Book of Abstracts

TEXTILE SCIENCE RESEARCH CENTRE

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PUSHING BOUNDARIES WITH NEW MATERIALS

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LECTURES

D. DRMAČ:

EU policies for future of chemistry and textiles

Abstract:

This session will present a high-level overview of upcoming EU policies affecting the textile and chemical sector (Sustainable product policy initiative, EU textile strategy, Safe and Sustainable by Design criteria for the making of chemicals).

The European Green Deal will roll out a number of actions impacting each and every sector, including chemicals and textiles. Overall aim is to make Europe climate neutral by 2050. Business will need to rethink the way the design, produce and dispose, minimize the amount of harmful chemicals in products while chemical production will become safer and more sustainable.

Key words:

EU textile strategy, Sustainable product policy initiative, The European Green Deal, Design for safe and sustainable products

Z. Kovačević, M. Grubor, S. Zjalić:

Fibers extraction from lignocellulosic biomass

Abstract:

The increasing utilization of agricultural waste and residues of biological origin has characterized biomass as one of the most important sources of renewable energy. In addition to the production of biofuels, biomass is becoming increasingly important in the production of chemical components, composite materials, filters and fibers. The projects KLIMA and BIOKOMPOZITI co-financed within the Operational programme Competitiveness and Cohesion from the European Regional Development Fund encompassed a total of 7 agricultural crops whose utilization for the production of fibers makes its potential waste becomes a raw material. Lignocellulosic biomass such as straw/corn (wheat, barley, maize), grass (*Miscanthus giganteus*, *Arundo donax*), legumes (*Spartium junceum L.*) and other agricultural energy crops, e.g., *Sida hermaphrodita*, was used in this study primarily as a feedstock for fiber production. The textile raw material obtained by pre-processing of mentioned agricultural crops, either in the form of long fibers or cellulose pulp, can be used in the production of fiber-reinforced composite materials, biofilters, paper or in the construction industry. Research has shown that the fibers yield ranges from 10-15%, and the residue can be excellently used for the production of 2nd generation biofuels based on the development and application of new technological solutions. If the residue of the lignocellulosic biomass after the extraction of cellulose fibers is richer in lignin then such raw material is used for energy production by direct combustion while the residue of the biomass which is richer in cellulose and hemicellulose indicates the possibility of its usage in the production of liquid biofuel. This paper proves that in accordance with the principles of circular bioeconomy, these crops can be fully utilized. What constitutes waste in the textile industry becomes a raw material in the production of liquid and/or solid biofuels.

Key words:

lignocellulose biomass; cellulose fibers; biofuel; circular economy

The research was done within the projects:

1) KK.01.1.1.04.0091 Design of advanced biocomposites from energy sustainable sources (BIOKOMPOZITI) https://biokompoziti.eu/
2) KK.05.1.1.02.0016 Production of food, biocomposites and biofuels from cereals in the circular bioeconomy (KLIMA) https://projekt-klima.eu/

S. KOVAČEVIĆ:

Multifunctional flame retardant fabrics

Abstract:

Nowadays, it is increasingly demanding and complex to achieve certain properties of fabrics or composites, defined by standards for a particular purpose. It is even more difficult to achieve the sustainability of these properties during fabric use. Woven fabrics that are characterized as flame retardant, with properties that ensures a high level of protection, must also be characterized by the properties of comfort, durability and fastness.

Single-layer protective technical fabrics with surface treatment, currently available on the global market in the segment of flame retardant fabrics, lack the integration of crucial properties, including comfort during wear, which makes the body feel "moldy". By selecting fibres with specific properties and optimizing their share in the final fabric, and by developing new woven structures and combining them with other relevant construction parameters, innovative fabrics with targeted properties regard to final purpose, will be designed and manufactured. The protective properties of newly developed fabrics will be primarily based on the incorporation of all influential parameters, combinations of single-layer and multi-layer interlacing woven fabrics, raw materials, yarn fineness and fabric density. The upper fabric that forms fabric face will have strong protection properties, while the back fabric part forms light, pleasant to the touch and breathable structure. The overall fabric with its final characteristics will provide comfort, durability, fastness and ultimately multifunctionality.

Research on multifunctional flame retardant fabrics, in the segment of technological process of design and production, as well as in the segment of finishing processes, represents a significant technological breakthrough, while newly developed fabrics will be characterized by innovation, uniqueness and competitiveness.

Key words:

Flame retardant fabrics, weave, structural properties, protection, comfort

The research was done within the projects:

1.) https://www.ttf.unizg.hr/razvoj-multifunkcionalne-negorive-tkanine-za-dualnu-namjenu/875

2.) https://www.ttf.unizg.hr/multifunkcionalni-tkani-kompoziti-za-toplinsku-zastitnu-odjecu/876

S. Firšt Rogale, D. ROGALE, Ž. KNEZIĆ:

Thermal properties of composite clothing

Abstract:

The dominant role of clothing is thermal protection. From ancient times, people dressed in layers, and the lower the ambient temperature was, more layers were used.

Engineering design of clothing from the aspect of thermal properties cannot be performed if the thermal parameters of the built-in layers that make up composite clothing and the success of installation of these composite clothing, selection of materials and construction of clothing on the final thermal properties of a newly designed and manufactured clothing are not known.

The assessment of the thermal protection of an individual clothing or clothing system can be obtained by subjective assessment of the wearer or by exact measurements on measuring systems intended for testing the thermal properties of textiles, composite clothing and clothing. A review of the available literature shows that there is a need for new research on the thermal insulation properties of clothing, especially temperature gradients.

In order to improve the process of technical design of thermal clothing properties, within the project HRZZ IP-2018-01-6363, a new measuring device was constructed, and a new measuring method was established for simultaneous measurements in determining the thermal resistance in one or more layers of articles of composite clothing and temperature gradients between composite layers.

At the INOVA 2020 innovation exhibition, the measuring device was awarded the Gold Medal in the Engineering / Materials Science category as well as the prestigious annual Nikola Tesla Grand Prix for the best Croatian innovation. Clothing technology does not have a long tradition of measurement and metrology techniques needed to test the properties of materials required for the technical design of garments. Therefore, the introduction of a new measurement method for the simultaneous measurement of thermal resistance and temperature gradients is an important novelty for the field of clothing engineering.

Key words:

materials, composite clothing, thermal resistance, temperature gradients

The research was done within the project: HRZZ IP-2018-01-6363

F. KARIN:

Sustainable fashion through fabric manipulation

Abstract:

Sustainable approaches in fashion and new methods of clothing production can minimize the generation of textile waste compared to conventional methods. Awareness of excessive waste in the fashion industry has become an area of growing interest so clothing designers are trying to find a variety of effective waste reduction solutions. In addition to examples of good practice in the manufacture of clothing according to the principles of sustainability, one of the good methods is the manipulation of materials which successfully affects the reduction of textile waste. New sustainable methods of making and manufacturing clothing are closely related to material manipulation. The aim of this paper is to show some of the methods of manipulating materials through the burst of fashion designers who successfully use them in their work. Through research and different approaches, designers can offer acceptable solutions in line with sustainability. One example is the origami paper folding technique applied to a textile material with the aim of maximizing utilization. Then the approach of the world-famous designer Iris Van Herpen, who combines architecture and fashion with modern technologies of recycling and reuse of fibers combined with traditional ways of making high fashion. Designing garments by draping fabric by designers Tomoko Nakamichi and Shing Sato, who transform two-dimensional flat shapes into three-dimensional ones, changing the surface appearance of the garment while creating timeless garments. In addition, there is a modern approach to the "zero waste" method aimed at preventing textile waste used in their work by Timo Rissanen and Holly McQuillan. Methods of sustainability in fashion by manipulating materials in the paper are presented through examples of students who have applied these approaches in their clothing collections and obtained satisfactory results which are an indicator that sustainable fashion is increasingly present in design practices.

Key words:

sustainability, material handling, origami, zero waste

I. Salopek Čubrić:

Materials for enhanced comfort of athletes

Abstract:

The world consumption of fibres and fabrics for the production of sportswear and sport-related goods has seen a significant increase in the last decade. The global sportswear market is expected to touch a valuation of US$ 108.7 Bn by end of the year 2025, which gives a clear picture of how important it is to direct scientific interest towards the development of materials for improved sportswear. The rising interest in the purchase of sportswear is due to a number of social factors. Among those factors is primarily increased consideration of well-being and good health, as well as promotion of sports activities and growth of indoor and outdoor sports facilities. The most commonly used fibres in the production of sportswear are still polyester, polyamide, elastane but also cotton, wool (although in a significantly smaller share). Also, the use of recycled raw materials is becoming increasingly important. New technological developments and increasingly demanding expectations of professional athlete are important factors driving the development of new, functional materials for sportswear. The performance requirements of materials for a defined sport widely differ in the properties defined by the nature of the specific sport. These properties, for example, refer to resistance to cold, heat, rain, snow, while the material still must fulfill the athlete's requirements of ease of movement, fit and drape. In active sports, the performance of sportswear is synonymous with its comfort characteristics and therefore the aspect of comfort is widely studied in the process of material design. It is obvious that the performance sportswear of today has become a truly engineered product that needs to be designed to completely fulfill the athlete's requirements. Furthermore, with the development of functional design, intelligent textiles, and wearable technology, innovative solutions have become imperative.

Key words:

material, sport, athlete, comfort, functional

This work has been fully supported by Croatian Science Foundation under the project

IP-2020-02-5041 Textile Materials for Enhanced Comfort in Sports - TEMPO

T. DEKANIĆ:
Materials of improved weathering requirements

Abstract:

The three main environmental factors are responsible for the behavior and resistance of materials to external influences. These are the so-called primary factors: solar radiation (light energy), temperature and water (moisture). These factors, in conjunction with secondary effects, i.e., atmospheric pollution, acid rain, etc., act synergistically and are called “weathering”. Depending on the geographical area and seasons, atmospheric conditions also vary and cannot be predicted and cannot be influenced. It is important to know whether and to what extent the material will be damaged, as well as how much it has been exposed to radiation because it points directly to the amount of radiation applied to its surface. On the other hand, it does not define the amount of radiation absorbed by the material and what effect it has on its properties and characteristics. The result of degradation will depend on the quality and amount of radiant energy deposited onto the material, the wavelengths of the radiation it has absorbed, and whether that absorbed radiation has enough energy to cause chemical changes. The damage can be microscopic and invisible to the eye, but also macroscopic and visible. For this reason, it is important to act earlier and affect the stability of the material and somewhat slow its damage, because it turned out that the combined effects are greater than the sum of the individual impacts. Even small changes to a product’s formulation, such as the addition of stabilizers, flame retardants, fillers, and absorbers, can change the degradation properties of that material as well as improve weathering requirements.

Key words:

weathering, artificial aging, fastness

The research is related to projects:

HRZZ IP-2020-02-7575, https://inwashed.wixsite.com/unizg-ttf

DOK-2021-02-6750, https://inwashed.wixsite.com/unizg-ttf

S. FLINČEC GRGAC:
Functionalization of fabrics for application in hospital environment

Abstract:

Numerous studies are focused on the modification of fabrics with the aim of developing the coating for wounds. Wound linings differ according to the impact on wound healing. Gauze and bandages are mostly used that adsorb the extrudation of wounds and provide additional physical protection but do not have an antimicrobial effect and do not contribute to the rapid healing of wounds. Due to its biocompatibility and biodegradability chitosan is one of the commonly used polycationic polymers that have been confirmed to have no allergenic effects. Also, a major impact on the wider use of chitosan to achieve an antimicrobial effect on various materials and in various preparations is its toxicity to fungi, bacteria and parasites. The possibility of binding chitosan on textiles using environmentally friendly agents and more economically efficient processing methods was investigated. Physico-chemical changes using FTIR in ATR technique, surface morphology using FE-SEM and antimicrobial properties according to AATCC 147 method were investigated on treated fabrics before and after maintenance process in order to monitor the durability of treatment.

Ključne riječi:

cotton, cotton / PES blend, chitosan, polycarboxylic acid

The research was done within the project:

HRZZ UIP-2017-05-8780 https://hprotex.online/?page_id=404&lang=en

HRZZ-DOK-2018-09-4254

N. Bilandžija:
The bioenergy potentials of agricultural lignocellulosic materials

Abstract:

Biomass represents one of the most important components of renewable energy sources and by basic definition it includes all organic residues from forestry, agriculture and related industries. The most significant potential in energy production considering lignocelluloses' biomass of agricultural origin have production of arable crops, vineyards, fruits and olives. Each year a significant amount of biomass remains from arable and permanent (grapevines / fruit trees) crops. Biomass of arable origin for energy production is associated with the term harvest residue, i.e. i represents biomass that remains on agricultural field after the harvest of primary product, while biomass of perennial origin mainly represents pruning residues obtained during the dormancy of vegetation. However, it is important to point out that all potentially available biomass of any origin, represents an extremely valuable raw material for preserving soil quality and its use for energy production that must be clearly and professionally defined. In addition to the above mentioned conventional types of biomass, advanced lignocelluloses' biomass obtains perennial energy crops, that due to their physiological and morphological characteristics could be cultivated on soils of poorer quality, and in that way energy production does not compete with energy production. All lignocelluloses' biomass can be used in the production processes of liquid and gaseous biofuels as well as in the processes during the conversion into heat and / or electricity.

Key words:

agricultural biomass, availability, crop residues, pruned biomass, energy crops

The research was done within the projects:

3) KK.01.1.1.04.0091 Design of advanced biocomposites from energy sustainable sources (BIOKOMPOZITI) https://biokompoziti.eu/
1) KK.05.1.1.02.0016 Production of food, biocomposites and biofuels from cereals in the circular bioeconomy (KLIMA) https://projekt-klima.eu/

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V. Ferenčak, S. Imamagić, R. Matašić, A. Miljković, T. Omerović, I. Pranjić, I. Škraper, K. Wolff & A. Sutlović: Student project ONLY-TTF

Abstract:

"Only natural - hygienic mask dyed with natural dyes" is a student project performed by the students of University of Zagreb, Faculty of Textile Technology, within which a prototype series of handmade unique ONLY TTF masks was realized. The project was initiated and implemented by first year Textile Technology and Engineering course graduate students, encouraged by epidemiological problems related to the spread of the Covid-19 virus and the numerous disadvantages of hygienic masks currently present on the market, such as wearing discomfort, allergic reactions, use of textiles from manmade fibers, artificial dyes, etc. The work methodology is set in 3 phases: product development, project presentation and product enhancement. As a part of product development, the first step included conducting a survey of potential users as well as the analysis of existing masks on the market. Additionally, country regulations and standards of the Republic of Croatia related to the production, use, maintenance, and disposal of hygienic masks were researched. Scientific research and artistic work included the analysis of 18 fabrics of different construction characteristics. Thereby the possibility of dyeing fabrics with natural vegetable dyes extracted from walnut shells and leaves, pomegranate shells and onions were examined. Materials with unique Shibori effect with harmonious color parameters of good washing resistance were obtained. In addition to aesthetic qualities, hygienic masks must provide three important parameters: particle filtration effect, enabling comfortable breathing and wearing comfort. Therefore, the analysis of fabric porosity and air permeability was performed. Based on the number of vertical pores on the fabric surface, pore size, Ferret diameter and air permeability a two - layer hygienic mask was made using a cotton woven fabric in plain weave dyed with natural dyes with Shibori effect and chemically bleached fabric in satin 4/1 weave. Furthermore, the choice of fabric, an optimized flat pattern and an adjustable fastening system ensure wearing comfort and dimensional stability. High-quality product is achieved not only by the realization of the functional and aesthetic properties of the main product, but also by designing the cotton bag to store the mask and packaging box with project and product information. Product presentation was conducted through print media, websites, social networks, active participation in television shows and museum exhibitions. Proposed future improvement of the product is a pre-treatment of fabrics with argon plasma which increases dye depletion and improves the fastness of washing. An additional significance of the project is the humanitarian activity within which 150 hygienic masks were donated and whose income is intended for scholarships for two students from the earthquake-stricken Sisak. As part of further research, improvement of the fastening system using additive technology (3D printing) is planned.

Ključne riječi:

hygienic masks; product development; breathing comfort; wearing comfort; natural dyes

Competition for the Award for the most successful scientific or artistic research work in the field of textiles

TSRC 2021 Award is give in two categories:

Category 1: Students of Undergraduate or Master studies of University of Zagreb Faculty of Textile Technology:

Ajna Prstačić Vuković

Category 2: Young scientists/artists (doctoral or postdoctoral students) of the University of Zagreb Faculty of Textile Technology (age limit is 35):

Ivana Čorak

A. Prstačić Vuković, M. Glogar; T. Dekanić;
S. Ercegović Ražić; A. Ludaš; I. Beritić:

Analysis of breakage of the polymer layer in the conditions of use and care of digitally printed textile products

Abstract:

The causes of breakage and damage of digital inkjet prints are analyzed from the aspect of the cotton fabric surface structural characteristics, physical parameters and the amount of pigment defined by the color characteristic, the method of pretreatment and in real conditions of use and care of a final product. After analyzing the physical and mechanical properties of the textile material, the non-coated samples and samples coated by acrylate-based binder, were digitally printed by inkjet technology. The printed samples were analyzed by spectrophotometric measurements, and in terms of the surface morphology by microscopic imaging with a Dino - Lite digital microscope. A test of fastness to different washing conditions was performed and the results are presented in terms of total color difference calculated based on the CIE76 formula, by comparing samples before and after washing. The research was performed in order to solve the real problem of the stability of digital prints in the conditions of care, in cooperation with the company Moira, Nova Gradiška.

Key words:

digital pigment printing, damaging of prints, wash fastness, spectrophotometric measurement, microscopic imaging

I. Čorak, A. Tarbuk:

The process sustainability for Polyester fabric hydrolysis

Abstract:

Due to high crystallinity of poly(ethylene-terephthalate) (PET) fibres, PET fabric has to be modified in order to increase the sorption properties and fabric comfort, to reduce static electricity and improve aesthetics. Conventionally, the alkaline hydrolysis at high temperature is performed for that purpose. Since that is not environmentally friendly process, more sustainable processes were investigated in this paper. The lower temperature and process time as well as lipase enzyme application were researched. The hydrolysis was performed with alkali at 60 and 100 °C, with and without accelerator, and with enzymes. The hydrolysis effects were evaluated by standard methods. Fabric weight loss, breaking force, elongation, whiteness degree and yellowing index were determined. The characterization of modified PET fabric surface was performed by scanning electron microscopy (SEM) with magnification 1000x. It has been proven that hydrolysis can be performed in more sustainable process – at 60 °C for shorter time or with eco-friendly enzyme.

Key words:

polyester, hydrolysis, enzymes, low temperature

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