of renewable energy within the sector, focusing on the opportunities and challenges involved in this transition. The analysis reveals that while significant opportunities exist, including cost savings, enhanced energy security, and reduced carbon footprint, the industry also encounters substantial challenges such as high initial investment costs, technological barriers, and policy limitations. By analyzing current energy utilization patterns, potential renewable energy sources, and existing infrastructure, the research identifies key areas for improvement and investment. Through quantitative analysis, we examine energy consumption data were examined and project the potential contributions of solar, wind, and biomass energy sources to meet the industry's energy requirements were projected. Case studies of successful implementations and stakeholder interviews offer insights into best practices and strategic recommendations. This study highlights the necessity for collaborative efforts among the government, private sector, and international organizations to create an environment conducive to renewable energy adoption, ultimately supporting the sustainable growth of Bangladesh's textile industry.

Keywords: *Renewable energy integration, sustainable practice, textile industry challenges, energy consumption analysis.*

Hydrogen Cells in Bangladesh's Textile Sector: A Comprehensive Examination of Opportunities and Challenges

Sunipun Seemanta*[1], Md Mehedi Imam Hasan[1], K. M. Tahsin Kabir[1], Md. Mortuza Ahmmed[2]

[1]*Department of Computer Science, American International University-Bangladesh, Dhaka, Bangladesh*
[2]*Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh*

Abstract

One of the main drivers of Bangladesh's economy, the textile industry, has substantial issues with energy use and environmental sustainability. This research examines the possibility of incorporating hydrogen fuel cells as a substitute energy source in the textile industry. Hydrogen fuel cells present a favorable alternative owing to their superior efficiency and less environmental footprint in contrast to traditional fossil fuels. The paper comprehensively analyzes the technological, economic, and environmental consequences of implementing hydrogen cells in this industry. Initially, the study analyzes the present energy situation of the Bangladeshi textile sector, highlighting the prevalent utilization of non-renewable energy sources and the resulting carbon emissions. The text subsequently examines the fundamental concepts and advantages of hydrogen fuel cell technology, emphasizing its capacity to diminish greenhouse gas emissions and decrease dependence on foreign fuels. An assessment is conducted on the practicality feasibility of producing, storing, and distributing hydrogen in Bangladesh, considering the country's infrastructure and economic factors. The research considers various crucial criteria, including the initial capital expenditures, the level of technological preparedness of hydrogen cells, the accessibility of raw materials for hydrogen generation, and the potential for establishing a regional supply network. Moreover, the article study examines the regulatory and policy environment in Bangladesh, evaluating how favorable policies could promote the implementation of hydrogen technology in the textile industry. An essential aspect of this assessment involves identifying obstacles such as exorbitant starting expenses, limited technological proficiency, and the requirement for significant infrastructure advancement. Potential solutions to these difficulties are presented, including public-private partnerships, government incentives, and international collaboration for technology transfer and capacity building. The report concludes that while considerable impediments exist, the integration of hydrogen fuel cells in Bangladesh's textile sector presents a potential path towards sustainable energy consumption and environmental stewardship. Strategic investments and supportive legislation might generate enormous advantages, placing Bangladesh as a leader in sustainable textile manufacturing and contributing to global efforts to mitigate climate change.

Keywords: *hydrogen fuel cells, textile sector, renewable energy, environmental sustainability, energy efficiency.*

Enhanced Safety and Monitoring for Special Needs Children Through Smart Textiles with Integrated GPS and Camera Systems

Monirul Islam*[1], Fuad Bin Ahmed[2], Abhisheke Chakrabortty[3], Md. Masum Billah Tarafder[2] and Md. Rafiqul Islam[2]

[1]F.F Trading Corporation, Bangladesh

[2]Bangladesh University of Textiles, Bangladesh

[3]Cotton Group BD, Bangladesh

Abstract

Special children, who need constant monitoring for their safety, have long been a significant concern for us. This work presents an innovative approach to the safety and monitoring needs of special children via smart textiles. The smart garment has been designed to track the children's location and monitor their surroundings in real-time. This smart textile garment utilizes a combination of GPS and Camera technologies to help the guardian keep track of their child with special needs by getting live updates via SMS. The built-in GPS module transmits position data continuously when triggered by a simple text message, and the camera broadcasts live video to a secure server. This provides a reliable and discreet solution for parents and caregivers, ensuring the child's safety without the need for additional devices. The key feature of this smart garment includes minimal power consumption. The initial testing has shown promise for real-world scenarios. This work paves the way for future developments in smart textiles by addressing a pressing need in child monitoring and making a valuable contribution to the expanding field of wearable technology.

Keywords: Smart Textiles, GPS Tracking, Real-time Monitoring, Special Needs Children, Wearable Technology

Valorizing of Post-Consumer PET Bottles into Functional Fabrics: Preparation and Characterizations

Md. Tanvir Hossain[1, 2,*], Md. Abdus Shahid[1]

[1]*Department of Textile Engineering, Dhaka University of Engineering and Technology, Gazipur 1707, Bangladesh*
[2]*Department of Materials Science and Engineering, Michigan Technological University, Houghton, MI 49931, USA*

Abstract
The valorization of post-consumer PET bottles into functional fabrics represents a sustainable approach to waste management and material innovation. This study focuses on the development and characterization of PET-Ag nano-coated silk technical cloth prepared through solution electrospinning. The resultant technical cloth exhibited a smooth nanofibrous coating on the silk-woven substrate, as confirmed by Scanning Electron Microscopy (SEM) analysis. Performance evaluations demonstrated that the PET-Ag nano-coated silk technical cloth possesses exceptional properties making it a promising candidate for air filtering applications. The Particle Filtration Efficiency (PFE) and Differential Pressure (DP) tests revealed excellent filtration efficiency coupled with low-pressure drops, ensuring its suitability for air purifiers. Moisture management tests highlighted the water-repellent properties of sample S-1 and waterproof characteristics of sample S-2. Radiative heat barrier assessments showed that both samples S-1(single side coated) and S-2(both side coated) provide effective thermal insulation. Tensile strength tests indicated that the developed samples have sufficient mechanical strength to withstand external forces during use. Antibacterial assays demonstrated significant antibacterial activity against *S. aureus* and *E. coli*, underscoring the fabric's potential in health-sensitive environments. Fourier-Transform Infrared Spectroscopy (FT-IR) confirmed the presence of all intended components in the technical cloth by identifying characteristic peaks. Collectively, these findings suggest that PET-Ag nano-coated silk technical cloth is a viable material for air filtration, combining high PFE and low DP properties with robust tensile strength and notable antibacterial efficacy. Future research should explore the application of twill and satin weave structures with nano coatings to assess filtration efficiency further. Additionally, incorporating plant extracts for antibacterial properties offers a promising avenue for enhancing the functional capabilities of these fabrics. This study underscores the potential of recycled PET in creating high-performance, eco-friendly technical textiles, paving the way for innovative applications in air purification and beyond.

Keywords: Post-consumer waste; PET bottles; Functional fabrics, Silk

Physiochemical Properties and Applications of Alginate in Smart Materials and Cosmetic Textiles

Md. Mostafizur Rahman[1, 2], Md. Abdus Shahid[1*], Md. Tanvir Hossain[1, 3], Md. Sohan Sheikh[2], Md. Sunjidur Rahman[2], Nasir Uddin[2], Abdur Rahim[4], Ruhul Amin Khan[5], Imam Hossain[1]

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Abstract

Natural polysaccharide alginate, mostly obtained from brown seaweed, has attracted a lot of interest in smart material and cosmetics textiles because of its exceptional physicochemical qualities and range of uses. Alginate-based composites have adaptable physicochemical characteristics that are improved by different fillers and processing methods. Alginate is extremely important in various applications due to its capacity to form gels in the presence of divalent cations such as calcium. The biocompatibility and non-toxicity of alginate are essential for developing wound dressings and wearable health monitoring systems in smart fabrics. Alginate's capacity to produce hydrogels makes responsive fabrics that detect and respond to changes in pH and moisture content. These smart textiles can include drug-delivery systems that rely on predetermined conditions to initiate the controlled release of therapeutic drugs. Moreover, the intrinsic film-forming characteristics of alginate aid in the incorporation of conductive substances, augmenting the performance of electronic fabrics. Alginate is highly valued in the cosmetics business because of its ability to create films and moisturize. It is a great thickening, stabilizing, and emulsifying agent that enhances the consistency and texture of many cosmetic products, such as masks, lotions, and creams. Because alginate can form hydrogels, novel skincare solutions like peel-off masks that efficiently deliver active chemicals and hydrate skin have been made possible. Alginate-based products are also good for sensitive skin because of their natural, soft nature, which also helps with wound healing and reduces inflammation.

Keywords: Alginate; Smart materials, Cosmetic textiles

Integration of Hydro Power in Bangladesh's Textile Industry: Challenges and Opportunities for Sustainability

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Abstract
The textile industry in Bangladesh is a driving force the country's economy. But it contends with significant energy needs which causes energy shortage contributing to environmental degradation and economic instability. The integration of hydro power can be a potential solution for this. This paper investigates the possible advantages and difficulties of using hydropower as a clean energy source to supply the energy needed for the production operations in the textile industries. Hydroelectricity offers a reliable and renewable alternative of fossil fuels for power generation by utilizing the abundant water resources of the country to generate clean energy. By utilizing hydropower textile industries in our country can reduce their reliance on fossil fuels and lower their carbon footprint, contributing to a more sustainable and eco-friendly manufacturing process. This study identifies the intricate dynamics of hydro power integration, examining technological advancements, regulatory frameworks, and market dynamics shaping its adoption. By performing statistical analysis, this study clarifies the potential benefits of hydroelectricity for the textile industry, such as increased energy security, lower costs, and environmental sustainability. Furthermore, the study identifies key barriers to adoption, such as infrastructure limitations and regulatory complexities, and proposes workable solutions to overcome these challenges. The study intends to facilitate a shift in Bangladesh's textile industry towards a more resilient and sustainable energy landscape through cooperative efforts among industry stakeholders, policymakers, and energy experts, ultimately leading to long-term economic prosperity and environmental responsibility.

Keywords: *Hydropower, Textile industry, Renewable energy, Environment, Sustainability.*

Progress in Conductive Materials for Smart Textiles

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Abstract
Over the last decade, research in advanced polymers have gained a great interest to the researchers and industrialist. Conductive polymers are an intriguing blend of materials science and electronics, with distinctive features that might transform several sectors. These polymers, usually organic molecules, display electrical conductivity while retaining the natural flexibility and processability of conventional polymers. Flexible electronics are electrical devices or circuits that are created to be capable of bending, stretching, or conforming to different surfaces. Conductive polymers are essential for advancing flexible electronics because they provide a unique blend of electrical conductivity and mechanical flexibility, making them ideal for smart textiles. Smart textiles are a revolutionary hybrid of traditional fabric materials and technology that enable a wide range of applications, from interactive fashion to health monitoring. The advancement of conductive materials, which provide a structure for smoothly incorporating electronics into textiles, is essential to their progress. Recent developments in conductive yarns, fabrics, and fibers have greatly extended the possibilities and uses of smart textiles. Advances in fabrication processes have also facilitated the integration of conductive materials into fabrics. Complex, multifunctional textile structures can be created with exact control over material placement and density thanks to techniques like electrospinning, 3D printing, and sophisticated knitting and weaving techniques. A new generation of smart textiles that are more comfortable, functional, and versatile has been made possible by advancements in conductive materials. These breakthroughs open the door for more wearable technology advancements, such as energy harvesting, interactive interfaces, and real-time health monitoring, which will turn common textiles into responsive, dynamic systems.

Keywords: Conductive polymer; Flexible electronics; Smart textiles

Correlation of Air Gaps and Dynamic Postures in Human Body-Clothing System: A Numerical Approach

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Abstract

Thermoregulatory performance dominantly depends on the microenvironment of a body-clothing system, where fluid dynamics is crucial. Heat and mass transfer in clothing are also connected with that. Therefore, the characteristics of the air gap in the body-clothing interaction is a principal analysis. There are a lot of factors that can affect the air gap but the governing one is the daily life posture of the human body. Moreover, real-life analysis of air gaps considering dynamic posture is an expensive time-consuming process. Therefore, the current study proposes a numerical investigation of air gaps regarding a large set of body postures. A virtual model of standard outerwear and manikin was generated in dedicated software while post-processing was done by a set of computational environments. The air gap thickness had a strong correlation with dynamic body posture in the critical region of the torso. The thickness of fluid layers can be varied from 1.5 cm to 16 cm for a certain body segment depending on the posture. There are 3 influential body segments identified that would be crucial for controlling air gap thickness and thus the fluid flow in the microenvironment. Furthermore, the behavior of the body-clothing gap was noted through cross-sectional analysis of the torso. The present investigation would be a significant addition for improving the thermal management of the protective and functional textiles in digital manufacturing and guide to predicting their functional properties on the human body.

Keywords: Computation, Modeling, Air Gap, Body Posture, Functional Textiles.

Characterization of Benzoyl Peroxide Treated and Polymer-Coated Sustainable Jute Fabric with and without Gamma-Radiation for the Use of Geotechnical Purposes

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Abstract

Natural jute fiber has significant potential for geotechnical applications due to its high tensile strength and staple length. This study investigates the enhancement of jute fabric performance for geotextile use by treating it with benzoyl peroxide and coating it with a bitumen emulsion/polyester resin polymer, followed by gamma (γ) irradiation. The pre-treatment of jute-woven fabric with benzoyl peroxide and applying gamma (γ) irradiation after polymer coating to decline the water absorbency of jute woven fabric for geotextile application. The decreasing value of moisture regain (MR%), moisture content (MC%) and water uptake (WU%) of treated jute fabric compared to raw jute fabric ensured the deterioration of water absorbency and improved the performance of geotextile application. The surface modification of the treated jute fabric was confirmed through Fourier-Transform Infrared Spectroscopy (FT-IR) and X-ray diffraction (XRD) analyses. The study found that the mechanical and thermal properties of the treated jute fabric were directly influenced by the concentration of benzoyl peroxide. A 2% benzoyl peroxide concentration resulted in the maximum breaking force, increased thickness, and enhanced thermal stability. Thermogravimetric analysis (TGA) revealed that the thermal degradation of the treated jute fabric, measured by weight loss, was significantly reduced for the 2% benzoyl peroxide concentration compared to both raw jute fabric and higher concentrations of peroxide. Additionally, Scanning Electron Microscopy (SEM) analysis indicated that at lower benzoyl peroxide concentrations, the bonding between the fiber and polymer was more effective, but this bonding decreased as the concentration of benzoyl peroxide increased. The untreated jute fabric surface was smooth because of the deposition of wax and lignin, the pre-treatment of jute fabric resulted in the removal of wax and all impurities from the fiber surface.

Keywords: Natural fiber, benzoyl peroxide, polymer, coating, gamma radiation, geotechnical, bitumen emulsion, polyester resin.

Identifying and Overcoming Critical Barriers to Circular Economy Transition in the Textile Industry

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Abstract

The idea of a circular economy is gaining traction today because it effectively responds to one of humanity's most important problems: the depletion of finite natural resources. To eliminate waste and lower the need for new raw materials, a circular economy model involves reusing, recycling, and regenerating materials in a system for as long as possible. In addition to lowering the harmful environmental externalities associated with the conventional "take-make-dispose" models of production and consumption, this strategy fosters innovation. It lessens reliance on the availability of raw materials boosts economic resilience and offers significant potential for economic expansion, the development of jobs, and the improvement of the environment. The circular economy is one such strategy that we can work our way to achieve Sustainable Development Goals through it. The textile industry is one of the largest in the world economy especially in Bangladesh, which requires it to be more environmental-friendly with sustainable modes such as circularity. Since a circular economy can help to minimize waste, conserve resources, and reduce environmental impact, undoubtedly these practices are needed for a sustainable future. The comprehensive review provided in this paper highlights barriers to adopting and implementing circular economy options for the textile sector. After an intense literature quest and empirical analysis, we have discovered several unique obstacles from regulatory boundaries and supply chain challenges to technology gaps and cultural resistance. A multi-criteria decision analysis was employed to choose among the identified barriers and a few critical challenges that will be analyzed in this work. These challenges, among many others, were considered relevant not only because they had major repercussions through their circularity shift but also due to their existence parallel in other parts of the textile sector. Solving these key barriers to circularity is vital if the textile industry's transition to a circular economy is best supported.

Keywords: Circular economy transition, Critical barrier, Sustainability, Minimizing waste, multi-criteria decision analysis

Fabric Waste Reinforced Bio-Composite: A Sustainable Flame Retardant using Banana Peel

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Abstract

Flame-retardant composite materials, essential for fire safety in industries like construction and electronics, often contain harmful chemicals. This study addresses the critical need for sustainable flame-retardant composite materials by introducing an innovative approach utilizing banana peels, a globally abundant organic waste reinforced with leftover fabric from the textile industry. In this investigation, banana (*Musa acuminata*) peels were meticulously processed—cut, blended, and combined with a synthetic binder in a 4:1 ratio followed by mixing it with fabric waste using the hand lay-up method, resulting in the creation of fire-retardant composite material (FRC). To gauge the effectiveness of the composite in retarding flames, a series of tests were conducted, including the Direct Heat Test, 45° Burning Method, Chemical Resistance Testing (H_2SO_4), BS 4790 Fire Test (Hot Nut Test), Direct Metal Heat Test, and Welding Spark Test. Comparative analysis with commercial plyboard samples revealed notable findings: the FRC samples demonstrated an extended ignition time and exhibited superior chemical resistance (H_2SO_4). Although banana peels are biodegradable, they can contribute to methane emissions posing environmental challenges when disposed improperly. The integration of banana peels into flame-retardant composite materials offers a compelling avenue for advancing both safety and sustainability.

Keywords: Flame-retardant, Banana peel, Bio-composite, Fabric waste, Sustainable.

Sustainable Bleaching of Juton Fabric with Peracetic Acid and Bleach Activators

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Abstract

Peracetic acid(PAA) bleaching of Juton (Jute- Cotton blend) fabrics provides an inadequate whiteness in neutral pH environments and at low temperatures. enhancement of the whiteness effect of PAA can be enhanced by the addition of a bleach activator, tetraacetylethylenediamine (TAED), and sodium nonanoyloxybenzenesulfonate (NOBS). The present study used six distinct bleaching styles to bleach Jute- Cotton blend fabric using only PAA, using PAA in combination with TAED, using PAA in combination with NOBS, using only H_2O_2, using H_2O_2 in combination with TAED, and using H_2O_2 in combination with NOBS. The Juton fabric was blanched at different temperatures (25, 30, 40, 50, and 60◦C) in varied pH (5,6,7,8 and 9) media, at different times (30, 40, 50, 60, and 70 twinkles), using PAA, PAA incorporated with TAED, and PAA incorporated NOBS and using H_2O_2, H_2O_2incorporated with TAED, and H_2O_2 incorporated with NOBS. FT- IR, XPS, and SEM analyses were used to dissect the chemical structure, chemical cling, and face morphology of Juton fabrics by following bleaching. The chemical structure, chemical bonding, and surface morphology after bleaching on Juton fabrics were measured by FT-IR, XPS, and SEM analysis. After the bleaching process, the highest whiteness index of the Juton fabrics was obtained by using PAA in combination with NOBS. likewise, bleached Juton fabrics treated with PAA with NOBS can have advanced L * values, reduced O/ C rates, and good tenacity.

Keywords: Juton fabric, Peracetic acid, hydrogen peroxide, tetraacetylethylenediamine, nonanoyloxybenzenesulfonate

Predicting the Stitch Density of Finished Fabrics using Weft Blended Grey Knit Fabrics

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Abstract

Stitch density is one of the critical quality parameters of knit fabrics. This parameter is closely related to other physical quality parameters like fabric weight, fabric tightness factor, fiber types, blend ratio, yarn diameter and linear density, and fabric structure. Selecting stitch density (wales per inch, course per inch) is essential to getting the appropriate fabric weight and desired quality. Usually, no rules or assumptions exist to get the desired stitch density in the finished fabric stage. Fifteen types of blended knit fabrics were prepared to conduct the study. The varying percentages of cotton, polyester, and elastane are incorporated in the blends. Regression analysis and regression ANOVA tests were done to predict the stitch density of finished fabrics. A suitable regression equation is established to get the desired results. The study also found that the stitch density value in the finished stage fabric decreases by approximately 15% compared to the stitch density in the grey fabric stage. This study will help the fabric manufacturers get the finished fabric stitch density in advance by utilizing the grey fabric stitch density data set. The author expects this research to benefit the knitting and dyeing industry, new researchers, and advanced researchers.

Keywords: Wales per inch, course per inch, stitch density, blended, knit, fabric.

Cotton Knit Fabric Coloration with Tamarind using Biomordants as a Greener Alternative to Metallic Mordanting

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Abstract

Commercial dyes and metallic mordants adversely affect the environment and the wearer's health. Therefore, the contemporary textile industry has shifted towards greener solutions. Due to the increasing demand in today's world, this research deals with the coloration of cotton knit fabric using a natural dye derived from tamarind (Tamarindus Indica) seeds testa. The fabric samples were treated with taro (Colocasia Esculenta) juice and lemon (Citrus Limon) juice as biomordants. In addition, metallic mordants, such as potash alum ($KAl(SO_4)_2 \bullet 12H_2O$) and copper sulphate ($CuSO_4$), were also used to compare the findings obtained from biomordants and metallic mordants. The tamarind seeds were broken down to extract top shells which were later blended into powder and strained to be used as dye. Both the biomordants were converted into liquid or juice form and filtered repeatedly to remove any solid residue. During the evaluation of fastness properties, such as- color fastness to wash, rubbing, water, and light; it was observed that the biomordanted samples exhibit either good results or comparable outcomes to the metallic mordanted samples in all aspects. Additionally, colorimetric appearance of the dyed samples was evaluated by using CIE L*a*b* color space in terms of color co-ordinates, and color strength (K/S). Here, excellent colorimetric appearance was evident showing that biomordants has the ability to significantly improve the efficiency of the dyeing process, and that natural dyeing offered a more environmentally friendly alternative.

Keywords: *Tamarind Seed Testa, Green Coloration, Biomordants, Mordanting, Fastness Properties, Color Strength*

Towards Sustainable Consumption and Production: A Focus on Bangladesh's Leather Tanning Industry

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Abstract

The leather tanning industry in Bangladesh plays a pivotal role in the national economy, contributing significantly to export earnings and employment generation. Despite its huge contribution to the country's national economy, leather making is a hazardous process because of the use of various toxic chemicals in tanning, re-tanning, and fatliquoring treatments, producing toxic solid, liquid, and gas emissions. Therefore, the need to optimize and manage the leather tanning processes and wastes generated is in line with the United Nations (UN), encompassing 17 sustainable development goals (SDGs) and 169 targets. However, the industry faces challenges related to sustainable consumption and production practices, particularly in the context of SDG 12. To tackle this problem, this research aims to display the current state of responsible consumption and production within the leather tanning industry in Bangladesh, focusing on environmental sustainability, chemical management, and supply chain transparency. A comprehensive review of the literature and available data on the leather tanning sector in Bangladesh was conducted. Key stakeholders, including tanneries, regulatory bodies, and industry experts, were interviewed to gather insights into current practices and challenges. The findings revealed that while efforts are being made to adopt cleaner production technologies and improve chemical management practices, significant gaps exist in achieving full compliance with SDG 12. The research will also advocate for actionable steps toward achieving SDG 12 through visually engaging graphics and informative content. It will also inspire tannery stakeholders and government officials to adopt practices that contribute to a more sustainable and equitable future, aligning with the broader agenda of the 2030 Sustainable Development Goals. It will hopefully smooth the way towards the quantitative and qualitative assessments of further alternative defatting procedures/products, which are proposed practically on a daily basis to significantly reduce the environmental loads of this tremendously impacting industrial activity.

Keywords: Leather Tanning Industry, Sustainable consumption and production, SDG, Sustainability

Building a Sustainable Supply Chain: The Role of Sustainable Supplier Selection in Bangladesh's Apparel Industry

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Abstract

Bangladesh is the second largest county to export readymade garments in the global economy surpassing Vietnam which has been reported in 2023. Not only in the global market, the garments industry is the highest contributor to its country's GDP which is 11-12 %. Almost 84% of the total export comes from this sector. However, the decision makers in this sector face great challenges due to the global supplier selection complexity. Decision making in souring is very important as the decisions will impact the whole production process. This is where Sustainable Development Goal 9 (SDG 9), "Industry, Innovation, and Infrastructure," is essential to solve the barrier. To address this challenge and align supplier selection with SGDs, a hybrid approach combining SWARA (Step-Wise Weight Assessment Ratio Analysis) and WASPAS (Weighted Aggregated Sum Product Assessment) has been proposed. SWARA incorporates diverse stakeholder opinions to determine the importance of various sustainability criteria which are marked by the stakeholders, while WASPAS evaluates potential suppliers based on these weighted criteria to ensure environmentally friendly practices are prioritized by the experts. This integrated approach promotes sustainable supplier selection and directly supports SDG 9. Additionally, it indirectly supports other Sustainable Development Goals, such as SDG 8 (Decent Work and Economic Growth), by fostering responsible industry practices that create quality jobs, and SDG 12 (Responsible Consumption and Production), by encouraging the use of eco-friendly suppliers and reducing waste in the process. By adopting this hybrid model, the Bangladeshi apparel industry can better navigate the complexities of a diverse supplier network and make informed choices that prioritize both economic success and environmental responsibility. This paves the way for a more sustainable future for the industry, aligning its operations with the broader vision of the SDGs.

Keywords: Sustainable Supplier Selection, Sustainable Industrialization, SDG, Green Manufacturing.

A Statistical Expedition on the Characteristics of Textile Wastewater Assessing the Aftermath on Environment and Urban Civilization

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Abstract

This research is an extensive statistical analysis of the properties of textile wastewater using data based on the negative effects of textile wastewater on the environment and the urban ecosystem. As stated within the framework of the previous research, which concerns the chemistry and biology of textile wastewater, this investigation aims to add value to the existing insight into the multiple connections between textile wastewater characteristics on the one hand, and the environmental and social impacts of textile production on the other. Through a parallel mixed methodology involving laboratory analysis of wastewater samples together with survey and interviews from affected communities in urban areas using textile wastewater pollution, this study found out that there is a positive relationship between waste characteristics and pollution impacts on the environment and human health in general and the urban affected communities in particular. These findings support the need for improved textile wastewater policies and practices, indicating that more efficient and effective policies and actions need to be implemented through the cooperation of the industry actors, government, and communities to reduce the negative impact of textile wastewater on the environment and society.

Keywords: *Textile Wastewater, Environmental Impact, Statistical Analysis, Urban Ecosystem Impact, Public Health*

Poster

International Symposium 2024, CSTI

Exploration And Innovation of Potato-Based Natural Flame Retardant Textiles.

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Introduction

Concerns regarding health risks and environmental degradation are growing in importance in the modern world. An increasing number of industries, including textiles are pushing for environmentally friendly and sustainable production methods as a result of this increased awareness. Conventional manufacturing techniques frequently utilize hazardous chemicals that are harmful for the environment and human health. As a result, there's a rising need for substitutes that might reduce these hazards without compromising or improving product performance. With the purpose of improving the performance of cotton fabric, this study particularly looks at the environmental and health advantages of applying potato starch as a natural flame retardant finish. Flame retardants are essential in textiles because they prevent or delay the development of fire, offering safety in a variety of applications including clothes, furniture and industrial products. [1], [2] Nevertheless, hazardous materials found in conventional flame retardants can be harmful to the environment and human health. When these chemicals are manufactured and used, they may release toxic vapors and when they are disposed of, they may contaminate the land and water. Besides all of these as it is non-toxic and comes from a natural source, potato starch offers a possible substitute. Because there are no hazardous chemicals used in the extraction and application of potato starch as a flame retardant, it is a safer alternative for both textile industry workers and final consumers. Potato starch is a sustainable option since it comes from potato tubers, which are a renewable resource. [3], [4]

Study objectives

1. Assess how potato starch reduces pollution compared to conventional treatments.
2. Evaluate health safety for workers and consumers using potato starch.
3. Determine the effectiveness of potato starch in enhancing cotton fabric's flame retardancy.
4. Promote sustainability by using renewable resources like potato starch in textile manufacturing.

Methods

Material:

Bleached Cotton fabric

Fresh, high-starch potatoes

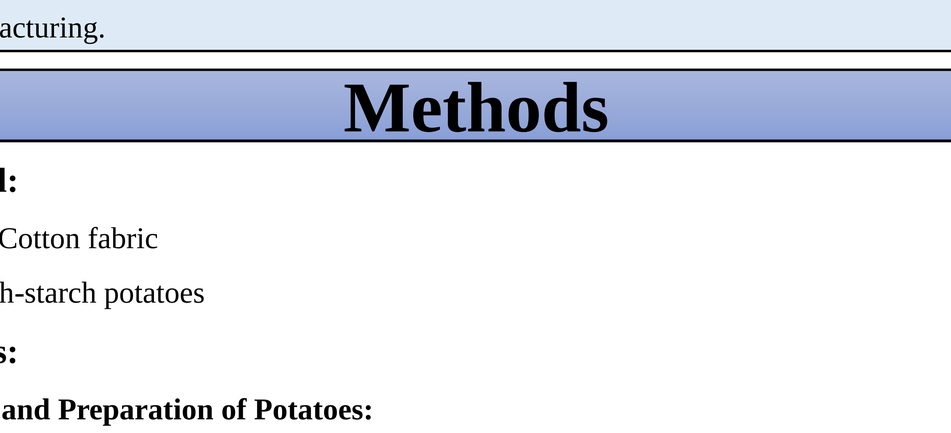
Methods:

Selection and Preparation of Potatoes:

Here, high-starch potatoes were chosen, washed to remove impurities, ensuring a clean material for starch extraction.

Extraction of Potato Starch:

Then potatoes were peeled, grated and soaked in water to extract the starch. For better starch extraction, potatoes were blended. The starchy liquid was filtered, left to settle and then poured off, which results in pure potato starch.

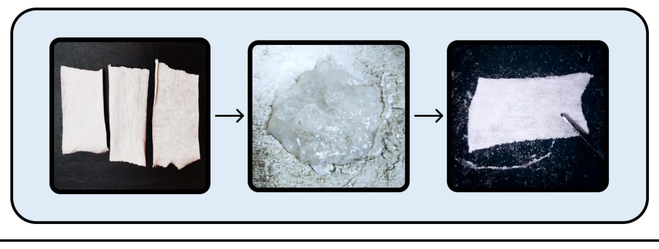


Preparation of Cotton Fabric:

Cotton fabric was pre-washed to remove impurities, then dried and cut into uniform samples.

Formation of Starch Gel:

The extracted starch was heated to form a consistent gel-like diluted liquid. The gel was applied to both sides of the fabric.



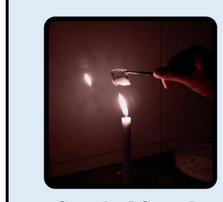
Curing of the Samples:

After starch gel applied, the fabrics were dried at room temperature and then cured at a specific temperature to ensure the starch was firmly fixed to the fabric fibers.

Flammability Testing:

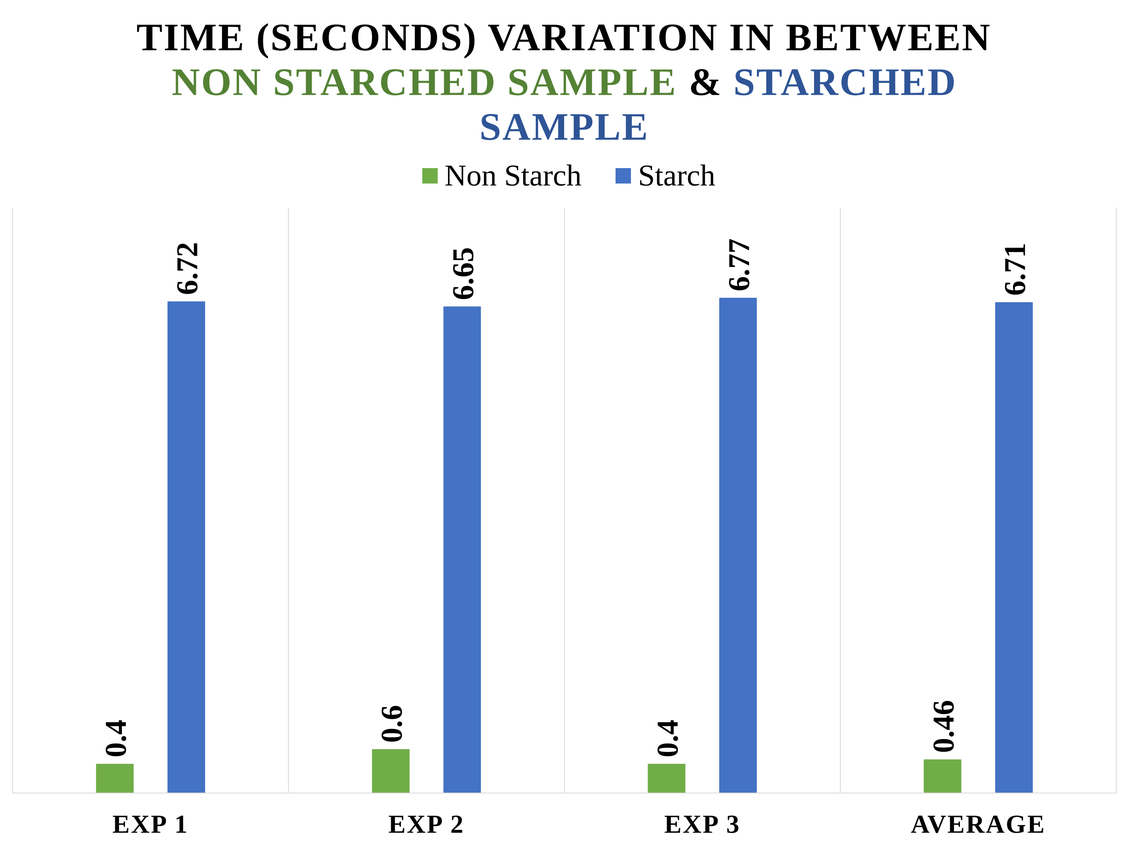
The vertical flame test was performed on both treated and untreated fabric samples. Data comparison was used to determine the outcome.

Non-Starch Sample



Starched Sample

Results



The non-starched samples exhibited significantly shorter flame resistance times compared to the starched samples. This experiment was conducted three separate times. The green line represents the non-starched samples, showing an average burn resistance time of 0.46 seconds, which is less than one second. In contrast, the blue lines represent the starched samples, demonstrating an average burn resistance time of 6.71 seconds. This indicates a much higher resistance to the vertical flame test for the starched samples.

Conclusion

This study shows that potato starch is an effective and eco-friendly flame retardant for cotton fabrics. Fabrics treated with potato starch have improved flame resistance while maintaining their physical properties. This method offers a safer alternative to chemical flame retardants and promotes sustainability in the textile industry. Future research should optimize the treatment process, assess the long-term durability of treated fabrics and explore scalability for industrial use. Using natural flame retardants from agricultural resources like potatoes is a promising path toward safer and more environmentally friendly textile products.

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Study of Adsorption & Equilibrium Isotherm of Reactive Dye Removal from Aqueous Solution Using Eggshell Biomass Adsorbent

International Symposium 2024, CSTI

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Introduction

The textile dyeing industry poses a significant threat to water bodies and the environment due to the widespread use of toxic synthetic dyes. Approximately 5,000–10,000 tons of dyes are released into the waterways annually. We focused on utilizing eggshells as an eco-friendly adsorbent to remove dye particles from aqueous solutions. The study revealed eggshells' potential to eliminate reactive dye and heavy metals. A thorough analysis of parameters like pH, biomass dosing, initial dye concentration, and contact time was conducted. Equilibrium isotherms were used to understand the adsorption process. This study aims to guide the textile manufacturing industry towards sustainable and environmentally friendly wastewater treatment, supporting a transition to a circular economy and mitigating the hazardous impact of waste.

Study objectives

1. To calculate dye removal percentage & adsorption capacity through batch adsorption process.
2. To simulate the equilibrium data from the batch adsorption experiment in the Equilibrium Isotherm models to find out the best-fitted Isotherm model for the adsorption process.

Methods

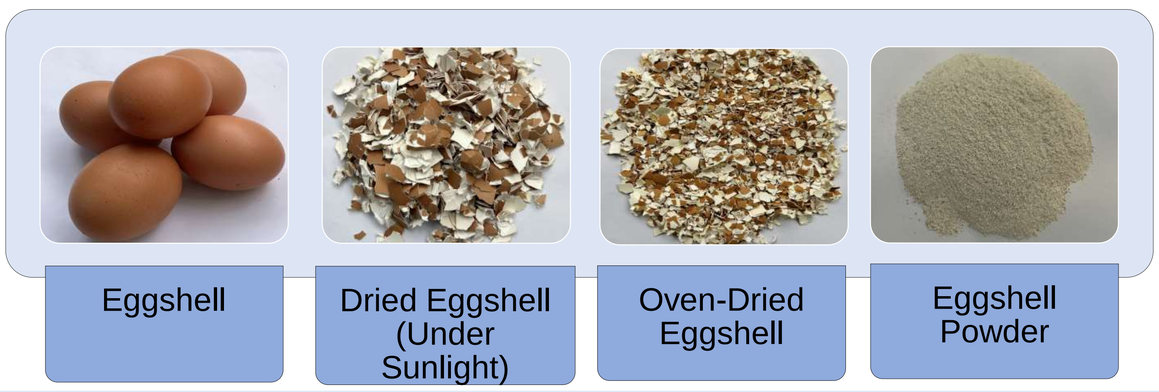

Figure 1: Development of Eggshell Powder. Oven-Dried at 150°C for 3 hours

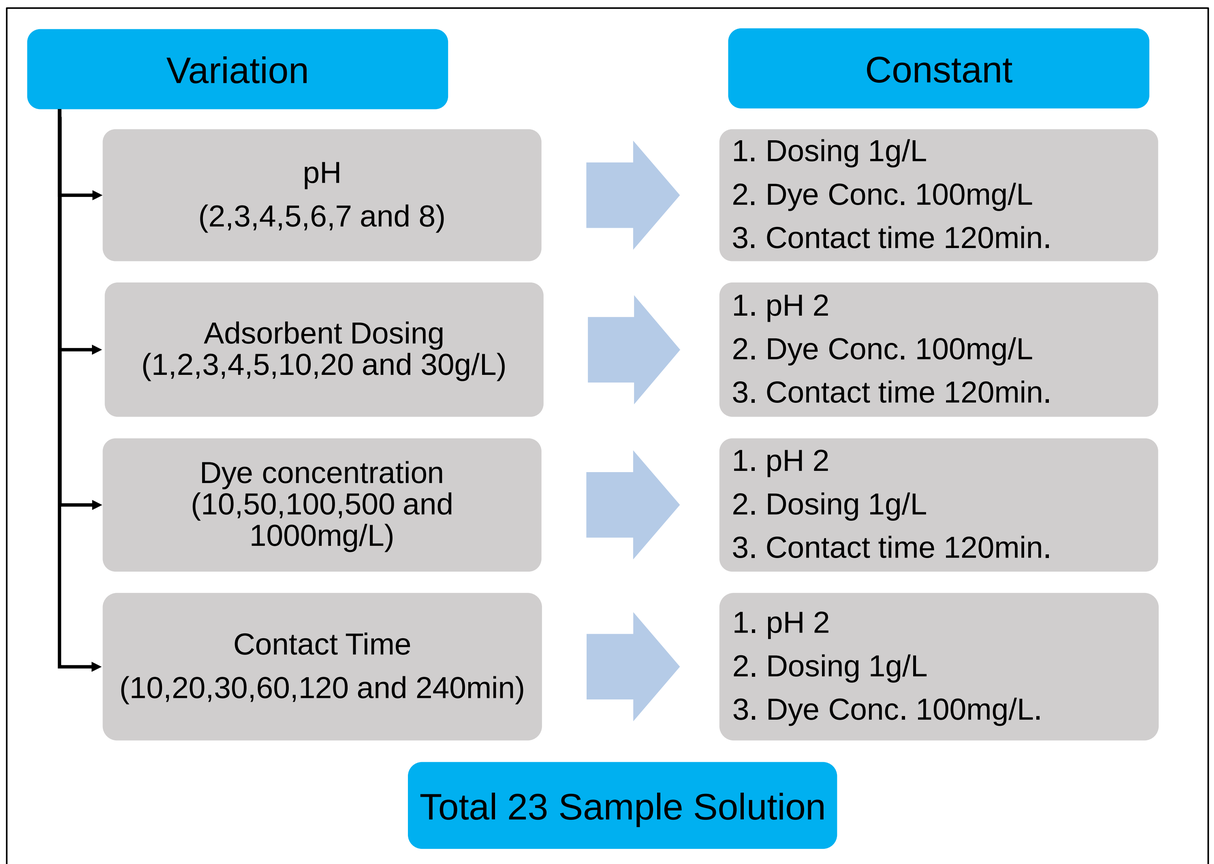

Figure 2: Batch Adsorption Process.

Results

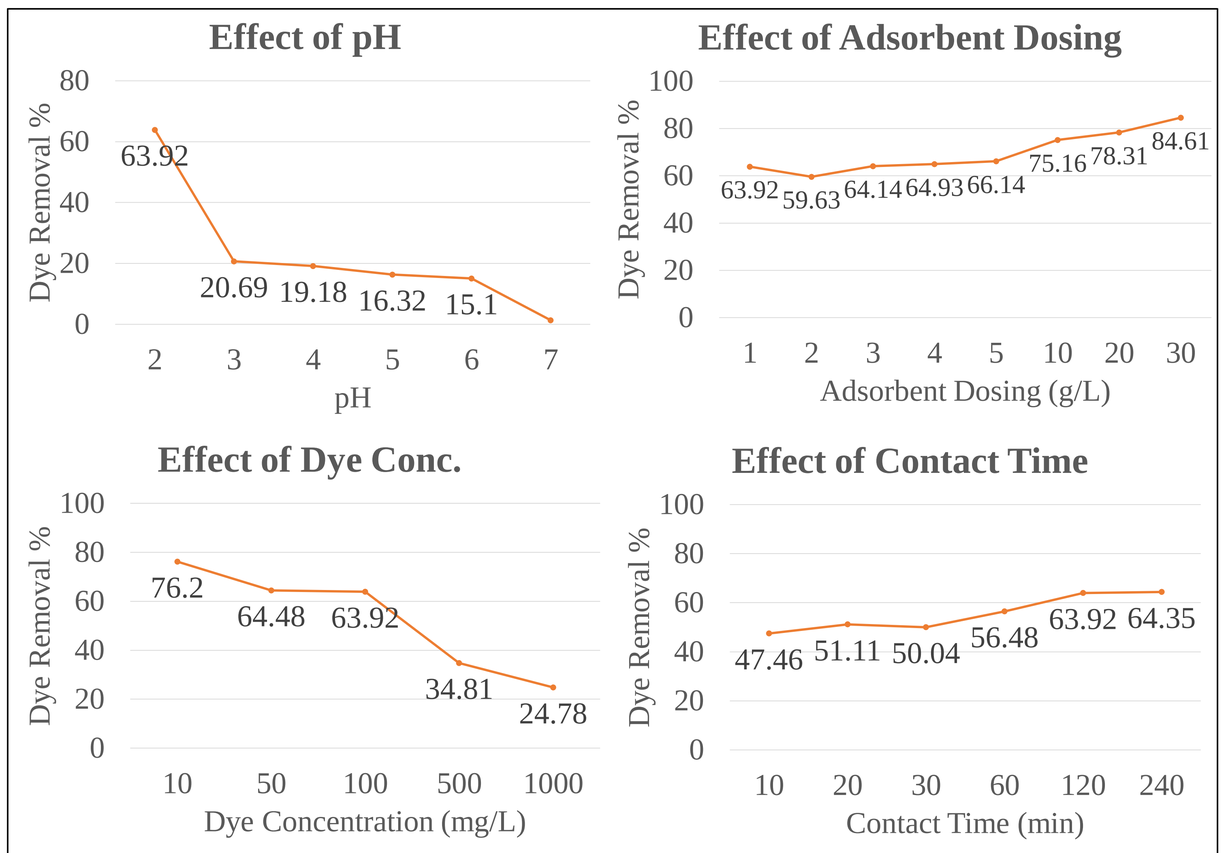

Figure 3: Effect of pH, Adsorbent Dosing, Dye Concentration and Contact Time. Optimum pH 2 and contact time 120min. Highest dye removal percentage (84.61%) by 30g/L adsorbent Dosing

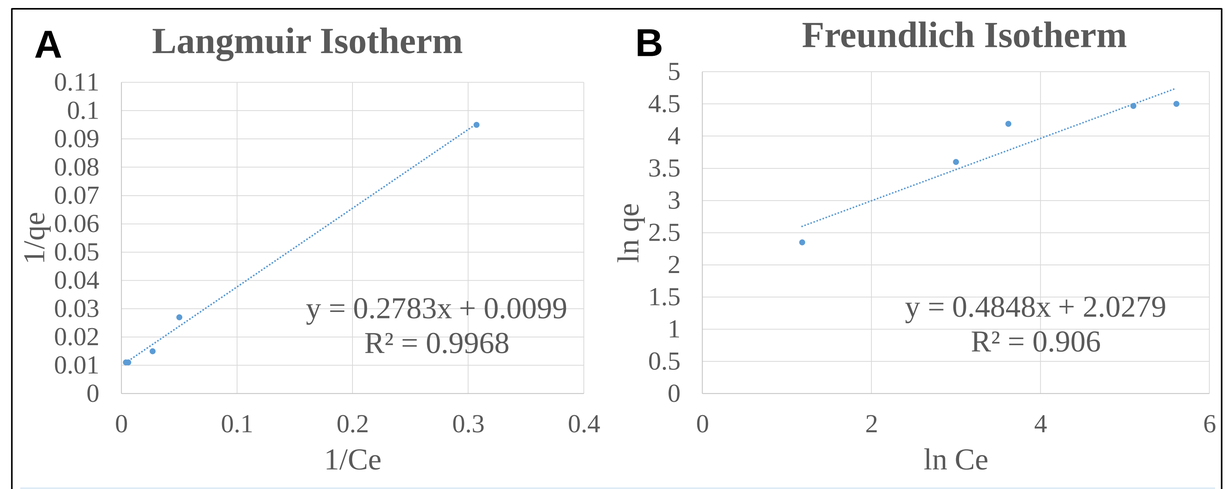

Figure 4: Graph for determining Isotherm (A) Langmuir (B) Freundlich

Figure 5: Dye Solution Before and After Batch Adsorption Experiment (A) pH (B) Biomass Dosing & (C) Contact Time Variation

Conclusion

- Raw eggshell powder can remove up to 84% of reactive dye from the water. Here, the maximum adsorption capacity is 101.01mg/g and the Langmuir isotherm model is the best-fitted model.

Future Studies

- Researchers may explore the potential of modified eggshells for enhancing eggshell stability and reusing eggshell powder.

References

S. Parvin, B. K. Biswas, M. A. Rahman, M. H. Rahman, M. S. Anik, and M. R. Uddin, “Study on adsorption of Congo red onto chemically modified egg shell membrane,” Chemosphere, vol. 236, p. 124326, Dec. 2019, doi: https://doi.org/10.1016/j.chemosphere.2019.07.057.

Study on the Effect of Natural Rubber as Binder on Pigment Printing in Combination with Synthetic Binder

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International Symposium 2024, CSTI

Introduction

Cotton is valued in textiles for its breathability, durability and absorbency, but its coloration process can harm the environment. Pigment printing often uses synthetic binders, which raises concerns about sustainability, environmental impact and potential health risks for workers. In response to the demand for sustainability, researchers have investigated natural alternatives to synthetic binders, such as chitosan and jackfruit latex gum. However, these natural alternatives have limitations. This study delves into the potential of natural rubber as a binder for pigment printing on cotton fabric. With its high tensile strength, abrasion resistance and low hysteresis, natural rubber emerges as a promising eco-friendly and cost-effective alternative to synthetic binders, making it an ideal choice for applications that require durability, flexibility and superior performance.

Study objectives

1. Assess environmental impact & explore sustainable alternatives.
2. Evaluate eco-friendly printing process.
3. Performance of natural rubber & synthetic binder combination
4. Investigate natural rubber as a sustainable alternative binder.

Methods

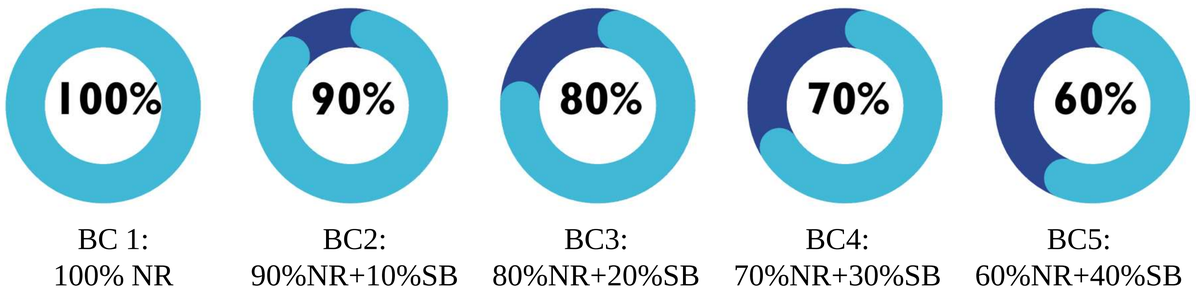


Figure 1: Preparation of the print paste (Binder Combination).

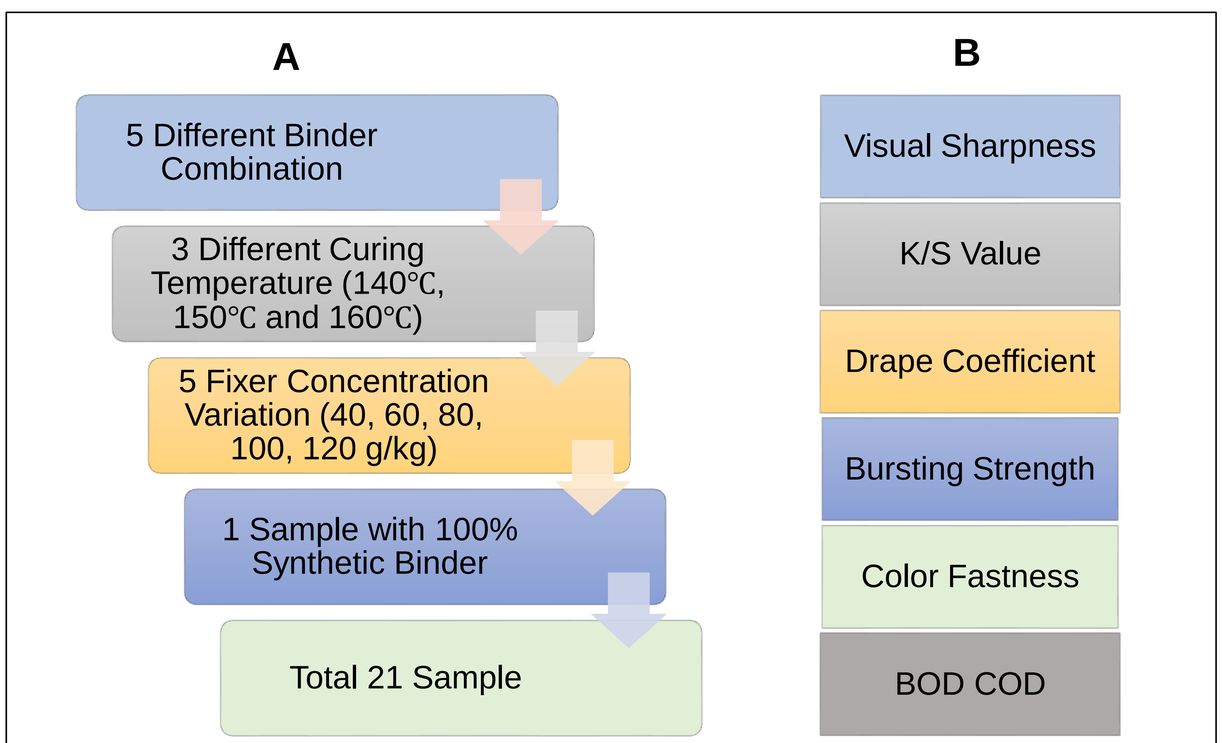
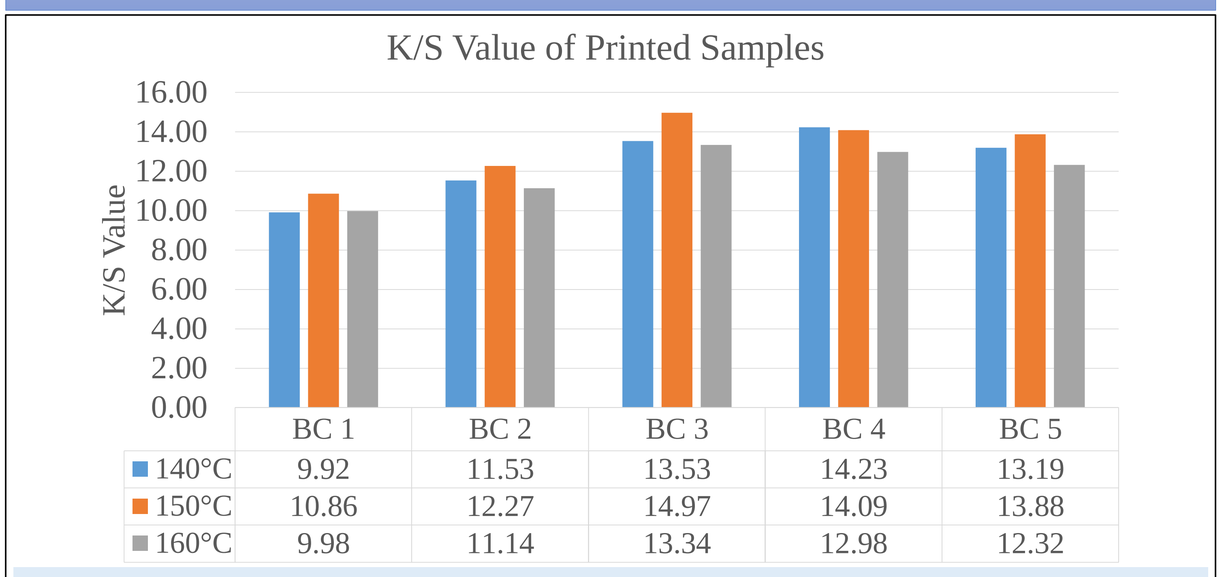


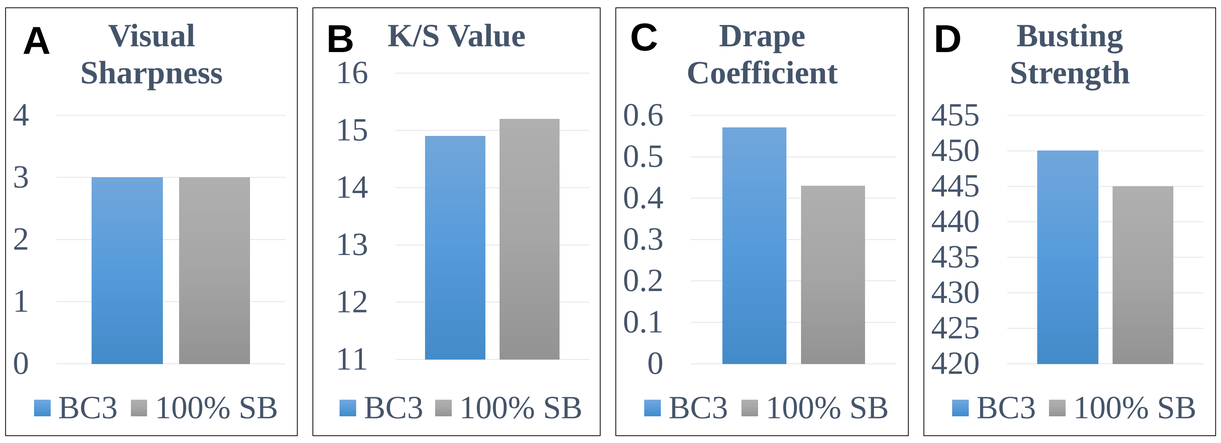
Figure 2: Methods (A) Printing Sample. 15 blotch-printed samples, resulting only from 5 binder combinations and 3 curing temperatures, were printed. And **(B) Testing.**

Results



	BC 1	BC 2	BC 3	BC 4	BC 5
140°C	9.92	11.53	13.53	14.23	13.19
150°C	10.86	12.27	14.97	14.09	13.88
160°C	9.98	11.14	13.34	12.98	12.32

Figure 3: Color Strength (K/S Value) of Printed Samples. BC3 with 150ºC curing temperature is the best performer.



Binder composition	Colorfastness to wash (Bleached Cotton)	BOD (mg/L)	COD (mg/L)	Air Permeability ($cm^3/cm^2/sec$)
100% synthetic binder	4/5	496	2466	54.2
BC 3	4/5	373	2875	59.5

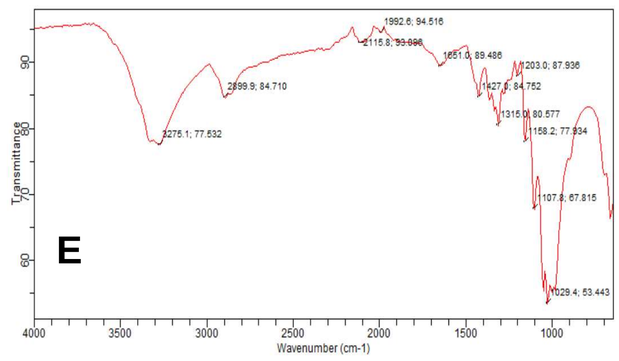


Figure 4: Comparison between BC3 and 100% synthetic binder (A,B,C,D). Fourier transform infrared (FT-IR): Cellulose treated with BC3 (E).

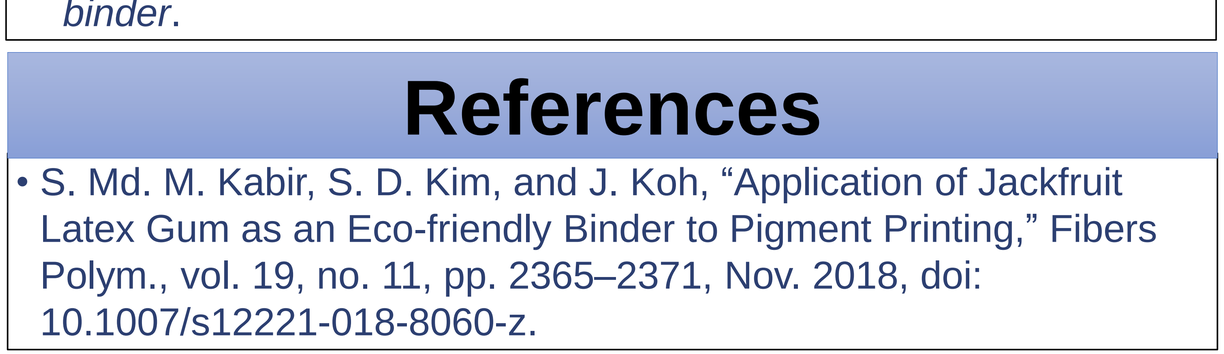


Figure 5: Printed Samples (A) Best Binder Combination (80% NR & 20% SB) (B) Best Fixer Concentration (80 gm/kg in 1kg pigment paste)

Conclusion

- 80% natural rubber and 20% synthetic binder combination improved color strength, visual sharpness, drape, bursting strength, fastness and air permeability with 150°C as the optimal curing temperature.

Future Studies

- Further studies needs to carried out on *100% Natural Rubber as binder*.

References

- S. Md. M. Kabir, S. D. Kim, and J. Koh, “Application of Jackfruit Latex Gum as an Eco-friendly Binder to Pigment Printing,” Fibers Polym., vol. 19, no. 11, pp. 2365–2371, Nov. 2018, doi: 10.1007/s12221-018-8060-z.

QR Code Printing on Apparel as an Alternative to Product Labels

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International Symposium 2024, CSTI

Introduction

All of the pre-purchased information regarding the apparel is visible with a product label [1]. As the care labels or product labels are increasing the clutter of the garment, an easy way will be to use something entirely different. QR codes are placed on the garment, which is also known as scannable codes, and they will link the code directly to an Universal Resource Locator (URL) via the Internet. They can carry both promotional and non-promotional aspects as well as countless information regarding the apparel [2]. In this study, QR codes have been printed directly on garments using DTF print and screen print, leaving out the label in separate fabric or paper. Cotton and polyester fabric were used for testing, and the QR codes can be accessed using a scanner and stable internet connection to access specific URLs or webpages.

Study Objectives

1. Reduce the use of different types of product labels on the garment and use a QR code instead.
2. Include all information regarding the garment in the QR code.
3. Printing of QR codes by direct-to-film (DTF) printing as well as screen printing and comparing their properties.

Methods

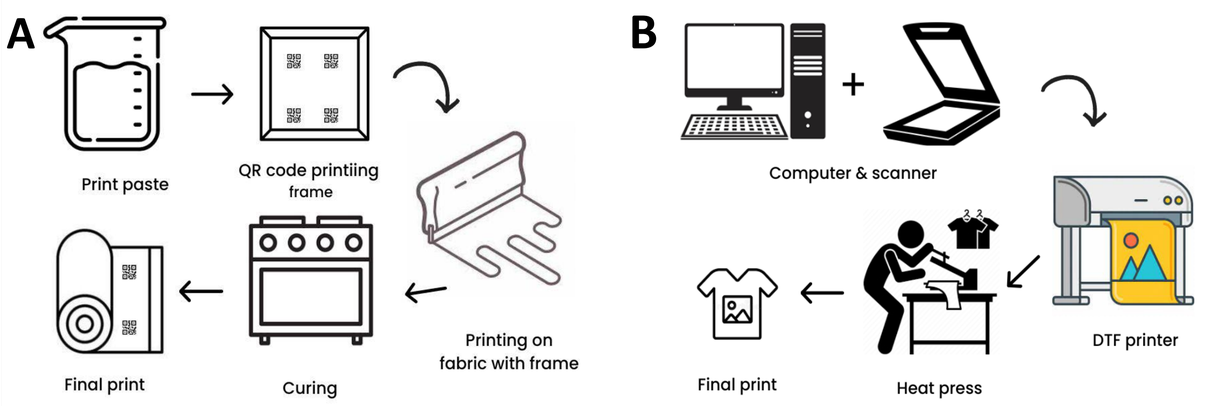


Figure 1: Screen Printing (A) and DTF Printing (B) Method

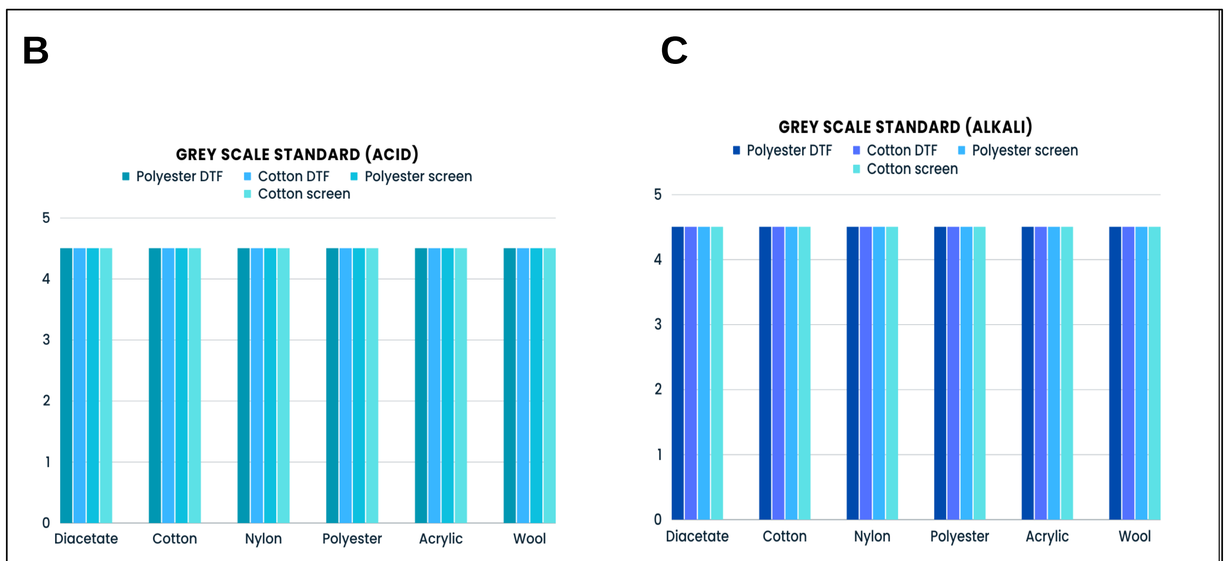
Figure 2: QR Code Scanning Process from a Printed Shirt

Results

A

COLOR FASTNESS TO WASH	POLYESTER DTF PRINTING	COTTON DTF PRINTING	POLYESTER SCREEN PRINTING	COTTON SCREEN PRINTING
GREYSCALE GRADE	4-5	4-5	3-4	4

B



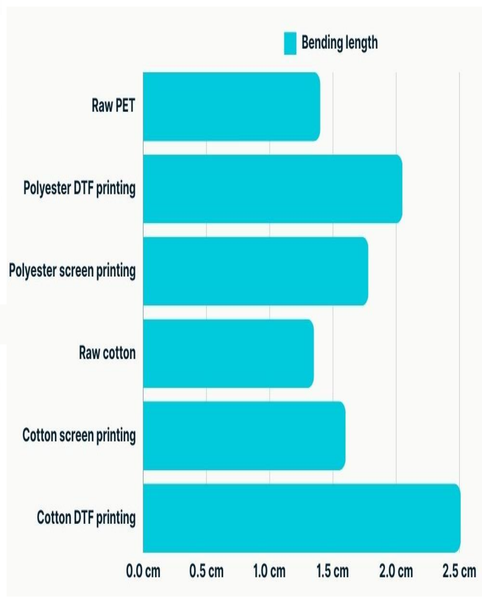
C

Figure 2: Color Fastness to Wash (A), Color Fastness to Perspiration with Acid (B) and Alkali (C)

A

VALUES FROM SPECTROPHOTOMETER	SCREEN PRINTING ON COTTON FABRIC	DIGITAL PRINTING ON COTTON FABRIC	SCREEN PRINTING ON POLYESTER FABRIC	DIGITAL PRINTING ON POLYESTER FABRIC
L*	74.23	48.13	77.29	54.78
A*	-25.06	0.26	-19.52	-0.51
B*	5.19	-0.10	-8.93	-5.48

B



C

WASH CYCLE	APPS	TIME FOR SCANNING (S)			
WASH 1	BUILT-IN SCANNER	87	1	1	1
WASH 2		99	1	5	1
WASH 3		⊗	1	17	1
WASH 4		⊗	1	⊗	1
WASH 5		⊗	1	⊗	1

Figure 3: Data Color Values of Printed Fabrics (A), Bending Test Results (B), and Scanning Performance after 5 Wash Cycle (C)

Colorfastness to rub								
	Polyester DTF printing		Cotton DTF printing		Polyester screen printing		Cotton screen printing	
	Dry rub	Wet rub	Dry rub	Wet rub	Dry rub	Wet rub	Dry rub	Wet rub
Grade	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4

Figure 4: Color Fastness to Rub in Dry and Wet Medium

Conclusion

Different technologies and features can be included with the QR code, and it is highly customizable and unique. Inserting a QR code with regular screen printing is possible, and it will give acceptable results.

Future Studies

- Application of different dyes on different fabrics for printing a QR code and studying the scan ability of QR codes on a bulk scale.
- Study on QR code print depending on different fabric structures.

References

[1] S. J. J. o. t. T. I. Shin, "Consumers' Use of Care-label Information in the Laundering of Apparel products," vol. 91, no. 1, pp. 20-28, 2000.

[2] A. Ziegler, "Promotional hang tag, tag, or label combined with promotional product sample, with interactive quick response (QR code, MS tag) or other scan-able interactive code linked to one or more internet uniform resource locators (URLs) for instantly delivering wide band digital content, promotions and infotainment brand engagement features between consumers and marketers," ed: Google Patents, 2012.

Towards Sustainable Consumption and Production: A Focus on Bangladesh's Leather Tanning Industry

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Introduction

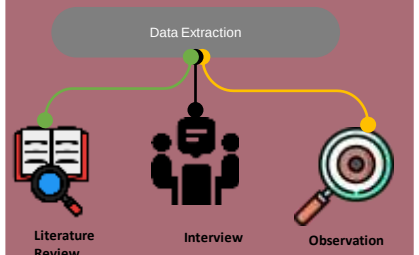
The leather tanning industry in Bangladesh plays a pivotal role in the national economy, contributing significantly to export earnings and employment generation. Despite its huge contribution to the country's national economy, leather making is a hazardous process because of the use of various toxic chemicals in tanning, re-tanning, and fatliquoring treatments, producing toxic solid, liquid, and gas emissions. Therefore, the need to optimize and manage the leather tanning processes and wastes generated is in line with the United Nations (UN), encompassing 17 sustainable development goals (SDGs) and 169 targets.

Problem Statement

The Bangladesh leather tanning industry is facing significant challenges in achieving sustainable consumption and production due to rampant environmental pollution, social issues, and economic inefficiencies, hindering its potential for growth and development with the context of SDG 12.

Methodology

A comprehensive review of the literature and available data on the leather tanning sector in Bangladesh was conducted. Key stakeholders, including tanneries, regulatory bodies, and industry experts, were interviewed to gather insights into current practices and challenges. Moreover, many tanneries have been observed carefully during data collection.



Key Findings

The investigation through a detailed literature review, semi-structured interviews, and observations of different tanneries reveals significant discrepancies between the industry's current practices and the principles of sustainable development, which hinder them from achieving sustainable production and consumption goals. The findings of this research highlight the pervasive environmental impact of the leather tanning industry in Bangladesh, particularly in terms of resource efficiency and promoting sustainable lifestyles. The main findings of this research are given below:

Environmental Concern

Pollution: They produce vast amounts of solid, liquid, and gas wastes, which pressure water, air, and soil and contribute to the damage to nature. They also lack knowledge of environmental preservation through sustainable tanning.

Social Impact Concern

Poor Working Conditions & Worker Safety: Tanneries fail to provide better working conditions and worker safety as they are exposed to hazardous chemicals for a longer period.

Economic Inefficiency

Many tanneries focus on low-value products, limiting economic benefits. They also rely on hazardous chemicals, which increases production costs and environmental liabilities.

Lack of Circular Economy Practices

Limited Recycling: They produce a significant amount of waste, but limited attention is given to recycling, reusing, and recovering.

Lack of Profit and Financial Incentives

Limited profit margins and Limited government support or incentives hinder tanneries from thinking about adopting sustainable practices.

The abovementioned points are the key driving factors that inhibit tanneries from adopting sustainable production and consumption.

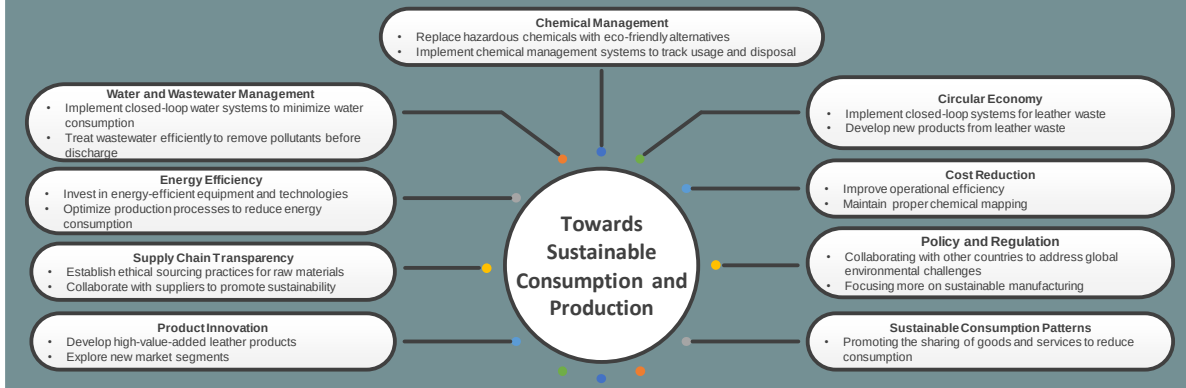


Fig.: How to achieve sustainable consumption and production goal in Leather Tanning Industry

Expected Outcome

The expected outcomes could be:

- Proper resource utilization
- Resource conservation
- Climate change mitigation
- Improved worker health and safety
- Proper supply chain maintenance
- Cost reduction
- Increased market access
- Enhanced brand reputation
- Contribution to SDGs
- Compliance with regulations
- Building a resilient and sustainable business

Conclusion

SDG 12 specifically focuses on ensuring sustainable consumption and production patterns. This means producing and consuming goods and services that meet the needs of the present without compromising the ability of future generations to meet their own needs. Tanneries often face significant challenges in adopting SDG 12 goal, for example – lack of profit and financial constraints, lack of policy, lack of circular economy practices, etc. To achieve this goal few actions need to be adopted by the tanneries, such as – proper chemical management, circular economy practice, strict policy and regulations, etc. Hence, if tanneries can follow these recommendations, It will significantly reduce the environmental, social, and economic loads of this tremendously impacting industrial activity

Acknowledgements

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