BOOK OF ABSTRACTS

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2ND INTERNATIONAL CONFERENCE ON TECHNICAL TEXTILES

18-19 FEBRUARY, 2020

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Dr. Munir Ashraf

Conference Secretary

Foreword

I feel great pleasure to write the foreword for 2nd international conference on technical textiles held at National Textile University, Pakistan on 18-19 February 2020 in collaboration with Higher Education Commission of Pakistan. It was a promising platform for the academic researchers, textile experts, industry professionals and entrepreneurs where the everybody contributed to realize the goals necessary for the development of textile industry and humanity.

The major topic covered in the conference are textile-based composites, functional textiles, electrospinning, sustainability, technical yarns, performance coatings, biomaterials for technical textiles and digital clothing. In fact, this forum provided a wonderful platform for linkage of industry and academia, resolving the issues through mutual discussion and deciding a way forward for the prosperity of textile industry.

I hope the abstracts included in this abstract book will present the novel research ideas beneficial for the readers. We are so thankful to all the plenary speakers and audience for sparing time and sharing knowledge for a noble purpose. We present gratitude to the sponsors including GIZ Pakistan, Interloop Ltd., WWF Pakistan, Nizam Sons, Jeanologia and i-textiles who supported the conference to overcome the financial barriers.

We hope that all the dignitaries participated in this conference will remember the event with beautiful memories and experience.

Dr. Yasir Nawab

Conference Chair

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THE LAUNDRY PILE: EXHIBITING ACADEMIC RESEARCH

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Abstract

Despite academic recognition that laundry practices are environmentally damaging, public engagement with the environmental issues associated with laundry is limited. As a collective activity, laundry annually uses up massive quantities of finite resources such as energy and water, and in the process, contributes towards greenhouse gas emissions, global warming and climate change. The series of exhibitions titled 'The Laundry Pile' focused on making these critical issues visible and accessible to the public. Traditional formats of disseminating academic research, such as conference presentations and journal articles, can prevent the development of 'civil literacy' and narrow the debate on the issues of sustainability. The Laundry Pile has communicated to diverse audiences, bringing about awareness and discussion of the historical and contemporary contexts to our laundry practices, focusing predominantly on the associated environmental issues. The curators selected work from a range of contemporary practitioners and researchers who explore laundry practices. The curation of the research ensured there were multiple points of entry for the audience, through the use of varied formats including video, artefact, stories, illustrated statistics and photography. This facilitated lively discussion and interaction from the exhibition audience.

PERFORMANCE EVALUATION AND PRODUCT DEVELOPMENT OF TEXTILE AND NON-TEXTILE TROPICAL BIOCOMPOSITES

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Abstract

Biocomposites have been regarded as important materials in engineering applications in the recent years. They are used in different industries such as energy, furniture, automotive, aerospace, agriculture and biomedical industries. Biocomposites or natural fibre composites can be used in different forms based on different fibre arrangements and types, matrix types, and fabrication processes. Natural fibres can be utilized in continuous unidirectional direction form, bidirectional, woven form, random chopped, particulates and in the form of very fine fillers, embedded in appropriate polymer matrices (synthetics or bio-based) to form biocomposites. For textile biocomposites, they are actually composites developed from natural fibres in the forms of woven or non-woven fabrics, knits or braids and the matrix could be made from bio-based resinous polymer, although synthetic polymers can also be the options. Generally, in textile biocomposites, natural fibres are developed in the form of bundle (slivers), and later spun to form a continuous yarn. Then, spun yarns were twisted around each other to make twisted or plied yarn, to form woven fabrics, knits and braids as reinforcements in textile composites in the. In this lecture, development and performance evaluation of selected tropical textile and non-textile biocomposites are presented. Different mechanical and other testing of non-textile based composites are discussed. Product development activities, focusing on conceptual design, materials selection and design for sustainability, are presented. Selected research work emphasizing on performance and product development of textile biocomposites is also reviewed.

WASTE-TO-ENERGY OPTIONS IN SOLID WASTE MANAGEMENT

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Abstract

A waste-driven factory is intended to valorize waste sources as renewable feedstock to recover value-added chemicals, materials, alternative fuels, and energy. The ambition of this concept is to integrate waste treatment, resource recovery, alternative fuels, and energy generation to shift from fossil-based linear economies to circular economies. Although the traditional linear economies have resulted in rapid economic growth, but at the cost of increasing energy demands, environmental pollution, and climate change. Recently, the Paris COP21 summit has set out a roadmap to reduce greenhouse gases (GHGs) emissions to keep global warming to 'well below 2oC'. Like global warming, the tremendous waste generation, and its unsustainable disposal has emerged as a potential threat to our civilization. It is estimated that the current waste generation rate would escalate by three times by 2025. Traditional waste remediation methods are concerned with waste removal from collection points and their disposal in designated dumping sites where waste valorization to generate energy, and other value-added products are rarely performed. These sites have become a major source of GHGs emissions contributing to climate change. As a result, nations are now focusing on treating or refining wastes instead of disposing, striving to recover energy and value-added products from waste to achieve a circular economy. In better words, using closed-loop waste bioprocessing units, the inherent net positive energy contained in solid, liquid, and gaseous wastes is harnessed and utilized as energy carriers. Despite their promising features, these individual processing technologies are incapable of handling the huge volume of waste at a single platform to achieve zero waste concept. They suffer from limited efficiencies and high capital and maintenance costs. Therefore, if these waste processing or waste-to-energy technologies could be integrated through the under-one-roof concept of a waste-driven factory, a significant part of wastes can be treated by various specialized techniques, while their outputs (heat, power, and fuel) could suffice the operating requirements of each other. An array of products including heat, power, fuel, and value-added chemicals, enzymes, and materials would be available, not only to run the waste-driven factory by itself but to support the national electric grids, vehicular gas stations, combined heat and power (CHP) units, and domestic heating and industrial furnaces. However, the overall sustainability of such waste-driven factories should be assessed through various tools, including life cycle assessment (LCA), life cycle impact assessment (LCIA), and exergy.

SISAL FIBRE FOR TECHNICAL TEXTILE APPLICATIONS

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Abstract

Sisal fiber is extracted from the leaves of Agave sisalana that is the Mexican plant and is now mainly cultivated in Tanzania, Brazil, Indonesia and India. Due to its strength and durability, it is placed in the category of "hardfibers". Sisal fibre has the great potential of generating revenue for the country through its applications for packing purposes and also for sisal fibre reinforced composites. The present study summarizes the potential of the sisal fibre being produced in Pakistan 'wild sisal' as raw material for natural fibre reinforced composite. The decorticating process, i.e. separation of fibres from the leaves is a difficult task. A decorticating machine has been developed to separate the fibres from the green matter. The decorticating action of the revolving knives in combination with the stationary knives, separate the fibres from the green matter and the fibres come out clean. Moreover, the potential of the wild sisal has been compared with world-known Tanzanian sisal fibre on the basis of the fibre characteristics. The results showed that Pakistani wild sisal plant is capable of producing natural fibre composite and a sustainable substitute for replacing the other bast fibres.

ELECTROSPUN CARBON NANOFIBERS FOR POTENTIAL GENETIC BIOSENSOR APPLICATIONS

***Yakup Aykut[1,2], Karima Sahtani[2], Nilay Aladag Tanik[2]**

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Abstract

Carbon nanofibers have been produced from electrospinning of a polymer precursor and following heat treatment processes. Carbon nanofibers also produces from various electrospinnable polymers including polyvynile alcohol (Gupta and Dhakate 2017), polyimide (Xuyen et al. 2007), lignin (Ma et al. 2016), etc. Polyacrylonitrile is the most common polymer and tend to electrospun easily and convert to carbon nanofibers form with heat treatment (Zhang et al. 2014; Aykut 2012; Wang et al. 2012). Graphitic electrodes have been used for electrochemical genetic sensor applications (Karimi-Maleh et al. 2015). Since their nanofibrous mat structures, electrospun carbon nanofibers could have more surface are comparing other carbon electrode surface such as carbon pasta electrode, carbon screen printed electrode and pencil graphite electrode. So, more surface are provides more space to immobilize genetic molecules on the surface to obtain better signal during the electrochemical measurement. In this regard, it has been aimed that the preparation of carbon nanofibers with the addition of natural catalysers to enhance the structural regularity and obtain more graphitic structure. Consequently, both more graphitic structure and higher specific surface enhance the electrochemical genetic biosensor performance.

DEVELOPMENT OF MULTI-STRUCTURAL AUXETIC YARN HAVING WOOL YARN AS CORE AND POLYESTER FILAMENT AS COVERING

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Abstract

Auxetic materials are a unique kind that exhibit a negative Poisson's ratio (NPR) effect. They get fatter when stretched and thinner when compressed. Auxetic behavior is a scale-independent property which can be achieved at different structural levels from molecular to macroscopic levels. The internal behavior of materials plays an important role in obtaining auxeticcity. The Poisson's ratio of a material is defined as the negative ratio of the traverse strain to the axial strain in the direction of loading. Auxetic yarns are getting more interest due to their applications in different textile products. There are three main techniques to develop the auxetic yarns; thermal, chemical, and physical while this study is only focused on the physical technique. To develop the auxetic yarn, one soft part was in the core, and stiffer one was wrapped around the soft part. Wool yarn is used in the core being soft and polyester filament as covering being stiff. The effect of wrapping twists and the diameter of the core yarn was mainly focused. Three different counts of woollen yarn are 10, 15, and 30 and three different wrapping twists per inch are 5,7, and 9. The results show that a higher diameter of the core material and more wrapping twist lead towards better auxeticity. For different diameters of wool yarns, auxeticity from -0.20 to -0.45 was achieved and for different twists per inch of polyester around the wool yarns, auxeticity of -0.31 to -0.46 was achieved. This auxetic yarn structure with spandex as core might be used for the development of crack resistance fabrics, high energy absorbent, and high compact resistance fabrics. These auxetic based yarns can also be used for the development of protective wears such as gloves and helmet etc. The polyester-wrapped structure can be used for the development of sportswear as protective cloths.

SURFACE DOPED ZnO: Fe^{3+} @CARBON FABRIC AS SOLAR PHOTOCATALYTIC REACTOR FOR TEXTILE EFFLUENT TREATMENT

Ambreen Ashar*[1,2], Ijaz Ahmad Bhatti[1], Munir Ashraf[3], Muhammad Tahir Hussain[4], Muhammad Mohsin[1]

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Abstract

Tertiary treatment of textile affluent containing azo dyes, is still a big issue, in context to the sustainable environmental policies. Under the umbrella of advance oxidation processes, heterogeneous photocatalysis, especially by employing nano semiconductor metal oxides is a promising technique to treat such effluents. The conducting carbon fabric based functionalized textile is remarkably appropriate as a substrate to be adorned with nano metal oxides. Doping of photocatalysts with a suitable dopant renders it capable of harvesting solar radiation to carry out the redox reaction. In this study, Fe^{3+} doped ZnO has been adorned onto carbon fabric using low temperature hydrothermal method to generate ZnO: Fe^{3+}@carbon fabric as solar photocatalytic reactor. The photocatalysts, pure ZnO and ZnO: Fe^{3+} grown on surface of fabric was found highly crystalline according to XRD, while elemental composition of the fabricated material was estimated by EDX and STEM. Discoid 2D morphology of photocatalyst has been examined by SEM and TEM. Thickness of discs was determined by AFM that was observed maximum5 nm and 7 nm for pure ZnO and ZnO: Fe^{3+} respectively. Diffused reflectance spectroscopy (DRS) and reduction of band gap from 3.2 to 2.7 eV confirmed the higher photocatalytic activity of ZnO: Fe^{3+}@carbon fabric in solar range. The characterized ZnO: Fe^{3+}@carbon fabric based solar photocatalytic reactor has been used to degrade RB5 bis azo reactive dye on irradiating with artificial sunlight (D65) under ambient conditions. The reaction parameters i.e. pH and irradiation time in addition to initial dye and oxidant concentration have been optimized by Response surface methodology (RSM). The extant of dye degradation has been evaluated by UV/vis spectroscopy, HPLC and FTIR. The maximum degradation achieved under optimized conditions was 92.89 % in 3 h.

TECHNIQUES FOR DEPOSITING NANO MATERIALS ON TEXTILE SURFACES

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Abstract

The technological advancement is attracting the attention of researchers to develop such techniques and products which can cope up with today's needs. The world full of technical users are expecting more advancements from textile sectors to develop such materials which can fulfil their requirements. Hence there is a need to focus the applications of functional textile materials where protection against harmful radiations, harmful microbes, sensors, electromagnetic interference shielding, security prints and many more along with their techniques of deposition should be covered. This article explains the techniques for metallization of textiles substrates including woven, non-woven, knitted and composite fabrics. The methodology adopted depends on type of substrate and its application area. Metallization of textiles can be done using metallic filaments and metallic nanomaterials where the nano metallic materials can be decorated on textile surfaces by various techniques; physical, chemical and electrochemical techniques, atomic layer deposition techniques, by virtue of some carrier, in situ deposition. The merits and demerits of these techniques along with their parameters have been discussed.

VOID CONTENT IN BAGASSE FIBER COMPOSITES USING IMAGE ANALYSIS TECHNIQUE

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Abstract

The void content is an important phenomenon in the field of composite materials. The presence of voids in the composite material is not desired because it has a negative impact on the quality of composite materials and their mechanical properties. The voids are the air bubbles generated during the process of mixing the resin and the hardener and when the resin flows in the reinforcement, attempts are made to minimize the void content. In this research work, the technique of hand lay up was used to manufacture bagasse fiber composites, the void content and the area of voids was determined using image analysis technique. This technique was utilized because the standard methods of acid digestion and calcination could not be used. The variables of alkali treatment (4, 6 and 8%), fiber weight percentage (10, 20 and 30%) and fiber length (1, 2 and 3 inches) were used for this research work. It was found that the void content and the area of voids have finally reduced as there was more interaction between the resin and the fibers. Due to increase in the alkali percentage, the lignin is removed, the increase in the fiber length provided more surface area for the resin to interact and more percentage of fibers has also increased the interaction of fibers with resin. This resulted in decrease in the flow rate of resin during the manufacturing process thus resulting in lower void content.

TEXTILE SUSTAINABILITY; OPPORTUNITIES AND THREATS FOR THE TEXTILE INDUSTRY

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Abstract

Importance of textile sustainability is increasing day by day due to more consumer awareness, brand pressure and strict legislations. Textile sustainability is getting more and more complicated as more and more complex things are included in this topic. In addition, rules and regulations are getting stringent day by day. Therefore, it is now becoming a serious threat for certain organizations which are not following or adopting it. Nevertheless, it is also a great source of opportunity for those organizations which are adopting it as they can get more orders and high price for their products. Some of the key parameters in the textile sustainability include raw material, machinery, chemicals as well as processes. Some of the developments in this area are development of sustainable raw materials, water and energy efficient machines, non-toxic chemicals as well as productive and efficient processes.

IMPACT DAMPING PROPERTIES OF LOW POISSON RATIO (AUXETIC) KNITTED FABRICS

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Abstract

The materials with low Poisson ratio and negative Poisson's ratio (auxetic) have the potential to meet the demand for different materials due to their superior properties, especially in technical textiles. Thanks to its impact on damping properties, it can be used as a protective textile product as bulletproof vest, explosion-proof curtain, seat belts. Auxetic fabrics can be produced by two approaches. The first one is to fabricate auxetic fabrics by using auxetic fibres or yarns, and the second one is to manufacture auxetic fabrics from conventional yarns by using special geometrical arrangements. Comparing to woven fabric, there is a more significant Poisson effect in the knitted fabric due to its stitch structure. In this study, force analyzes were performed for knitted fabrics with a low Poisson ratio. Thus, the relationship between the Poisson ratio and impact damping effect was investigated. As a result, it was found that the fabrics with a low Poisson ratio reduce the internal tension by transmitting the applied force to the side surfaces. As the Poisson ratio decreases, the amount of energy required to obtain elongation increases, so they can absorb more energy per unit length.

ECHO-FRIENDLY, AEROSOL-BASED DYEING AND FINISHING OF TEXTILES

Abdul wahab

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Abstract

Textile processing industry is considered as one of the largest consumers and worst polluters of fresh water resources. Since ages, water has been used as a major processing medium for the pretreatment, dyeing and finishing of textiles. Aim of this study was to compare the traditional aqueous textile processing with water-air mixture as the processing medium using aerosol technology. The concept originally developed by Jeanologia for denim processing, has been adapted with appropriate equipment modifications and parameter optimization for the pretreatment, dyeing and finishing of socks at commercial scale at Interloop Industries Pakistan, which is one of the largest socks manufactures in the world. In the new process, a blend of pressurized air with minimal amount of water is used to transfer the dyes and chemicals to the garment surface for subsequent absorption. The results show 80% savings in water consumption, 47% savings in energy, 80% savings in salt and 50% savings in other chemicals used in socks processing at commercial scale. The new process has huge potential to reshape the garment processing industry by minimizing its water, chemical and carbon foot print.

AUTOMATION AND SUSTAINABILITY OF DENIM PROCESSING

Amna Ansari, Muhammad Shahzad*

Govt. Institute of Emerging Technologies, Lahore.

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Abstract

Laser and Ozone Fading Processes on Denim are the value addition of the final products now a day in the apparel business. There are numerous operations exist for fulfilling of denim treatment. This paper "Automation and Sustainability of Denim Processing " deals with the recent developments of the sustainable, environment-friendly and emerging industrial approach of Laser and Ozone Fading Processes for the treatment of the denim. This paper based on the personal experiences and cross questioning with relevant experts. This Paper observed that how laser and Ozone washing Processes work, there effects, benefits towards eco-friendly and sustainability of technology with accuracy of design. It is also notified that by adoption of these automations reduces water treatment and reduces water consumption as well as less use of chemicals which cause environmental pollution. The acceptance of this technology has brought about an essential change in the garment industry, which is changing from an artisanal, labor intensive industry towards an industry based on knowledge and technology that feels more responsible for the environment, for workers and for the quality of work. This paper helps the industry to understand the importance of new technologies in Denim industry and got a reason to adopt it.

DEVELOPMENT OF SUSTAINABLE APPAREL PRODUCTS THROUGH DOPE DYED FILAMENTS

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Abstract

Sustainable development has emerged as the most vital issue in recent years and has now become an essential part of economic and environmental policies in developed as well as developing countries. Most of the ecological problems arise from the growing volumes of production and consumption and the associated material flows. Textiles chain is also one of the leading sectors which are polluting our environment. To reduce this impact, sustainable textiles are grown and created in an environmentally friendly way, using minimal chemicals and water consumption. Consequently, health and environmental problems are reduced. This study aims to develop sustainable yarns and their products without chemical processing, coloration, and finishing processes. The coloration process of fabrics required scouring and bleaching to get attractive shades. All these processes need to use different chemicals that pollute the drain of wet processing mills and create hazardous effluents. Further, the odour of these chemicals pollutes the surroundings while untreated effluents damage the soil and groundwater of effluent drain areas. Dope dyed filaments are used to develop the yarns and sustainable and eco-friendly apparel products. These new products showed better mechanical, aesthetic, and comfort properties. The use of these unique yarns for apparel products will reduce the chemical processes required for good shades as well as the use of chemicals. Thus, the consumption of water, chemical and energy will be reduced. As a result, the processing department and mill's environmental air will not be polluted along with the drain of the mills which in turn will save the agriculture land and groundwater, being used for drinking and bathing.

QUANTITATIVE MANIFESTATION OF TECHNO-MECHANICAL TRAITS OF COCOON FILAMENT OF MULBERRY SILKWORM (BOMBYX MORI) STRAINS

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Abstract

Rearing of the Mulberry Silkworm Moth (*Bombyx mori* L.) has a long history spreading over a time period of about 5000 years. A large number of silkworm strains are reared worldwide with variable productivity potential. This study was conducted to assess the techno-mechanical traits of cocoon filament of three inbred lines and two hybrids of the silkworm. The commercial cocoon traits were assessed based on 11 quantitative traits giving equal weight to each trait, while strength of single fibres was tested on Testometric M 250 machine using the ASTM D3822 standard test method. Overall results showed that inbred lines and hybrids gave equally better growth performance. The inbred line (205PO) produced the heaviest dry cocoon of 0.61±0.04 g with 0.30±0.02 g raw silk cocoon-1. The hybrid J101*205PO and 206PO*J101 produced dry cocoon of 0.58±0.04 g and 0.29±0.01 g raw silk cocoon-1, respectively. 205PO produced the longest single filament of 1203.1±20.42 m. The silk filament size was thicker in hybrids compared to inbred lines. The mean multiple evaluation index ranged between 45.67 and 53.29. The mid parent heterosis effect was 0.07-0.76%. The better parent heterosis effect was greater in 206PO*J101 compared to J101*205PO. 206PO resulted in the highest filament tensile strength (0.093 Ncm-1) and strain rupture (1.764%). J101 gave the highest tenacity rupture (35.373 cNTex-1). J101*205PO and 206PO*J101 gave the highest filament tenacity (36.525 cNTex-1) and strain yield (9.363%), respectively. The filament diameter varied between 22.01±0.42 μm and 21.98±0.15 μm. Based on these findings, it is recommended that strains with superior techno-mechanical properties may be reared for production of superior quality natural silk.

MECHANICAL AND TRIBOLOGICAL PROPERTIES OF EPOXY MATRIX REINFORCED WITH CARBON NANO MATERIALS

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Abstract

Carbon nano materials were synthesized in two different morphologies namely carbon nano beads (CNBs) and a mix of carbon nano tubes and carbon nano beads (CNMs) using chemical vapour deposition (CVD) technique. Structure and diameter of the synthesized materials were studied through field emission scanning electron microscope (FESEM) and the purity through thermogravimetric analysis (TGA) and Raman spectroscopy. CNBs showed an average diameter range of 100~1000 nm while the carbon nano tubes depicted an average diameter range of 50~ 200 nm. Both materials depicted high purity of more than 90%. Epoxy composites were produced using the CNBs and CNMs as filler in 1% and 3% by weight. Mechanical properties and tribological properties were compared with the composites of commercial Multi Walled Carbon Nano Tubes (MWCNT) having average diameter of 50 nm. It is observed that the in house generated CNBs & CNMs composites show overall better mechanical and tribology properties compared to the blank resin and the commercial MWCNTs based composites. Morphology of the composites was analyzed through FESEM to study the interaction of the filler with the matrix that lead to improved performances.

RECENT TRENDS IN THE USE OF BIOMATERIALS FOR INNOVATIVE TEXTILES

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Abstract

Cellular metabolites are a source of biomaterials which may be either extracellular or intracellular produced. Their versatile native attributes are applicable in various sectors of life and materials sciences. For instance, cellulose, an extracellular metabolite, usually obtained from cotton plant, caries various toxins including pesticides and heavy metals from seed germination stage to the end product, and also inherently carries a large component of lignin and hemicelluloses which limit their biomedical applications. Likewise, plants and animals are sources of variant biomaterials like polysaccharides, chitosan, poly(lactic acid) and so on. Other sources of biomaterials may be microbial one, which utilize renewable carbon sources to be transformed into value added products like enzymes, bacterial surfactants, celluloses and biopolyesters depending upon the culture type and fermentation conditions. The above mentioned biomaterials when functionalized with other active molecules find enormous applications in various fields like biomedical engineering particularly in wound dressings; drug delivery systems and so on.

DYEING OF WOOL WITH THE NATURAL DYE EXTRACTED FROM DALBERGIA SISSOO PLANT LEAVES

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Abstract

Among textile sectors, textile dyeing has major contribution on environment load in the form of effluent due to the use of hazardous chemicals, high consumption of water and use of synthetic dyes. The depletion of any of the causes mentioned above could lead the process towards sustainability and this project is focused on the same concept. In this project, the main focus is the use of natural dye extracted from dalbergia sisso plant leaves and its application on wool which is natural being used in winter and high quality clothing. The natural dye on wool fabric is applied with the help of different mordants namely ferrous sulfate, alum and stannous chloride. In this research, wool fabric was mordanted with different mordant techniques such as pre-mordanting, meta-mordanting and post-mordanting and the effect of dye extract concentration, mordant type, mordant technique and salt concentration were studied. The results showed that color coordinate values was maximum with ferrous sulfate and meta-mordant technique. Fastness properties (wash, light, staining, dry and wet rubbing) were moderate to high and results indicated that color strength was increased by increasing dye extract concentration. Color components from plant leaves powder extracted and were characterized by FTIR technique.

MANEUVERING SURFACE STRUCTURES OF PS FILAMENTS BY CONTROLLING SOLVENT SYSTEMS AND CONCENTRATIONS

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Abstract

Polystyrene (PS) fibers have been of increasing interest due to their unique structure and properties. The porous structure of PS filament can make it a promising candidate for high capacity of oil sorbent. The PS filament with porous structure produce via celectrospinning is reported in this study. PS was chosen as a functional polymer in the process, in which PS tends to produce porous structure on the cross-section and surface of filaments. The morphology and structure of PS filaments were observed with the help of Field Emission Scanning Electron Microscope (FE-SEM). The processing parameters i.e. concentrations of polymer, DMF, DMF/THF as a solvents with different amount of LiCl to produce continuous filament with porous structures, and applied voltage are influence the filament morphology were investigated. The oil sorption experiments show that the PS filament sorbents have the advantage of showing large sorption capacity. It is expected that the filament sorbent can make a promising candidate for potential applications in those fields such as filtration, separation, and sorption.

DEVELOPMENT OF MODAL AND RECYCLED POLYESTER BLENDED KNITTED FABRICS FOR THEIR COMFORT AND MECHANICAL PROPERTIES

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Abstract

As the weather in summers is humid and hot, we require fabrics which have a comfortable feel to them. This feeling is achieved by fabrics which can quickly expel the heat and moisture produced by our body. In this regard, different fibers Modal, Polyester, cotton and Recycled Polyester fibers were used to develop a fabric with better or comparable comfort properties to the already established CVC 60:40 being used for summer clothing. CVC is made from Cotton and Polyester which are harmful for the environment. Cotton consumes a large amount of water and insecticides and pesticides during its production while Polyester is not decomposable as well as it is made from petroleum in which many hazardous side products are produced. Modal is studied as an ecofriendly replacement for cotton with high wet modulus and Recycled Polyester is a sustainable alternative to Virgin Polyester. Different knitted samples with ring spun yarns of different blend ratios using Modal and Recycled polyester fibers are tested for their mechanical and comfort properties. It is found that out of the all blends, the blend with 60% Modal and 40% Recycled Polyester can be an alternative for CVC 60:40 as the new developed blend has comparable comfort properties to CVC 60:40 although the mechanical properties are inferior to CVC 60:40.

ECOFRIENDLY DYEING OF COTTON WITH TURMERIC USING CHITOSAN

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Abstract

The dyeing of cotton using synthetic dyes has series of problems which significantly damage the environment by producing the effluents loaded with the unfixed dyes and the chemicals which actually do not become the part of the final product rather find their way in the streams after dyeing. In this piece of research work, the cotton fabric was dyed using turmeric as a natural colorant. Usually the cotton is dyed with the natural colorants using mordents but in this work the chitosan was used to replace the mordents. The color strength, wash fastness, rub fastness and light fastness were studied. All the color fastness properties including color strength of the cotton dyed fabric samples found quite promising.

ASSESSMENT OF CLOTHING FIT OF DIFFERENT FABRICS FOR CASUAL WOMEN'S SHIRT

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Abstract

Clothing comfort is gaining more importance in consumers to improve their quality of life while performing daily life activities with different requirements of the environment. These expectations of the end users had led the researchers to identify how humans perceive the clothing comfort and also reveal the factors that affect the clothing comfort. Garment fit is one of the important attributes of clothing comfort and integration of proper amount of ease allowance to the patterns is very important to achieve garment fit. The amount of ease allowance in a garment depends upon the fabric properties, body size, body type and garment design. There is a lack of work in defining the relationship of garment fit with the different fabric types in order to achieve the clothing comfort. In this study, female subjects were selected on the basis of their height and weight with in a defined age group and their anthropometric data was extracted. Different quantitative and qualitative testing methods were used to evaluate the fabric properties, while required amount of ease allowance with respect to each fabric was measured by subjective assessment of garments. The final values of ease allowance are achieved after repetitive assessments such that the subjects felt satisfied with the fit of final garment. The results had shown that fabric properties strongly relate to ease allowances at different body measures. The findings of this research would be useful to improve the garment fit for different fabrics.

COMPARATIVE STUDY OF DIFFERENT CAD SYSTEMS OF GARMENT INDUSTRY

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Abstract

At present, garment industries are working on reducing their costs which is very important for manufacturers to survive by providing its customers with the best product at a low price. Controlling the fabric cost is one of the crucial things in the apparel industry. Earlier, pattern making, grading, and marker making were done manually which was costly, time-consuming, and requires high skill. To overcome this issue, the computer-aided system was introduced for the garment and fashion industry that not only speeds up the process but also provides the possibility for product development, garment designing, and improves process efficiency. There are different options for CAD systems that can be used in the garment industry now a day. There is a need to conduct a comparative study to provide information that which CAD software is economical and efficient for an organization or individual according to their business. For this purpose, three CAD software (Accumark of Gerber, Lectra, and Tukatech) and three garments (hood shirt, midrise, and crew neck) are selected. Pattern making, digitizing and marker making for all there selected garments are done on all the sizes (S, M, L, XL, 2XL) using selected software. Subjective and objective data were collected based on marker efficiency, ease of use, and cost. As far as the marker efficiency is concerned, the significant difference among the software were not observed. It was also perceived that the skill of an operator affects significantly marker efficiency. On the other hand, significant differences were observed with respect to the cost and ease of use. To meet the manufacturing requirements, the organization requires such a system that can save time, fabric, and labor. Such studies can help the organizations to adopt the CAD system that can take up their industry to advanced level in terms of product quality and process efficiency.

DEVELOPMENT & CHARACTERIZATION OF HELICAL AUXETIC YARN BY WRAPPING METHOD

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Abstract

The helical auxetic yarn was successfully developed by warp filament and a core filament based on a direct twist system, which describes auxetic effect when stretched i-e expanding crosswise under tension. Yarns were spun using different parameters of the warp filament and weft filament including wrapping angle, diameter ratio and modulus ratio. Knit fabric having rib structure was manufactured using Flat knitting machine and cut sew technique was used to develop gloves. The strength of Helical yarn was characterized using single yarn strength and Image J software was used for the calculation of poison's ratio. The impact resistance of the gloves was characterized using gloves impact strength tester. The results showed that the core filament of auxetic yarn expanded in transverse direction under tension and a significant negative poison's ratio was investigated. The values of poison's ratio showed that the auxeticity had a direct relation with a diameter of the core filament and inverse relation with the diameter of wrap filament while the helical angle had an inverse effect with the poison's ratio. The gloves of Kevlar / Nylon HAY filament showed the highest value of impact resistance.

JOINT-LESS 3D SHAPED WOVEN FABRICS WITH IMPROVED PEEL STRENGTH

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Abstract

The 3D woven fabric (Flat and Shaped) is a single structure containing three constituent yarns inclined at the right angle to each other owing better mechanical properties has been preferred in high-end applications like aerospace, sports, construction, and automotive industries. The present study aims to produce joint less, T and H shapes using four different types of 3D multilayers structures i.e. orthogonal layer to layer (OLL), orthogonal through thickness (OTT), angle interlock layer to layer (ALL) and angle interlock through thickness (ATT) and peel strength at the point of T-joint was measured and compared with each other. 3D multilayer T and H shapes were prepared on the conventional dobby loom using the jute yarn having 490 tex linear density A Total of eight shapes were produced using four different types of 3D multilayer structures. 3D multilayer T and H shapes were produced using their corresponding weave designs. The peel strength of shapes was tested using the Universal Testing Machine (Z100 Zwick Roell) with the ISO 11339 standard test method. Peel strength of T shapes was checked while H shapes were a combination of two T shapes.

Table 1 Peak force versus maximum deformation of different 3D multilayer shapes

3D multilayer (T and H shapes)	Peak Force (N)	Maximum Deformation (mm)
Orthogonal layer to layer (OLL)	413.60 ± 10	300
Orthogonal through thickness (OTT)	365.40 ± 08	160
Angle interlock layer to layer (ALL)	24.25 ± 02	300
Angle interlock through thickness (ATT)	334.20 ± 05	300

The OLL shapes bear the highest force in its elastic region and peak force against deformation during the peel strength test followed by the ATT and OTT shapes as given in Table 1. Because the cluster of yarn starts to made and bears max force after the breakage of stitching/interlocking yarns. While the least resistance was offered by the ALL shapes against the applied force due to the pulling out of stitching yarns instead of breakage. Also, OTT shapes showed least deformation against applied force because of two truly vertical orthogonal binding/interlocking yarns.

EFFECT OF HYDROPHILIC FINISH TREATMENT ON COMFORT AND PERFORMANCE PROPERTIES OF WORKWEAR FABRICS

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Abstract

Textile industry has now intentions towards improvement of wear comfort, higher machine productivity and lower production costs. Currently the more focus is on improving the comfort properties of workwear fabrics. Most of the quires from consumers are related to the comfort aspects of the wearing substrates especially widely used wearing substrates made from PC blend substrates. In this study different moisture management finish are applied on workwear twill fabric and their effect on comfort properties are analysed. The finish application has increased the Top and Bottom spreading speed of the fabric while one-way transport Index is reduced with the application of finish. Overall moisture management of PC fabric is retained with the application of finish. The Air Permeability of the fabric has no significant effect with the application of finish. While porosity of the fabric is not significantly affected by the application of moisture management finish. The pilling rating of fabric is reduced with the application of the finish. The treated samples of PC blend fabric have decreased pilling rating. Bending length and flexural rigidity of the PC fabric is improved with the application of finish. This improve in these properties are caused by imparting softness in the fabric. The treated PC fabric has depicted good comfort properties with slight decrease in the performance properties.

PREDICTION OF AIR PERMEABILITY USING FABRIC GEOMETRICAL PARAMETERS

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Abstract

The woven fabric structure is defined by the interlacing pattern of threads in the fabric and geometrical models are concerned with the shape adopted by yarns in the fabric cross-section. These parameters affect the properties of woven fabrics, and it is necessary to understand the fabric geometry for production of fabrics with optimized performances in specific conditions and applications. Fabric geometry is a relatively complex domain owing to certain parameters like yarn structure, manufacturing tensions, yarn flattening, etc. These issues demand great attention and research to understand or determine the geometry of fabric. Fabric permeability is largely affected by the yarn flattening. The air permeability is a crucial parameter in applications like clothing, parachutes, sails, vacuum cleaners, air bags, filters, etc.Three parameters mainly considered for permeability are related to the pores, i.e. cross-sectional area of pore, depth of pore and the number of pores per unit area. In this study, these parameters are considered to develop a simple theoretical approach for the determination of air permeability and validation by experimental results. The parameters like fiber type, yarn count, twist and cover factor were kept constant in all fabrics. Six different fabrics were produced in 1/1 plain, 3/1 twill, 2/1 warp rib, 2/1 weft rib, 2/2 matt and 12 end satin weaves using 100% cotton yarn. Warp was 4 ply yarn, while weft was 3 ply yarn; with liner densities of 2.2 and 2.9 Nec respectively. The ends and picks per inch were 16 and 36 respectively. The yarn cross-sectional shape and dimensions were determined using optical microscope and Digimizer software. The following analytical model was used to calculate air flow through fabric:

$$\boldsymbol{Q} = \frac{\boldsymbol{2\Delta P}}{\boldsymbol{5}\mu} \frac{\boldsymbol{R^4}}{\sqrt{\boldsymbol{\beta a R}}}$$

The air permeability was also determined experimentally to validate the modelling results. Both the results were found to be in close accordance.

SIMULATED RESIN: AN APPROACH TO APPROXIMATE THE FLUID FLOW THROUGH REINFORCEMENT

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Abstract

Several techniques exist for the fabrication of composite parts. The resin infusion is considered as one of the sophisticated techniques to fabricate high quality composite parts. The vacuum infusion process has gained importance due to elimination of mold, ease of molding and elimination of volatile organic compounds. The flow behavior of resin through reinforcement is the major parameter that needs to be considered before infusion. It also helps to estimate the permeability of reinforcement stack as per requirement of process. The resin flow through a fibrous reinforcement is governed by certain parameters like ply compaction, porosity/permeability of reinforcement, fluid viscosity and pressure drop from injection point to flow front. This study presents an experimental approach using simulated resin to approximate the resin flow. Simulated resins offer advantages of reproducible / controlled viscosity and ease of processing. Sugar solution of a particular viscosity (0.180 Pa.s) was used as simulated resin while polyester fabric (230 GSM, basket weave) was used as reinforcement. Experiments were performed using 2,4 and 6 plies of reinforcements, using parallel flow method. The thickness of ply stack was determined in each experiment to determine the free volume available for the flow of simulated resin. The 2-ply, 4-ply and 6-ply stack thickness was found to be 0.75, 1.36 and 2.29 mm respectively. During resin flow, the progression of flow front was recorded as a function of time. The mold filling time was 336 s for 2-ply, 372s for 4-ply and 418 s for 6-ply stack. This variation in the mold filling time is directly related to the stack thickness and the compaction pressure on the stack. Another factor contributing to this variation is the number of channels available for resin flow. There are more channels for flow in 6-ply and less in 2-ply stack. The outcomes of the experimental results may be used to modify the process parameter when performing infusion with actual resin.

REMOVAL OF REACTIVE YELLOW 176 FROM TEXTILE WASTE WATER USING PEANUT HUSK AS AN ADSORBENT

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Abstract

In this study, peanut husk was used as adsorbent for the removal of reactive yellow 176 from textile waste water. Different important parameters like contact time, pH, agitation speed, dose of adsorbent and concentration of dye were optimized. Amount of the dye adsorbed on peanut husk was analyzed by UV visible spectroscopy. Maximum removal of reactive yellow 176 dye was observed at pH 3 with 0.5g of biosorbent dose and 1200 ppm of dye solution concentration at 150 rpm for 60 minutes and obtained 83% adsorption of dye. The experimental data were examined by the Langmuir and Freundlich models of adsorption. Equilibrium data fitted well with the Freundlich model with the maximum monolayer adsorption capacity of the peanut husk and between reactive yellow 176 dye. The rates of adsorption were found to follow the pseudo second order kinetics with good correlation coefficient. The kinetics parameters of this best fit model were calculated and the results are discussed. The results indicated that peanut husk is very effective for removal of dyes from textile waste water.

DYEING OF HIGH-PERFORMANCE META-ARAMID FABRIC USING DIFFERENT SOLVENTS

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Abstract

Meta-aramid fibers share a high degree of applications in technical textiles keeping in view its flame retardancy and UV stability. The use of aramid fibers in technical textiles is increasing day by day due to its high tenacity, high impact and high modulus. This high crystallinity makes the m-aramid fiber dyeing very difficult and tricky. This research reports the development of dyeing method for meta-aramids with high dyeing depth by optimizing the type and amount of solvents. The dyeing of m-aramid fabric is performed at high temperature with cationic dye Basic Red 18. The effect of different solvents on dyeing behavior with cationic dyes is analyzed by K/S, fastness properties, Fourier transform infrared spectroscopy (FTIR) and X- ray diffraction (XRD). The results were showed with explanation of each and combined effect of solvents with reasoning.

MECHANICAL PERFORMANCE OF 3D WOVEN COMPOSITES WITH VARYING FABRIC STRUCTURE

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Abstract:

The textile composite materials are extensively used for high-tech applications, and application of 3D fabrics as reinforcement for composites is trending. The 3D reinforcements are mostly studied in research and currently, fewer products are being manufactured from them. This thesis focus on the investigation of variation in 3D woven structure and its effect on the mechanical properties of composite. four different 3D reinforcements (6 layered) were woven using flax yarn having a linear density of 38.5 Tex. These four 3D structures had varying number of stuffer yarns. The specifications of fabrics are given in Table 1. These reinforcements were then converted into composites using a green epoxy resin system. The mechanical performance of developed composites was investigated in terms of tensile, flexural, impact and short beam shear strength.

Table 1 Specifications of fabric samples developed with variation in stuffer yarns

ID	Ends/cm	Picks/cm	Areal Density (g/m^2)	Stuffer yarn/cm^2
SY1	36	130	606.84	26
SY2	36	130	607.15	33
SY3	36	131	610.12	39
SY4	36	129	602.45	44

The results showed a slightly increase in tensile strength (6.8%) with increase in the number of stuffer yarns. An overall increase of more than 10% in modulus was also observed. The Flexural strength and modulus were found to decreases with the increase in stuffer yarn density. In terms of impact strength, an increase was observed from SY1 to SY4. The stuffer yarns present in the fabric offer more resistance to the low velocity impact as compared to the crimped yarns, therefore it results in increased impact energy absorption and a higher impact strength. The enhanced short beam strength along weft direction is because of the through-thickness reinforcement, that delays and then bridges delamination cracks with increase in stuffer yarn density.

USE OF DIFFERENT ORGANIC SALTS TO ASSIST CARBONIZATION OF ACRYLIC COATED GLASS NONWOVENS THROUGH CO_2 LASER IRRADIATION

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Abstract

Acrylic fibers are based on Polyacrylonitrile (PAN). PAN is a well known raw material for making carbon fibers. This study is about dissolving waste acrylic fibers in suitable organic salts to make thick acrylic solution. This solution has been coated onto glass fiber nonwoven sheets. These acrylic coated glass sheets were irradiated with laser beam and carbonizing behavior of acrylic was investigated. Furthermore, the coated samples were preheated at different temperatures from 200 °C to 500 °C to stabilize Polyacrylonitrile before converting it to carbon structure. It is found that stabilization at 270 °C works well in order to stabilize acrylonitrile prior to laser irradiation. Both stabilized by oven heating at 270 °C and non-preheated samples were irradiated by laser beam for studying carbonization of PAN polymer. It is found that laser treatment of acrylic coated glass fiber sheets produces electrically conductive lines on the surface of the material. Moreover, the conductivity is increased when the material is preheated to 270°C before laser irradiation.

ENHANCING THE PIEZOELECTRIC RESPONSE OF PVDF:CNT COATINGS DEPOSITED ON TEXTILE FABRICS

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Abstract

Recently, piezoelectric textiles have gained interests in wearable electronics having applications like energy harvesting, sensing and health monitoring due to excellent wear-ability of textiles. The present research is based on piezoelectric textiles developed through coating by polyvinylidene fluoride (PVDF) and carbon nanotubes (CNTs). A simple 'dip' coating technique has been adopted to fabricate knitted fabric with various concentrations of PVDF and CNTs. The piezoelectric properties were evaluated using digital storage oscilloscope. FTIR and XRD confirmed the proportion of β-phase of PVDF. DSC was performed to measure thermal behaviour of PVDF. There was observed a significant elevation of piezoelectricity of CNT and PVDF coated fabric; as CNTs assisted in additional formation of β-phase crystals of PVDF upon Sonication during preparation. Such flexible, wearable piezoelectric textiles can find applications in energy harvesting systems and health monitoring systems.

TEXTILE BASED PIEZOELECTRIC COATINGS FOR SENSORS

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Abstract

For sensor and energy harvesting applications piezoelectric polymeric composites are significant because of flexibility, sufficient output, low cost and durability. The piezoelectric properties of polyvinylidene fluoride (PVDF) always were of great concern and these properties enhanced by the generation of β-phase. This research reports the synthesis of ZnO nanoparticles by co-precipitation method and the development of nano-composite coating with PVDF. The coatings were prepared by dispersing various concentrations of ZnO nanoparticles in 5% PVDF solubilized in Dimethylformamide. The coatings were deposited on textile fabric. SEM gives information about surface morphologies, DSC investigates the thermal behaviour of coatings, XRD gives phase identification, FTIR spectra confirms the chemical composition and generation of β-phase in nanocomposite coatings. The prepared samples show promising piezoelectric properties as assessed by the generation of voltage and current by the application of load.

CATIONIZATION OF METAL OXIDE NANOPARTICLES TO ENHANCE THEIR AFFINITY FOR DURABLE FUNCTIONALITY

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Abstract

Nanoparticles have been used in every field of life similarly in textile industry due to their awesome attributes. But, the immobilization of nanoparticles at the surface of textiles is a big task because they do not have affinity for textiles. Due to their lack of bonding they are moving out into terrestrial environment and also leaching out into aquatic environment. Hence, hazardous to both terrestrial and marine lives. Also, the other negative effect of lack of adherence is the non-durable functionality of textiles. Therefore, to address this issue, the textile researchers have been trying hard. They are applying different pre-and post-finishing treatments to increase the adherence. Different binders have also been tried for this purpose. Though, enough affinity of NPs and durable functionality has been achieve by these practices, but, the mechanical and comfort properties have to be compromised along with decrease in functional performance of NPs. Also, the cost, time and energy wastage occurs due to these methods. Therefore, a study was conducted in which cationization of TiO_2 NPs was done by cationic organo-silane coupling agent that not only increased the affinity of NPs with the cotton fabrics due to strong electrostatic force of attraction between cationized NPs and cotton but, also the comfort properties were not compromised. The highly durable functional performance was achieved upto 20 industrial washing cycles making it potential candidate for outdoor and indoor applications.

ENCAPSULATION OF COCONUT OIL FOR THERMO-REGULATING TEXTILES

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Abstract

Phase change material (PCM) with its heat storing and releasing ability provides thermo regulating effect. Smart textiles is a major field where PCM has found enormous application. For thermoregulation, different kind of organic and inorganic PCMs are used among which the paraffin are widely used due to their high enthalpy values. In this research, coconut oil was used as PCM in the core by encapsulating cellulose based shell. Mostly melamine formaldehyde based shells are used for encapsulation due to their ease in formation which provide toxic effect on human health and environment so bio-degradable shell based capsules were synthesized to overcome the drawback. Ethyl cellulose with its outstanding properties and biocompatible nature provide eco-friendly microencapsulation. This research reports development of microcapsules of ethyl cellulose as shell and coconut oil as core PCM via solvent evaporation technique and its application on cotton fabric through screen printing method. The resultant fabric and capsules were characterized using Zeta Sizer, DSC, Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR).

INFLUENCE OF TRI-BLEND YARNS ON THERMOPHYSIOLOGICAL COMFORT OF WOVEN FABRICS

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Abstract

Comfort is a pleasant state of psychological, physical and physiological harmony between environment and human beings. The essential requirement of clothing to provide comfort to the wearer along with the protection. Moreover, textiles consumers are attracted to those clothing which have an aesthetic appeal and also provide exceptional comfort to the body. The comfort properties of textiles are mainly influenced by the kind of fibers used to produce clothing. In this study, the key objective was to develop tri-blend yarn and to convert it into the woven fabric for winter suiting by using three different types of textile fibers. Firstly, tri-blend yarn was developed using micro polyester, acrylic, and viscose fibers, and then converted into twill weaved fabric. The yarn quality parameters and fabric thermophysiological comfort characteristics were investigated. The results showed that the woven fabric which has the highest content of acrylic fiber shows the lowest air permeability and highest thermal resistivity. The moisture management results indicated that the fabrics, which contain the highest content of micro-polyester fiber showed the highest overall moisture management capacity. Hence, based on comfort properties, thermal characteristic and OMMC winter suiting can be developed to protect from a cold condition.

SUSTAINABLE TEXTILE PRODUCTION

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Abstract

In recent two decades, pressures from brands and government on textile industry in Pakistan have increased to adopt best practices and improve textile manufacturing and processing towards sustainability, specially for waste management and health and safety protocols. Ultimately, the industry faces many challenges to comply ecological, health and safety compliances. This keynote speech reviews the possible areas of sustainable approaches for manufacturing and processing. The speech will include highlights on sustainability issues of textile material, additives and wastes, greener material and additives and alternate manufacturing and processing techniques.

AN ONLINE NOVEL METHOD TO CHARACTERIZE THE DISPERSION OF NANOFILLERS IN THE RUBBER COMPOUNDS AND BLENDS

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Abstract

A novel online method based on the measuring electrical conductance is presented to characterize the dispersion of different types of nanofillers like nanoclay, carbon nanotube and carbon black in rubber compounds and blends as well. There are different charge carriers depending on the nature of the nanofillers. Thus, during melt mixing process the conductance of the nanocomposites is altering. An appropriate installation of sensors inside the chamber of the internal mixer enables an online measurement of the electrical signal of the nanocomposites during the mixing process. The online conductance shows a characteristic chart, which is related to different dispersion processes of the nanofillers. In order to clarify the structural background of the conductance curve the dynamics of macro and micro dispersion of nanofillers have been investigated using different techniques like atomic force microscopy (AFM), transmission electron microscopy (TEM)X-ray diffraction (XRD) and optical microscopy as well as bound rubber measurements. A close correlation has been found between the development of the online conductance chart and the filler dispersion. For example, in case of nanoclay, it becomes obvious that in the first mixing step different processes take place simultaneously: breakdown of the tactoids, diffusion of the polymer chains into the galleries of the clay, wetting and intercalation. As a result, a significant increase of conductance is observed in this period. Subsequently, the intercalated structures undergo the exfoliation process, which causes a further but moderate increase of conductance. After finished exfoliation no change of the conductance and dispersion has been observed that indicates a completed mixing process. Similarly, the method has been successfully used for the characterization of dispersion of carbon nanotubes and carbon black in the polymer compounds and blends as well. The method was used as a powerful tool, for characterization of the dispersion of the nanofillers on the laboratory scale and has potential to apply on the production scale for monitoring the quality of polymer compounds and blends nanocomposites.

MECHANICAL CHARACTERIZATION OF BASALT FIBER REINFORCED POLYMER COMPOSITES

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Abstract

The purpose of this research is to find the mechanical properties of Basalt fiber reinforced polymer composites. Due to significant low cost as compared to equivalent strength carbon fiber based composites, very high temperature resistant and biodegradable properties, BFRP composites are need of the day. The mechanical properties like tensile strength, flexure Strength and compressive strength of basalt woven fabric composite material have been studied experimentally. The simulations were carried out on ABAQUS for comparison with experimental values. The elastic constants for FE simulation were taken from literature. By comparison of the aforementioned properties, it was found that the simulations were in good agreement with experimental values. It was found that in order to save time, material and experimentation cost, engineering analysis can be performed in ABAQUS during designing phase of product.

FRP USE IN CONSTRUCTION INDUSTRY

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Abstract

The scope of fibre reinforced polymers (FRPs) in construction sector is enormous. FRP composites are used in a wide range of applications in construction ranging from strengthening of existing weak structures to the full-scale use for new projects because of the benefits they provide over conventional building materials. Such advantages include but not limited to lightness, high mechanical performance, flexibility in shape, ease in installation, require less labour, lesser formwork and rapid implementation. This paper presents a general overview on some of the applications of fiber reinforced polymers (FRP) composites in construction. The paper focuses on FRP use in new construction and repair/strengthening of existing civil infrastructures. The prime objective is to highlight its scope to general masses and specifically the industries with potential to invest in its large-scale manufacturing.

EVALUATION AND OPTIMIZATION OF NANO-SCALE BIO-BASED ADDITIVE TO WARP SIZING FORMULA

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Abstract

The weaving process is the bottleneck in the production pipeline of woven fabrics. For this reason, weavers has to size warp yarns to withstand the rigor of weaving. Research on sizing has focused on improving sizing machines, reduction of energy via high squeeze and elimination of cooking, reclamation of sizing during de-sizing, and pre-wetting. Sizing recipes vary from company to another even for the same type of fabric using same type of weaving machine. While size agent producers propose recipes, these are only used for guide. Weavers develop their proprietary sizing formals and come up with sizing process parameters to optimize size add-on based on weaving efficiency and woven fabric quality data over long period. Published research on warp sizing is very limited and outdated, especially limited trials using full scale sizing and weaving equipment in an industry setting. Very recently, Lawter Inc introduced a new nano-scale bio-based product (known as WS-1208) that can be used as an additive to size formulas. The main objective of our research is to conduct systematic investigation to evaluate and reveal the optimum size add-on with Lawter nano-scale bio-based additive, which produce best performance of different sized yarns. The performance is judged by sized yarns' breaking load and elongation at high breaking rate to simulate what the warp yarns are experiencing during weaving, hairiness, and diameter. The yarns were sized using a sizing winder. The tensile properties and hairiness of sized and unsized yarns were evaluated using Uster Tensojet 4 and Uster UT, respectively. Our research revealed that yarns treated with the nano-based additive exhibited better fiber cohesion compared to their counterparts that were sized without the additive. There are numerous advantages resulting from higher fiber cohesion. These include (1) reduction in yarn diameter and hence more warp length can be put on weaver's beam resulting in efficiency increase, (2) higher sley allowing production of fabric with high count, (3) reduction of size add-on and hence cost, and (3) reduction in yarn-yarn and yarn-machine parts friction/abrasion. These lead to reduction in warp stops and hence higher weaving efficiency, weaving productivity, and quality of the fabric. While sizing winders are currently used as standard equipment for short and medium orders, we are conducting in-plant trails using warp sheet full-scale sizing equipment.

ON THE MECHANICS OF 3D PRINTED FIBER REINFORCED COMPOSITES: ASSESSMENT OF TENSILE AND IMPACT OF CELLULAR STRUCTURES

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Abstract

Three-dimensional printing (3DP) is at the forefront of the disruptive innovations adding a new dimension in the material fabrication process with net-shape complex geometrics that other traditional technologies cannot achieve. Especially, the ability to reinforce the plastic matrix with fillers such as nanofiber, microfiber, chopped fiber and continuous fiber has put the technology in a way beyond imagination in terms of multidimensional applications. In the present research, fiberglass reinforced Nylon composites have been printed with different cellular structures (triangular, hexagonal, rectangular, and solid as control) and fiber orientations (0/0, 0/90, -45/0/+45/90), and their tensile and impact behaviors have been assessed. Results indicated outstanding towerdrop impact resistance but poor tensile strength while comparing with fiberglass reinforced 3D orthogonal woven composites. The effect of fiber orientation is dominant dictating both mechanical properties. Unidirectional (0/0) fiber orientation showed the best tensile strength, as all the fibers aligned in the test direction followed by 0/90 and 45/0/+45/90, respectively. On the other hand, 0/90 cross-lay orientation is the most preferred structure for impact resistance followed by 45/0/+45/90 and 0/0 orientations, respectively. Although the influence of cellular structure on both properties is significant, their relative contribution is confounding indicating further research. However, incorporation of cellular structures approaches a lightweight composite fabrication without compromising the performance.

INNOVATION IN WEAVING AT ITMA 2019: IS THE WEAVING INDUSTRY READY FOR THE 4TH INDUSTRIAL REVOLUTION?

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Abstract

At ITMA 2019, machine manufacturers marketed their technologies as 4.0 ready indication of readiness for the fourth Industrial Revolution. The first industrial revolutions started in about 1784 with the invention of the steam engine that converted the limited hand production to mechanical (machine) production. The textile industry was the most beneficiary from steam engine invention. During this era, textile pioneers invented cotton ginning, yarn spinning, flying shuttle weaving machines powered by the steam engines for production of woven fabrics and Jacquard shedding system. The second industrial revolution started about 1870 by harnessing electrical power for mass production and witnessed the advent of assembly line. The third industrial revolution (started about 1969) brought automated production, electronics and computers. The fourth industrial revolution (or 4.0 for short) started in 2000 and is being continued. The 4.0 industry is taking advantage of electronics and computers of the 3.0 era to create applications using robotic, internet of things (IoT), artificial intelligent, big data, and other unknown features to be developed. Just like the first industrial revolution, the textile industry has its sizable share of the 2.0 and 3.0 revolutions. Additionally, the textile industry is working toward its contribution to 4.0. Based on his direct observations at nine ITMA shows, including 2019 show, meeting with machine manufacturers and plant visits, the Author sheds the light on what the textile industry (with focus on weaving) has achieved for the readiness for 4.0. The challenges and requirements to face the challenges to advance the weaving industry to 4.0 revolution are addressed.

RECENT DEVELOPMENTS IN TEXTILE BASED POLYMERIC SMART SENSOR FOR HUMAN HEALTH MONITORING: A REVIEW

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Abstract

In the modern age the most important and prevailing issue is the monitoring of human health. In order to tackle these problems, several devices/gadgets have been investigated. Hence, textile based smart sensors find its place as a front-liner in this race. Recently, ICPs have attracted the attention of investigators due to their ability to adapt the mechanical characteristics of textile, such as light weight, stretchability, and wearability etc. Now a days, these are considered as useful tool in several fields of disciplines and open new avenues of development not only in health monitoring but also in biomedical, sports, and military fields etc. The idea behind wearable sensing devices to be a basic part of our daily life wears. Such gadgets have to encounter special needs concerning wearability. In future these techniques can also be used for online monitoring applications. The purpose of this review article is to discuss the recent developments in smart monitoring sensors.

GRAPHENE OXIDE EMBEDDED ANTI-STATIC POLYVINYL CHLORIDE FOOTWEAR

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Abstract

Electrical and thermo-mechanical properties of PVC/GO composites were characterized. Robust interfacial interaction between PVC and GO, helped in procuring good reinforcement of PVC for the preparation of high-performance anti-static composites. The electrical and thermal properties of PVC/GO composites were improved by the addition of GO as a filler. Tensile modulus and tensile strength of PVC/GO composites decrease whereas elongation increases as the amount of GO was increased. The electrical conductivity of composites increased due to the uniform dispersion of GO. The resistance of PVC/GO composites also improved as a function of GO loading.

SMART ENVIRONMENTAL MANAGEMENT PRACTICES AND CLEANER PRODUCTION IN TEXTILE INDUSTRIES; PROGRESS IN SUSTAINABLE TEXTILE SECTOR OF PAKISTAN

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Abstract

The sustainability is a principal characteristic of textile product in recent time where the glocalization results in both pressure and drivers for all countries and enterprises in the countries that are trying and willing to improve their environmental performances. Increased of awareness on global pollution are prompting consumers to seek environmentally friendly and healthier choices. World's textile industries are focusing more on sustainable production these days, so they want to meet the environmental and social aspects. If the companies want to achieve more competitive advantage in fashion business the textile manufactures have to take care of social, political, economic and environmental issues, they also need to aware about current market trends.

Pakistan textile sector is a big exporter sector in many countries of world and it contributes 60% to the country export. According the ministry of textile industries, in today's highly competitive global environment, the textile sector needs to be proactive with the technology and smart management to upgrade its supply chain and improve supply chain. To reach sustainable economic growth, the textile industries were assisted to make the most of GSP+ trade policies. To avail and to increase the export under the GSP+ is to implement and comply with twenty-seven mandatory international convention, out of these twenty-seven, eight convention are of environment protection and conservation.

To cope with the economic turmoil and environmental crisis which are key impediments in sustainable development and economic growth of Pakistan. The project implemented with the name International Labour and Environmental Standards Application in Small and Medium Enterprises (SMEs) in Pakistan (ILES). This project is providing technical and capacity building support to the textile industries in Punjab and Sindh. ILES project is spreading Cleaner Production (CP) techniques and Smart Management Practices (SEMPs) at large level. This project is contributing to make production process more efficient in resources utilization, decrease in production and waste management cost, Compliance with environmental laws, regulations and relevant national strategies and increase the export from Pakistan.

The project will also contribute to the Consumer Information Programme (CIP) and Sustainable Livelihood and Education (SLE) programmes of the United Nation's 10 Year Framework of

Programmes (10YFP). In a short span of three years, the ILES project is successfully able to support twenty-three textile SMEs to achieve significant resource savings, reducing carbon footprint and saving a considerable amount of money by implementing various interventions. Interventions by which industries are able to rethink and readjust or replace some elements to save environment and better compliance with environmental standards. Intervention such as Renovation of dryer, Use of LED lighting system applications at apparel department, Installation of servo system in fabric cutting edge process, Use of 5S methodology in chemical warehouse and feeding area, Replacement of inefficient and the environment lamps with LED lighting, Use of Reverse Osmosis systems in boiler feedwater, Installation of steam trap maintenance program to avoid from steam and heat loses and also increase equipment lifetime. In the theme of training and workshop, in three years, under ILES, eight-hundred-and-thirty-seven industrialists, government representatives and personnel of these domains was trained and equipped with knowledge and skills to comply and apply Smart Environmental Management Practices.

IMPROVEMENT IN QUALITY AND PRODUCTIVITY THROUGH IMPLEMENTATION OF MEASUREMENT SYSTEM ANALYSIS APPROACH

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Abstract

The technological revolution has educated consumers to be more specific and quality conscious in their daily life. This mindset changes in the industrial approach to be more quality and productivity conscious, especially in handmade products. In this study, lean manufacturing tool has been implemented in a garments industry to support and enhance productivity and reduce the wastes of material and labor time. Measurement system analysis tool has been implemented in the knitted garments production unit. The working labor was provided garments for faults inspection and their skill level before and after training was recorded. An 80% threshold skill level of an individual was made to classify skilled and non-skilled labor. The average skill level has been improved from 80.7% to 89.35% after four months of continuous training and implementation of MSA. The results suggested that implementation of Measurement System Analysis has improved the quality as well as productivity of the industry. These techniques and training methods could be implemented in garments and other industries as well to improve productivity and quality.

INVESTIGATION OF THERMO-PHYSIOLOGICAL COMFORT PROPERTIES OF FABRICS PRODUCED FROM TRI-BLENDED YARN

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Abstract

With increased consumer awareness, the demand for clothing with improved comfort properties has increased significantly. The comfort of the dress depends on several factors related to fibers, yarn and fabric, of which garment is produced. The blending of different fibers with varying properties is one of the most vital strategies to modify the comfort properties of the garments. Various benefits concerning cost and desired properties can be achieved by blending different fibers used in the production of the yarn. The comfort properties of different fabrics produced from di-blended yarns have been investigated intensely in the literature. However, there is significant room to tailor the comfort properties of the fabrics by blending more than two types of fibers during yarn production. In this study, thermo-physiological comfort properties of the fabrics made of tri-blended yarns were investigated in detail. Tri-blended yarns were produced by mixing and blending polyester, viscose and cotton fibers in varying blend ratios. The produced yarns were characterized for linear density, strength, elongation and imperfections in the yarn. Air permeability, overall moisture management capability and thermal resistance of the produced fabrics were also evaluated. The results of this study show that the mechanical properties of yarns are improved, and the comfort properties of the fabrics can be enhanced through optimizing the blend ratio of different fibers used in a tri-blended yarn.

VALUE EXTRACTION FROM END-OF-LIFE TEXTILE PRODUCTS

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Abstract

End-of-life (EOL) textile products have substantial adverse impacts on environment, society, and economy. The environmental impact of disposing EOL textile products has been observed in terms of landfills and water pollution. The reverse logistics operations of such textile products can mitigate these effects. The trend of value extraction from EOL textile products in Europe and other developed countries has emerged to setup reverse logistics operations, where the EOL textile products are reused, remade, and recycled. In developing countries such as Pakistan, the reverse logistics operations for such products have been neglected that is creating a huge loss to the economy and polluting the environment severely. This study investigates the possible reverse operations on EOL textile products, which could help to extract value from these EOL products. The process of converting post-consumer textile waste into secondary products such as yarn, fabric, and a consumer product is investigated. The setup cost, operating cost, and profit is estimated that is maximized by optimizing the operating significant variables. Finally, sustainability indicators (economic, environmental, and social) are compared to estimate the benefits of the suggested technology and operations.

DEVELOPMENT AND CHARACTERIZATION OF CELLULOSE ACETATE/DIMETHYL-TETRADECYL ELECTROSPUN NANOFIBERS FOR ANTIBACTERIAL ACTIVITY

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Abstract

Nanofibers are unique and diversified structures to apply in different fields that require a high specific surface area. Indeed, a small material can be used to achieve the desired properties in any application when it can be available at the nanoscale. Electrospinning is one of the simplest methods to achieve these goals. However, the polymer and solvent system needs optimization to achieve optimum viscosity which is necessary for the architecture of nanofibers.

In this study, Cellulose Acetate (CA) was dissolved in two solvent systems, including an antibacterial agent for the optimum production of nanofibers. The solution parameters were rheologically studied and optimized for the electrospinning procedure. Courses of actions were set up in mixed dissolvable solvents containing 2:1 w/w% of acetone and N,N-dimethylacetamide (DMAc). Then the CA solution was electro-spun to produce nanofibers. The morphology and functional group identification of nanofibers were evaluated through Scanning electron microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR). SEM images revealed that a beaded stringy structure could be electrospun beginning at 13 % CA to 17.5 % CA in Acetone/DMAc. The test results demonstrated that smooth fibers were obtained at 20 % CA in Acetone/DMAc. Nanofiber morphology was changed by CA concentration. Solution viscosity and fiber diameter were increased by increasing concentration of CA. CA nanofibers have a unique property and have incredible use for medicinal fields. Electrospun nanofibers containing the antimicrobial agent were tested through Agar Tests and found that electrospun fibers showed antibacterial activity. This property indicated that the nanofibers have potential applications in medical fields and electrospun webs containing antibacterial agents can be used for wound care purposes.

DEVELOPMENT OF WET SPUN FIBERS CONTAINING NOVEL DRUG FOR HEALING DIABETIC WOUNDS

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Abstract

Polysaccharide based biocompatible materials have extensively been used in wound care due to their unique liquid management and ability to control the infections. This research work comprises the development and characterization of tri-component fibers loaded with model drug, followed by the optimization of three variables factors (Sodium Alginate, H.T, NASD) with three different levels to achieve best characteristics in the fibers. The fibers were developed using alginate, chitosan and carboxy methylcellulose (CMC). The fiber development was done by wet spinning technique. Sodium Sulfadiazine (NaSD) was used as a model drug for loading on the fibrous substrate for topical drug delivery application. The fibers were characterized by rheological, physical, mechanical, comfort & serviceability characterization. The drug release profile was also analyzed. It was observed that model drug loaded fibers contain good liquid absorption properties with a certain release profile and anti-microbial efficacy. The overall results expressed good promise to use the developed fibers in medical applications. These fibers will find wide accessibility to be used as medical patches in wound care application for non-healing burn and diabetic wounds.

HIGH-THROUGHPUT PREPARATION OF CHITOSAN/POLY (ETHYLENE OXIDE) HIGH QUALITY NANOFIBERS BY FREE SURFACE ELECTROSPINNING

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Abstract

The preparation of electrospun pure chitosan (CS) nanofibers is still very challenging due to the repulsive forces in ionic groups within the polymer produced by high electric field in the electrospinning process. It is usually blended with other natural or synthetic polymers for electrospinning. In this research work CS/poly(ethylene oxide) (PEO) nanofibers were produced by a modified free surface electrospinning (MFSE). Effects of the acetic acid (AA) and CS/PEO concentration on the conductivity of spinning solutions, morphology, crystallinity and yield of CS/PEO nanofibers were studied. And the preparation mechanism of MFSE was studied by simulating the electric field distribution using Maxwell 3D due to the importance and better understanding of electric field distribution in this process.

Comparison of Thermo-Physiological Comfort Properties of Cellulosic based Woven Fabrics

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Abstract

The term comfort is defined as "the absence of unpleasantness. Comfort mainly is of three types: sensorial, psychological and thermo-physiological comfort. Thermo-physiological comfort is achieved by controlling the air permeability (AP), moisture management and heat transfer regulation properties of the fabric. Cellulosic base yarns are more compatible with human body because of their better moisture management, heat transfer regulation, and tactile properties. In this study, woven fabric made of four different types of cellulose yarns i.e. cotton, bamboo, tencel and viscose were selected and their thermo-physiological comfort properties were compared. Yarn liner density, fabric areal density, and weave design of all samples were kept constant (3/1 twill). Three different types of tests i.e. air permeability (AP), Permetest (thermal resistance), overall moisture management capability (OMMC) were performed to check their thermo-physical properties. The results showed that cotton sample performed better when it's Air Permeability and Thermal properties were compared to other cellulosic fabrics. But in terms of overall moisture management properties cotton performed poorly where Tencel performed much better than cotton and other cellulosic materials.