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Analysis of thermal and moisture transfer performance of Fire-fighter's protective clothing

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Abstract

Fire-fighter's protective clothing are mostly made using multilayered textile materials. Each layer of textile material has specific use to protect wearer form fire, heat, chemicals, moisture vapour etc. However it has been seen that these layered structure make wearer uncomfortable due to low ventilation and high heat stress and thus reduces their work efficiency during fire fighting operation. In this study various types of outer shell fabrics, thermal barriers along with moisture barrier are used in fire fighter protective clothing assembly and tested before and after washing treatment for limited flame spread, convective heat, radiant heat, water vapout resistance (Ret) and heat transfer performance (HTP). The effect of dry and wet textile material on these properties were also compared. The study revealed that the material compositions and moisture content also effect the performance of fire fighter's protective clothing. On the basis of thermal and moisture transfer performance properties, suitable multilayered textile material for fire fighter's protective clothing was selected.

Key words: convective heat, fire-fighter protective clothing, heat transfer performance, radiant heat, water vapour resistance,

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Jute fabric: a green alternative to fiberglass fabric for preparing orthopedic casting tape

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Abstract
Orthopedic casting tape is used to immobilize joints during fracture and injury. It is made of two components 1) polyurethane prepolymer and 2) glass fabric. Around 60% of this casting tape is made of fiberglass which creates hassle in its disposal. The glass fabric is non-biodegradable and disposal of the cast is causing great environmental problem. So in search of a good alternative to the above problem, jute fabric emerged as the most promising material to replace glass fabric. Jute fabric was abundantly available, less expensive, easily degradable and a have a high specific strength. It can be developed as an equally compatible material to fiberglass based cast in its mechanical strength and technical parameters. In this study, we discuss the technical challenges involved in developing jute fabric based casting tape. The main drawback of jute fabric is its highly hygroscopic nature which needs to be minimized for giving better shelf life to the casting tape. There are many surface treatment methods available for making the jute fabric hydrophobic.

In the current study, the surface modification of jute fabric has been carried out by silane treatment method. The effect of silane treatment on the moisture absorption behaviour and mechanical properties of the jute fabric was investigated. FTIR technique is used to establish the formation of Si-O- linkage. The surface morphology was studied by Scanning Electron Microscopy.

The results revealed that the hygroscopic nature of the jute fabric is substantially reduced on account of silane treatment. A significant improvement in mechanical properties is also observed with increasing silane concentration. Thus it can be inferred that jute fabric could be a favorable material for developing easily degradable orthopedic casting tape.
Keywords: Orthopedic casting tape, Jute fabric, Silane treatment, Water absorption

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Flexural properties of coir-banana based hybrid biocomposites

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Abstract

Hybrid composites were prepared from randomly oriented banana and coir fibres using polypropylene as matrix. Compression moulding technique was used to prepare the specimen. Effect of mass fraction and dispersion of fibres within the composite structure on the flexural properties of hybrid composites was determined. A fixed coir to banana fibre ratio of 1:1 by weight was used to prepare hybrid biocomposites at different total fibre fractions. The results were compared to single fibre composites and the hybrid effect was discussed in detail. It was observed that placement of fibres and their dispersion in composites played a key role in determining the bending characteristics of the composites.

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An Overview of Advanced Fibers and Polymers

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Abstract

Nowadays uses of textile fibers and polymers are not only confined to apparel and household textiles but also as industrial fiber or high performance fiber in technical textiles. To produce such products requires outstanding fibers and polymers in terms of properties and functionality. Further, in view of the major technological developments seen all over the world, the demand for more specific function to be performed by the fibers and polymers has grown considerably in past few years. These fibers and polymers find their applications in sportswear, protective wear, geo-textile and other high performance applications.

Quest for innovative material to meet further stringent requirements in respective fields has yielded sustainable growth of high performance fibers and polymers through technological innovations. These developments give a new dimension to the use of textiles. This paper focuses on innovations pertaining to these fibers and polymers.

Exploring The Role of Sustainable Leadership on Sustainable Performance - A Case-study of Sangam India Limited - A Textile Industry in Bhilwara, Rajasthan

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Abstract
Today, every business house is exposed to umpteen numbers of internal and external stimuli. Each of these business houses need to respond them in a right manner so that their business is not affected adversely. Many a time the business leaders need to be acutely proactive in responding to various such internal and external factors so that they can manage some threats in timely manner. There could be any type of crisis or threats which the business leaders along with its key people need to encounter strategically to sustain their organization. Perhaps, it's a fact that leadership styles change with the change of time. In the second and third decades of twenty first century, possibly, the key people of any business organization should strive to sustain their business with sustainable strategy. And this sustainable strategy can only come forth with key people having sustainable leadership ability.

Here in this paper an attempt has been made to find out what happens to sustainability with reference to one particular textile industry in Bhilwara, India. A meticulous and in-depth study was made with Sangam India Limited at Bhilwara – a textile industry.

In this work an attempt has been made to explore i) whether at Sangam Textile industry sustainable leadership philosophy is practiced and to what extent it influenced the performances of the organization for its sustainability. ii) It further attempts to identify the dimensions of leadership which may be cared by the top management to create a sustainably performing organization. iii) And eventually to structure a comprehensive sustainability efforts which may be practiced by key people of the industry to create it a sustainable organization.

Keywords: sustainable leadership, sustainable performance, sustainable management practices

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Design and Development of Smart Wrist Band Using Sensors

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Abstract

In recent years, the integration of various electronic components and sensors with textiles to give additional functions have become more common. In this way the wrist band can be made functional while retaining the aesthetic appeal and style at lower cost which is in high demand. Smart textiles are fabrics that have been designed and manufactured to include technologies that provide the wearer with increased functionality. Smart textiles can be produced by Knitting, weaving and embroidery of conductive threads, conductive metal coating and screen printing can

Fig 2.10 smart wrist band and reading

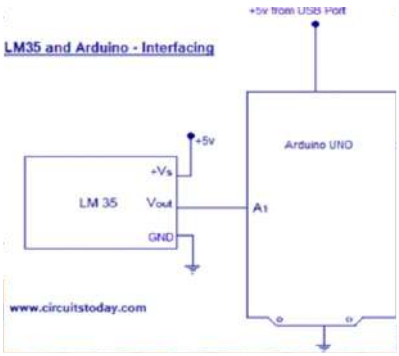
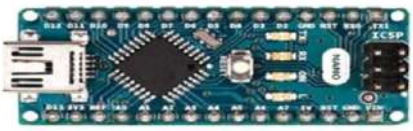
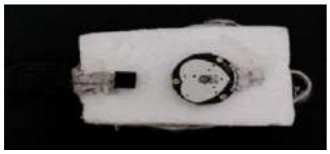


Fig.2.6. Connection between arduino and LM35

be used to develop wearable electronic textiles but amongst these, use of conductive inks onto textiles has gained interest due to its ease of use and manufacturing scalability.





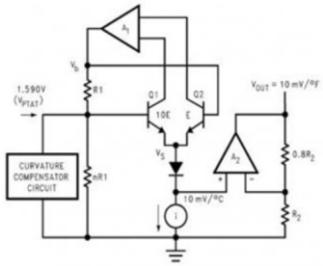


Fig.2.9 circuit connections, Fig.2.8 Arduino nano, Fig.2.4.Temperature sensor (LM35), Fig.2.5. Temperature sensor circuit.

The emergence of wireless technologies and advancements in on-body sensor design can enable change in the conventional health-care system, replacing it with wearable health- care systems, centered on the individual. Wearable monitoring systems can provide continuous physiological data, as well as better information regarding the general health of individuals. Thus, such vital-sign monitoring systems will reduce health-care costs by disease prevention and enhance the quality of life.
This dissertation is aimed at developing smart band by incorporating vital-sign monitoring systems. Using this assembly the recent progress in non- invasive monitoring technologies for chronic disease management is reviewed. In particular, devices and techniques for monitoring pulse rate, and body temperatures are discussed. For our research additionally conductive ink, conductive fabrics are presented. The main aim of this project is to produce a wearable wrist band which detects vital body parameters like pulse rate, temperature using sensors, conductive ink and conductive fabric. Finally the recorded temperature and pulse rate readings are send to mobile app via Wi-Fi.

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Abrasion Behaviour Analysis Of Tibetan Handmade Wool Carpets Using Response Surface Methodology

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Abstract
Handmade carpets are produced in three different types, namely knotted, flat woven and tufted. Knotting is an extensively used method for carpet manufacturing. The texture of hand knotted carpets is produced by the independent knots. Tibetan, Persian or Sehna, Turkish or Ghiordes, Spanish and Kiwi knots are used in handmade carpet industry. Among these, Tibetan knot is widely used in handmade carpet sector. The durability of handmade carpets is very important as these are costlier than normal apparel. Abrasion behavior is one of the most important characteristics of carpet durability. WIRA Carpet Abrasion Machine is extensively used to judge the durability of carpets. Durability property is important for carpet manufacturers to meet the customer requirements on the basis of their end-uses. The effect of knot density, pile height, number of ply in pile yarn and pile yarn twist on abrasion resistance of Tibetan handmade wool carpets has been studied. The interaction between the process variables has been analyzed by using response surface methodology based on the Box-Behnken design of experiment. Pile height, number of ply, pile yarn twist, interaction terms of knot density × number of ply as well as quadratic term of pile height are significant process variables. The minimum abrasion loss occurs at the combination(s) of lowest values of knot density (five knots per inch), pile height (ten mm) and number of ply in pile yarn (two ply) as well as maximum value of pile yarn twist (four and a half twists per inch).

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Comparison Analysis Between Jute fibre and Bamboo Fibre Reinforced Polymer Hybrid Composites

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Abstract

Natural fiber composites are becoming an alternative to many of the dominant chemically synthesized fibers such as the carbon and glass fibers since the 1990s. For the last few years there is surge in increase of the importance given to the natural fibre composite materials in research activities and everyday uses. Its biodegradability, eco-friendly in nature make an exceptional candidate to replace a synthetic fibre reinforced composite. Among the various natural fibres available for manufacturing polymer matrix composites, jute and bamboo fibre stands out exceptionally well because of their various advantages. In the present study the composite specimens are fabricated by using jute fibre and bamboo fibre as reinforcement, epoxy as matrix. To improve its tensile strength, flexural, inter laminar shear strength and micro-hardness, a supplementary reinforcement i.e. cenosphere is added. This supplementary reinforcement meets an important role to determine the properties of the composite. Rigid spherical fillers, especially micro or nano-sized fillers, are added to the composite to get improved surface quality and strength. These rigid spherical fillers are usually ceramic or metallic fillers and are costly. However, cenosphere present in fly ash could serve the above purpose. Because it has a micro hollow spherical structure and It contains mixture of ceramic particles. It is a cost effective option to be chosen as filler material in composite. Cenosphere is an industrial by-product produce from thermal power plant during burning of pulverised coal. Selection of the cenosphere is not only address the concern regarding environment issue but also it shows its capability to blend with fibre reinforced composite to make a value added materials. Though the application of cenosphere into different matrix composite is large, study of its effect on mechanical properties of natural fibre reinforced composites is very few. Cenosphere filler with different weight percentages (0wt. %, 5wt. % and 10wt. %) is added into the jute fibre and bamboo fibre separately. Objective is to study its effect on mechanical properties of natural fibre composites and compare their mechanical properties.

In the present work, the composite specimens are prepared by hand lay-up technique and tested for mechanical strength conforming the ASTM standards. Composites consists of woven jute fibre with addition of different weight percentage cenosphere (0wt. %, 5wt. % and 10wt. %). Similarly bamboo fibre reinforced composites with same weight percentage cenosphere as a filler material is added. It is observed that addition of 5wt. % cenosphere filler into jute fibre reinforced composite increases the tensile, flexural, interlaminar shear strength, impact strength and hardness of the jute-epoxy and bamboo-epoxy composite respectively. At 10wt. % of filler addition the mechanical strength is reduced for both the composites. The mechanical property of bamboo fibre is higher that jute fibre composite.

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Isolation of Bahunia Racemosa Nano Fiber using Steam Explosion Method

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Abstract

Now a days, researchers are focusing their interest towards making of biodegradable composite using natural lignocellulosic fiber. Cellulose nanofibers which are extracted by acid hydrolysis are very much useful for making bio based composites due to their physical characteristics such as stiffness, thickness and length [1]. Cellulose-based fibers such as, banana, jute, sisal, cotton and wood fiber etc. are utilized to reinforce with plastics due to their relative high-strength, high stiffness and low density [2,3]. Especially, Bahunia Racemosa fiber is also an essential natural fiber that show high specific strength and stiffness. In this study, cellulose nano fibers were extracted from raw Bahunia Racemosa (BR) fiber (Figure 1a) using traditional steam explosion technique. This work was done to analyze the effect of chemical treatment on morphology of BR fiber from Macro to nano scale. The image of nano BR fiber after steam explosion is shown in figure 1b. The chemical composition of various stages of BR fibers during chemical treatement were analysed using suitable ASTM standards. Chemical charecterization of BR fiber has shown to increase cellulose content during alkali and acid treatments. Scanning Electron Microscope (SEM) images also support the evidence for the isolation of nano fibril from BR fiber (Figure 1c). The extracted nanofibril can be used effectivly in wide range of biomedical applications such as tissue engineering and medical implants.

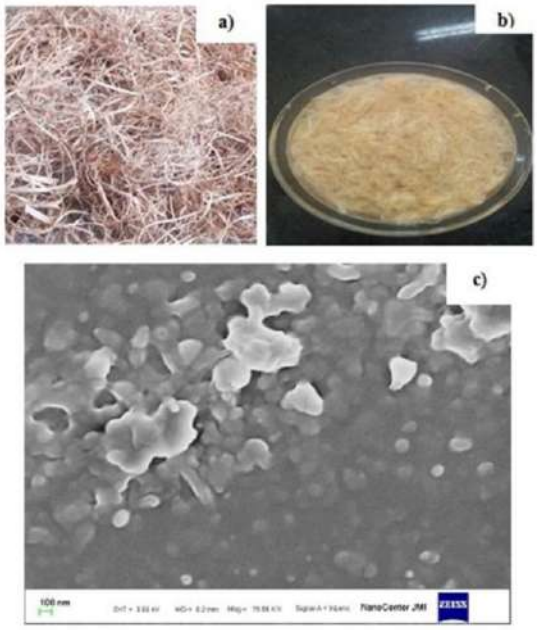

Figure 1 a) raw Bahunia Racemosa fiber b) cellulose nano Bahunia Racemosa fiber c) SEM image of cellulose nano Bahunia Racemosa fiber

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Study on tuft withdrawal force and compressibility of hand tufted carpet

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Abstract

Carpets are mostly used for floor coverings. Ninety percent of the carpet constructed is tufted carpet [1]. Manufacturing of tufted carpet may be done by machine or manually. This present study is done on hand tufted carpets. Compression and tuft withdrawal force are two main parameters to assess the performance of tufted carpet. Several studies reveal the effect of pile density, pile height, fineness of pile yarn, and pile yarn twist on compression behaviour of carpet [2-3]. However, there is little knowledge on effectiveness of various parameters on tuft withdrawal force. Therefore, this study aims to analyse the effect of fineness of pile yarn and number of ply of pile yarn on tuft withdrawal force. The effect of above mentioned parameters on compression behaviour is also studied as this is the main criteria of carpet performance. Nine different types of hand tufted carpets were prepared by varying the above mentioned variables. Samples were analysed in terms of their physical and structural parameters as well as thickness loss, compression percentage and tuft withdrawal force. It has been observed that tuft withdrawal force increases as the pile yarn becomes coarser and number of ply of pile yarn increases. Compression percentage decreases as the number of ply increases. Compression percentage increases as the yarn becomes finer. But thickness loss increases as the yarn becomes finer and the same decreases as the number of ply increases. Statistical analysis is also done considering compression percentage as response. ANOVA study shows that number of ply of pile yarn and fineness of pile yarn are both significant parameters to control the compressibility of tufted carpet. A model equation is suggested to predict the compressibility. A contour graph is also plotted to get the desired compression percentage with right combination of number of ply of pile yarn and fineness of pile yarn.

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Development Need & Methodology of Engineered Manmade Fibre Production

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Abstract

With the rapid industrialization globally, the demand for effective Engineered Flame & Heat Resistant textile material has increased disproportionately for both, Textile as well as the Technical textile sector. The most common way of producing a FR textile product is coating the fabric, treating the yarn or using FR fibres. In FR fibre manufacturing, there are two major routes: injection of FR chemicals into the polymer/ dope or using a different polymerization chemistry using FR monomers. In both the applications, the FR agents are usually halogens, antimony, phosphorus, alumina compounds, etc. However, there is a growing awareness among consumers for the above chemicals, which are to be certified by regulatory authority like REACH, Oeko Tex, FDA etc.

For industrial applications, the fibre should be resistant to acid, alkali, oxidizing agents, hydrolysis and solvents. Environmental norms and FR protocols are getting more and more stringent, focusing on emission of smoke and toxic gases when exposed to fire.

Next-to-skin garments require comfort, the ability to absorb moisture, dye-ability to different colours and hygiene properties such as antibacterial functionality. Different working conditions for example under extreme temperatures require good thermal insulation and poor thermal conductivity as well as being resistant to liquid Metal splash and UV light. When exposed to direct fire, the fibre and therefore the garment should not Melt, Drip or Shrink, which only comes with an exceptionally high fibre LOI value.

As of today, there is no single Manmade fibre in market, which can combine all these requirements together. So, there is a need to introduce the concept of an "Engineered fibre", which can provide all the functional characteristics and can demonstrate the product performance against established protocols for different end use applications.

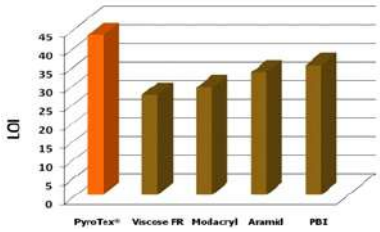
Man-made fibre → Chemical modification → Engineered Fibre

Engineered fibres have a wide variety of characteristics, multiple functions & applications and high performance. In recent past, most successful Engineered fibre in world market is the new generation PyroTex® fibre, which creates wide range of solutions for customers in innovative product development, not only in FR Personal Protective Equipment (PPE) segment, but also in Heat & Chemical resistant & Filtration, Public Transport (Aircraft, Train, Bus) & Building / Office / Auditorium internals and customized Technical end use applications.

PyroTex®

- Flame resistant – LOI 43
- Resistant to Acid / Alkali / Solvents / Hydrolysis / Oxidizing agents
- Heat resistant up to 250°C (continuous)
- Does not Melt / Drip / Smoke / Emit toxic fumes

Higher the LOI
Better the Flame Retardancy



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Aqueous phased electrospun bioactive glass incorporated Gelatin -Pectin composite fiber matrix for 7-dehydrocholesterol delivery

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Abstract
Ultrafine fibers and fibrous mat of gelatin-pectin blends are produced by electrospinning in aqueous phase. Gelatin-pectin blend acted as a template fiber composite matrix for the in situ mineralization of bioactive glass. Further, in situ mineralized bioactive glass in gelatin-pectin blend fiber acted as a site for 7-dehydrocholesterol i.e. a vitamin D precursor incorporation. This engineered fibrous mat resulted in the sustained release of the drug which is necessary for the strengthening of the neo regenerated bones. Bioactivity has also being evaluated on the proposed system.

Keywords
Gelatin-Pectin electrospun fiber, bioactive glass, 7-dehydrocholesterol

3d Virtual Technology for Customized Sports Textile Development

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Abstract

In recent times, Apparel fit has long been regarded as the most important element in clothing which is mandatory for the wearer of the garment. Good fit is crucial to clothing comfort, appearance and consumer satisfaction. Apparel fit is one of the most important factors that influence physical and psychological comfort of the wearer.

Especially in sportswear, the most critical function to be performed is the fit of the garment. Compromise in fit in sportswear may lead to psychological inconvenience which may lead to lack of concentration in sports and physical inconvenience which may lead to serious medical problems. For example wearing wrong size sports brassiere may not tend to provide adequate support for bust and it will lead to chest pain and even soft tissue damage.

To address the issues related to fit of active wear, this research work aims to study the influence of fabric areal density and pattern contours on the FIT of the women sports garment with the aid of 3D virtual software.

Knitted fabrics with three different areal densities i.e. 120 GSM, 160 GSM, 200 GSM have been chosen for the study. For pattern alteration, three different arm hole contours followed in industry and three different position of darts have been chosen. Patterns were developed for the measurement taken from female sports personnel. Twenty-seven patterned samples have been developed from the three varying parameters. Virtual avatar has been created from the sports personnel measurement in Lectra – Modaris 3D FIT software and all the sample patterns were simulated to check the FIT on the avatar. Based on the stress strain values obtained from the simulation software, the parameters such as areal density, arm hole shape and dart position were optimized to get the perfect fit on the customized avatar. Sportswear has been constructed from the optimized parameters; subjective evaluation is also done with a Shuttle Badminton sport player from Decathlon Sports to compare virtual and real FIT of the sportswear.

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Acknowledgment

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Energy Efficient Agrotextiles for Agricultural / Horticultural Applications

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Abstract
The demand for food is increasing with human population and conventional agriculture cannot fulfill food requirement with this acceleration. While environmental problems such as climate change, hail storm, rise in temperature / heat Waves, changing rainfall patterns and desertification have threatened agricultural productivity and food safety; the application of Agrotextiles in cultivation has provided sustainable solution to climatic hazards. The Agrotextiles protect crop from adverse weather conditions and influence the microclimate modifying the growing conditions of crops in comparison with the open-field climatic conditions. Sustainability of agrotextiles in protected cultivation can be increased with innovative covering materials aimed at obtaining energy savings together with profitable yield.

Indian farmers are affected in terms of availability of electrical power during the last few decades. The negative environmental impacts, reducing sources of fossil fuels and a high consumption of energy and food have caused the increase in demand for solar energy as a green and sustainable choice. The present study focuses on application of photovoltaic materials on polymeric fiber / yarn to harvest solar energy along with cultivation of crops using Agrotextiles so that not only the crops are protected from hazardous climate, but also electricity can be produced. The photovoltaic fibre/ yarn were developed by layered coating of the photovoltaic materials (like PEDOT:PSS, PCBM, P3HT, etc) on base HDPE yarn. The developed yarn was used in agrotextile shade net. The energy harvested at different time along the day has been recorded. The trends obtained during the laboratory trials for energy harvesting are shown in the table, the efficiency of energy harvesting has increased during the afternoon period and this may be due to the higher light intensity. Shade net is one of the potential agrotextile products which are used for protected cultivation, energy harvesting feature has been augmented to make it self-sustainable wrt in-house energy demand. The usage of agrotextiles with photovoltaic yarns would serve dual purpose of protecting the crops from adverse climate and production of renewable energy.

Sr. No.	Time (24 hrs format)	Temperature (°C)	Voltage (V)	current density [Jsc] (mA/cm2)	Efficiency η (%)
1	10:00	27	0.62	8.71	4.75
2	12:00	34	0.84	9.20	4.85
3	14:00	32	0.87	9.50	4.95
4	16:00	29	0.78	8.65	4.78
5	18:00	25	0.57	8.15	4.69

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Oil Spill Cleanup by Acetylated Nettle Fibers

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Abstract
Oil is a naturally occurring substance. Oil has been a part of the natural environment for millions of year. When oil is spilled on sea water, oil spreads for kilometers around causing major economic and environmental problems. In the modern era, the application of environmental friendly natural material for oil spill clean-up is highly appreciable than the synthetic one. Nettle is a cellulosic plant fiber which is abundantly available in tropical wasteland areas around the world. However, chemical modifications of these fibers such as acetylating of hydrophobic monomers, can impart them ability to absorb oil and the modified fibers thus can be converted into oil sorbents. In this study nettle fibers are acetylated with acetic anhydride using N-Bromosuccinimide as catalyst. Box-Behnken experimental design has been used to study the effect of various parameters such as time, temperature and catalyst % on the WPG (weight percent gain) and oil sorption. Nettle fibers were also characterized by FTIR, TGA and SEM.

Acknowledgment
The authors thank M/s University Grant Commission (UGC), Government of India for Sponsoring this Project under UGC Major Research Scheme (F.No-43-158/2014).

Antibacterial dyeing and printing of wool using natural dyes from Ratanjot

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Abstract
Ratanjot, a common natural dye used for fabric and food colorations has been used as an antimicrobial finish due to its bactericidal properties on dyed textiles. The suitability of printing wool fabric with this natural dye using pigment-printing technique has also been investigated. Dye was extracted in an aqueous medium at 1000C for 1 hour. Wool fabric was then dyed using this dye and effect of pH on the dye uptake was studied. The influence of pre- and post-mordanting with alum and ferrous sulphate has also been investigated in this paper. Beautiful prints were obtained when Ratanjot dyed fabric was printed with dye pastes of different pH. Qualitative assessment of antimicrobial activity of the dyed fabrics showed good results against E.coli and S.aureus, thus ascertaining a promising role in the field of medical textiles. Durability of dyed and printed fabric to laundering and light has also been discussed.

Zinc oxide nanowire reinforced Polyvinylidenefluoride (PVDF) filaments with enhanced piezoelectric property

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Abstract

Among the different types of smart materials, piezoelectric materials are the most widely used due to their fast electromechanical response. Ceramics are well accepted piezoelectric material. However in certain applications polymeric piezoelectric materials are suitable over the ceramic due to their unique properties such as processing flexibility, toughness, high strength and high impact resistance. Piezoelectric property in Polyvinylidenefluoride (PVDF) was first observed by Kawai. During his research, Kawai found a value which is about ten times larger than that had been observed in any other polymer. After this discovery, many studies on further enhancement in piezoelectric property of PVDF/nanofiller composite using various nanofillers such as amino modified double wall carbon nanotube, carbon black, multiwalled carbon nanotube and ZnO nanoparticle have been reported by researchers.

The increase in aspect ratio of nanostructure helps to induce and retain the alignment of polymer chain to fibre axis due to higher degree of interaction with polymer chain along their length. In this study, PVDF/ZnO nanowire hybrid composite filament has been prepared by melt spinning process to increase the piezoelectric property of PVDF, further, to make it suitable for different applications. Standardisation of nanowire loading percentage has been done based on the β phase content in the filament. Significant increase in β phase content and in piezoelectric property was observed in the prepared composite filament compared to the normal PVDF filament. Effect of various spinning parameters such as melt draw ratio, draw ratio, drawing temperature and hydrophobic functionalization of nanowires on the β phase content was investigated. The β phase content was analysed using the wide angle X ray diffraction and FTIR spectroscopy. Based on the above studies, it is confirmed that increase in aspect ratio of nanostructure and use of ZnO, a piezoelectric material helps to enhance the piezoelectric property of PVDF/ZnO nanowire composite filament. Experimentation on its application as a flexible sensor is in progress.

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Influence of Inlay Yarn Density and Fabric Structure on Air and Water Vapour Permeability Properties of various Elastane yarn Knitted Rib Fabrics

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Abstract
The flat bed double knitted rib fabrics were used to investigate the air and water vapour permeability properties. The inlay-elastane yarns (rubber, Lycra® and Lycra® wrap) inserted fabrics were produced with varying inlay yarn density and fabric structures. Three rib knitted structures (shown in figure 1a to 1c) developed with varying knit and miss stitches contribution such as 100K:0M, 87.5K:12.5M and 83K:17M are used as ground structure and three inlay yarn insertion frequency such as 2 course, 4 course and 6 course were adopted for this study. The air permeability and water vapour permeability results were obtained from standard testing methods and procedure. Design expert V.11 software is used for the experimental design and statistical analysis. Based on the test results, the inlay yarn type influences more on air permeability and water vapour permeability of rib knitted fabrics.

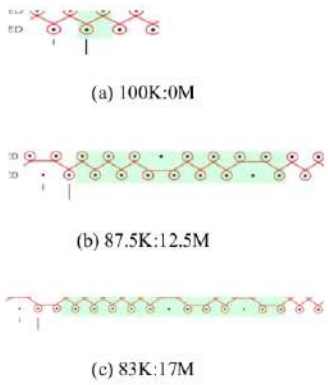

Figure 1: Needle representations for Rib knitted fabrics

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Graphene Oxide: A Novel Synthesis Approach, Coated on Textile Material for Biosensor Applications

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Abstract
Wearable electronics are expecting most attractive valuable research field in recent years. It could be used in various field of applications like Sports, Healthcare monitoring, protective clothing etc. and this wearable electronics are embedded on textile materials because of flexibility, comfort, ready to make any desirable shape and durability properties. Graphene is 2D structured sp2 carbon atoms in monolayer. In recent years graphene material was used in my area due to its light weight, flexibility, high mechanical robustness, higher electric career mobility and environmental sustainability. In this work we synthesized graphene oxide (GO) by economic novel chemical method by using sugarcane bagasse with hydrogen peroxide and it is simple process than other methods like modified Hummer's method, chemical vapour deposition (CVD) method. Raman spectra, FTIR and XRD characterization results confirming the presence of GO. This GO goes further reduction process to convert to rGO and this is directly coated on textile material by Pad-Dry- Cure technique. rGO Coated textile material is used for biosensor applications.

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Properties of PPE after contamination and cleaning

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Abstract
Personal protective clothing PPE can be contaminated during the daily work. These contaminations can influence the protection function and can lead to additional risks to the health and safety of the workers. So personal protective clothing must be maintained, repaired or replaced so that it continues to minimise the risk to the worker who uses it. The conditions of the various washing and drying processes can influence the protective function and also the comfort. After all treatments it must be ensured that the protective function is given. If the reprocessing is done in industrial laundries and textile services, the protective function must be ensured by these companies. Sometimes dependent from the kind of PPE various special laundry processes are necessary to ensure the protective function. This talk will give an overview about research projects concerning maintenance of PPE. In various research projects, different clothing ensembles (e.g. fire fighter clothes, cool protective clothes, high visible clothes) were treated according DIN EN 6330 for household washing and DIN EN ISO 15797 for industrial laundry. The functionality and comfort parameters were proofed with different test methods according different standards dependent on the function of the protective clothes. Non-destructive methods are necessary to control the functionality during the lifetime of the PPE. The results show that the washing and drying process can have an important influence on the protective clothes. This depends on the textile materials, the connection of multilayer material, the washing and drying parameters (e.g. temperatures, process period, detergents, amount of water, pressure). In some cases, the protective function of the clothes must be reactivated or renew by an additional treatment. E. g. for fire fighter clothing the hydrophobic treatment is necessary in the last rinsing process and this process show a negative influence on the comfort. The insulation layer of cool protective clothing can be compressed during the washing and drying process and the thermal insulation decreases. So, it is necessary to find the right washing process parameter which show no or only a low influence on the product performance. One big challenge is to find new not destructive test methods for PPE.

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The author wishes to express her gratitude to Forschungskuratorium Textil e.V for financial support of the research project AiF-No 16676N provided from funds of Federal Ministry for Economic affairs and Energy (BMWi) via a grant of German Federation of Industrial Research Associations (AiF).

Thermo-physiological properties of Polyester-Cotton Plated Fabrics in relation to Fibre Linear Density and Yarn Spinning System

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Abstract

Clothing is considered to be second skin owing to significant influence on heat and mass transmission from human body to environment or vice-versa. Thermo-physiological properties of textiles are related to the thermal properties, air permeability, moisture management properties along with the drying ability of the textiles. Several fibre, yarn and fabric constructional variables play an important role in governing thermal, moisture vapour and liquid moisture transfer properties of textile structures and hence the overall wearer comfort. The present study attempts to engineer polyester-cotton plated fabrics intended for next to skin applications with correct combination of fibre linear density and yarn structure in inner and outer layers respectively. An increase in thermal resistance, air permeability and moisture vapor transmission rate, trans planar wicking, and absorbent capacity and decrease in thermal absorptivity was observed as the inner layer fibre linear density increased. Plated fabrics knitted with ring spun cotton yarn were warmer to touch characterized by low thermal absorptivity, had higher thermal resistance, air permeability and moisture vapor transmission rate. Fabrics when compared to rotor yarn counterparts were superior in liquid moisture transfer properties with high trans planar wicking. The present study therefore proposes the development of polyester-cotton plated knitted fabrics with coarse polyester fibre in the inner (next to skin) layer and ring spun cotton yarn in the outer layer to achieve wearer comfort involved in physical activity in cold and humid conditions.

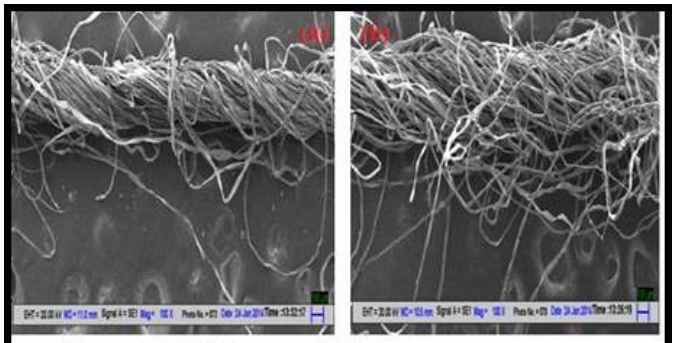

Figure 1 SEM images of (a) Ring (b) Rotor spun yarn

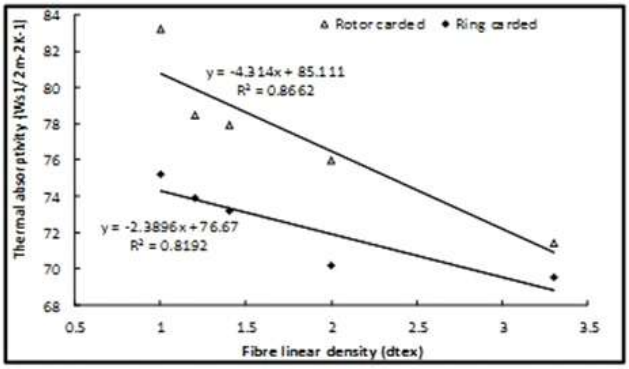

Figure 2- Thermal absorptivity of ring & rotor yarn fabrics with varying polyester fibre linear desnsity

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Combined dyeing and finishing of silk fabric using Bauhinia vahlii bark extract: An ecofriendly approach

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Abstract
In the current context of environmental contamination due to disposal of textile-manufacturing waste, substitution of synthetic dyes & chemicals with bio-colour or bio-extract is a big confront. Thus, the need of the hour is to develop green chemicals or dyes for sustainable textile processing with an eco-friendly approach. Extraction of colorants from natural substrates and its application on textiles has drawn considerable attention in recent past. Several studies on the extraction of natural dyes and its application on textile fabrics have been carried out and in most of the cases a metal salt based mordant and synthetic axillaries are used to fix the dyes on textile fabrics. Applications of these metal salt base mordant and synthetic axillaries retards the sustainability of textile processing.

In light of above, a bio-colour has been extracted from Bauhinia vahlii bark and was applied on silk fabric without using any metal salt based mordant and synthetic axillaries. The bark of Bauhinia vahlii creeper was collected from Simlipal forest, Odisha and dried for extraction of colour. The extraction process was carried out under optimized [M:L ratio, temperature and pH) condition. In this process, the dried bark was immersed in distilled water for 24 hours with varied M:L ratio (1:5, 1:7 & 1:10) and pH (3, 7 & 10) and was heated for 2 hours at varied temperature (45-50oC, 65-70oC & 90-95oC). Then, the extract was collected by neutralization. The concentrated extract was applied on the degummed and beached mulberry silk fabric at room temperature, 65-70oC and 90-95oC respectively for 45 minutes. Moreover, bio acids (citric acid) was also applied to enhance the shade depth and significant results were obtained for all treatments (Fig.1). Further, colour fastness to washing, crocking, dry cleaning, sublimation, perspiration and light properties of the dyed fabrics were analyzed.

Notably, fabric samples were also tested for their color value, crease recovery, stiffness and drapability. Satisfactory results were found in all cases. Report (Das et al., 2013) suggested that, the Bauhinia vahlii bark extract is a potential antimicrobial agent and depicts satisfactory result.

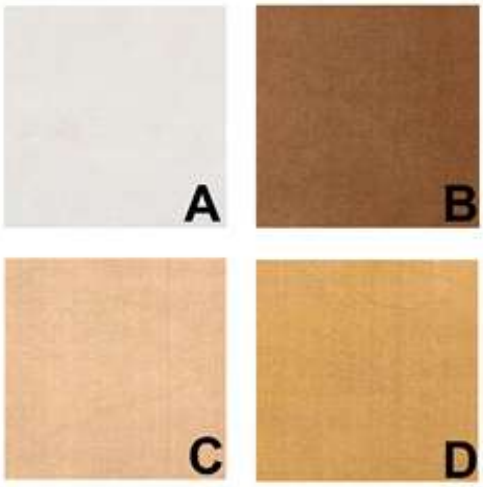

Fig.1 A- Control fabric, B, C & D – Dyed with extract in different condition

However, the bio-colour or bio-extract dyed fabrics was not evaluated for its antimicrobial efficacy. In this research, it was observed that the bio-colour or bio-extract dyed silk fabric has broad range of antimicrobial activity against various Gram +ve and Gram –ve bacteria. Further experimentation is highly indispensable for validation of the research work.

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Numerical Study to Analyze Effect of Fabric Radiative Properties on Heat Transfer and Protective Performance

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Abstract

Thermal protective clothing is used to safeguard people from high heat exposures involving fire and radiant heat. Development of reliable and accurate heat transfer model is essential to understand heat transfer mechanisms and to develop light weight and effective thermal protective clothing. A three-dimensional conjugate heat transfer model is developed for thermal protective clothing which can be used to analyze heat transfer and fluid flow in the clothing system as well as to predict skin burn injuries. Radiation plays an important role in overall protective performance of the clothing in such high heat conditions. It is thus important to determine effect of radiative properties of fabrics used in thermal protective clothing on their protective performance. So, in this study, effect of fabric emissivity and extinction coefficient is analyzed on heat transfer through the clothing system and on the second degree skin burn time (i.e., protective performance of the clothing). It is found that the fabric emissivity affect the heat transfer through thermal protective clothing system significantly. Protective performance of the clothing increases as the fabric emissivity and extinction coefficient increases.

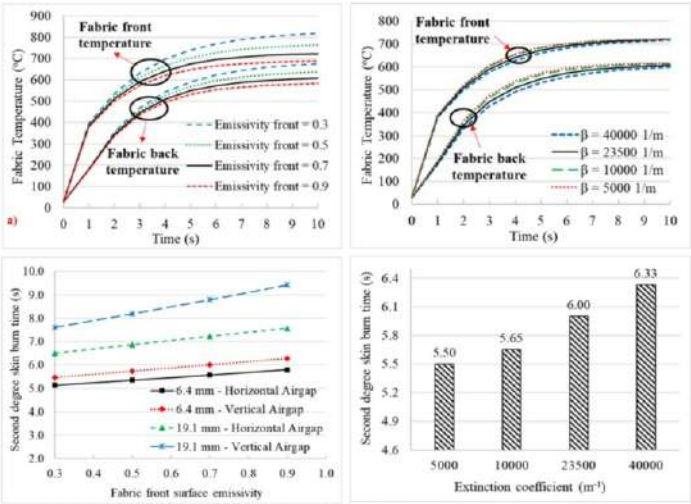

Figure 1: Fabric temperatures for different (a) fabric emissivity and (b) extinction coefficient. Second degree burn time for fabrics of different (c) emissivity and (d) extinction coefficient.

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Adsorption and Kinetics of In-situ Chemical Polymerization of Polypyrrole onto Textile Substrates

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Abstract

Adsorption at the liquid-solid interface is widely used by the textile industries in processes such as dyeing, finishing, wastewater treatment etc. This phenomenon has been successfully employed to adsorb and polymerize pyrrole on the surface of textiles. An effort has been made to investigate the interaction between textile material and polypyrrole for formation of self-assembled layer of polypyrrole on textile surface. It is found that, the different textile fibres such as cotton, silk, wool, polyester, nylon, polypropylene etc. has dissimilar influence on the kinetics of in-situ chemical polymerization of pyrrole. Some of these fibres show great influence on the reaction kinetics attributing to significant chemical interaction with polypyrrole resulting durable electro-conductive textiles. Unlike metals, these durable electro-conductive textiles are strong, flexible, durable, polymeric and light-weight. The most superior qualities of these novel electro-conductive textile are that their conductivity can be tailored as per the requirement to suit any specific application and even they can alter their resistivity in various stimuli such as strain, torsion, pH, humidity etc. These qualities of the fabrics make them suitable for various novel applications as such as sensors, heating garment, EMI shielding, etc.

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Adsorption and Kinetics of In-situ Chemical Polymerization of Polypyrrole onto Textile Substrates

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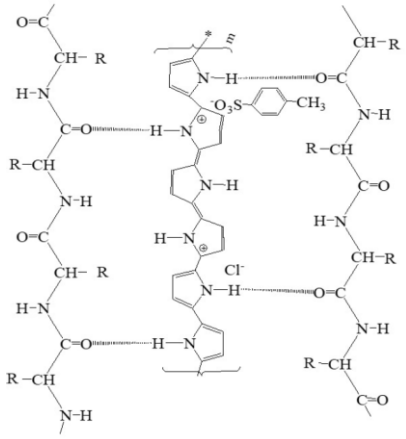
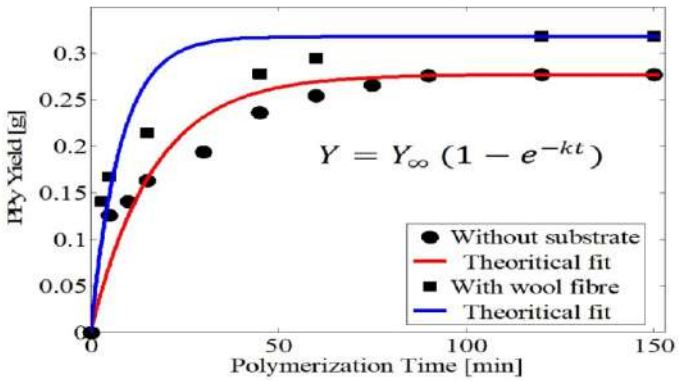
Abstract

Adsorption at the liquid-solid interface is widely used by the textile industries in processes such as dyeing, finishing, wastewater treatment etc. This phenomenon has been successfully employed to adsorb and polymerize pyrrole on the surface of textiles. An effort has been made to investigate the interaction between textile material and polypyrrole for formation of self-assembled layer of polypyrrole on textile surface. It is found that, the different textile fibres such as cotton, silk, wool, polyester, nylon, polypropylene etc. has dissimilar influence on the kinetics of in-situ chemical polymerization of pyrrole. Some of these fibres show great influence on the reaction kinetics attributing to significant chemical interaction with polypyrrole resulting durable electro-conductive textiles. Unlike metals, these durable electro-conductive textiles are strong, flexible, durable, polymeric and light-weight. The most superior qualities of these novel electro-conductive textile are that their conductivity can be tailored as per the requirement to suit any specific application and even they can alter their resistivity in various stimuli such as strain, torsion, pH, humidity etc. These qualities of the fabrics make them suitable for various novel applications as such as sensors, heating garment, EMI shielding, etc.



Hydrogen bonds between wool and polyrrole



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Synthesis of zn/zr Dopant M Type-hexagonal Ferrite Material for Em Shielding of Textiles

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Abstract

From last few decades M-type hexaferrite (Ba,Sr, Pb) have gained much attention due to their exceptionally high magnetic, good dielectric properties and chemical stability. These materials find application in every sphere of life such as simple loud speaker magnet, refrigerator door magnet, magnetic hose, microwave devices, electromagnetic shielding devices, MRI, NMR, magnetic recording devices and super capacitors. We can improve the properties of M-type hexaferrite materials and increases its application area by substituting Ba,Sr,Pb or Fe with different types of cations. Different techniques were used for synthesis of M-type hexaferrite of nano dimensions such as the solid-state method, the co-precipitation method, glass crystallization method, aerosol synthesis, modified pechani method, milling method, citrate precursor method, molten-metal method, solution-combustion method, sol-gel-auto-combustion method. Among these techniques the sol-gel-auto-combustion method have many advantages over other techniques such as simple, no sophisticated instrument, low temperature, uniform grain size and low cost. During present work, we have synthesized a series of $BaZn_xZr_xFe_{(12-2x)}O_{19}$ ferrites (x= 0.0, 0.2, 0.4, 0.6, 0.8 and 0.10) using sol-gel auto combustion method using citric acid as fuel and precursor was calcined at 900°C for 6 hours. These compounds were characterized by FTIR, XRD, VSM, UV-Vis-NIR Spectroscopy, Raman Spectroscopy, FE-SEM and EDX. XRD data of Barium hexaferrites material reveals pure phase and have no traces of intermediate phase such as α/γ –Fe2O3.and BaCO3. The crystal size of barium hexaferrites series ranging from 25.4 to 39.3 nm and average size of particle is 31.5 nm. FTIR analysis shows that no residue carbon was present in the calcined barium hexaferrite material. Magnetic measurements reveal that the values of coercivity ranges viz Hc 4875Oe (x = 0) to 956Oe (x=1). The saturation magnetization (Ms) values are in the range of 58.3 to emu/g.

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Developing Chemical Protective Work Wear Fabric for Workers Working in Chemical Industries

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Abstract

The workers working in chemical industry have to do various tasks like loading and unloading of chemicals, transportation of various chemicals from one place to other, pouring of chemicals from one container to other, mixing of chemicals together to convert them in to resultant product etc. In India, there are numerous numbers of chemical manufacturing units, which are involved in production of wide range of chemicals. These chemical manufacturing units employed large number of skilled and unskilled work force. These workers are always in risk of chemical hazards, which includes exposure of skin with chemicals which resulted burn injuries. The skin injuries of these workers can be reduced by providing chemical protective work wear. In India, still there are large numbers of such units, which do not provide suitable work wear to these workers. The aim of the study is to develop chemical protective work wear fabric. For this purpose, 21 fabric samples were developed with three different weaves and three types of yarn. The samples developed were analysed for protection against chemicals, comfort and durability properties Figure 1a) & 1b). These samples were finished with two types of chemical finishes to impart chemical protection properties. The finished samples were again analysed for protection against chemicals, comfort and durability properties. With this study a suitable chemical protective work wear fabric was developed.

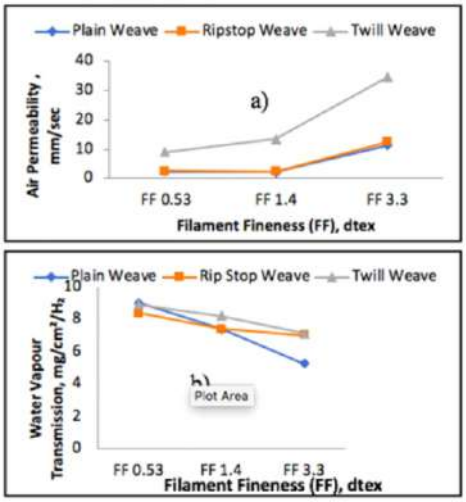

Figure: 1 a) Result of Air Permeability; b) Result of Water Vapour Transmission

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Chemical Bath Grown Nickel Oxy-Hydroxide Nanoflower on Cotton Fabric for Ultraviolet Filter and Gas Sensing Applications

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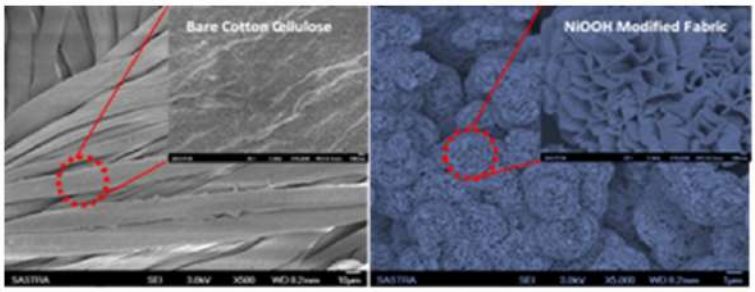
Abstract

Technical textiles find applications across various fields including agriculture, biomedical, sports, clothing, packaging, defense, etc. Integration of multifunctional nanomaterials with textiles could be a significant value addition to the bright future of this growing smart technology "Technical Textiles". Development of textiles with anti-electromagnetic radiation and in particular anti-ultra violet features could be one of the best solutions to the ozone depletion induced ultraviolet pollution of the environment, which is a major concern in the context of surging skin cancer cases. In this background, multifunctional nanoflower structured nickel oxy-hydroxide (NiOOH) material was grown on cotton fabric using chemical bath deposition technique for the development of UV filter and gas/chemical sensor. The structural, morphological, optical, super-hydrophobic and thermal characteristics of the surface modified cotton fabric were investigated using X-ray Diffractometer, Field Emission Scanning Electron Microscope, X-ray Photoelectron Spectrometer, Fourier Transform Infrared Spectrometer, Goniometer, Differential Scanning Calorimeter and Thermogravimetric Analyzer. Further, Ultraviolet Protection Factor (UPF) of the NiOOH nanoflower modified cotton fabric was measured using UV transmittance analyzer adapting the AATCC 183:2004 standard. The enhanced absorbance of ultraviolet rays at 388 nm resulted in the UPF of 1995. The chemical / gas sensing features of the functional textile were explored using the custom-made gas testing facility. NiOOH modified cotton fabric showed a selective response towards ammonia with fast response and recovery times of 2 and 26 s.



Keywords: Technical textile, Nanostructures, Nickel oxy-hydroxide, UV filter, Gas sensor

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Biodegradable Polymeric-based Microencapsulate for Value-Added Multifunctional Finishing of Linen

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Abstract
Essential oils are known for imparting various functionalities to textiles fibers; however, their topical application on the fabric results in limited durability of functional properties. In this work, thyme oil (TO) embedded functional microcapsules were prepared and characterized using FTIR, TGA, and SEM techniques. The microcapsules were utilized for multifunctional finishing of linen fabric. The finished fabric displayed efficient antimicrobial, fragrant and mosquito repellent properties which were found semi-durable against repeated launderings.

Keywords: Thyme oil; Microencapsulation; Antibacterial; Mosquito repellent.

3D Self-Assembled Tasar Fibroin Nonwoven Mats for Skin Tissue Engineering

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Abstract
This paper was focused on the regeneration of tasar fibroin in the form of electrospun 3D self-assembled nanofibrous nonwoven mats using two steps process. In the step one, the tasar silk fibroins were dissolved in ionic liquid and dialyzed against water. In the second step dialyzed tasar fibroin is dissolved in formic acid/CaCl2 solution before subjecting electrospinning. The silk fibroin concentration and spinning voltage affects the self-assembled structure of tasar nanofibrous nonwoven mats. Fourier transformation infrared spectroscopy was used to evaluate the secondary conformation of tasar fibroin protein. Scanning electron microscope was used to look the morphology of the nanofibrous mats. The self-assembled 3D tasar nonwoven nanofibrous construct was a highly porous and spongy structure with high water absorption and water vapor transmission. Highly porous 3D self-assembled tasar nonwoven nanofibrous construct favored good growth and proliferation of L929 skin fibroblast cells. Based on these properties, 3D self-assembled tasar nonwoven nanofibrous construct is a promising material for skin tissue engineering.

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Investigation on Mechanical Behaviour of Woven Fabric Hybrid Composite Laminates

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Abstract

In this research, hybrid yarns prepared from carbon and SS filaments using direct twisting machine have been made into woven fabric samples using sample loom. Various composite laminates have been made by sandwiching hybrid yarn fabrics between the polypropylene films in a compression molding machine at 180°C for 5 min. The structural changes in the fabric as well as mechanical properties of the composite were investigated. As the pick density and fabric's architecture are varied, the fabric cover and pore area distribution of the fabric are also varied. It could be observed that for 1/1 plain fabric, an increase in pick density from 3.9 ppcm to 6.3 ppcm increased the fabric cover from 87.8% to 97.25%. Similar results were found for other fabric structures. The mechanical strength of C/SS/PP hybrid yarn fabric and the composite has been evaluated using a Zwick Roell tensile tester. It has been observed that the work of rupture of C/SS/PP hybrid yarn was higher than pure carbon and stainless steel filaments. In the case of tensile behavior of a composite, 8 end float fabric composites showed highest tensile strength of 6990 N than 4 end float (6484.4 N) and 1 end float fabric composites (4804.9 N). The developed C/SS/PP composite can be used as electromagnetic shielding panels for attenuating radio and microwave frequencies.

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Coating of Cotton with Blend of Natural Rubber and Chloroprene Containing Ammonium Acetate for Producing Moisture Vapour Permeable Waterproof Fabric

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Abstract

Cotton fabric was coated with blend of natural rubber and chloroprene rubber containing ammonium acetate as the water soluble salt, employing a calender coating technique. Rubber formulations also contained filler, homozenizer and a typical sulphur curing system. Natural rubber and chloroprene blend in the blend ratio of 30: 70, containing 25 PHR sodium acetate, when coated on the fabric and vulcanized thereafter at 140oC for 3 h with subsequent dipping in aqueous solution for 45 min ,followed by drying in air, produced optimum results. Such coated, vulcanized , washed and dried cotton fabric showed optimum developments in the property profiles in respect of waterproofing, breathability as revealed by moisture vapour transmission rate , coating adhesion, tensile properties, abrasion resistance , flex endurance and fire retardancy. Incorporation of highly water soluble ammonium acetate salt in the coating formulation and their subsequent removal from vulcanized coated layer effected by post washing in consequent to dipping in the waterbath produced holes of only few microns in the coating matrix of the fabric.

Such microporous membrane formed on the cotton fabric allowed only transportation of moisture vapour through them giving a moisture vapour transmission rate of 3734 g/m2/24h, while acting as a barrier for large liquid droplet resisting 120cm of water column in hydrostatic waterhead tester, rendering the coated cotton fabric waterproof. Examination of surface morphology of vulcanized coating by scanning electron microscopy supported the mechanism proposed for development of breathable waterproof layer on cotton fabric by the process employed above.

An Overview of Oeko-tex Certification System

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Abstract
Textile industry uses a lot of harmful chemicals and materials that can cause damage to the environment as well as pose a serious threat to the safety of the end user of that textile product. Many of these chemicals have been proven to be carcinogenic, mutagenic and hazardous from the environmental perspective. Oeko-Tex is the world's leading certification system for textiles, leather and accessories that have been tested for harmful substances. It was introduced in 1992 and now

Product class I	Product class II	Product class III	Product class IV
Textiles and textile toys for babies and small children up to 36 months.	Textiles which, when used as intended, have a large part of their surface in direct contact with the skin.	Textiles which, when used as intended, do not come into contact with the skin, or only have a small part of their surface in contact with the skin.	Furnishing materials for decorative purposes
Baby garments, pajamas, sheets, stuffed animals, etc.	Trousers, stockings, T-shirts, shirts ,blouses, sheets, towels, etc.	Jackets, coats, neckties, outdoor goods, etc.	Tablecloth, curtain, carpets, cushion, chair tension cloth, wallpaper, etc.
Large	Degree of contact with skin		narrow

more than 10,000 producers in nearly 90 countries along the entire textile chain participate in the Oeko-Tex® certification system.

The Standard 100 by Oeko-Tex is a global independent testing and certification system for raw, semi-finished and finished textile products at all stages of production. The certification proves that the finished textile product is free from harmful substances (e.g. prohibited azo dyes, carcinogenic and allergenic dyes, phthalates, formaldehyde, pesticides, heavy metals, certain organochlorine and organotin compounds, biologically active products, flame retardants etc.). A product may only be Oeko-Tex labelled or certified if all the components meet the requirements.

This article highlights the special features of Oeko-Tex standard 100 and different product classes.

Nissenken is the only one authorized Oeko-Tex test institute in Japan. Since it joined the Oeko-Tex association in the year 2000, Nissenken has been certifying human-friendly textiles.

This article provides information about widely used harmful chemicals in the textiles industry in processes that range from cleaning or scouring of fibres, to dyeing, printing and finishing. We will explore their impacts on human health and the role of Oeko-tex towards assuring the safety of end user and environment.

Effect of ZnO Nanorods Grafting on The Impact Resistance Performance of Uhmwpe Fabrics

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Abstract

Soft body armor technology revolves around fabrics woven from high performance yarns. Of late, UHMWPE yarns have gained predominance over aramid yarns owing to their higher strength to weight ratio. The only disadvantage associated with them in context of ballistic applications is low coefficient of friction. During an event of impact, high friction contributes towards keeping the structural integrity of the fabric, generates higher resistance to the projectile, and leads to more involvement of secondary yarns; whereas, low friction causes slippage of primary yarns at impact center, thereby leading to easy penetration of the projectile [1].

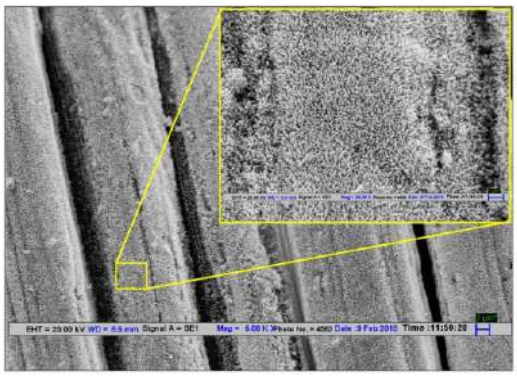
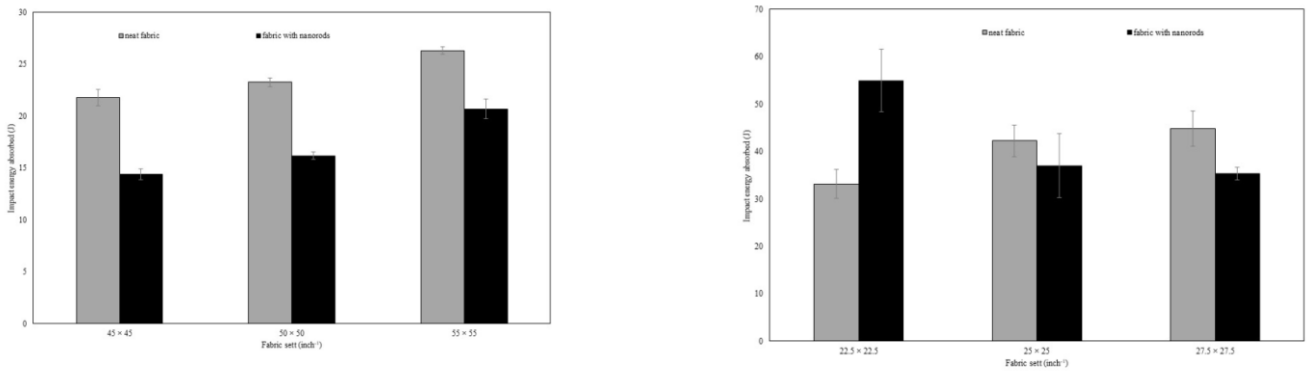


Fig. 1. SEM image of UHMWPE fabric grafted with ZnO nanorods

In this study, it was attempted to increase the inter-yarn friction by growing ZnO nanorods (in-situ) on plain 2D fabrics of different areal densities woven from 400 den and 1350 den UHMWPE yarns. Using hydrothermal method [2], hexagonal shaped ZnO nanorods of approx.100 nm diameter and 1 µm length were grafted on the surface of the filaments as shown in Fig. 1. The neat and ZnO nanorods grafted fabrics were then evaluated for yarn-pull out behavior and energy absorption at low velocity impact. As envisaged, grafting the fabrics with nanorods significantly increased their inter-yarn friction. However, as can be observed from Fig. 2, the contribution of this increment in inter-yarn friction towards absorption of impact energy was found to be beneficial/detrimental depending on the fabric structural parameters.



(A) *(B)*

Fig. 2. Impact energy absorbed by neat and ZnO nanorods grafted fabrics woven from (a) 400 denier yarn, and (b) 1350 denier yarn.

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Sacrificial Polymers for Rapid Vascularization of Multifunctional Polymers and Composites

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Abstract

Complex vascular architectures have been manufactured through removal of sacrificial templates embedded in polymer matrices using the Vaporization of Sacrificial Component (VaSC) technique.1 Prior work with VaSC required elevated temperatures (ca. 200 °C) and prolonged exposure times under vacuum, limiting application of the process to matrices that remain stable under these conditions. In this work, the feasibility of using cyclic-poly(phthalaldehyde) (cPPA) as a sacrificial polymer for rapid vascularization of polymers and polymer composites at lower temperatures is investigated. cPPA is a metastable polymer which depolymerizes completely into monomer units upon exposure to acidic or elevated temperature conditions.2 As a first demonstration, rectangular solvent cast cPPA films (15 mm x 5 mm x 300 μm) were embedded in a poly(dicyclopentadiene(DCPD)) matrix and depolymerized at temperatures ranging from 95 – 110 °C within 3-1 hours, respectively. Successful vascularization was confirmed by optical imaging and pumping fluid through the resulting channel. Next, we investigated a rapid vascularization process at room temperature with minimal energy requirement. An exothermic curing reaction front can convert a liquid or gel-state DCPD monomer into a solid matrix after a localized heat trigger using frontal polymerization (FP).3 When a poly(DCPD) gel with an embedded cyclic poly(phthalaldehyde) (cPPA) polymer template undergoes FP, the released heat is sufficient to concurrently degrade and volatilize the cPPA template during solidification of the host matrix (Fig. 1a-b). The cPPA degradation results in rapid formation of hollow microchannels inside the matrix without any additional energy (Figure 1c-e). Current research is focused on creating more robust melt-processed cPPA fibers and 3D printed scaffolds to expand the range of vascular architectures. This material system enables a new manufacturing process that is faster and more energy-efficient for making microvascular polymers and composites with properties like self-healing, self-cooling and electromagnetic reconfigurability.

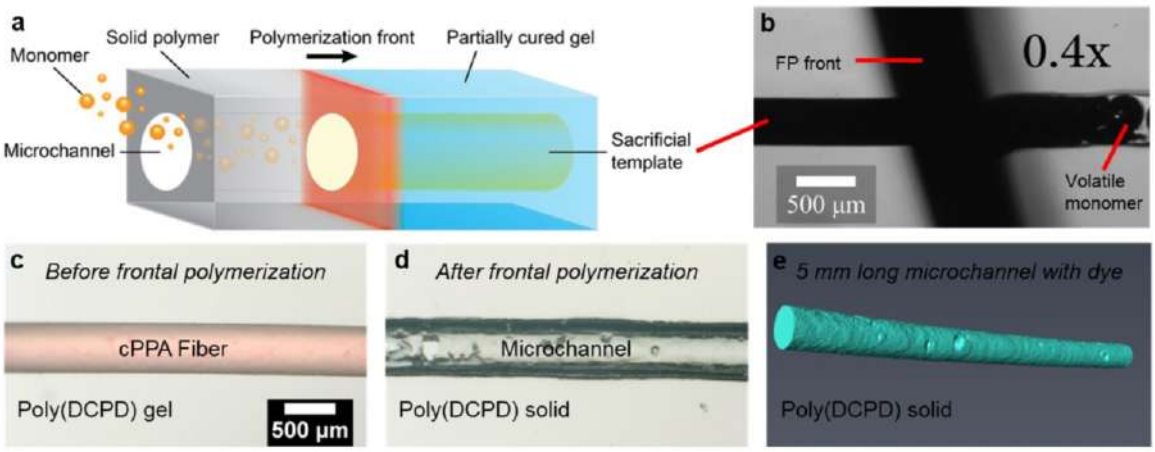

Figure 1 (a) Schematic and (b) video snapshot of cPPA fiber depolymerization in a rapidly curing poly(DCPD) during FP. Poly(DCPD) matrix with cPPA fiber template (c) before and (d) after FP. (e) Micro-CT of microchannel after FP.

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Development of Antibacterial Knitted Fabric From Nanocomposite Fibres

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Abstract

Textile materials have long been recognized as media which supports the growth of microorganisms such as bacteria and fungi. Antibacterial textile products are gaining popularity with time as the demand for fresh smelling and skin friendly fabrics is increasing. Nano-silver is one of the most popular agents for imparting antibacterial properties to textile materials [1-3].

Herein, the development of knitted antibacterial fabrics made from nano-silver embedded polyester fibers has been discussed. The aim of the work was to cover the entire domain of antibacterial textiles development starting from fibre to the end product, namely knitted textiles. Polyester-silver nanocomposite fibers were blended with normal polyester fibers in different weight proportions (10, 20 and 30%) to prepare 100% polyester yarns. Similarly, 50:50 polyester-cotton blended yarns were also prepared keeping the proportion of nanocomposite fibre at three levels (10, 20 and 30 %). Three parameters, namely blend percentage (wt%) of nanocomposite fibers, yarn count and knitting machine gauge were varied for producing 27 knitted samples, each from 100% polyester and 50:50% polyester-cotton. The antibacterial activity of knitted fabrics were tested against both Gram-positive (S. aures) and Gram-negative bacteria (E. coli) following AATCC 100-2004 method.

Result shows that the nanocomposite fibres impart very good antibacterial activity [Figs. 1-2]. Antibacterial activity increases rapidly with the increase in blend percentage of nanocomposite fiber [Fig. 3]. With 30% of nano-silver embedded polyester fibre, knitted fabrics demonstrated 90% or higher bacterial colony reduction. Higher machine gauge and coarser yarn count also have beneficial effect on antibacterial activity. The tightness factor and areal density of knitted fabric have good association with the antibacterial activity. Statistical analysis revealed that all three parameters (blend percentage, yarn count and machine gauge) were significant. Blend percentage of nanocomposite fibre was the most dominant factor in case of 100% polyester knitted fabric while in case of 50:50 polyester-cotton fabric; y e

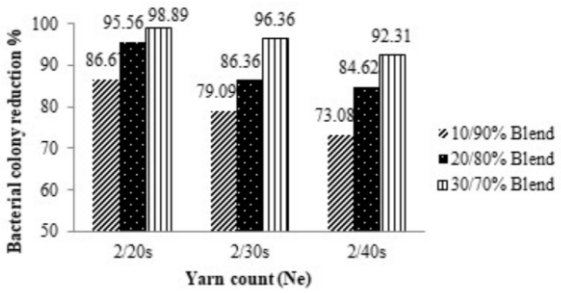

Fig. 1. Effect of nanocomposite fibre percentage and yarn count (for 20 npi) against E.coli in 100% polyester knitted fabrics.

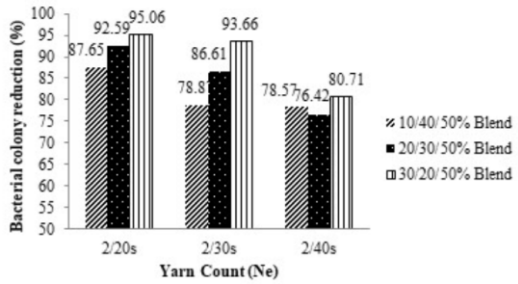

Fig. 2. Effect of nanocomposite fibre blend percentage and yarn count (for 20 npi) against E.coli in 50/50% polyester-cotton knitted fabrics.

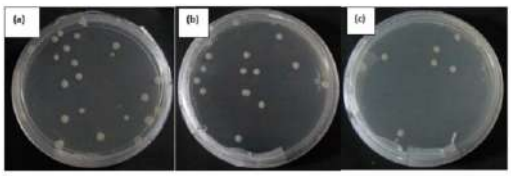

Fig. 3. Bacterial colony growth at different blend percentages of nanocomposite fibres (a) 10/40/50%, 2/20s, 12 G, (b) 20/30/50%, 2/20s, 12 G and (c) 30/20/50%, 2/20s, 12 G against E. coli.

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Polyurethane/clay nanocomposite films with enhanced helium gas barrier property

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Abstract

In this study, thermoplastic polyurethane (TPU)/clay nanocomposite films were produced by two different routes: direct melt-mixing and master-batch based melt-mixing, followed by film preparation by compression molding. In master-batch processing, 20 wt% clay loaded master-batch was prepared by solution mixing which resulted in the effective dispersion of clay platelets in polyurethane matrix. The prepared master-batch was further mixed with neat TPU for better exfoliation of clay-platelets in final nanocomposites, in comparison to the nanocomposites produced by direct melt-mixing. As a consequence, master-batch processing resulted in superior gas barrier and mechanical properties (tensile and tear) compared to direct melt-mixing. In both routes, two different organomodified clays [Cloisite 30B (Montmorillonite based) and Claytone APA (Bentonite based)] were used and their concentration was varied from 1-5 wt%.

The mechanical and helium gas barrier properties of TPU/clay nanocomposite films reinforced with both types of clay enhanced significantly compared to neat TPU film. Depending on the chemical nature of clay-modifier the interaction chemistry between TPU and clay changed which controlled the dispersion of clay platelets in TPU matrix and also the properties of nanocomposites. The presence of hydroxyl group in the clay modified of Cloisite 30B resulted in exfoliated nanocomposite structure up to 3 wt%, due to improved interaction between TPU and clay by hydrogen bonding. On the other hand, due to the absence of any polar group in clay-modifier, the Claytone APA reinforced TPU/clay nanocomposite films showed partially intercalated and flocculated morphology. As a result, TPU/Cloisite 30B nanocomposites showed much better mechanical and gas barrier properties than TPU/Claytone APA nanocomposite films. For both clays, up to a certain concentration of clay (3-4 wt%) good dispersion was obtained, while slight agglomeration was observed at higher concentration (5 wt%), which resulted in slight deterioration of properties. The TPU/clay nanocomposite films prepared by master-batch route showed about 39% and 32% reduction in helium gas permeability with 3 wt% loading of Cloisite 30B and Claytone APA, respectively. The experimental results of helium gas permeability were also compared with different model predicted results and a good correlation was found at the lower volume fractions of organoclay.

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Development of composite handmade paper using sugarcane baggase and other natural agro based fibres

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Abstract

The handmade paper industry in India offers considerable potential to meet the increasing demand for paper products in an environmentally sound way. People are moving to maximize the use of handmade and recycled paper to generate a reverse chain reaction. Locally available ecofriendly renewable resources viz., sugarcane bagasse, sisal fibre and maize husk have been used for development of composite handmade papers with different blend proportions (60:40 and 40:30:30). Extracted baggase fibres were subjected alkali treatment of NaOH at room temperature with 1:15 MLR for 6 hours and the processed fibres were further used for production of composite handmade papers using other natural fibres viz., sisal fibre, maize husk and knitted cotton rags . The selected fibres were stapled into required length and blended proportionately viz., baggase fibre: knitted cotton rags (60:40), bagasse: sisal: knitted cotton rags and bagasse: maize husk: knitted cotton rags (40:30:30) respectively. Based on the proportion all the fibres were mixed properly and soaked in lukewarm water for an hour. The blended stock was subjected to beating in a Hollander beater and a fixed quantity of pulp (180 GSM) was poured evenly on mould, then lifted using a lever mechanism followed couching, pressing and cutting. Further, developed composite handmade papers which were subjected to physical properties using TAPPI standards. Among the papers 60:40 bagasse/cotton handmade papers possessed significantly greater thickness, more uneven surface, low folding endurance with greater busting and tear strength than the composite handmade papers. Further, busting, tear and tensile strength was found to be greater in bagasse/sisal/cotton composite handmade paper (40:30:30) followed by bagasse/maize husk/cotton handmade paper than the baggase/cotton paper. Compared to bagasse/cotton handmade paper folding endurance was found to be good in bagasse composite papers. Among the blend ratios 40:30:30 (bagasse/sisal and maize husk/cotton rags) was found to be more suitable for production of handmade paper with optimum physical properties which can be suitable for production of various applications ranging from packaging materials to disposable paper plates. Thus, production of composite handmade paper is eco-friendly, bio-degradable, recyclable, the best in quality as well as utility with an affordable cost and above all it provides sustainable enterprise for rural artisans.

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"Study on multilayer foundation fabric used for manufacturing of flat tops"

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Abstract

Flat top is a perfect symbiosis of steel and fabric foundation. Foundation fabric for card clothing should have high tensile strength, less in elongation percentage, should have excellent elastic recovery and should support carding wires well to avoid cracks in foundation which affects the durability and working of flat tops. The foundation must serve two functions. It should provide a firm support for the hooks while ensuring sufficient flexibility. This flexibility allows a certain "evasion" of the hooks; however, they always return to their initial position. This results in consistently good carding during the entire service life of the flat top. The strength of the top from a carding point of view is in the foundation and is affected by the number of plies and the type of material used. Foundation fabric for flat top is manufactured by 6 layer of fabric and one layer of rubber. It is manufactured by standard procedure and requires fabric with specific requirements like weave; threads per inch, thickness of body and selvage should be same without any crease to be wound on a wooden roll of specific length and width. The manufacturing process also requires specific tensile strength, GSM. Such a 6 layer fabric and one layer of rubber of 0.5mm thickness are glued and calendared together to make final foundation of 3.2mm thickness.

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Innovative fibers for Smarter non woven Wipes from Birla Cellulose

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Abstract
With the highest standards of safety and purity, Birla Cellulose's nature-based man-made fibres are best suited for all non-woven applications. Birla Cellulose's range of fibres are superbly adaptable, with properties engineered to suit a vast range of applications. With high absorbency and unmatched purity, they are ideal for personal care, hygiene and medical applications. Antibacplus, Color Catcher, Birla Hope FR, Purosilk FM, Spunshades and Coarse denier are few engineered fiber for speciality applications. Color catcher is modified man made viscose fibre, with superior colour absorption properties, absorbs and traps loose dyes in your wash water, protecting your clothes against damage from color bleeds and helping preserve those vibrant original colors. .Antibackplus: A specially treated antibacterial fibre has been manufactured for exceptional protection and safety from bad odor causing bacteria. Purosilk FM is a fibre specially developed for face mask application, has an unmatched silky soft surface that pampers the skin. Where as a vibrant coloured, spun-dyed fibre that is made by placing colour pigments within the fibre itself. This results in a color that fully saturates the fibre. Also coarse denier fibers are best suited for industrial substrate applications. At Birla Cellulose, the team is dedicated to improving our products and processes, making eco-friendly innovations that create value for our consumers and partners

Development Of Sanitary Napkins From Biodegradable Materials

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Abstract
This project deals with the characterization and development of sanitary napkins from completely biodegradable materials. A sanitary napkin consists of three layers- top layer, bottom layer and the absorbent core. Viscose and bamboo spun lace non wovens are taken for the study and are characterized as per standards. The results obtained are optimized using One-way Anova and the non woven with the better results are chosen for the making sanitary napkin. Kenaf, Banana and flax fibers are chosen for the absorbent core because of their good absorbency and antimicrobial properties. The fibers are boiled for nearly 3 hours and are pulped using a Hollander beater in order to be made into a soft absorbent sheet. These three layers are characterized as per standards and are optimized using one-way anova. The absorbent sheets with better results are chosen for making sanitary napkin. Bioplastics made of starch and enzymes are chosen for bottom layer of the napkin. These bioplastics are characterized as per standards and are optimized using One-way Anova. The bioplastic with the best result are chosen for making sanitary napkin. The materials optimized and found to best from results are sandwiched to be made into a sanitary napkin. The produced sanitary napkin is tested as per BIS standards and is compared with commercial sanitary napkins. Thus the produced napkin is completely biodegradable and in par with the commercial sanitary napkin focusing towards a sustainable environment.
Keywords: Biodegradable materials, Characterization, Sanitary napkin, Testing, Sustainablilty

Biodegradable 3d Porous Polymeric Constructs Synthesized As High Internal Phase Emulsion Templates

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Abstract
3D porous polymeric constructs of biodegradable, biocompatible and bio-resorbable polymer, poly(ε-caprolactone) (PCL) have been derived as high internal phase emulsion (HIPE) templates. Oil-in-oil HIPEs were prepared by dispersing an olefin to continuous phase of HIPE comprising monomer, cross-linker, catalyst and stabilizer. Subsequently, continuous phase of HIPE was polymerized to obtain polyHIPEs (porous constructs) with shape similar to vessel in which the parents HIPEs were prepared. PolyHIPEs were purified through soxhlet extraction followed by drying and storage under vacuum. Scanning electron microscopic (SEM) images portrayed well defined pores and interconnections within porous constructs. Porous constructs showed characteristic recoverability under compression tests and associated with low to high Young's modulus depending on degree of cross-linking and dispersed phase volume fraction. Porous constructs prepared using HIPE templating have high potential to be used as implants in tissue engineering, selective sorption and separation.

Comparative Study of Natural Fibre Composite for Technical Application

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Abstract
Natural fibres with low density, biodegradable, recyclable and environmental friendly are abundantly used in all fields to replace polymers. Natural fibers has its origin from cultivated plants, animals and trees which have intrinsic properties such as low weight, cost, high specific strength, and specific stiffness. These natural fibres offer a number of advantages over traditional synthetic fibres. Natural fibres which have low specific gravity, tensile strength, high modulus which also offers renewability biodegradability and cost saving when compare to synthetic polymers and fibres. Some biodegradable fibers, flax, hemp, may provide the specific mechanical properties compared to those of the glass fiber, due to their high strength and low density of their volume. Due to these characteristics the replacement of the synthetic fibers with natural fibers has a wide range of technical application. Due to these characteristics, natural fibers have recently become attractive to researchers and scientists as an alternative method for protective textiles and fibers reinforced composites. This paper focused on combination of different properties of natural fibers (such as cotton, hemp, jute, bamboo and sisal) and its applications which were used to protective textiles and natural fibre composites. Also this paper study of mechanical characteristics of natural fibres and their application in composite and protective textiles.

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Effect of Frictional Characteristics of Wool in Industrial Textiles

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Abstract

Wool as a natural protein fibre with its unique characteristics property, to use wool successfully in technical applications requires a high-value application that can exploit its natural properties, a reduction in costs, or modifying the fibre to achieve a particular target performance. Wool is increasingly being used in technical applications in which its unique properties and the opportunities for specific enhancements can be profitably utilized. This paper examines wool's attributes for technical textiles and introduces a wide range of new and future applications. Wool has a directional frictional effect (DFE) which results in friction under applied force of action. Wool fibre with its structure of cuticle cells is the main reason for surface friction. When the fibres are rubbed along with scale or against the scale leads to friction. A ratchet mechanism, however produce DFE, as a result of interaction between the tips of scales and asperities on the other scales, due to frictional behavior its slides past each other and polishes the abrasive surface. When the fibers are slide part on the other surface due to (DFE) scales rubbed against the surface which assists in polishing. Also due to the interlocking of scales which involves ratchet mechanism, is considered as a merit for polishing of rough surface such as leather. In this paper study of DFE characteristics of wool fibre in the form of woven woollen cloth and its various applications in industrial textiles.

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Seeded Zinc Oxide Growth on Soft Matter Substrates

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Abstract
Durable and effective incorporation of metal oxides onto soft matter substrates such as textiles, has long been an issue for wider and long-term commercial use. However, such barriers can be circumvented by exploring novel seeding strategies, investigating new deposition methods and/or manipulating deposition parameters to tailor coatings for idealised properties.

The work presented here explores the effects of seeded growth of ZnO layers on soft matter substrates. Marked changes in both morphology and performance are observed as a result of the seeding layers, coupled with the metal oxide overlay. Optimised deposition conditions result in impressive coating properties, as well as substrate mechanical properties. Synthetic, compositional, durability and optical properties of these seeded systems will be presented. The variations in morphology and control of structure deposition will also be explored.

Findings and related properties prove superior to previously reported and/or commercial standards to date, in certain cases and offer great hope for solar control in textiles. Thus, the results will help advance the cause of UV- and heat-protective clothing of the future.

Chemical Bath Grown Nickel Oxy-Hydroxide Nanoflower on Cotton Fabric for Ultraviolet Filter and Gas Sensing Applications

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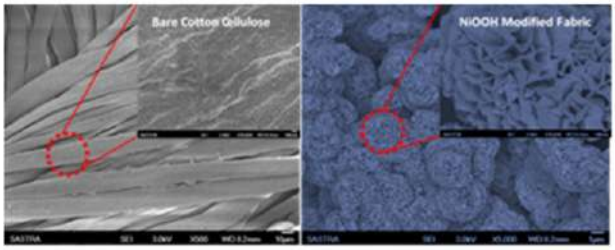
Abstract

Technical textiles find applications across various fields including agriculture, biomedical, sports, clothing, packaging, defense, etc. Integration of multifunctional nanomaterials with textiles could be a significant value addition to the bright future of this growing smart technology "Technical Textiles". Development of textiles with anti-electromagnetic radiation and in particular anti-ultra violet features could be one of the best solutions to the ozone depletion induced ultraviolet pollution of the environment, which is a major concern in the context of surging skin cancer cases. In this background, multifunctional nanoflower structured nickel oxy-hydroxide (NiOOH) material was grown on cotton fabric using chemical bath deposition technique for the development of UV filter and gas/chemical sensor. The structural, morphological, optical, super-hydrophobic and thermal characteristics of the surface modified cotton fabric were investigated using X-ray Diffractometer, Field Emission Scanning Electron Microscope, X-ray Photoelectron Spectrometer, Fourier Transform Infrared Spectrometer, Goniometer, Differential Scanning Calorimeter and Thermogravimetric Analyzer. Further, Ultraviolet Protection Factor (UPF) of the NiOOH nanoflower modified cotton fabric was measured using UV transmittance analyzer adapting the AATCC 183:2004 standard. The enhanced absorbance of ultraviolet rays at 388 nm resulted in the UPF of 1995. The chemical / gas sensing features of the functional textile were explored using the custom-made gas testing facility. NiOOH modified cotton fabric showed a selective response towards ammonia with fast response and recovery times of 2 and 26 s.



Keywords: Technical textile, Nanostructures, Nickel oxy-hydroxide, UV filter, Gas sensor

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Poster Presentation

Textiles In Buildings And Constructions

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Abstract
Already many lightweight membrane structures are in existence, and an increasing number of them are planned for the future. In this chapter different materials and coatings for textile membranes are introduced and discussed, which have to fulfil a wide range of properties. The main task of the membranes is to act as a barrier function against water, IR- and UV-radiation and excessive heat, and they should provide, amongst others, mechanical stability, light transmission and resistance to environmental impact.

Coated fabrics and foils, used for architectural applications, are presented in the first part of this chapter. The current fibres and coatings available on the market are described in detail according to their performance, the advantages/ disadvantages and current applications in architecture. The second part is focused on the most common typologies of tension structures, the design process and the comparison with conventional roofing forms. The main physical and digital techniques for form-finding, static and dynamic analysis, patterning and manufacturing are described in detail. Current trends indicate that ways of living will change due to longer life expectation, urbanization, scarcity of raw materials and energy resources and increased mobility leading to a need for flexible housing.1. 2. Using textiles in architecture can be energy efficient and economic: it is lighter to transport and easier to (dis)assemble. We are interested in an aesthetic approach to using textiles in architecture: textiles can i.e. be soft, foldable, elastic and they are available in a variety of colours and textures. We want to play with the sensory capacity of textile to give architectural spaces a different touch and feel. Our team of designers, architects and engineers at the Lucerne University of Applied Sciences and Arts (LUASA) is currently working on the project 'Stoffwechsel' ("textile change") with the aim to disclose the aesthetic potential of textiles in architecture. In this paper we focus on two sub-components within the 'Stoffwechsel' project: textile insulation and textile pavilion. We present the state of the art and key learnings from the project and end the paper with offering suggestions for further research.

Keywords: Coated fabrics Foils PVC PTFE ETFE Form-finding Force density Dynamic relaxation Patterning

Study on Coatings for Textile Substrate

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Abstract
Breathability is the implied need of the waterproof fabrics. When waterproof fabrics are used for protection from external climate of rainfall and wind, the user must also be protected from the heavy perspiration generated. This perspiration should be diffused out from the garments used in the form of water vapours, simultaneously. In this research work, we have tried to develop the waterproof breathable fabric from cotton as well as polyester by applying hydrophilic polyurethane resin by employing knife coating technique. The effect of % add-on on the properties of coated cotton and polyester fabrics with different GSM has been studied. The result of the effect is also analyzed statistically by calculating regression coefficient for each property.

Hydrophilic polyurethane resin can produce efficient waterproof breathable effect on both cotton and polyester fabric. As add-on increases, pore size reduces substantially and proportionately. Optimum result in terms of pore size, water vapour permeability, air permeability, bending modulus, flexural rigidity, thickness, % elongation has been obtained at 17.07% and 41.06 % add on for low coat and high coat in cotton fabric and 26.9% and 42.3 % add on for low coat and high coat in polyester fabric respectively. High coat produces better waterproof breathable effect on cotton as compared with polyester.
In case of cotton fabric, sample CC i.e. 90s × 90s / 62 ×44 with GSM 40 shows best result in terms of Air resistance, air permeability, pore size and water vapour permeability which are essential for waterproof breathable effect. In case of polyester fabric, sample PE i.e. 110s × 60s / 88 × 64 with GSM 41 shows best result in terms of Air resistance, air permeability, pore size and water vapour permeability which are essential for waterproof breathable effect.

Polyester fabric shows better waterproof breathable effect as compared with cotton fabric. Increase in GSM of fabric results in improvement in the properties of waterproof breathable coated fabric. Proper viscosity of the coating paste should be maintained so as to promote spreadability. The cost of coating for low coating is Rs.16/meter and for high coating is Rs. 24/meter irrespective of the type of fabric. Both polyurethane resin coated cotton and polyester fabric are suitable for application in moderate active-wear like bicycling, skiing, walking in adverse conditions.

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Does Fabric Type Determine It's Microbial Load? Assessment For Recommendation In Health Sector

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Abstract

Several studies have shown that healthcare apparel plays a significant role in the transfer of nosocomial infections in a hospital environment. Despite this, the norms have not been laid down in the medical sector in India for the type of fabric to be employed in hospitals. Studies performed on assessment of microbial load on fabrics have addressed the question by employing traditional cultivation-dependent methods for quantifying microbial load on textile surfaces, thereby introducing a bias in the quantification methodology. Besides, analysis of all three stages in textile processing (fibre, yarn and fabric) needs to be performed to get a better understanding of microbes-textile interaction. Hence the present study was designed to check for correlation between fabric type and its respective microbial load. Six different fibres (cotton, polypropylene, polyester, silk, wool and viscose) were incubated with an array of microorganisms Samples were collected at different time points and were enumerated for evaluating microbial load using dilution plating method. Scanning electron microscopy was also performed to get an insight into the binding pattern of different genera on fibres and fabrics. The bacterial cell surface were characterized by estimating the charge on theircell surface and hydrophobicity Further charge and hydrophobicity were also estimated on these fibres to derive a correlation. To target the total microbial diversity (not limited to only the culturables) a methodology for extraction of nucleic acid from fabrics has also been developed, which bypasses the need to culture microorganisms. 16S rRNA gene was employed as a marker to target the bacterial community. Community profiles were generated with the 16S rRNA amplicons from real life samples using the technique of denaturing gradient gel electrophoresis. Microbial community dynamics could be adequately studied. Hence the technique is believed to have a crucial application in the intensive assessment of total microbial load. The study is of utmost significance in recent context when there have been reports showing an increase in the number of multi-drug resistant bacteria in hospital environments.

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Pectin Based Edible Hydrogels For Nutrient Delivery

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Abstract

Incorporation of nutraceuticals–such as vitamins, probiotics, bioactive peptides, antioxidants and minerals etc. into edible systems provide a simple way to develop novel functional foods not only for physiological benefits but also to reduce the risks of diseases [1]. Recently, hydrogels have received great attention in the field of the drug and nutrient delivery through oral route [2]. It is well known that hydrogels of biopolymers have excellent biodegradability and biocompatibility with the living tissues present in the body. Among the existing bio- polymers pectin, which is a heteropolysaccharide found in the plant cell wall, finds increasing applications in the pharmaceutical and biotechnology industry. Further, it finds diverse food applications such as that of a gelling agent, stabilizer, and fat replacer. Most importantly, Pectin is intact in the upper gastrointestinal tract and degraded by colonic microflora. Thus, pectin-derived drug carriers provide promising potential for nutrient delivery [3].

The aim of the present work is to synthesis pectin based PEG crosslinked edible hydrogels to deliver nutraceuticals to the colon through the oral route. FTIR confirms PEG crosslinking with pectin was through hydrogen bonding. Further, these hydrogels were subjected to morphological characterization by SEM indicating presence of added nutraceuticals and upto 200°C thermal stability was observed for the various hydrogel samples using TGA. Thorough rheological studies on various pectin based various hydrogel systems were also carried out. Further, in-vitro release of nutraceuticals was also tested in simulated gastric fluid followed by simulated intestinal fluid.

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Preparation of guidelines and recommendations for developing standard test method for sanitary napkins

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Abstract

According to some estimates, only 12% women in India use sanitary napkins today, mainly because of lack of affordability, accessibility, awareness and disposability. The Ministry of Health and Family welfare is promoting menstrual hygiene among adolescent girls in a big way, to improve the health of Indian girls and women. The market for sanitary napkins is currently dominated by large multi national companies. In the last few years, some local companies as well as several NGOs have started manufacture and sale/distribution of sanitary napkins in the country.

The key component of a sanitary napkin is the central absorbent layer which is made from a natural cellulosic material (pulp). Premium products also contain, along with the pulp, a synthetic super absorbent material (SAP). SAP, while being highly effective in absorbing is very expensive and non-biodegradable, thus adding to the huge burden of landfills. However, no systematic study has ever been conducted to study the properties or effectiveness of the various types of sanitary napkins being produced and sold. No standards are available for testing, characterising or evaluating the absorbing efficiency of the absorbent layer.

In the current study, 8 types of sanitary napkins have been characterised in terms of their dimensions, construction and composition. Burette test, modified burette test and Gravimetric Absorption Testing System (GATS) were used to test the absorbency of the absorbent layer. Results indicate that sanitary napkins vary greatly in their physical and chemical properties as well as the composition of layers. The study also proposes an effective and simple laboratory test method for measuring and comparing the absorbancy efficiency of the absorbent layer.

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Antimicrobial Activity of Sidarhombifolia (SRF) Fibre for Medical Applications

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Abstract
Sidarhombifolia is a natural fibre which inherently posses antimicrobial agents that are anti-rheumatism, anti-asthmatic and anti- inflammatory agents. It has high medicinal value and has been investigated as a raw material for the production of non-woven fabrics for application in medical textiles such as healthcare products. The antimicrobial activity of Sidarhombifolia (SRF) fibre was tested on micro-organisms (Pseudomonas aeruginosa and Escherichia coli) by well diffusion method. The test shows good antimicrobial activity on both the micro-organisms. The results of phytochemical analysis of Sidarhombifolia fibre show that, it contains therapeutically active agents viz; alkaloids, flavonoids, sterols, carbonhydrates, saponin. The FTIR analysis of the fibres exhibits good strength and absorbance behavior. This medicinal fibre can be effectively utilized for the production of non-woven materials for healthcare products such as surgical masks, caps, compressions, bandages and wound dressing.

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Graphene oxide: A Multi-functional technology in smart textiles

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Abstract
The aim of this work was to introduce multi-functional properties into flexible cotton fabric especially for waterproof, Antibacterial, UV radiation protection, and electrical conductivity. Graphene is a flat monolayer of covalently bonded carbon atoms tightly packed into two-dimensional honeycomb lattice which possesses a number of extraordinary electrical, electrochemical, optical and thermal as well as mechanical properties. Here, I have synthesized graphene oxide by modified Hummer's method and used ultra-sonication method for better dispersion. Regarding these functions, graphene oxide and polyacrylic binder composites were applied on the surface of the fabric substrate by simple pad- dry- cure process with different concentrations. The effects accessed on these finished cotton fabric is evaluated through X-ray diffraction (XRD), scanning electron microscope (SEM) and Fourier transform infrared spectroscopy (FTIR). The Graphene oxide finished fabric shows the good multi-functional properties.

Keywords: Graphene, Smart textiles, Medical clothing, Electrical properties, Thermal properties, Cytotoxicity effects, Waterproof, Sport clothing.

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Shape Memory Polymer and its Applications in Textile

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Abstract

Shape memory materials are a group of stimuli responsive materials that can regain their original shape from a prior programmed temporarily deformed shape, when subjected to different external stimuli such as, heat , light , magnetic field ,moisture, pH and electric field. They may be broadly classified as alloys , ceramics and polymers. In view of superior expandability , recovery with adjustable key temperature and ease of processing of shape memory polymer to those of alloys and ceramics, shape memory polymers are conveniently and effectively integrated and/or applied into textile structure in order to make textile , functional and smart , for many applications following a cost effective route. In case of polymers , prior programmed deformed shape can be imparted to the material employing different means such as, by a sequential process of heating , deforming and cooling or by a process of cold drawing . Polymers known and reported to show shape memory effects are polyurethane , polysilamine , polyhydroxyproline , polynorbornene , trans polyisoprene , styrene butadiene copolymer , ethyl vinyl acetate copolymer , crystalline polyethylene etc. Some of the applications of such shape memory polymer integrated textile worthy of mention, are thermoresponsive clothing , clothing with dual functional properties of smart breathabilty and wettability , wrinkle free effect , deodorizer incorporated textile , fibres with high damping capacity , medical stockings , materials that adjust to the contour of the body , garments with dual functional properties of high water vapour permeability and UV resistance, self healing effect in engineering structure and others. This paper makes an attempt to review and summarise briefly principles involved, mechanisms therein and observed effects of some of such shape memory polymers that have already established potential applications in the area of technical textile. Various methods of fabrication of shape memory polymer integrated textile and their apparent limitations are also discussed in this article. The possibilities of extended use of some shape memory polymer integrated textiles in newer areas of application as envisaged by the scientific workers form also a part of discussion in the present paper.

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Thermo-mechanical Characterization of Shape Memory Knitted Textiles

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Abstract

Recent progress on smart materials is driving researcher to create novel textile product for various medical problems. Herein, we are utilizing the potential of an intelligent material, i.e. shape memory polymer, in the form of textile filament and then fabric structure for developing responsive textiles. The, shape memory polymer, by the name itself suggests that a material that remember its original or permanent shape that can be recovered from a temporary shape in presence of an external stimulus like heat (Figure 1a). This research explores the thermo- mechanical properties (shape fixity & shape recovery) of the shape memory filament and related knitted textile structure. Shape fixity and recovery of the memory textiles alters when used for multiple cycles (Figure 1b & 1c). A completely recoverable memory textile structure can be achieved only after a few initial cycles. Such textiles can be used for the development of custom sized pressure garments to encounter chronic venous disorders, such as oedema, leg ulcers and venous hypertension. Other related areas such as vascular, orthopedic, and neuronal can also be explored.

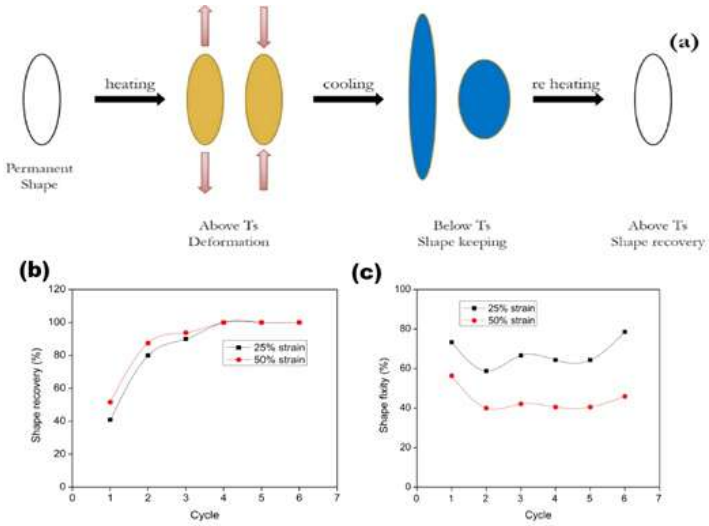

***Figure 1**: a) Shape memory effect; b) Shape fixity with number of cycle; c) Shape recovery with number of cycle*

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Functional Finishing of Cotton by Itaconic Acid with Citronela Oil in Presence of Sodium Tri- Citrate and Potassium Per Sulphate as Catalysts under Thermal Treatment

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Abstract
Cotton was modified using itaconic acid as the finishing agent in presence of potassium per sulphate (K2S2O8) and sodium tri-citrate catalyst separately or in selected combinations employing a Pad-Dry-Cure Technique. Treatment with 10% itaconic acid at 30° C and PH 7 produced optimum effects: batching time of 45-60 mins at 30° C followed by drying of the batched fabric at 95° C for 5 mins and curing of the dyed fabric at 140° C for 5 mins produced most balanced improvements in the textile related properties.

Sodium tri citrate allowed esterification of itaconic acid with cotton and K2S2O8 allowed radical polymerization of free itaconic acid or cotton bound itaconic acid moieties; the said processes ultimately led to some degree of cross-linking chain polymers of cotton. Simultaneously anti-microbial finish of itaconic acid cured d cotton fabric was achieved when citronella oil was included in the padding formulation. Such itaconic acid bound citronella oil present in the pad-dry-cured cotton showed anti-microbial activity even after 10 repetitive wash of itaconic acid finished cotton.

3d Knitted Spacer Fabrics

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Abstract
The differential characteristics of 3D speciality structured spacer fabrics offer more extensive conditions for varied applications including automotive textiles, home textiles, sport textiles, medical textiles, and technical textiles. 3D spacer fabric is comprised of an initial layer for moisture release, an interior layer for air flow, and a third outer layer for heat dissipation. These fabrics are produced through knitting or weaving technologies, among these technologies knitting is preferred for the production. The stable 3D structure of spacer fabrics encompasses scope for distinctive design and possesses special physical attributes. Spacer fabrics offer a viable alternative to address demands for home textiles with bio-climatic and hygienic properties and optimum conditions for preventing the build-up of moisture and heat close to the skin and for creating a skin-friendly micro-climate. Functional improvements coupled with good pressure-elastic properties and surface characteristics of spacer fabric made them suitable for the application of skin sensor technology.

Technical Textiles-automotive Textiles

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Abstract
Mankind knows textiles by generations. On a broad outlook it appears that textiles have no application other than apparel purposes. But as a matter of fact, there are non-apparel uses of textiles such as technical applications.
It is projected that nearly 45 square meters of textile material is utilized in a single car for interior trim (seating area, headlines, side panel, carpet and trunk). According to a survey, the percentage of textile in a motor car amounts to 2 per cent of the overall weight of a car. Apart from this, visible textile components, eliminating hidden components such as in tyres and composites, hoses and filters; amount to 10-11 kg per vehicle in absolute terms. Industrial textiles are largely utilized in vehicles and systems including cars, buses, trains, air crafts and marine vehicles.Nearly two third of the automobile textiles are for interior trim, i.e. seat cover, carpets and roof and door liners. The rest is utilized to reinforce tyres, hoses, safety belts, air bags, etc It is projected that nearly 45 square meters of textile material is utilized in a car for interior trim (seating area, headlines, side panel, carpet and trunk). According to a survey, the percentage of textile in a motor car amounts to 2 per cent of the overall weight of a car. Apart from this, visible textile components, eliminating hidden components such as in tyres and composites, hoses and filters; amount to 10-11 kg per vehicle in absolute terms. Industrial textiles are largely utilized in vehicles and systems including cars, buses, trains, air crafts and marine vehicles.Textile materials are used in automobiles for interior trim and for ensuring comfort (e.g. seat covers, carpets, roof liners, and door liners) as well as for reinforcement (e.g. tyre) and filters. Textiles also offer weight reduction which in turn results in fuel economy. Airbags help to save lives, but at times they can also be a source of serious injury. The search for a uniform smart airbag, which can perceive the size of the passenger or whether the seat is empty and react in that manner, is in progress. Such a 'smart' airbag will incorporate sensors to judge the weight, size and location of the car passengers and hence deploy more appropriately. In addition, incorporated safety devices associated with the seat belt along with other safety items, particularly for child passengers, are under development. The trend towards uncoated fabrics is anticipated to continue and so is the improved trend towards more airbags per car and full-size bags. There is also a technical challenge of producing the bag by using more rational techniques and related specifications made by the automotive industry.

Smart Chitosan Nanoparticles for Curcumin Entrapment and its Delivery

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Abstract
Chitosan nanoparticles are good drug carriers for drug delivery because of their good biocompatibility and biodegradability and can be readily modified. As a new drug delivery system, they have attracted increasing attention for their wide applications in loading of protein, gene, and anticancer drug. Our research focuses on synthesis of these novel curcumin loaded chitosan nanoparticles and their characterizations. Ionotropic gelation method was employed for synthesis of chitosan nanoparticles where 1% solution of chitosan was prepared using 2% aqueous acetic acid, simultaneously, 0.1% solution of TPP was dropwise added. Chitosan nanoparticles were spontaneously formed in the solution as white precipitates. These precipitates was deep freeze at -80C and then freeze dried until the complete drying of the nanoparticles. Curcumin loaded chitosan nanoparticles were synthesized by adding 0.1% ethanolic solution of curcumin and mixed in chitosan solution before addition of TTP solution in above process.

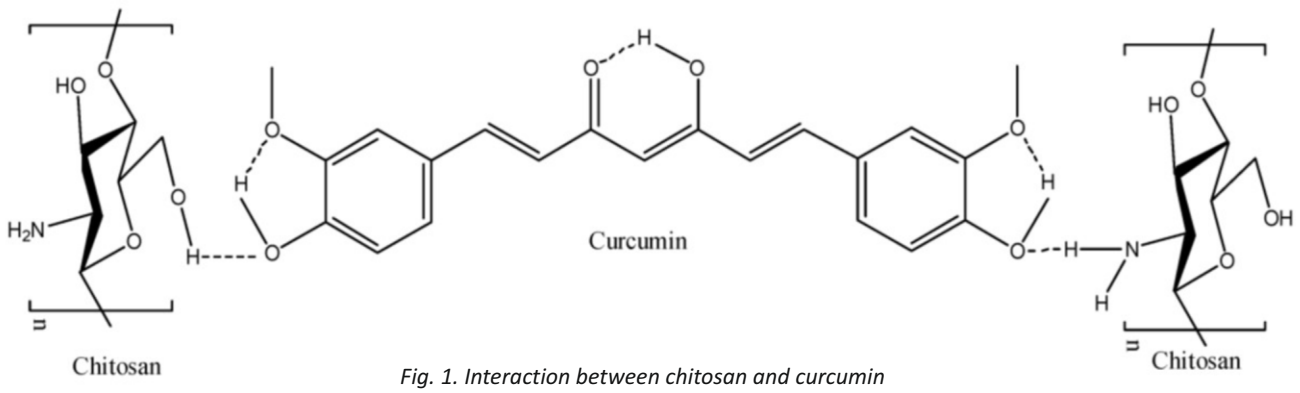

Fig. 1. Interaction between chitosan and curcumin

The loading of curcumin into chitosan nanoparticle is observe due to the formation of hydrogen bonding between curcumin molecule and two chains of chitosan molecules on both ends as shown in Fig.1. These nanoparticles are then characterized using various techniques like TEM and DLS spectroscopy. These curcumin-loaded chitosan nanoparticles could be used in drug delivery application and holds a great potential for their use in the future.

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Designing of Smart Nanogels of Tragacanth Gum For Anticancer Drug Delivery

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Abstract

Smart materials transmit and respond to stimuli against external factors by producing a useful effect. The smart polymeric materials respond with a considerable change in their properties to small changes in their environment such as pH, temperature, humidity and light. Smart materials can be either synthetic or natural. Polymeric nanostructured materials have been playing an increasingly important role to revolutionize the diagnosis and treatment of diseases. Polymeric nanostructured materials including micelles, polymersomes, nanoparticles, nanocapsules, nanogels, nanofibers, dendrimers, brush polymers and nanocomposites, can be prepared by various methods. Their properties, such as stability, size, shape, surface charge, surface chemistry, mechanical strength and porosity can be tailored towards the specific functionalities that are required to meet the needs of the targeted biomedical application. Polymeric nanoparticles made from natural polymers have received the majority of attention due to their stability and ease of surface modification.

Tragacanth Gum (TG) is a polysaccharide which has excellent biocompatibility, hydrophilicity and functionality. TG was functionalised by grafting of itaconic acid using chemical initiation process. This is a very attractive approach for incorporation of new features within the biopolymer without any significant loss of inherent properties of the substrate. These smart hydrogels have been used for the immobilisation of anticancer drug. The investigation of the immobilised nanoparticle have been undertaken by the different techniques.

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Nanofibrous Structure of Polyvinyl alcohol for Wound Dressing

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Abstract

Over the last 10 years, great research interest has been directed towards nanofibrous architectures produced by electrospinning of hydrogles with bioactive plant extracts. The resulting structures possess excellent structural integrity, porous three-dimensional strucutre, antimicrobial, anti-inflammatory, and anti-oxidant activities, which are attractive for various biomedical applications and food industry. In the present study, we used polyvinyl alcohol, a most biocompatible synthetic hydrogel which is frequently used in wound care system to drug delivery applications. Another component is lecithin, another biocompatible emulsifier and use for the dvelopment of stable emulsions. Among wide range of anitmicrobial agents, we choosen clove oil (herbal strong antimicrobal agent) for our work. Intially, different concentration of PVA solution was prepared and optimized the electrospinnig parameters for the designing of scaffolds. In further step, lectithin clove oil and Tween-20 (as co-surfactant) were mixed in water and stirred continously to make the stable micro emulsion. This solution is left to cool down and nanoparticles of lecithin and clove oil were formed by simple cooling of micro-emulsion. Finally, the colloidal solution of nanoparticles were mixed with PVA solution in required quantity and that solution is electrospun at different conditions.

Electrospun PVA and lecthin/clove oil web

These nanoweb were characterized using various techniques, SEM and TEM. The PVA electro spun nanowebs which contain herbal agents can be used in wound dressing and these are highly biocompatible and hold a great potential for their use in the future.

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Functionalization of Polyurethane for Development of Antimicrobial Catheter

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Abstract
Urinary catheters are medical devices which are bestowed to get relief from urinary retention and urinary incontinence problem. However this catheterization is accompanied by the catheter associated urinary tract infections (CAUTI) which is responsible for >40% of all episodes of sepsis in hospitals. Inherent antimicrobial catheter should be there to prevent it. Wide range of catheters is available in market, but polyurethane (PU) was adopted for the research because it is non-allergic in nature, non inflammatory, can easily be functionalized.

The aim of this study involves the development of antimicrobial polyurethane catheter by adopting the chemical functionalization route. Aminolysis using diamine was done to generate the amine functionality on the PU surface. Aminolysis developed hydrophilic character in the PU material. Surface functionalization was confirmed by various characterization techniques like contact angle, FTIR, Raman, SEM, AFM and functional groups was quantified using dye staining method.

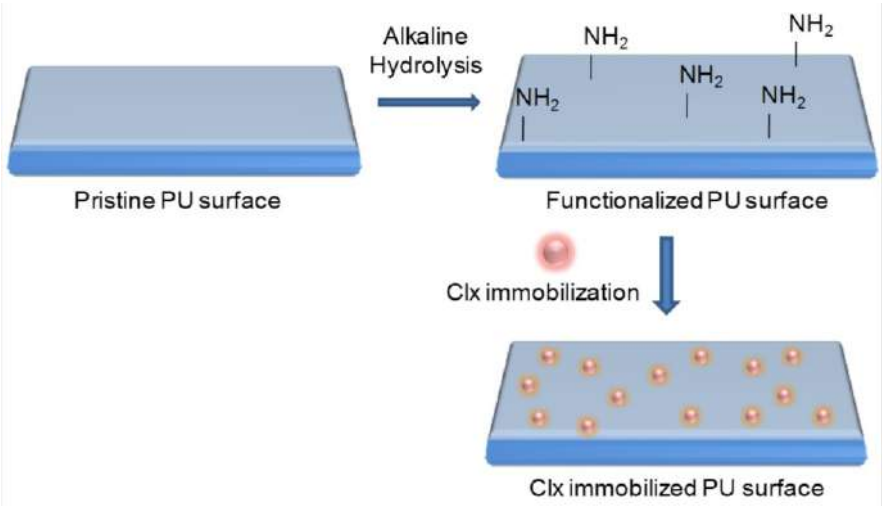

Fig: Aminolysis of Polyurethane

To develop antimicrobial nature in the catheter material we added chlorohexidinedigluconate as a bioactive agent. Different concentration of Clx as drug was immobilized on functionalized PU surface and immobilized surface was characterized by SEM and EDX analysis Bacterialcidal study of immobilized surface was investigated against both E. coli. and S. aureus and results shows that Clx drug don't allow any bacterial growth on surface. The antimicrobial activity of the material observed against common bacterial strain by zone of inhibition, bacterial colony reduction.

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Mechanical properties of Ramie/Polylactic acid (PLA) composites with Polyethylene glycol and halloysite nanotubes

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Abstract

Poly-lactic acid (PLA), a polyester derived from natural resources, has gained a lot of attention due to its biodegradable nature [1, 2]. As it is brittle and has poor thermal resistance, its mechanical properties need to be altered by some biocompatible modifiers [3]. In this study, effect of incorporation of halloysite nanotube as reinforcement and PEG as a plasticizer on mechanical and thermal properties of PLA was investigated. PLA was plasticized by low molecular weight polyethylene glycol (PEG-600) via solvent casting route using dichloromethane as solvent. Plasticized PLA was further blended with halloysite nanotubes (HNT) in solution stage and films were prepared. These films were used to prepare ramie/PLA composites by compression molding technique. Properties of these composites were investigated through tensile testing, three-point bending and differential scanning calorimetry (DSC). Morphology of the films were investigated through transmission scanning microscopy (TEM) and scanning electron microscopy (SEM).

Tensile results revealed that with 5% PEG and 10% HNT concentration (on weight of PLA) maximum tensile strength and bending stiffness were achieved. The glass transition temperature of PLA went down from 61o C to 51o C in case of ternary composite film of PLA. Tensile strength of ramie/PLA composite decreased by 46% from 78.14MPa to 41.93MPa while elongation at break was increased by 23% from 7 to 8.76%.

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An Experimental And Numerical Study on Tensile Behavior of Needle-punched Nonwovens

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Abstract

Nonwovens are the fibrous porous materials, usually found in the form of a flat sheet or thick fleece mainly composed of fibres assembled in the form of web. The fibres in the webs are consolidated by means of friction, along with cohesion/adhesion. The prepared nonwoven materials are used in many durable products by offering sufficient resistance to the mechanical deformation. Although a lot of tensile tests have been carried out on nonwovens but there exists only few scientific bases available onto which practical understanding can be built. The present work is focused to perform a finite element analysis on tensile behaviour of needle-punched nonwovens. The needle-punched nonwovens under in-plane tension is modelled as a plane truss structure where each fiber is considered as a 1-D bar element. A series of fibrous networks with varied levels of fibre crimp and fibre-to-fibre entanglements were generated using an in-house MATLAB code. Thereafter the effect of fibre crimp and fibre-to-fibre entanglement on the tensile strength of nonwovens is studied. Updated Lagrangian formulation is employed to simulate the progressive deformation of the nonwoven . Computer simulations are carried out on the grab test of nonwovens and the results are validated with experimental ones showing a good agreement.

Synthesis And Evaluation of Different Biopolymer-acrylamide Hydrogels

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Abstract

Hydrogels are hydrophilic organic cross linked polymers that form three-dimensional molecular structures and show the ability to swell and hold a large amount of water while maintaining their chemical structure and integrity.

Polyacrylamide based hydrogels have been extensively studied & commercialized for a host of purposes such as ophthalmic operations, drug treatment, food packaging products, and water purification. At the same time, biomass derived polymers such as gelatin, chitosan & sericin are known for their excellent biocompatibility, biodegradability and abundant availability. This study attempts to link these two ideas and quantitatively study them.

In this study, semi-interpenetrating networks of polyacrylamide & various biopolymers were prepared by firstly polymerizing the monomer through free radical initiation, then networking it with the biopolymer through chemical crosslinking. The samples were physically dried & crushed, and then subjected to experimentation.

These were investigated for swelling kinetics in distilled water at room temperature & relative humidity conditions. This was followed by quantifying their release kinetics at constant temperature of 38⊠. These two sets of data were used for comparative analysis of these hydrogels.

After this, copolymer hydrogel of polyacrylamide & sericin was dealt with in detail, characterizing the chemical structure through FTIR. The performance of this hydrogel was investigated by varying different parameters such as surface to volume ratio and pH, nature & concentration of the medium. All these parameters can potentially aid in optimizing the behavior of the hydrogel systems.

Quantitative analysis of the swelling mechanism in hydrogel was also attempted by understanding the underlying reasons for the non-fickian behavior of diffusion in the present polymer system. Finally, a potential application of this hydrogel in agriculture for controlled irrigation systems was studied. For the same, release kinetics study in locally procured soil medium was done. Swelling kinetics in natural fertilizer was also performed and studied for possible use as fertilizer systems.

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Extraction and Application of Wool Keratin on Cotton Fabric

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Abstract

Wool, being a protein fiber, depending on the region and other factoring has keratin of about 35 to 75 % of its chemical composition, rest of which are wax, suint, mineral matter and dirt. Wool is one of the purest form of keratin in all the biomass. Yet utility of wool waste for keratin and exploitation of keratin for various applications is not vast. Keratin is a filament forming protein of compact structure is a resource of greater potential. It is the durable fibrous protein found in epithelial cells. Even though there are vast applications exploring the possibility of usage of keratin in diverse fields, their consumption is very low and considerable amount of these products are wasted. Keratin's unexplored character is its UV resistance and flame retardancy. This research work concentrates on analysis and incorporation of the extracted wool keratin on cotton fabrics to explore the possibility of replacing synthetic UV resistance and Flame retardant compounds. Merino wool was procured and extraction of keratin from the same was done using Na2S and NaOH under 80°C for 3 hrs. Characterization of extracted wool keratin for structure analysis and acquisition of functional properties such as UV resistance, flame redardency, ability to act as dyeing additive was done. Treatment of extracted wool keratin on cotton fabric with and without fixing agent was carried out through pad-dry-cure process. Property analysis for fabrics treated by both the process for durability and functional performances was done.

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Nettle: A Novel Natural Fibrous Material for Oil Spill Cleanup Applications

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Abstract
In recent times oil/water separation has become a global task due to oil pollution as a consequence of oil spillage accidents and hazardous oily industry water. The oil spilled above water is removed using various techniques such as skimmer, chemical, bacteria, etc. But these techniques are harmful to the environment and time consuming. In order to a better one, the fibrous assemblies in filled or structured forms are being researched for their potential for oil spill cleanup. Nettle is a cellulosic plant fiber which is abundantly available in tropical wasteland areas around the world. Nettle also possesses advantages characteristics such as low density, stiffness, mechanical properties and renewability; moreover they are also recyclable and biodegradable. In the present work, 100% nonwoven nettle fibrous assembly has been produced using needle punching machine and investigated for its suitability in oil spill cleanup applications.

Acknowledgment
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Disposable Wet Wipes - A Sustainable Approach

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Abstract
Global market for technical textile industry is currently valued at around US$130 bn and disposable wipes nearly accounts for US$ 11bn. However, disposable wet wipes itself accounts for nearly 70% of total wipe market. Wet wipes are a specially engineered non-woven fabrics used to absorb, retain the dust and supply necessary moisture to surface. These wet wipes are essentially blended material uses fibers form both natural and synthetic polymer domain in definite proportion. The most dominant fiber in the wipes is polyester and viscose having high carbon footprints. This research study investigates the alternative solutions to develop pre-moistened wipes with zero or minimal environmental impact.
Keywords: Wipes, Wet-wipes, pre-moistened wipes,

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Development of Thermal Insulatiion Fabric Using Cluster-spun-yarn

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Abstract
The aim of this work is to produce a cluster spun yarn using siro-solo method.Cluster yarn is a type of composite yarn which is manufactured by a spinning frame which is retero-fitted with the spread slotted roller. Two rovings are fed as a sheath and filament as a core. In this method solo roller will divide the filament into sub-groups which is known as cluster. This clustering is done by means of fine grooves which is present in the solo roller. In this present work acrylics is used as a sheath and hollow polyester multifilament is used as core and converted into a thermal insulating fabric with enhanced properties. Cluster spun yarn will have better properties than the conventional core spun yarn because the core filament is uniformly distributed, so the yarn has even porosity which leads to have better thermal insulation. The basic properties of fabric are tested..

Keywords: siro spinning,solo roller, acrylic fiber, polyester multifilament.

Novel bio-based polyol for waterbore functional polyurethane coating on textile

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Abstract
Textile coating is widely used in technical textiles to impart functionalities to the textile materials. Polyurethane (PU) is one of the most widely used polymer in textile coating. Primary raw materials for PU synthesis are polyols and isocyanates. Polyols, derived from petroleum products, mainly consist of high molecular weight organic polymeric chains terminated by a hydroxy groups which are non-biodegradable. The application process of PU mainly involves the use of organic solvents which are hazardous to our environment. This necessitates the need for bio-based polyol and PU with water dispersible property.
In the present work, bio-based polyol was synthesized and used for synthesis of water-based PU. The synthesised polymer was coated on textile material and the coated fabric was evaluated for mechanical, thermal and functional properties. The synthesised polyol can be claimed as waterborne antibacterial ingredient for PU synthesis. The synthesised polymer can find applications in coating formulations of technical textiles utilized for outdoor applications

Keywords: Waterborne, Polyurethane, PU, Bio-based Polyol, Antibacterial

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Electromagnetic shielding behavior of different textile structures

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Abstract

Electromagnetic wave pollution or 'electrosmog' arises as a serious concern in this century after waste and noise pollution especially for circuit designers and it appears to become more severe in the future.

Shielding an electromagnetic field is complicated and intimidating process. This paper describes the mechanism of electromagnetic shielding and measurement of shielding efficiency in detail. The methods of electromagnetic shielding from conventional to the recently developed such as metalized textile fabric with woven, knitted and non-woven structures, coated textiles with conductive polymer, structures with incorporated high performance fibres, conductive polymer nano-composite, multilayer sets of textile and 3-dimensional network structure have been reported with their mechanism of shielding and relative merits and drawbacks In addition, some commercial products for electromagnetic shielding have been highlighted.

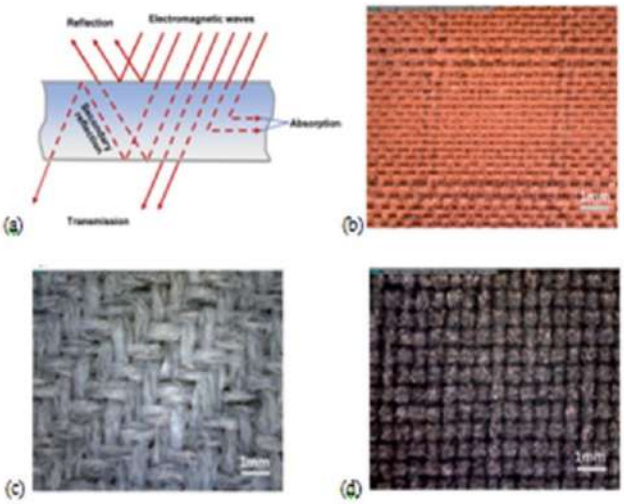

Figure 1: a) Mechanism of EMI shielding; b) Cu-Ag plated Nylon fabric;
c) Hybrid stainless steel and polypropylene structure; d) Polypyrrole coated polyester fabric

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Design and Development of Fibrous Based Material for Sound Absorption

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Abstract

Rising demand for good sound quality in auditoriums, music studios, and corporate workplaces are key factors driving the global acoustic insulation market size. The product not only curbs the ill effects of sound but also boosts the sound quality. The rapidly growing social conscience of people and the increase of machine noise in general have combined to give great drive towards the study and control of noise.Hence sound insulation in building is necessary. The source of noise is recognizable and it can be controlled by using absorbents. Audible range of frequency by human ear is 20Hz to 20KHz. The frequency is also classified as low(100-400Hz), medium(500-1600Hz) and high(2000-6300Hz). Among this, textile Materials can able to absorb high and mid frequency sound waves. It is still a problematic one to absorb the low frequency sound waves, which reduces the clarity of sound in the concert halls. Commercially available sound absorption panels can able to absorb low frequency sounds with increased thickness. So this research work mainly aims to develop a fibrous panel with various parameters like, using different fibre densities, by combining different layers of fabric from different manufacturing technologies,etc., which can able to absorb both high and low frequency sounds at reduced thickness and study their sound absorption characteristics using sound impedance tube method.

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Development Of Hybrid Structure Non Woven With Coir & Film For Broad Frequency Range Acoustic Absorption

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Abstract

Human hearing sound level is 20-2000Hz. Noise level higher and lower than this range affects the ear functioning like psychological and physiological aspects. Textile sectors generate both lower and higher frequency noise. So good sound absorption material is necessary for spinning, weaving and processing sectors for comfortable working. Textile porous absorber materials arrest higher frequency sound is not good in lower frequency sound. Commercially available acoustic materials have NRC Value ranging from 0.2-0.5.Synthetic fibers like polyester, pp, etc are used commercially. This project aims to developing hybrid structure made of coir non woven and insert with polymeric material to absorb lower frequency sound absorption and also to improve higher frequency sound absorption by providing surface modification .Lower frequency absorption is by fabric inserting with polymeric film, its act Helmholtz resonator for lower frequency sound.

To improve the higher frequency by creaky of surface roughness by profile(round).It will reflect within the structure to reduce the sound energy by that viscous and thermal effects cause acoustic energy to be dissipated.

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Studies on Coir Reinforced Composites in Civil Engineering Application

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Abstract

The overall goal of this research is to investigate the effect of natural fibre in concrete structure. The coir fibre recently attracted an interest as a sustainable fibre composite material, due to some specific mechanical and thermal properties. In this experimental study compressive strength and split tensile strength and flexural strength of coir reinforced concrete are carried out using different coir fibre of 10mm, 30mm and 50mm length of two different amounts e.g. 0.1% and 0.3% and cured over 28 and 56 days time.

From these composites it found that the compressive strength, spilt tensile strength and flexural strength of the composite made up of fibre length of 30 mm with fibre volume of 0.3 % give excellent strength results (Table 1 and Figure1). With increase of fibre volume there is increase the compressive, spilt and flexural strength of composite. It found that from control sample which is made up of without fibre have very little strength as compared to the composite made up of fibres .With addition of fibers to the concrete would provide a better control of the crack initiation and its subsequent growth and propagation to improve the structural durability.

Keywords: Coir, Toughness, Concrete, Plasticizer etc.

Table 1: Results of Compressive, Spilt Tensile Strength, Flexural Strength of composites.

S. No.	Fibre length In mm	Fibre Volume Fraction (%)	28 Days Compressive Strength (Mpa)	56 Days Compressive Strength (Mpa)	28 Days Spilt Tensile Strength (Mpa)	56 Days Spilt Tensile Strength (Mpa)	Flexural strength (Mpa)	Toughness (kN- mm)
1.	10	0.1	23.9	31	3.8	5.46	3.97	0.25
2.	10	0.3	25.08	39.66	4.2	3.98	3.82	0.28
3.	30	0.1	26.8	29.93	4.2	5.62	6.5	0.4
4.	30	0.3	25.24	26.6	4.4	4.23	4.96	0.56
5.	50	0.1	34.2	39.43	4.3	4.65	3.58	0.18
6.	50	0.3	25.83	37.5	2.74	4.87	3.34	0.3
7.	Without Coir (Control)	0.0	22.06	14.5	2.84	3.46	2.64	0.12

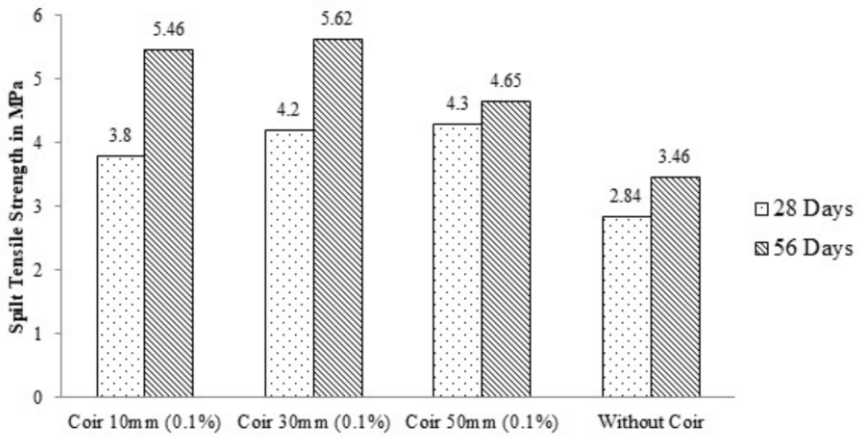

Figure 1. Effect of fibre length on spilt tensile strength of composite material (28 and 56 days of curing and 0.1% Fibre volume)

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Effect of laundering on antimicrobial and aroma finishing of organic cotton fabric using Vetiver oil microcapsules

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Abstract

Vetiver has traditionally been used as medicinal and aromatic plant in many places of India and it is popularly known as khas grass. The study was designed to impart antimicrobial and aroma property on organic cotton fabric using vetiver essential oil microcapsules by exhaust and pad dry cure method and evaluated for wash durability. Vetiver essential oil was diluted with coconut oil for preparation of microcapsules by interfacial polymerization technique and subjected to Gas Chromatography Mass Spectrometry (GCMS), bioassay and Scanning Electron Microscope (SEM) for characterization of microcapsules. The microencapsulated organic cotton fabric was analysed by SEM after every washes to know the antimicrobial and aroma efficiency. GCMS spectral analysis showed that, diethyl phthalate (28 %) was the major compound found in vetiver oil followed byisoaromadendrene epoxide (7.72 %), beta-vetivenene (6.92 %), solavetivone (5.58 %), aromadenderene (4.63 %) and alpha cadina naphthalene (4.80 %), viridiflorol (4.32 %), azulene (2.62 %) and khusimol (1.38 %). Bioassay method (Paper disc diffusion method) resulted that, the vetiver oil and diluted vetiver oil possessed greater zone of inhibition against S. aureus and E. coli than the pure coconut oil. The size distribution of vetiver essential oil microcapsules (SEM) ranged from 1.73±0.423 to 60.02±14.16. The shape of the microcapsules was regular and round, some were spherical in shape and few were rounded by small aggregates (Fig.1). Irrespective of methods of application, organic cotton fabric finished with microcapsules by pad dry cure method showed maximum zone of inhibition compared to organic cotton finished by exhaust method against S.aureus and E.coli (fig. 2 & 3). The antimicrobial activity of the finished samples was subjected to multiple washing which indicated that organic cotton fabric finished with pad dry cure method showed a zone of inhibition even after 20th wash. A panel of judges opined that the organic cotton fabric treated with vetiver oil microcapsules by pad dry cure method exhibited good to excellent aroma retention even after 20 washes compared to organic cotton fabric finished with the exhaust method of application. Thus, the vetiver oil microencapsulated organic cotton fabrics is free from hazardous chemicals and have multi-functional properties that can be suitable for medical and healthcare textiles. Hence, promotion of this traditional bio resource provides an innovative and sustainable green approach in the textile sector.

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Separation of Oil From oil-water Emulsion by Coalescence Filtration

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Abstract

According to central pollution control board (CPCB) India, the effluent from oil drilling industries and steel and iron manufacturing industries discharged into the marine environment should not contain oil more than 10 mg/l for the ecologically sensitive zone and marine culture. Oil needs to be removed from the oily water before it gets discharged into the environment because even low concentration can be toxic to aquatic organisms. The kapok fibres due to their oleophilic nature are known to absorb oil from water. The abundantly available cotton fibres especially waste fibres from the textile industry can be chemically treated to improve their hydrophobicity. In this study, stable emulsion of engine oil in water using non-ionic surfactants was prepared by high speed mechanical stirring. The concentration of engine oil in water was 20%. Raw and chemically treated kapok and cotton fibers were used for filtration experiments. Surface morphology of fibers was investigated by using scanning electron microscopy. Chemical bond and elementals analysis of fibers after treatment were done using FTIR and EDX. Both raw and chemically treated fibres were used as filters to separate oil from oily water. The fibers were manually filled into the sample holder with three different thickness (bed heights 1cm, 2cm, 3cm) and porosities (90%, 95%, 98%) for preparing coalescence filter. The oil-water emulsion (influent) was pumped into the sample holder. The coalesced oil droplets, water, and un-coalesced oil droplets especially the finer ones oil droplets were collected (effluent). Oil separation efficiency was evaluated in terms of change in droplet size (D50) and oil concentration from influent to effluent. The oil droplet sizes and oil concentration were evaluated using Droplet size analyzer and UV Vis- spectroscopy respectively. Treated kapok fibres performed better than raw kapok followed by treated cotton in terms of oil separation efficiency. Except for raw cotton, the oil separation efficiency improved with increasing thickness of bed height (1cm to 3cm) and it is maximum at a porosity of 98%. Raw cotton fiber could not coalesce the oil droplets.

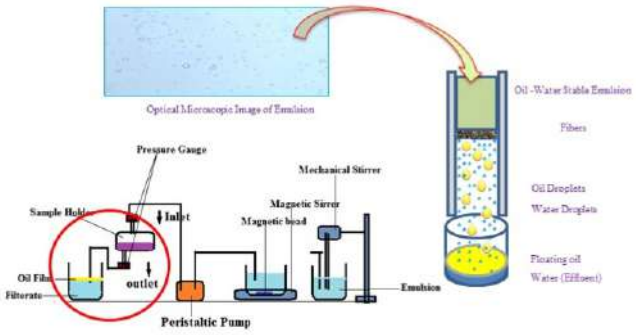

Figure: Filtration Setup for collecting oil from oil-water Emulsion

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Effect of Modified Carrier Fluid Based Shear Thickening Fluid on Impact Energy Absorption

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Abstract

Shear Thickening Fluid (STF) is a dense colloidal dispersion, exhibits an abrupt change in viscosity above a certain shear force and acts like a solid material [1]. This phenomena is highly favorable for impact energy absorption. It has been established that STF-treated high performance fabrics exhibit enhanced ballistic protection. Rheological performance of STF is dependent on interaction between media and particles which in turn is dependent on the surface chemistry of the two. This media-particle interaction can also be modulated by altering different parameters like, particle shape, size, volume fraction, different types of dispersion media, etc. In the last few years many attempts have been made to improve the rheological characteristics of STFs, mainly peak viscosity and critical shear rate, by different approaches, such as use of additives, usage of different molecular weight media, altering particle surface chemistry, etc. However, very few literature is available on chemical modification of the dispersion media to alter the particle-media interaction. Modification of media is one of the novel approaches for improving the rheological performance of STFs. Hence, in this study, effect of chemical modification of STF media has been attempted and its effect on rheological characteristics of STFs is analyzed. Moreover, these modified STFs have been applied to Kevlar 802 fabrics to investigate its impact energy absorption performance.

In this study, PEG200 was modified by citric acid at optimum conditions [2]. Modification of PEG (M-PEG) was confirmed by FTIR, H-NMR, C-NMR analysis and molecular weight distribution was analyzed by MALDI-TOF analysis. Further, the M-PEG was used for STF preparation with silica nanoparticles having 500 nm diameter. Solid fraction of modified PEG based STFs (M-STF) were maintained up to 63%. In viscosity vs shear rate analysis it was observed that the presence of modified PEG actually increases peak viscosity to a significantly high level, while the critical shear rate decreases. The media particle interaction was thoroughly studied by dynamic rheological analysis of 63% STF. In impact energy analysis, 7% increase in impact energy absorption was observed.

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Acknowledgment

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Influence of Layering and Differential Punching on Functional Properties of Needle Punched Nonwoven

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Abstract

Nonwovens find a wide spectrum of end uses from medical textile to filtration. In this work, the authors have focused on needle punched nonwovens for filtration purpose. In most cases, it is seen that the punching remains the same for needle punched nonwovens i.e. they remain single punch. Here an attempt has been made to produce a needle punched nonwoven by sequential punching and study its effect on the functional properties of the nonwoven. Sequential punching comprises of two-stage punching wherein already punched layers are further punched together to form the nonwoven of desirable basis weight (grams per square meter) and thickness. Various needle punched samples prepared of semi punched layers were compared against the conventional needle punched samples. It was found that the sequential needle punched samples showed enhanced functional properties like air permeability, pore size, filtration efficiency for a particular value of pressure drop and air velocity. These properties were also found to be in good correlation with each other. The effect of sequential punching on different layers was further confirmed by varying the basis weight and punch density for the respective layers to confer the effect of differential punch density on the functional properties of the needle punched nonwoven. It was found that the sequential punching with differential punch density for each layer modifies the functional properties like air permeability and filtration, positively.

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Graphene Nanoplatelets-silica Based Shear Thickening Fluids for Improving The Impact Resistance of Kevlar Fabrics

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Abstract

Multiphase shear thickening fluid (STF) has been recently explored for its applicability in improving the impact or stab or puncture resistance of high performance fabrics (HPFs). The ongoing research shows that the incorporation of such additives into a neat STF generally gives rise to positive results, at least in the final application of the HPFs treated with STF, if not always exactly reflected in the rheological behaviour of the fluid itself. This implies that the rheological behaviour of the multiphase STF is not always relatable to the response of the STF treated HPFs to impact. Moreover, the amount of additives, particularly when they are in the nanoscale, has been reported to be very small, whereas the effects, to be significantly enhanced.

In the present work, effect of addition of graphene nanoplatelets (GNs) (thickness 4 nm, size up to 2 µm) on the rheological behavior to Si-PEG based STF has been studied. The rheology of the different STFs with varying concentration of GNs (0.2%, 0.4% and 0.6%) did show an increasing trend in terms of peak viscosity. Kevlar fabrics were treated with the virgin and multiphase STF. Yarn pull-out test showed a slight enhancement in yarn poll-out force with increasing GN content. Dynamic impact test at 4.5 m/s and the ballistic test at 180 ± 15 m/s was also carried out for the Kevlar fabrics treated with virgin and multiphase STF. Though STF treatment improved the impact resistance performance of Kevlar fabrics, the reinforcing effect of GN was not very prominent.

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Ballistic Performance of Stf Treated Soft Body Armour: Effect of Panel Configuration

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Abstract

Since the last decade, researchers have been working on shear thickening fluid (STF) to improve the ballistic performance of bullet resistant and stab resistant personal protective armor. However, in most of the research studies, STF treated fabrics, or soft body armour panels have been evaluated against low velocity (up to 180 m/s) projectiles.

In this study, STF treated soft body armour panels have been explored against the high-velocity lead core bullet. STF was prepared with silica (SiO2) particles of 100 nm size dispersed in polyethylene glycol(PEG200). Kevlar 363 2S fabrics were impregnated with STF on a padding mangle. Multiple layers of fabrics were stitched to prepare soft armour panels. In the ballistic study, minimum performance evaluation (BFS-back face signature) was carried out against 9×19mm lead core bullet having a velocity of 430±15 m/s. Five bullet shots were fired on each panel. There were two sets of soft armor panel configuration, one set having fixed areal density for neat and STF treated panels and the other having a fixed number of fabric layers (STF treated and untreated) but with varying positions of STF treated fabric layers. This study revealed that STF treated panels gave 7% lower back face signature compared to neat panels and 11.8% lower back face signature when the neat fabric was at the strike face and STF treated fabric as baking materials.

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Acknowledgment

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In-situ Synthesis of Nano Silver Inside Chitosan Nano Fibrous Web and Its Deposition on Polyester Nonwoven Structure For Water Purification

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Abstract

Advances in nano-scale science and engineering have provided solution to many of the current problems involving water filtration. Utilization of specific nanoparticles, either embedded in membrane or in the form of nano filaments web membranes, or on other structure media, can effectively and economically filter contaminated water to consumable form. Nanofibrous membranes have drawn significant attention in fluid filtration systems due to their capability to withstand fluid flux while removing micro and nano sized particulates from solution [1, 2]. In the present study, electro-spun nanofibrous web is prepared from chitosan solution embedded with nano-dimensional structure of silver, and subsequently deposited over nonwoven polyester surface. The surface morphology of prepared samples was evaluated using scanning electron microscope which showed uniform distribution of nano structured silver. Antibacterial efficiency of the prepared sample was tested quantitatively against both Gram-positive and Gram-negative bacteria which showed a significant reduction of bacterial load. Bacterial contamination in the input water was also found to be significantly reduced after passing through the sample. Moreover, the leaching out of nano silver in the filtered water was also observed to be in the acceptable range. Thus, the developed material may be considered as a promising candidate for filter media to be used in water purification systems.

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Study About The Effect of Punching on The Orientation of Fibres and Properties of Needle-punched Nonwoven

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Abstract
An attempt has been made by the authors to investigate the punching effect on a non-woven prepared form the webs of equal areal density. Three important punching parameters such as punch density, needle penetration depth and strokes frequency are taken as variables. Primarily, it was noticed that the punching parameters were influencing the fibre orientation to a great extent. Subsequently, the influence of that different orientation on other properties was studied. Interestingly a spreading effect detected in both machine and cross direction, which affected the thickness, basis weight and tenacity. Another important aspect is, with the change of stroke frequency, the width of the web, as well as nonwoven, also changed due to the spreading towards the cross direction. It was also observed that when strokes per min increased, the basis weight thickness decreased as well as tenacity got affected.

Keywords: Tracer fibre technique, Punching parameters, fibre breakage, orientation, areal density.

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Investigating the role of KNN nanostructures in Poly (vinylidene fluoride) (PVDF)/ Potassium Sodium Niobate (KNN) based flexible nano-fibrous web: a unique piezoelectric energy based nanogenerator

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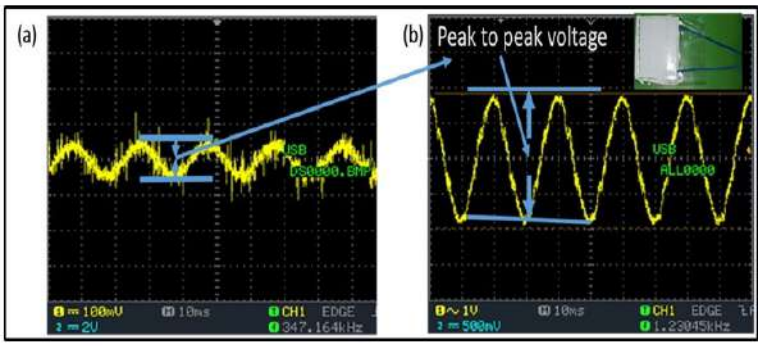
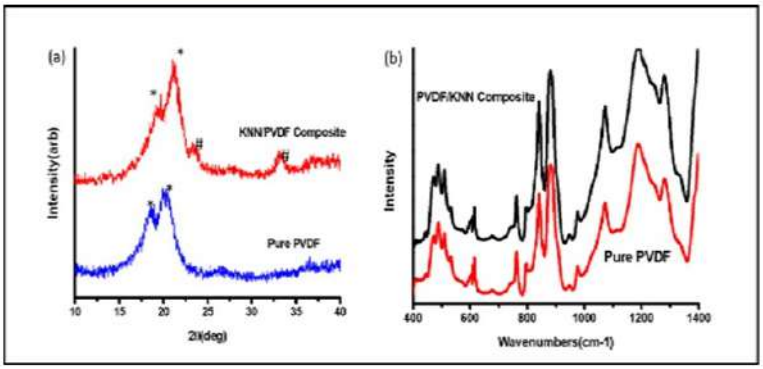
Abstract

The recent trend of finding alternative renewable sources of energy is worthwhile to mention in the global arena of energy efficient systems. Piezoelectric energy systems stands a way apart from its counterparts like solar, wind, thermal energy and many others in terms of its energy density. The current study focussed on the use of Poly(vinylidenefluoride) (PVDF)/Potassium Sodium Niobate (KNN) nanostructures based electrospun nanofibrous web. The various parameters affecting the growth and structure of KNN in hydrothermal synthesis method was studied as higher aspect ratio of nanostructures offered a unique and continuous connection between KNN and PVDF embedded in fibre matrix. The higher aspect ratio of KNN acted as a beta nucleating agent in PVDF matrix and enhanced the β-phase in the overall domain of the piezoelectric energy harvesting capacity manifold in comparison to the pristine PVDF fibre. Electrospinning offered several advantages of in-situ poling as the nanostructures were axially oriented along the axis of PVDF fibre. The loading of nanostructures in the pristine polymer by electrospinning avoided the disadvantages in case of highly loaded nanoparticles based composite. The addition of 5% KNN enhanced the piezoelectric property without any poling requirements. The addition of KNN at only 5% in presence of PVDF generated peak to peak voltage of 1.9V which was markedly high as compared to only PVDF based nanogenerators: the energy generated can be utilised to power various electronic portable gadgets.





Keywords: electrospinning, nanostructures, peak to peak voltage, β-phase, in-situ poling, piezoelectric

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Textile-Based Low Power Output Energy Harnessing & Storage System from Physical Motion of Human Body

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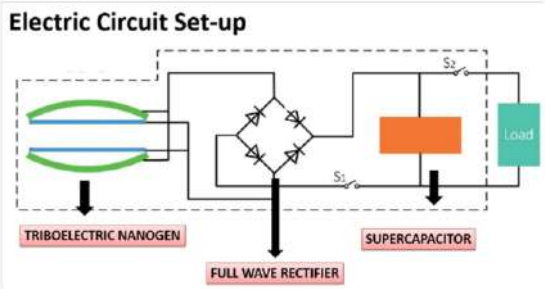
Abstract

With the rapidly evolving inclination towards an off-grid system of energy availability to the users, the importance of energy generation being an off socket-system becomes crucial. We have moved beyond the very need of a portable energy system to the scenarios where these portable energy systems need to be charged or in that respect, any other equivalent device that might require charging impromptu. Keeping this in mind and the fact that how inevitable physical movements are to us, an approach to harness energy out of these movements have been developed. Incorporation of various textile fabric structures: knitted (single jersey, double jersey, pearl etc.) or non-woven to enhance the performance of textile-based triboelectric nanogenerator (Nylon-6 /PET based energy harvesting) & supercapacitor(PANI-coated cotton/ pristine Cotton based- energy storage) has been carried out. Tough the output of the present study is lower as compared to the presently available hardware-counterparts but the motivation lies in the fact that the user is able to generate green electricity even when absolutely no source of power generation is available.



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Influence of various forms of polypropylene matrix (fiber, powder and film states) on the flexural strength of carbon-polypropylene composites

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Abstract
An investigation into the flexural properties of unidirectional composites (UDC) produced from blending of carbon fiber and polypropylene (PP) matrix in varying forms of fiber, powder and film are reported. Dr. Ernst Fehrer (DREF) hybrid yarns were manufactured from PP fibers and carbon tows, and were consolidated to yield UDC-D. PP powder was layered on carbon tows by electrostatic spray coating and were consolidated to form UDC-P. A third laminate, UDC-F was manufactured by the consolidation of PP films stacked between carbon tows. The fiber volume fraction was ~ 50 % in the UDCs. Better mechanical properties of UDC-P were observed in 3 point bending and short beam tests. Analysis by micro-computed tomography, and scanning electron microscopy indicate better impregnation of PP powder in UDC-P despite higher viscosity than PP fiber.

Solvent Free Electrospinning of Cross-linked Fibrous Matrices

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Abstract
Electrospun nanofibres and fibrous matrices have found application in many areas including selective sorption and separation, filtration, energy storage, catalysis and tissue engineering. The prime challenge involved in using such matrices is their poor mechanical properties and retention of structural integrity during application. This becomes more specific due to solubility of polymer forming the matrix in a liquid media or loss of shape when exposed to high temperature. In the present work, cross-linked fibrous matrices of polystyrene are produced using solvent free electrospinning. Gelation of the fiber forming mixture was controlled prior to electrospinning and uniform fibers were obtained which upon post-electrospinning heat treatment resulted in complete monomer conversion as well as desired extent of cross-linking. The cross-linked fibrous matrices thus produced showed significantly enhanced oil sorption capacity as compared to an uncross-linked matrix.

Geotextiles and Geo-membranes

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Abstract
This kind of material are having a traditional history not only in advanced countries but in our country also. The usual application of geotextile is carried out in a soil related man-made project as their definition also suggests that. It has become new construction material for use in various civil engineering applications as it serves functions like separation, filtration, reinforcement and drainage. The subsidiary of IGS (International Geotextile Society) is also formed in India and the Centre of Excellence like BTRA (Bombay Textile Research Association). These kind of materials find their utilities on most prominent scales, because the developmental works are at pace in our country and should be coupled with international philosophy of geo-related works. The geotextile market is expected to be valued at USD 5.76 Billion in 2017 and is likely to reach USD 9.35 Billion by 2022, at a CAGR of 10.2% from 2017 to 2022. This paper mainly gives information about the development and use of geotextile in India.

Key words: Geo-materials, IGS, Functions of Geotextiles, Centre of Excellence.

Dye Sensitized Solar Cells In Textiles: Problems And Some Solutions

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Abstract
Solar energy harvesting has become extremely important in the current situation where the entire world is transitioning towards more sustainable energy sources. Textiles has also moved to this field and a new field of smart textiles in solar energy harvesting application has been a hot research topic nowadays. There are ways to integrate silicon-based solar cells on the textile substrate. But comfort and aesthetics, which are the basic needs of the textile to be wearable, are compromised with. Also, the negative effects of temperature on the efficiency of these silicon-based solar cells and unsustainable method of silicon based solar cell manufacturing make it necessary to find an alternative material for the concerned purpose. Efforts are going on in order to integrate Dye sensitized solar cells (DSSCs) with textiles due to their many advantages. Here we present some limitations and solutions provided through research for the integration of DSSCs on textiles and give a future outlook of research in this field.

Keywords: Energy harvesting, Dye sensitized solar cell.

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Development Of Mosquito Repellent, Antibacterial, Fragrant And Wrinkle-free Cotton Fabric Using Functional Microcapsules Containing Deet And Citriodiol

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Abstract
Due to the spread of microbial contaminations and the deadly mosquito-borne diseases, there is an urgent need to develop efficient protective systems against these biological agencies. Textile materials, the barrier layer between the human body and the environment, can serve as the protective layer against these agencies. This necessitates the functionalization of textile materials to impart the desired functional properties. DEET and citriodiol are the best-known insect repellents which have different mechanisms for their action and blending of such chemicals can show synergism in their performance. The wash-fast stabilization of these chemicals on the textile structure is essential to impart durability of functional properties. In the present work, DEET-Citriodiol embedded functional microcapsules were prepared using the spray drying technique. The microcapsules were characterizedusing FTIR, TGA, and SEM techniques and utilized for multifunctional finishing of cotton fabric. The resulting fragrant cotton displayed an efficient multifunctional properties viz.mosquito repellency, antibacterialactivity and wrinkle resistance. Most of the functional properties were retained to a satisfactory level after 5 washes.

Keywords:Cotton; Microencapsulation; Mosquito repellency; Antibacterial.

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Graphene-polyaniline Based Nanocontainers with Epoxy for Corrosion Protection of Mild Steel

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Abstract
Graphene and polyaniline have been shown to have superior anti corrosive properties due to barrier formation. As single layer graphene is porous and due to percolation, can also encourage corrosion, hence an attempt has been made to cover the graphene layers with doped conducting polyaniline to further enhance anti corrosion.

Sodium zinc molybdate nanoparticle was used as the core material for entrapment into graphenepolyaniline based nanocontainer so as to achieve superior anti corrosive property. Inexpensive methods are used to synthesize all materials to make this process as economic as possible. Nanocontainer synthesis has been done by two approaches, viz; layer-by-layer and coupling technique. Few layered graphene sheets (1800 S/m) and Polyaniline nanofibers (2000 S/m) have been successfully incorporated to entrap Sodium zinc molybdate nanoparticles (280 nm) in two different approaches and tested for anti-corrosion application in epoxy based system for MS panels. SEM and TEM images show flower like morphology of sodium zinc molybdate nanoparticles, which have been synthesized by a novel method. Various characterisations like Zeta potential, Particle size, FTIR, TGA, 4 probe conductivity etc. suggest successful formation of nanocontainers and EIS plots suggest good anti corrosive behavior of the resultant coatings.

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