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Value-addition and Innovation in Textiles

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Online Edition

Protective Textiles/
Nonwoven
In wake of COVID-19

Advancement
in Textiles

Nanotechnology
& Surface
Functionalization

Technical
& Coated
Textiles

Smart &
Functional
Textiles

Advanced Textile
Structures &
Composites

BOOK OF ABSTRACTS

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NATIONAL TEXTILE UNIVERSITY, FAISALABAD

6th International Conference on Value Addition & Innovation in Textiles (COVITEX)

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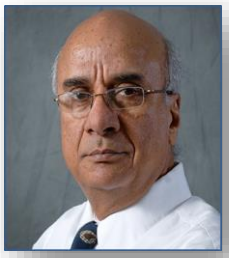

Abdel-Fattah Seyam
North Carolina State University, USA
"A Generalized Model for Predicting the Tensile Behavior of 3D Orthogonal Woven Composites from Natural Fibers"

Prof. Xungai Wang
Deakin University, Australia
"Waste Textiles and Colour Recycling for Fashion Sustainability"

Dr. Robin Mann
Massey University, NZ
"Fast-tracking Productivity in Pakistan via Business Excellence"

Prof. Mohd Sapuan Salit
Universiti Putra Malaysia
"Contribution of biocomposites during Covid 19 pandemic"

Prof. Mehmet Karahan
Uludag University, Bursa, Turkey
"Damage initiation and propagation in 2x2 twill woven carbon-epoxy multi-layer composites"

Prof. Francois Boussu
GEMTEX, ENSAIT, France
"Interesting mechanical properties of 3D warp interlock fabric for composite materials"

Prof. Xuehong Ren
Jiangnan University, China
"Antimicrobial textiles based on N-halamine hybrids"

Prof. Dr. Yakup Aykut
Uludag University, Bursa, Turkey
"Using nanofiberous interfaces for enhanced electrochemical genetic biosensors"

Prof. Usha N Massika Behary
ENSAIT, GEMTEX, France
"Universal masking during COVID-19 pandemic"

Prof. Xiaodong Wang
Beijing University of Chemical Technology, China
"Long-Carbon-Fiber-Reinforced Polyamide-6/Nickel Powder Composites for Electromagnetic Interference Shielding and High Mechanical" Performance

List of National Speakers

Mr. Ijaz Khokar
Chief Coordinator,
PRGMEA
"Garments led exports enhancement: Challenges & opportunities"

Mr. Shahid Sattar
Executive Director
APTMA
"Challenges to textile industry and way forward"

Mr. Tahir Jawaid
CEO, HUB Power Services Ltd.
"Future of Work: Innovation & Innovators"

Mujeebullah Khan
CEO, iTextiles® (Pvt) Ltd.
"Post COVID Fashion Trends"

Dr. Yair Nawab
Dean, SET
NTU, Faisalabad
"Technical Textile: Value Chain Mapping and SWOT analysis of Pakistani Industry"

Dr. Tanveer Hussain
Rector, NTU, Faisalabad
"Post-COVID-19 Recovery and Trends in Textiles and Clothing Industry"

Professor Dr. Tahir Shah,
NTU
"Impact of Covid19 Crisis on Textile, Education and Industry"

Dr. Awais Khatri, MUET
"Role of Industry 4.0 Technologies Towards Sustainable Textile Manufacturing in the Post Covid-19 Era"

Interesting mechanical properties of 3D warp interlock fabrics for composite materials

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Abstract

Three-dimensional (3D) woven composites have shown great potential in the aerospace and automotive applications due to near net shape, high structural integrity and low manufacturing costs. Thanks to the through-the-thickness fiber reinforcement, 3D woven composites exhibit higher damage tolerance, higher inter-laminar performance and elevated impact resistance. Many previous works have characterized the mechanical properties of these composites and especially on the effect of weave parameters on the mechanical properties of 3D woven composites.

Considering the urgent need to reduce CO_2 emission, a huge growing demand pushes to replace existing synthetic fibers and matrix by more sustainable bio-based or natural fibers for reinforcement of composite material. A bio-based composite material is a composite material in which one or all of its components are of natural origin. As oil prices rise and bio-polymer production methods improve, the appeal of bio-based composites continues to grow. Among all the existing natural fibers, flax fibers appear to be one of the most promising material to be used in a fibrous reinforcement of composite material.

In this study, different 3D warp interlock architectures have been woven with the same flax fiber linear density to understand the role of the architecture of binding rovings on the mechanical properties of the dry 3D fabric. The results reveal the importance of considering the properties of the fiber and roving at these scales to determine the more adequate raw material for weaving. Further, the characterization of the 3D woven structures shows the preponderant role of the binding roving on their structural and mechanical properties. Besides, it has been revealed the influence of product and process parameters of the 3D warp interlock fabric on mechanical properties of the resulted composite material.

Keywords: Flax fiber; 3D warp interlock; tensile properties; green composite

Bio textiles for medical implants and regenerative medicines

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Abstract

This paper provides a comprehensive discussion about textiles that are used in the fabrication of numerous medical devices, comprising the replacement of injured, diseased or non-functioning organs within the body and for regenerative medicines. The manufacture, properties and types of bio textiles used for medical implants and regenerative medicines such as, resorbable polymers, nanofibers and shaped bio textiles are discussed. A range of different medical devices based on bio textile structures are described in detail, such as arterial prosthetics, vascular implants, hernia repair, percutaneous aortic valve, lever, nerve, and cartilage regeneration. The versatility of textile structures enables to modify their architecture, assisting to control their unique properties including fiber orientation and size, matrix shape and size, pore geometry and size, total porosity and surface topography, which influence the biocompatibility and mechanical properties of the scaffold. Advantages of various biomaterials, textile structures and recent trends in development of medical implants and regenerative medicines are discussed. The various textile technologies used to design and develop the fibrous scaffold structures for tissue engineering applications are addressed. Such technologies include weaving, knitting, braiding, melt spinning, electrospinning and flocking.

Keywords: Bio textiles, medical, polymers, implants

Scrutinizing the air permeability of a coated cotton/ polyester blended fabric designed for producing medical protective gowns

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Abstract

The coronavirus crisis is spreading all over the globe causing daily high mortality rates and affecting the world economic situation. Scientists are trying to find out manners to stop the virus spreading. When it comes to textile area, new functional garments such as protective gowns and barrier masks are immerging to help protecting individuals in this pandemic situation. The aim of this research is to develop a coated textile that can be used for producing medical gowns. For this purpose, a cotton/polyester blended plain weave fabric was treated by using the screen coating technique and a coating paste comprising acrylic and fluorocarbon resins.

The ability of the gown to confer comfort to the wearer is an important factor to be analyzed. Since air permeability is related to garment thermal comfort, this response was measured by using the FX3300 Tester. Air permeability was evaluated for both fabric surfaces before and after the coating treatment. Before applying the coating paste, the air permeability was equal to 396 (CV= 3.5%) and 403 (CV= 2.9 %) L. $m^{-2}.s^{-1}$, respectively for inner and outer fabric faces. After the coating treatment, air permeability values were found between 24 (CV= 2.938%) and 118 (CV= 4.237%) $L.m^{-2}. s^{-1}$.

Keyword: Protective gowns, Box-Behnken design, air permeability

Optimization of wet baby wipes manufacturing conditions and performance assessment

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Abstract

Increased use of wipes in industrial and consumer applications as a result of modernization and increased consumer awareness has led to a big market among personal hygienic products. Baby wipes consist of a nonwoven substrate immersed with a lotion. The design of the substrate is such that it provides the necessary strength to clean babies, while the lotion is transferred to clean the skin. The lotion consists primarily of water. The product design allows consumers to use the product without the need for any other material or appliance during use. After use, the product is disposed with the normal household waste.In this study, wet wipes were produced for baby body applications with spunlace nonwoven fabrics consisting of 50% polyester and 50% cellulose (viscose). Fabrics were wetted by a commercial wetting solution composed of water, surfactants, perfumes, solubilizer, preservatives, vitamins and antibacterial agents. Besides physical characteristics such as weight, thickness, porosity, air permeability, and absorption capacity of the dry nonwoven fabrics were determined.

Optimum mixing conditions mainly time, mixing speed and order of product addition were determined rigorously with a magnetic mixer and homogeneous solutions were obtained through microscopic analysis. It is observed from the results that a homogeneous wetting solution may be obtained applying mixing conditions of 107 rpm for 20 min. Performance evaluation was carried out to determine the sufficiency of the wipes for uses. Wiping efficiency of produced wipes was determined by the gravimetric method using melted chocolate soil. Wetting solutions were applied on nonwoven fabrics by padding and wet pick-up was first arranged for optimum wiping efficiency. A wet pick up about 70% is both necessary and sufficient to ensure a good wipe. Central composite design experiment is also used to study the effect of lotion component percentage on foaming power of the wetting solution on an industrial scale. Desirability function is applied to optimize lotion recipe with compliant cleanability performance.

Keywords: Wet wipes, wetting solution, mixing conditions, foaming power, wiping efficiency,

Structure and geometry of single-layer and two-layer stitched woven fabric

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Abstract

The structure and properties of a woven fabric are dependent upon the constructional parameters such as thread density, yarn fineness, crimp, weave, etc. It is always assumed that the variation of the fabric structure is insignificant in the analysis. The models given by different researchers can describe the internal geometry of woven fabric by describing some parts of the binding/crimp wave. But we need a model that can describe binding wave in whole repeat. Therefore, in this study, an attempt is made to derive a theoretical model for description of mutual interlacing of threads in multifilament woven fabric structures using the Fourier series. The internal geometry of the woven fabrics and the deformation in the multifilament single-layer and two-layer woven structures have been evaluated by the cross-sectional image analysis method using NIS elements software. Later, the approximation using the Fourier series along longitudinal and transverse cross-section has been performed, which fits well with the experimental binding wave. The spectral characteristics of binding waves obtained by the Fourier series (theoretical) have been compared with the experimental values, which are also in accordance with each other. So, it is possible to compare the geometrical parameters of yarn in real cross-section of woven fabric with the theoretical shape of a binding wave.

Keywords: Woven fabric, structure, modelling, fabric geometry

Manufacturing of non-woven fabric with sisal and cotton fibre blend: a study to analyze the physical properties of non-woven fabric

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Abstract

Sisal Fiber is one of the most widely used natural fiber and is very easily cultivated. Sisal fiber is biodegradable and has the potential to grow in dry and hot climates that are often not suitable for other plants. Sisal fibre is extracted from sisal plant by decortication method. In this research work, these fibres were used to prepare a non-woven fabric. Sisal fibres are harsh in nature that's why non-woven fabric was manufactured by blending of extracted sisal fibre with cotton fibres. This non-woven fabric was subjected to different physical tests like bursting strength, absorbency test and air permeability test in order to check the durability of the fabric. The main objective of this research work was to manufacture a non-woven fabric from natural source that is sisal fibre and to check the physical properties of this fabric. The results exhibit that the non-woven fabric have good physical properties like high bursting strength and higher air permeability which are suitable for home interior and as textile products. However, for future studies the sisal fibre may blend with other cellulosic fibres to check its durability and for best utilization.

Keywords: Sisal, biodegradable, decortication, non-woven, bursting strength, absorbency, air-permeability

Ag/PA based electro-conductive heating fabrics in orthopedic compression support

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Abstract

Conductive textiles have gained greater interest for its multi-scale functions. Its use for heating purpose is an important field of application for electrically conductive fabrics. Heating fabrics have been used in various arenas, such as sports, automotive, household use, industrial or technical purposes such as motorbike gloves, heating pads, leisure garments, medical fields such as electrotherapy treatment, orthopedic supports, medical blanket for maintaining patient's body temperature, strain sensors, and motion capturing devices. The aim of this research was to investigate the heating behavior of silver (Ag) coated polyamide (PA) knitted fabrics designed for orthopaedic support. Temperature feasibility was explored based on amount of conductive yarn used in the knitting pattern. The effect of yarn linear density on the thermal behavior was also considered and compared. The fluke 561 HVACPro infrared thermometer was used to measure the surface temperature of the specimens. Two copper plates were placed on the opposite edges of the specimen and connected with DC power. The surface temperature was measured at different time intervals at fixed voltage applied. The temperature generates quickly on the electro-conductive fabric surface at first two minutes and then very slowly afterwards and finally, leveled off at a particular temperature. The stretching has a negative influence on heat generation.

Keywords: Electro-conductivity, heat generation, knitted fabrics, orthopaedic compression support

Effect of ozone treatment in the bagging behaviour of denim garment

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Abstract

This work deals with the effect of ozone treatment parameters on the bagging behaviour of denim fabric samples. To achieve this goal, six fabrics were washed in different conditions. Then, the bagging test is performed for five times in order to have an average. Thanks to main effect plots the results of these tests were analyzed. It can be concluded that characteristics of samples and ozone concentration have a very significant effect on the bagging recovery percentage.

Keywords: Ozone treatment, bagging recovery percentage, main effect plots

Basalt fiber: The new game changer

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Abstract

Technical textiles are new horizon for achievements in textile industry and it has become talk of the town in the recent past. Technical textiles have a variety of applications and industries. Meeting end product specification is a big challenge especially for industrial goods. Mineral fibers from basalt is natural, safe and easy to recycle. Basalt fiber is a green, healthy and environmentally friendly high-tech fiber product without environmental pollution. It is widely used in military and civilian fields. Basalt fibers have good physical and chemical properties, as well as good adhesion to metals, epoxies and glues. The growing use of polymer composite materials in various field of technical textiles applications demands the development of products able to fulfill both technical and ever-stricter environmental requirements. Basalt fiber has good mechanical properties, acid-alkali resistance, excellent electrical properties, high wave permeability, non-conductive, and excellent sound insulation and insulation performance. Due to all these favorable properties, Basalt fiber can be used in several applications in technical textile.

Keywords: high performance fiber, basalt fibers, technical textiles

Comparison of protective cut resistance gloves for better comfort properties

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Abstract

With the increasing awareness to use personal protective products such as cut resistance gloves to secure hand in accidental injuries. For better performance of user, the comfort properties have become essential need with the functional properties. In many occupations such as in meat cutting process, metal sheet and glass manufacturing units, during the use of sharp and edges tools, workers hand need protection. In this research, development and comparison of comfortable and protective cut resistance gloves were done by using blends of high performance fibers and regenerated fibers. Fiber used were para aramid , high density polyethylene, glass fibers to achieve technical properties and mode acrylic, viscose were used for comfort characteristics .All the samples were developed on Shima Seiki gloves knitting machine. All the samples physical properties were tested i.e. gsm, count, stitch density and thickness Cut resistance index and comfort properties i.e air permeability, thermal resistance and water vapor permeability were also tested. All the results were analyzed and compare w.r.t comfort characteristics. It was observed that the blend of high performance fibers and regenerated fibers give the best comfort by keeping cut resistance index constant. Theses gloves will fulfill the customer expected requirements and boost the industrial growth.

Keywords: Cut resistance gloves, comfort properties, technical textiles, protective textiles, high performance fibers

Development of nanoarchitecture PVDF coatings for enhanced piezoelectric response and sensing

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Abstract:

When a stress is applied on a piezoelectric material it generates an electric charge. Different natural and man-made materials exhibit piezo response such as quartz, lead magensium niobate, Rochelle salt, tourmaline, sugarcane, PLA, PVDF, ZnO composites etc. In this study piezoelectric response and sensing of PVDF will be increased which can be used in smart textiles. Polyvinylidene flouride (PVDF) is polar compound monomer as $-CH_2-CF_2-$ consisting of electropositive hydrogen atoms and electronegative fluorine atoms. It has four crystalline phases α, β, γ, and σ. Among all these phases most strong polarization occurs in β phase significantly responsible for ferroelectric and piezoelectric effect. Enhancement of piezo response of PVDF by spray coating technique is done. Polyester fabric was decorated with vertically grown ZnO nanorods on which different numbers of PVDF coatings were done by spray gun. Characterization were done which reveals increase in the piezoelectric behavior of the prepared samples. By the application of load a considerable output voltage was observed.

Key words: Piezoelectric response, PVDF, ZnO nanorods, spray coating, smart textiles

Challenges of processing post-consumer textile waste

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Abstract

The textile industry evolved from fulfilling the basic human need of covering themselves to the rapidly growing fashion industry that has created a huge environmental impact. The consumption of textile products has increased many times during last decade that created the problem of dealing with a huge quantity of post-consumer textile waste. The conversion process of the post-consumer textile waste into useful fibers includes some additional operations as compared to the conversion process of pre-consumer textile waste. The major challenges are collection of the end-of-life textile products, their classification/segregation based on their color and composition, and removal of accessories. Besides, the quality of the products prepared from the post-consumer textile waste is not as good as that of the products prepared from pre-consumer textile waste and virgin materials. This study investigates such issues for processing post-consumer textile waste and outlines the necessary operations for the conversion process. Moreover, suggestions are provided for improving quality of the products prepared from the post-consumer textile waste. The success of such conversion process will benefit ecologically as well as economically.

Keywords: Post-consumer textile waste; recycling; environment; sustainability

Mechanical and comfort properties of cotton blended lawn woven fabrics

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Abstract:

Lawn made from usually cotton is a lightweight pure fabric which is famous due to its fineness and somehow transparent. It is soft and excellent to wear, so it is suitable for summer clothing or everyday wear in hotter climates. To improve the comfort properties of lawn fabric by using Cotton and different blending ratios of Cotton with micro-Modal, micro-Tencel and micro-Polyester and decreasing the ratio of cotton were used to manufacture lawn fabrics. For this purpose, fine yarn of Ne 80/1 were manufactured and plain woven fabrics were produced, 100% cotton fabric was prepared and compared with blends of cotton: micro-Polyester, Cotton: micro-Tencel and Cotton: micro-Modal having blend ratio of 50:50 and 67:33. It is concluded that the blend of Cotton and micro-Tencel 50:50 has comparatively better mechanical properties (tensile and tear strengths) and comfort properties (air permeability, thermal resistance and moisture management properties).

Keywords: Cotton, comfort properties, air permeability, thermal resistance, moisture management

Microencapsulation for the development of multifunctional textiles

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Abstract.

Micro/nanoencapsulation is a technique where active ingredients are encapsuled using protective walls, also called shell. The purpose of using this technique is either to save active ingredient from outer environment or release them slowly to the environment. The technique is used in encapsulating phase change materials for the development of thermoregulating textiles with other functionalities if required. This work focuses on the novel technique of microencapsulation with embedded nanoparticles for the incorporation of different functionalities such as antibacterial, photocatalytic effect along with thermoregulation. The developed capsules were applied on 100% cotton fabric using pad-dry cure techniques. The characterization showed that the results of thermal management, antimicrobial and photocatalytic effect are promising.

Keywords: Microencapsulation, phase change materials, antibacterial, cotton

Sustainable dyeing process for polyester fabrics: Replacing conventional toxic agents

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Abstract

The Global polyester market was USD 109.75 billion in 2019. It is one of the preferred synthetic fibers in the textile industry. After dyeing polyester fibers with disperse dyes, the excess dye on the fiber surface is reductively degraded to increase the dyeing fastness. Generally, drainage is performed after dyeing, and reduction clearing (RC) is performed under alkaline conditions. As a reducing agent under alkaline conditions, hydrosulphite and thiourea dioxide are used. Also, after alkaline reduction clearing, a neutralization process using acid is necessary. The process is time-consuming, unhealthy for the environment due to the waste of a considerable amount of water and utilization of aggressive chemicals that increase the Biological and Chemical oxygen demand of the wastewater. Instead of draining the dye liquid, we have tried to use the same acidic bath for RC. The preliminary results are comparable to conventional RC regarding fastness properties. The process could avoid a massive amount of water, and increased production capacity could be achieved due to fewer processes involved.

Keywords: Disperse dyeing, sustainability, textiles, environment

Color fading of denim garments through ozone treatment

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Abstract:

Ozone treatment of denim garments for color fading is a sustainable alternative for conventional bleaching agents. Although prominent research work had been done in this, studies for the application and optimization of the operating process parameters and conditions are still in run to make this process applicable in industry. This work will address the application of ozone treatment (an alternative to conventional fading processes) on garments to achieve color fading effect and to make a dialogue predictive model with optimum conditions so as to evaluate the color properties, chemical, mechanical characteristics of the treated specimen with the process control attaining prescribed results. An industrial scale L1 Eco-free 2 ozone washing machine was utilized for color fading of garments. Since, the color fading process factors are inter-related to each other, so our focus will be on optimization of these parameters to acquire quality color fading effect under optimum conditions. In this study, three process parameters will be under study as: (i) feeding rate of ozone (ii) moisture content in the fabric; and (iii) treatment time. These factors have significant impact on the fading effect. Ozone treatment will provide reproducible results in repetitive runs, minimal loss of fabric tensile strength and neutralization of dye molecules in the wastewater effluents. High volume of wastewater effluents containing high concentration of COD, BOD, TDS, TSS and organo-chlorinated materials will also reduce to a great extent. This work will also provide characterization of fading and comfort characteristics of fabric. The ozone treatment of denim garments will make the bleach wash process eco-sustainable for humans, marine life, society, environment and will open up the route for application of ozone at an industrial scale for achieving sustainability in the textile industry.

Keywords: Color fading, denim, ozone

Development of composite polymeric electrospun nano fibrous webs with antibacterial properties

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Abstract

In this study, composite polyvinylidene fluoride (PVDF) and polyvinylpyrrolidone (PVP) nano fibrous webs containing silver nano particles (NPs) were prepared via electrospinning. Silver NPs were synthesized using reducing and stabilizing properties of PVP without using any additional reducing agents. Thus, the composite membranes containing silver NPs were prepared in a simple one step process. The silver NPs were synthesized successfully in PVP solution as confirmed by absorption peak at 398 nm in the UV-vis spectroscopy. The structure of the composite polymeric webs was verified using FTIR spectroscopy. The webs were prepared with different concentrations of silver NPs. The produced webs demonstrated good antibacterial activity against Staphylococcus aureus, a Gram-positive bacterium, in disk diffusion test. The prepared webs can find applications in air or water filtration applications.

Keywords: electrospinning, nanofibers, antibacterial

Development of CVC yarns by filament blending

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Abstract

The aim of this study is to develop CVC yarns by filament blending instead of fiber blending. For this, polyester filament yarns of 100 Denier, 150 Denier and cotton roving were used to make two yarns of 16 Ne and two yarns of 10 Ne on ring machine having core yarn attachment. Similarly, two yarns of 16 Ne and two yarns of 10 Ne were made by cotton and polyester fiber blending to compare the results. Twist multiplier was kept same as that of comparable yarns. Physical and mechanical properties of all the 8 yarn samples were investigated as per standard test methods. Analysis of yarns physical and mechanical properties show that yarns made by filament blending is better than fiber blending w.r.t tenacity, unevenness, hairiness, and TPI. Further, these yarns may be made in spinning mills which is making only 100 % cotton without addition of polyester blow room, card, drawing machines and sections. Thus building, lighting and conditioning will also not be required.

Key words: CVC yarn, filament, blending, core attachment, ring spun

Statistical study to explore important factors in upper body measurements for lean manufacturing in garment industries

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Abstract

The focuses of this study are to identify the important factors about upper body measurements and re-examine the measurements for clothing product development which are essential for upper body measurements in the garments industries. This will increase not only the production of garments but also eliminating the amount of pre-consumer waste (i.e. Waste at factory's cutting department and during the manufacturing process of apparel). Cutting fabric waste can be reduced by selecting appropriate 3-D upper body measurements instead of traditional upper body measurements. Data are collected from 320 university students by using simple random sampling technique. Eighteen items of human upper body measurements sizes, including the Chest, Waist, Arm length (shoulder to wrist), Arm length (CB Neck to wrist), Shoulder length, Shoulder slope arctan, Across shoulder, Cross back width, Cross chest width, Mid neck, Neck base, Upper arm, Elbow, Armscye, Bust_Pt to bust_Pt, Neck to bust_ Pt, Scye_depth and wrist are taken from individuals. To increase the efficiency and accuracy of upper body measurements and reduce pre-consumer waste in cutting department floor, principal component analysis method (PCA) and factor are proposed to identify the key upper body measurements which can provide the basis for classifying the population.

Keywords: Upper body measurements, random sampling, pre-consumer waste, principal component analysis, factor analysis.

Improvement of operator's skill and accuracy level through quality management system in apparel industry

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Abstract

Quality is basically to meet the customer requirements and satisfaction in simple words to follow the given standard and instruction and produce required products. In manufacturing, quality control is a process that ensures customers receive products free from defects and meet their needs. The main objective of this study is to determine the skill level of the individual operators and improve their skill and accuracy level through implementation of Quality management system. In order to reduce the number of operator errors, a training method was developed with the support of the attribute agreement analysis method with test images presented to operators for classification. By using this methodology, it was possible to check the capability of each operator and improve the operator's evaluation score. After the application of the tool, the improvement of results is better than the previous. The error percentages before improvements were 19.3% and after improvement their error percentage were reduced up to10.7%. The operator skill level is increased from 78% up to the 97% skill level. The highest skill level is reached up to 97% and 5 out of 16 operators are increased from below 80% to the autonomous level above 90%.

Keywords: Operator, skill, accuracy, quality management system, apparel

Improvement of quality and skills level of quality control inspector through traffic light system and measurement system analysis in apparel industry

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Abstract

In this study we improve the quality of the apparel industry and skill level of quality checker by using the traffic light system (TLS) and measurement system analysis (MSA) tool. TLS is more efficient tool to control the quality in unit than other quality control tools. TLS is a random garment inspection system. For quality improvement MSA tool is used to determine the skill level of operators and quality checker. Measurement system analysis is used to determine the amount of variation within a process. Measurement system analysis is the best tool to improve the process yield and measure the precision, accuracy, and stability of the process and appraisers. It was observed that the average defects percentage during inspection reduces from 34% to 11% after implementation of traffic light system. The inline overall percentage accuracy before implementation of MSA was found as 66.7%, which was improved up to 97.2% after training. The end line overall percentage accuracy was found 75.0% before and 95.8% after implementation of MSA.

Keywords: Quality, skill level, traffic light system, apparel

Dyeing of cotton with tea as a natural colorant: an approach towards the cleaner production strategy

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Abstract

In this piece of research work, the cotton fabric was modified with cationising agent with four different concentrations to replace metallic salts as mordant. The fabric was treated with 3-chloro-2-hydroxypropyl) trimethylammonium chloride to enable its dyeing with the black tea extract. Methanol as an organic solvent was used for the extraction of the colorant from the black tea leaves. The extraction of the tea was filtered, and the methanol was evaporated to get the black crude of the colorant which was later dried and converted into powder for further application onto the fabric. The natural colorant was applied with different shade depths onto the cationised and uncationised cotton fabrics. In case of cationised cotton fabric samples, the color yield achieved was significant as compared to uncationised fabric samples which gave little color strength values. The cationised dyed cotton fabrics with different shade depths offered enhanced color fastness properties with significant color strength values.

Keywords: Cotton, natural colorant, cationising agent, dyeing, color strength, color- fastness

Investigation of mechanical properties of cotton fabric after hot and cold mercerization

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Abstract

The cotton satin fabric is mercerized with sodium hydroxide at different concentrations, time, and temperature of treatments. The mercerization and neutralization of the fabric is done in tension state in order to remain the dimensions of fabric as minimum effected by the process of application. The Central composite design (CCD) of statistical analysis is employed to analyze the conditions best suited for less loss of mechanical properties after mercerization. Mechanical properties of the fabric were studied against the time, temperature, and concentration of sodium hydroxide. The tear strength of the fabric is a function of time and temperature of treatment as these parameters increases the tear strength decreases linearly while concentration of sodium hydroxide has different impact on both tear and tensile strength of fabric, at lower concentrations it remain constant while at higher concentration the decrease in both tear and tensile strength are observed. The absorbency of the fabric is not significantly changed by analysis of the results.

Keywords: Mercerized fabric, central composite design, tensile strength, tear strength

A generalized model for predicting the tensile behavior of 3d orthogonal woven composites from natural fibers

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Abstract

Due to the mounting environmental concerns, researchers have been prompted to conduct investigations in fiber reinforced composite from natural fibers such as hemp, flax, cotton and coir. Unlike the synthetic fibers, natural fibers are inherently non-uniform in length, fineness, surface characteristics, and mechanical properties, which pose serious challenges to manufacture composite parts with required performance. While the effort of researchers in this area covers broad and varied natural materials, it is limited to experimental work and their results are only valid within the range of variables used and their levels and cannot be generalized. This directed our attention to develop a generalized analytical model to predict the entire load-extension of composites from any 3D orthogonal woven architecture in terms of number of layers, x- and y-thread density, weave of Z-yarns, and the variability of fiber mechanical properties. The model was validated experimentally, and a good agreement was observed between the predicted and measured load-extension results.

Keywords: 3D fiber reinforced composites, natural fibers, modeling, fiber properties variability

Natural textile fibers: A sustainable solution to decrease energy consumption in buildings

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Abstract

Global population increase and urbanization has brought up energy management challenges. Demand for energy has witnessed a major uplift in recent decades. Sustainable energy solutions are in demand with definite applications. The way we construct civil structures may reduce the consumption of energy. The research community and construction industry are trying to achieve this goal by using sustainable thermal insulation material. Composite materials are well known for their wider application areas, due to improved properties, and civil engineering is no exception. They offer better insulation in buildings which in turn lowers the amount of energy required in maintaining indoor environment. A study was conducted to analyse the impact of fibre reinforced concrete as insulation materials in buildings. Specimen of concrete were prepared using environmentally friendly natural fibres (sugarcane, jute, basalt, sisal and coconut) as reinforcement. The thermal conductivities of the prepared specimen were measured using standard procedure ASTM C518-04. The analysis of obtained results revealed that natural fibres reinforced concrete materials have 15-20 % better thermal insulation properties as compared to plain concrete. Thanks to the porous structure of natural fibre reinforcements. The study findings can be applied by constructions industry for decreased cooling and heating cost of buildings.

Keywords: Energy consumption, thermal insulation, reinforcement, natural fibres, concrete

Damage initiation and propagation in 2×2 twill woven carbon-epoxy multi-layer composites

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ABSTRACT

Damage and mechanical properties in textile composites are closely connected with the textile reinforcement's internal structure. This paper reports and discusses a study of the mechanical behaviour and damage of a 2×2 twill woven carbon/epoxy composite resulting from uniaxial tension in the warp and bias directions. A damage investigation was performed by using acoustic emission, full-field strain optical measurements, as well as X-ray and optical microscopy. As a result of the tests, the mechanical properties and strain values of the composite's damage threshold were determined. Damage initiation when loaded in the warp and bias directions occurred between 0.2-0.3% and 0.88-1.71% of the applied strain, respectively. Microscopic examination showed that damage or cracks initiated where the yarn was crimped and at interactions between the warp and filling yarns. Full-field strain measurements highlighted the relation between the strain concentrations that are linked with the damage initiation and the reinforcement structure.

Key words: 2×2 twill woven composites, mechanical properties, damage, acoustic emission, full-field strain measurement.

Textile based-3D printing materials for insulation

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Abstract

Fused deposition modelling (FDM) is one of the renown additive manufacturing (AM) technique due to the ease of 3D printing process, low cost of materials and affordable initial (capital) cost of 3d printers. Various developments are reported in various fields of FDM that includes novel materials, modified FDM printers, feeding mechanisms, parametric optimization, product characterization etc. However, the field of materials is still one of the core topics now-a-days as applications due to the ever-growing demand of FDM materials for structural applications. One of such demands is the novel material's development for high strength FDM based insulations. In this regard, this research proposes a green composite material of biodegradable polymer and biodegradable textile fibers. The textile fibers will provide both mechanical (tensile) strength and thermal insulation to the FDM structure. Furthermore, the novel material will help to overcome the carbon footprint in the earth's environment as the material will be discarded in the land for biodegradation.

Keywords: Fused deposition modelling, insulation, green composite martials, textile fibers

Long-carbon-fiber-reinforced polyamide-6/nickel powder composites for electromagnetic interference shielding and high mechanical performance

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Abstract

Long-carbon-fiber-reinforced polyamide-6/nickel powder composites were designed as electromagnetic interference (EMI) shielding materials and then were prepared through the joint processing of melt blending and thermoplastic pultrusion. The obtained composites show high conductivity and high permittivity as well as a high dielectric loss with co-addition of carbon fiber and nickel powders, which makes the resulting composites a higher level of shielding effectiveness due to the combination of conductive and magnetic fillers. The composites are capable of shielding mainly through absorption rather than reflection. On the other hand, the composites achieved significant improvements in tensile, flexural, and impact strength due to the superiority of the long-carbon-fiber-reinforced technique. The residual fiber length in the injection-molded specimens is greatly superior to the critical one predicted by the Kelly–Tyson model. This takes full advantage of the strength of the reinforcing fiber itself, thus leading to a promising reinforcement effect. The enhancement of impact toughness is due to the energy dissipation by fiber fracture as a result of long fiber effect. The morphologic investigation indicated that the fiber fracture and fiber pullout concurred on the impact and tensile fracture surfaces, and the former preceded the latter. Highlighted with both good EMI shielding properties and excellent mechanical performance, the composites designed by this work exhibit potential applications for the automotive, electronics, aerospace, and military industries.

Keywords: Shielding effectiveness; long carbon fiber reinforcement; polyamide-6-based composites; mechanical performance; morphology

Development of cost and performance effective bio based anti-viral mask and PPE

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Abstract

The COVID-19 pandemic has shaken the whole world. The importance of anti-viral finishes and treatment has significantly increased due to the current pandemic. However, typically metal (silver, copper, zinc) oxides or toxic amines are used for achieving effective anti-microbial and anti-viral performance for textile. These metal compounds can be extremely dangerous especially when the product is going to be used next to mouth for longer period of time like mask. Typical mask and full body protective suit do not kill airborne pathogens. They are based on a passive mechanical filtration design only. Thus, microbes on or inside the suit can stay alive for many hours, greatly increasing the likelihood of cross-contamination specially during removing of the mask and PPE or disposal. As per the latest research findings the virus that causes coronavirus disease 2019 (COVID-19) is stable for several hours to days in aerosols and on surfaces. However, UET Textile department have indigenously synthesized and developed 100% bio finished anti-viral mask and PPE which is metal and amine free. The finished product has exhibited the "Full effect" which is the highest level against viruses test for textile as per the testing of ISO certified lab.

Keywords: PPE, masks, antiviral, COVID-19

Operation wise implementation of OEE to improve garment manufacturing process

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Abstract

Nowadays, the demands of the user have been a challenge to the manufacturing industries. This goal can be achieved by lean manufacturing which eliminates all types of wastes to maximize the user value. This study deals with the application of Lean philosophy to the mass production sector with a focus on a single knit sewing line of the garments industry. In this concern, Overall Equipment Effectiveness (OEE) has been applied for measuring the performance of the sewing line and making a process smooth, consistent, and defect-free. This paper proposes a complete methodology to implement OEE operation-wise in a garment manufacturing unit. For this purpose, the study was conducted in three stages. Firstly, a baseline study was conducted to analyze the current performance of each operation of a T-shirt manufacturing line. The baseline data were compared with world-class values of OEE to highlight the deficiency areas. The route cause analysis was carried out to improve the value of OEE. Similarly, the second and third stages were carried out to improve the value of performance and quality of each operation. The obtained results showed an improvement of 5 – 7 % in OEE value in every operation of the line after applying the suggested techniques.

Keywords: Lean manufacturing, machine maintenance, quality, productivity, overall equipment effectiveness

Antimicrobial textiles based on N-halamine hybrids

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Abstract

Microbe related issues and biofilm formation have been great challenges in the medical care. Antibacterial hybrid composites are of great significance on the basis of modern biological-medical engineering, new materials, and nano-science and technology, which show promising application in clinical medical treatment, health care, medical device packaging, etc. Herein, we demonstrated various routes for the manufacturing of N-halamines/metal oxides hybrids with tunable monomer composition and multifunctional characterizations by sol-gel process, ultrasonic-refluxing method, atom transfer radical polymerization, and miniemulsion polymerization. The prepared hybrids were incorporated to different substrates, such as cotton, chitosan dressing, and electro-spinning fibers. Antibacterial efficacies were evaluated against E. coli O157:H7 and S. aureus. Biofilm-controlling ability of the prepared materials was investigated against selected model microbe S. epidermidis, E. coli, and C. albicans using cotton fabrics as biofilm formation substrates. No potential skin irritation and toxicity were detected using in vitro cytocompatibility and a skin stimulation test. The constructed hybrid structure also exhibited quick biocidal, prominent biofilm-controlling efficacy, excellent cytocompatibility, UV light stability, and favorable regenerability.

Keywords: Antimicrobial, N-halamines, nanotechnology, biomedical textiles

Investigation of interlock fabric with different feed patterns to improve comfort

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Abstract

The worldwide knitwear market is expected to reach USD 699 billion. In 2019 t shirts, shirts, and innerwear (weft knitted) obtained more than 40% share and it will increase in future. Its growth rate is expected to grow at a rate of 5.30% for forecast period 2020 to 2027. Weft knitted structures are gaining the market due to their comfort, elasticity, soft touch, lightweight, and wrinkle resistance properties. The interlock structure that has a combination of hydrophilic and hydrophobic material was developed in such a way that each material is prominent in consecutive wales and courses. Cotton, modal, viscose rayon, and polyester were used for sample preparation. Thermo physiological comfort, touch and serviceability were investigated on interlock knitted fabric. After testing, it becomes clear that wales wise alternate yarns provide better overall moisture management properties than course wise. Due to higher thickness of interlock fabric, it entrapped more air in the structure, so it provides better thermal insulation properties.

Keywords: knitted fabric, interlock structure, comfort, kids wear garment

Waste textiles and colour recycling for fashion sustainability

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Abstract

The textile/fashion industry has emerged as the 2nd most polluting industry in the world. The problem is particularly dire in developing nations. This talk will give selected examples of recent research activities on textile recycling. Both mechanical and non-mechanical approaches will be discussed. The focus will be on coloured waste textiles and innovative ways of recycling both the fibre material and the colour in the coloured waste.

Keywords: Waste textile, recycling, fashion sustainability

Potential of nanotechnology for the growth of Pakistan's industry

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Abstract

Nanotechnology is the engineering of practical systems at the molecular level which provided the advancement in all the industrial systems especially materials and electronic industries. Nanotechnology has revolutionized the realm of science and engineering to the extent that it has changed the approach of thinking, influencing future technologies and solutions. The limitations of nanotechnology are higher costs and a shortage of technical labor. However, it gives the solution to various problems faced by modern industries. Well-known industries in Japan, South Korea, USA and Europe have already adopted nanotechnology in many ways to improve their products, production, and also productivity. Many developing countries including Pakistan, are reluctant to adopt this new technology and science due to its limitations. Though, very few Pakistani industries have introduced nanotechnology in their production sector which has improved their products and raised their sales. In the agriculture sector, nano-pesticides, nano-fertilizers, nano-sensors could be used to enhance productivity and profitability. In the textile sector, hydrophobic, optical displaying, sensors, UV-blocking, anti-bacterial textiles could easily be manufactured using existing machinery setups. In the medical industry, nano-robotic surgeons, nano-drug delivery, nano-diagnostics, nanofiber bandages could be easily manufactured and marketed. In the plastics industry, UV-resistant plastics, anti-bacterial food packaging, high strength plastic furniture can be manufactured with conventional machinery using new materials. In paints/coating sectors, weather-resistant, antifouling, UV-resistant, fire-resistant, self-cleaning paints/coating can be manufactured on a large scale. In the automobile industry, dirt repellant, anti-reflection, scratch-resistant coatings can be applied to the vehicle. In conclusion, there are various nanotechnology applications in multiple fields from which Pakistani industries can take advantage to grow their markets. This will open new horizons for Pakistan's industry which undoubtedly will increase the GDP of the country through increasing exports and decreasing imports.

Keywords: Nanotechnology, applications, industry, Pakistan, growth

Development of PVDF/graphene composite coatings on fabrics for enhanced piezoelectric response

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Abstract

Smart textiles have gained huge attention in recent era making a paradigm shift in wearable devices. Here, PVDF/graphene composite coatings have been deposited on textile fabrics through dip coating technique varying the concentration of graphene and Ag decorated graphene to use for energy generation and sensing characteristics. The β-phase and thermal properties of coatings were characterized using Fourier transform infrared spectroscopy, X-ray diffractometry and differential scanning calorimeter. The interfacial characteristics were observed by contact angle goniometer. The incorporation of graphene into PVDF have induced the β-phase by self-polarization of PVDF that enhanced the piezoelectric response of composite coatings. The prepared samples exhibited less bending rigidity making them flexible devices. These textiles based flexible piezoelectric coatings can provide the solution for wearable sensing devices.

Keywords: Coatings, graphene, PVDF, sensing, smart textiles

Development of jute fiber reinforced fire retardant composite

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Abstract

A composite consists of a reinforcement and a matrix. Fiber reinforced polymer composite (FPC) is the most commonly used type of composite. The composites are gradually replacing convention materials in furniture industry due to their high strength, weather resistance etc. Furniture is commonly made up of wood, however, wood has poor moisture resistance. Therefore, FPC is replacing wood in furniture industry. Synthetic fibers are mostly used as reinforcement in FPC but synthetic fibers are not eco-friendly, hence scientists are trying to replace synthetic fibers with natural fibers. Jute fiber is the most commonly used natural fiber as it has the highest strength to cost ratio among all the natural fibers. Jute fabric gives more mechanical strength as compared to jute fibers. Epoxy is the most commonly used thermoset matrix as it gives high strength. Many articles have reported the exceptional strength of jute fiber reinforced epoxy composite. The limitation of jute-epoxy composite is that it can burn when ignited. So, fire retardants are mixed in epoxy before applying it on jute. Fire retardant added epoxy-jute composite can be used to manufacture fire-retardant furniture.

Keywords: Composite, jute fiber, fire retardant

Technical textiles: value chain mapping and swot analysis of Pakistan's textile industry

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Abstract

Textile is the biggest industrial sector in Pakistan, which contributes 58% of exports, 8.5% to the GDP and 45% to the total employment in the country. After Bangladesh, Pakistan is the 2nd most dependent country on textile with respect to exports. During the last ten (10) years, the growth in Pakistan's textile exports was 28%, which is quite low in comparison to growth in regional countries. During the same period, the textile exports of Bangladesh (36.6 B USD) increased by 177%, Vietnam (36.16 B USD) by 256%, India (37.01 B USD) by 64% and China (266.5 B USD) by 48%. The slow growth in the textile sector is badly affecting the overall exports, current account deficit and new employment generation. As per (International Trade Center) ITC's export potential map, Pakistan has an untapped export potential of 12.2 billion USD out of which untapped export potential of textile and clothing is about 7.0 billion USD. Pakistan's textile and clothing export product range is very narrow i.e., 97% of the textile exports are in 4 product groups. In the biggest export categories (HS code 61 and 62 worth 474 billion USD), the Pakistan's position is 18th and 17th (with a share of 5.4 billion USD) respectively as an exporter. Pakistan's exports are mainly concentrated to USA (22%) and European Union (>40%). Pakistan is not tapping markets like Japan, Russia, Korea, Mexico, Switzerland etc. which are importing more than 100 billion USD of textiles and clothing.

Pakistan ranked at 107th position among the 140 countries in the global competitiveness index. In the category of human skills, Pakistan ranks at 125th position. Further, the subcategories of human skills do not have satisfactory values that include quality of vocational training (90th), skill set of graduates (51st), ease of finding skilled employees (63rd) etc.Technical textile is performance textiles with an emerging market of 200 billion USD. The share of technical textiles in Pakistan's export is about 0.3% against 2.4 % share in export of conventional

The first part of the study focuses conventional textiles. Existing conventional textile value chain in Pakistan is reviewed, followed by a detailed analysis and findings regarding Pakistan's exports. Second part of the study focuses on technical textiles, their classification, global technical textile market, global market drivers. Then Pakistan's technical textile market is discussed in detail. This includes identification of stakeholder of technical textile market in Pakistan, technical textiles value chain (Process wise) mapping, list and capacity of educational and technical textile research institutes, testing methods and testing bodies. Global and Pakistan's trade Analysis in the domain of technical textiles for each of the 12 categories is discussed, followed by trade analysis of technical fibers, Technical yarns and technical fabrics. Major findings are divided into two parts, namely, category wise and product wise findings. Opportunities for localization and export enhancement are enlisted and discussed in detail. SWOT analysis of Pakistan's technical textiles value chain is presented followed by major findings, recommendation and required interventions. The study concludes with examples of regional and international success stories and proposed technical assistance interventions in the future.

Keywords: Technical textile, Pakistan textile industry, growth potential

Functional textiles for personal protection

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Abstract

In this age of rampant industrial and technological growth, the incidence of emerging pathogen, culminating into global pandemics, has plagued every form of life on planet. To counter such evolving problems, protection of vulnerable segments of society is needed to be ensured preferentially. Functional textiles, being a growing area of research, offer desired characteristics and addition of nanoparticles imparts unique functional properties favorable for personal protection against life-threatening viruses and bacteria. This work is focused on developing bioactive protective textiles by exploring four frontiers of textile functionalization including (i) metallization of fabric by solution-phase metal deposition; (ii) Nanoparticle immobilization by means of coupling agents; (iii) development and immobilization of visible light driven photocatalysts on fabric and (iv) development and application of functional reactive dyes for bioactive textiles. Metallization of fabric provides durable metallic deposits with controllable crystallite size and concentration. Such metallic deposits when come in contact with infectious bacteria and viruses readily disintegrate them and protect human bodies. Similarly, nanoparticles when functionalized using silane coupling agents exhibit robust bonding with available functional groups over cellulose fiber and provide excellent washing fastness and antibacterial activities. Visible light driven photocatalysts generate electron-hole pairs after absorbing light and exhibit excellent oxidizing and reducing properties pivotal in inhibiting bacterial and viral growth. Similarly, notable anti-pathogen activity has be achieved from functional dyes while ensuring good dye retention on fabric. In this work, remarkable antibacterial activities against both gram-positive (Staphylococcus aureus) and gram-negative (Escherichia coli) bacterial strains under qualitative and quantitative analysis have been accomplished. Meanwhile, robust washing fastness properties and functional durability have also been achieved. Now, this work is being extended in the antiviral domain and significant progress is anticipated in near future on all four frontiers of research.

Keywords: antibacterial, bioactive textiles, metallized fabrics

Recent apparel advancements for lactating/breastfeeding mothers

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Abstract

Breast milk provides ideal nourishment for infants. It contains all required vitamins, fats, proteins and antibodies which a baby needs to grow. Where breastfeeding provides many benefits, it comes with various challenges for the mother including latching pain, milk stasis, sore nipples, dry and cracked nipples, breast engorgement, mastitis and milk stains on garments. Bras protect breast tissues and keep the breasts in a firm support which is especially crucial during breastfeeding period. The conventional bra designs and accessories attached to them do not fulfil all functional aspects and satisfy desired comfort level which makes them irritate to skin. Recent advancements in breastfeeding bra designs offer various solutions along with their own design and functional limitations. These limitations include discomfort, ease in breastfeeding and liquid absorption in case of milk let-down.

Bra designs with free size offer a limited solution for lactating mothers which is often not practical. Front open bras are available in only few sizes and often do not provide support. Often these bras have uncomfortable shells and under-band blocks blood flow in veins. For milk let-down problem disposable and reusable breast pads are available which pose hazards due to chemicals and fungus development. There are few products named as milk collections shells. These shells have design problems and spill issue.

Keeping in view the latest solutions for breastfeeding mothers, there is a huge gap for research, design and development of innovative solutions for breastfeeding bras, tops, absorbent pads and similar products. There is a demand to provide breastfeeding solutions in terms of breastfeeding bras which are comfortable, adjustable, able to provide proper support for breasts, ease in breastfeeding and can absorb milk let-down. Pattern designing, pattern making, padding designs and optimized material combinations need to investigate further to provide better resolutions.

Keywords: Breastfeeding, lactating mothers, breastfeeding bras, absorbent pads

Composite materials, a tailorable solution for Pakistan's future manufacturing economy

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Abstract

The composite materials are combination of matrix and reinforcement, each having its specific role in the performance of the composite. The properties of composite material are governed by the reinforcement material, its geometry/architecture, matrix material and the relative fraction of these constituents. Hence, the composite materials may be termed as tailorable materials that may find applications from low tech (fiber glass shades) to high tech applications (aerospace). Another option is the use of two different reinforcements for the composite materials, i.e. filler loaded fiber reinforced composites. These composites offer enhanced performance, as compared to the composites without fillers. The composite materials were fabricated using UD glass as reinforcement, vinyl ester as reinforcement and silica micro particles in different concentrations (0, 2 and 5%) as fillers. The mechanical characterization of these composites revealed that composite material becomes stiffer by the addition of particles, and also absorbs more energy in case of low velocity impact.

Despite the potential of composite materials to replace traditional metals and wood, our manufacturing, defense and construction industry is currently working on the last generation materials. Those who shifted to modern materials, lack innovation and technology is outdated/products are low tech. Our supply chain in composite industry is incomplete and human resource lacks training. There are opportunities for our composite industry in defense, sports, automotive and construction sector. The defense sector needs indigenization in terms of ballistic vests, armored vehicles, security check posts, etc. The sports industry needs to adopt modern advanced techniques like 3D printing to get more share. The auto manufacturers are targeting Pakistan, and a shift from metal to composites can revolutionize this sector leading to increased fuel economy. To grasp the opportunities, there need to be a policy shift towards composite materials at government level.

Keywords: Composite, manufacturing economy, Pakistan, policy shift

Reuse of denim fabric for remediation of water

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Abstract

Though this is the era of growing technology, but, still the concentration of heavy metals in water is not within the suggested range in many countries as suggested by regulatory authorities. Mostly, the water is contaminated with various heavy metals like cadmium, arsenic, mercury, lead and chromium that are hazardous to human health. These metals are becoming serious health concern. Due to increased consumption of these heavy metals through drinking contaminated water, diseases like diabetes, neuronal damage, cardiovascular disorders, renal injuries and even cancer have been diagnosed. Dwarfism, kidney diseases, circulatory system malfunctioning and sometime autoimmunity responsible for rheumatoid arthritis, could be triggered due to mercury, aluminium and lead utilization. The main reason behind the heavy metal toxicity is generation of reactive oxygen species that are responsible for oxidative damages and health associated disastrous effects. The mortality rate is also increasing due to excessive utilization of various heavy metal.

The denim jeans are mostly made up of 100% cotton and it is thought that it would be easily degraded, but, in actual it takes very long time causing negative ecological impact. According to Environmental Protection Agencies, it is estimated that about 5% of all landfill space is textile waste including denim. Literature shows that jeans waste production is nearly 2.16 million tons and only 35-50% is this waste is collected for recycling or reuse after sorting. The post-consumer waste of denim has completed its life cycle and has no use aesthetically and functionally, however, recycling of post-consumer denim waste could have enormous environmental impact. Recycling is a buzz word for the sustainable world now. And every organization is trying to achieve sustainability through recycling of the pre or post-consumer wastes. Therefore, the aim of this study was also to recycle the denim waste and removal of unsafe heavy metals from the drinking water. The denim waste was treated with environment friendly H_2O_2 under alkaline conditions to create several functional groups at the surface that could trap the metal traces. This functionalized denim fabric was immersed in heavy water containing several heavy metals under controlled processing conditions and enormous results were obtained. Nearly 90-94 % of heavy metals were absorbed by the functionalized denim. Thus, the worn-out denim could be used to treat heavy water.

Keywords: Denim, environmental sustainability, heavy metals, recycling