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Session Abstracts

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Silk: its importance in the Brazilian economy and the textile value chain/fashion

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The context of the textile industry in Brazil shows that the country is the fifth largest textile producer in the world, with a consolidated industry, which has almost 200 years in the country. Brazil is also self-sufficient in cotton production and is the last complete textile chain from the West with the production of the fibers, such as cotton plantation, through spinning, weaving, hulling, clothing and retail, to the fashion shows. Although everything is very good, there is a thread that is produced in Brazil, which places it in the textile context as the 5th world's largest silk producer and the State of Paraná, the largest silk producer in Brazil [1].

In the current context of the textile/fashion value chain, where the paradigm shift is revealed as significant, silk as a renewable raw material, low environmental impact and possessing exceptional characteristics related to termofisiológico comfort and touch, is of importance increased in the context of global textile chain/fashion.

Therefore, important to analyze the importance of silk in Brazil's economy and the development trend of production of this raw material, and to evaluate the potential of the sector's sustainability, as its continued incorporation in fashion products depends on its quality, abundance and price.

This paper presents the results of a study on the production of textiles and silk in Brazil. The impact of silk in the sector is presented in the general economic point of view, but also in what is for the producing regions and for silkworm rearers in particular.

The study exploratory and qualitative was performed by collecting and processing statistical information, literature, conducting interviews with silkworm rearers and the case study of a company producing silk yarn.

The findings to assess the importance of silk production for Brazil's economy, but above all for regional GDPs. However, its social impact is too significant which makes the central silk production for the well-being of the people of the producing regions. These factors make the production of strategic silk in these regions by which demonstrates the need for sustainable development models capable of linking producers to consumers of the raw material in question, ie, to ensure the sustained demand for fashion brands or clothing either home textiles/decoration.

Acknowledgments

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Design and characterization of textile extension sensors for sports and health applications

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Abstract

The study of textile stretch sensors for several applications, such as posture, joint angles or breathing rate, has been widely described in literature. Byrne [1] has used embroidery technique to design a stretch sensor to measure the angle of the knee. Gioberto and Dunne [2] used a coverstitch to create a stretch sensor. This type of sensor was later used in a garment to measure the angle of the hips and knee [4]. Stewart and Skach [3] report the characterization of machine-knitted, hand knitted and conductive polymer coated sensors. The authors identified precision as one of the main challenges of creating textile stretch sensors, which can be related to the elastic recovery of the used substrate. Zhang [5] has studied knitted stretch sensors and found that a silicone layer can improve the sensor's response.

Termoplastic polyurethane films (TPU) and adhesives are claimed to provide high elastic recovery, which may contribute to a higher precision of the sensor. Bonding conductive fabrics and termoplastic polyurethane films (TPU) also allows the production of conductive tracks using three dimensions, unlike other textile processes already reported, such as conventional knitting, embroidery or sewing, which only work in two dimensions. Since the circuits can overlap each other, being isolated from each other at the same time, the circuit's pattern is not limited by the garment's measurements.

This paper reports the production and characterization of termobonded textile stretch sensors. Tests will be carried out to determine the electrical resistance as a function of stretch, and to evaluate its capacity to monitor breathing rate.

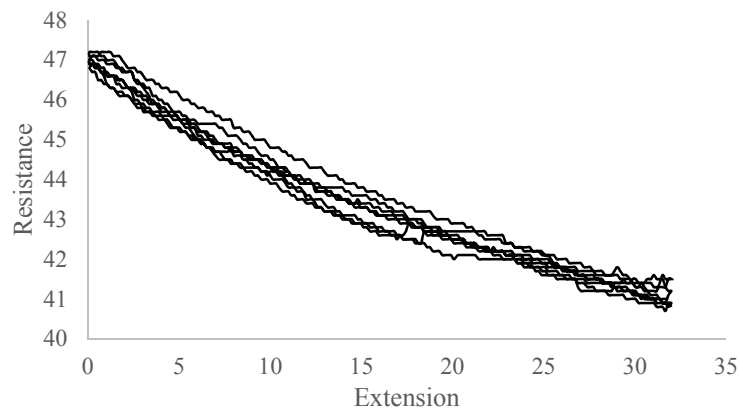
Materials and Methods

Three samples of stretch sensors were produced and tested. In all three samples, conductive knitted strips were cut and bonded to textile substrates using a polyester based thermoplastic adhesive (Bemis 5256), which improves elastic recovery. The conductive knitted fabric is a jersey fabric composed of cotton (83%) and silver coated polyamide (17%) – Statex Silverell. The strips are of 13 cm length and 1 cm width. In samples i) and ii), the sensors are bonded to a jersey PA/Lycra fabric and in sample iii), it is bonded to an elastic band. In sample ii), the strip was covered with a thermoplastic polyurethane (TPU) film (Exoflex 3900) that decreases elasticity and improves elastic recovery. The strips and TPU film were bonded to the substrates using a flat press machine, at 130° and 5.5 Bar, for 20s.

Preliminary tests were executed to determine the change in electrical resistance over time. A dynamometer was used to stretch the sensor to 20% of its initial length, 5 times, at 20 mm/minute. A multimeter was used to measure the electrical resistance during stretching and relaxing.

Results

The graph bellow shows the results obtained from sample i), where it is possible to observe the variation of electrical resistance while the fabric is stretched or relaxed.



Graph 1. Resistance vs. Extension results for sample 1.

Conclusion

Preliminary tests have shown a good response at low speed. Future tests need to be carried out to determine its response with other speed and elongation values, and its capacity to determine the breathing rate.

Acknowledgments

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Options indication

*1. Indicate your option for the presentation: **Oral**.*

*2. Indicate the option for the **topic**: Textile Engineering*

A Research on the Use of Copper Core Yarns in Electromagnetic Shielding Application

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With technological progress, electrical and electronic devices become irreplaceable items of our life with numerous facilities they provide. Usage of these devices, both facilitate our life and bring along environmental pollution. Because, while they are working, they emit electromagnetic waves to their surroundings. Electromagnetic waves are known to have harmful effects for both sensitive electronic equipment and also for human health [1,2].

There are some previous studies conducted on electromagnetic protectiveness with conductive materials [3-7].

In this work, textile materials were developed so as to protect from electromagnetic waves and their usage areas were investigated. For this purpose, Cu/Co core yarns were produced by using copper filaments as core material and cotton as sheath material. Production of the yarns was carried out on a ring spinning frame. Copper monofilaments of 0.05 mm and 0.07 mm were used as core materials. All core yarns are produced with Ne 8 yarn count. Conductive Cu/Co yarns were integrated in to the 3/1 twill woven fabric structure in the weft direction with 5 different weft densities (8, 13, 18, 23 and 28 per cm). Fabric samples have been coded according to their wire diameters and weft densities as in Table 1 [8].

Table 1. The specifications of conductive fabrics.

Fabric Code	Wire Diameter (mm)	Weft Density (weft/cm)	Yarn Count	Fabric Structure
5.28.	0,05	28	Ne 8 Copper Core Ring	3/1 Twill Woven
7.28.	0,07	28		
5.23.	0,05	23		
7.23.	0,07	23		
5.18.	0,05	18		
7.18.	0,07	18		
5.13.	0,05	13		
7.13.	0,07	13		
5.8.	0,05	8		
7.8.	0,07	8		

Electromagnetic shielding properties of the woven fabrics were tested by using anechoic chamber test system according to EN50147-1 standard, in 1GHz- 6GHz frequency range. The results were attained in decibels (dB) [1].

The effects of fineness of the core filament, wave frequency and weft density on the electromagnetic shielding effectiveness of fabrics were investigated. The results were analyzed by using Excel tables, diagrams and SPSS statistic software.

When all the results are analyzed, the highest shielding effectiveness were achieved with yarns comprising 0,05 mm diameter copper filament, with 23 weft/cm woven fabrics (sample 5.23.), in the 2 GHz frequency. The value of the highest shielding effectiveness is (sample 5.23.) 42,47 dB.

Because of the fabrics produced in this study give satisfactory results in 1GHz- 6GHz frequency range, these fabrics can be use so as to protect from sources of electromagnetic fields like electrical and electronic home appliances, mobile phones and computers. For this purpose, these fabrics can be use for curtains, bed nets, uniforms, protective clothings, military tents and awnings.

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Options indication

1. Oral

2. Textile Engineering

The Omni-channel Concept: a Case Study about the Union of Sales Channels in Portugal

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Introduction

This article contributes to a better understanding of the omni-channel concept in fashion retail, more specifically, in the Portuguese footwear segment and understand if the current challenge of brands is based on the union of all sales channels in order to gain, to locate and to provide a perfect experience to their customers, having regard to the online world and the offline world.

The technology evolution, in particular, mobile devices (smartphones and tablets), social media/networks and related software with these applications (applications for mobile payments, coupons, digital brochures, location services, among others) have provided new approaches, opportunities and strategies extremely creative for retailers implement in their organizations, creating new points of contact with the consumer. Agis refer that one of the three concepts in Retail 3.0 is the omni-channel, which, according to this author, consist in the integration of the online world with to offline world [1].

Before the globalization, operated the uni-channel concept when the retailer had a unique contact point with the consumer: the physical store [2]. Thus, observing the rise of multi-channel concept to the omni-channel concept that consists in the union of all channels on unique and exclusive means of interaction with the consumer, where they live an exclusive experience with the brand [2,3], allowing access and getting in touch with her through the middle that their want.

Omni-channel should be considered the most advantageous way of extracting the best of each channel to achieve the best for business, for the brand and its consumer [1].

The omni-channel, comparing with the multi-channel, operates in synergy so the distinctions between borders tend to disappear, transforming the world in an environment without walls [4,5].

The figure 1 shows the evolution of concepts presented previously.

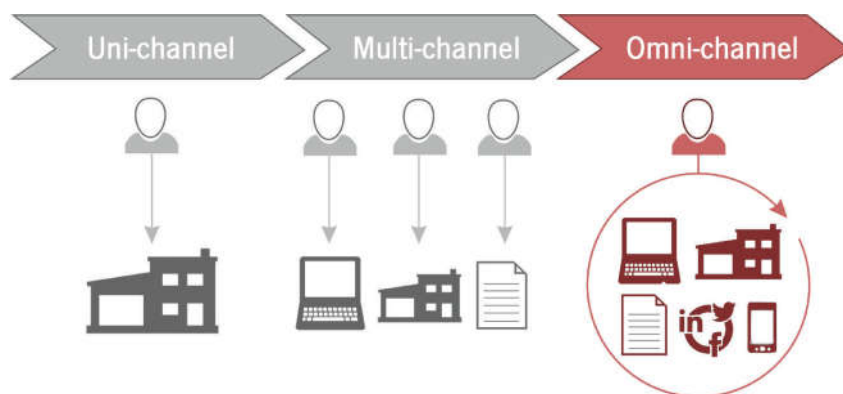


Figure 1. – The omni-channel evolution.

METHODOLOGY

The methodology employed was the case study of two Portuguese footwear brands. The collection of data was obtained through two distinct and complementary tools: the semi-structured interview and indirect observation of how brands are moving in their sales channels.

CONCLUSIONS

The data collected have concluded that there is a big discrepancy between the integration of brands' sales channels, one brand implements more strategies that aims to unify the channels compared to the other.

Key words: Omni-channel, Sales Channel, Fashion Retail, Footwear brands

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This work was supported by FEDER funds through the Competitivity Factors Operational Program - COMPETE and by national funds through FCT – Foundation for Science and Technology within the scope of the project POCI-01-0145-FEDER-007136.

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EMI protection elements on cadmium telluride thin films

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Introduction

The problem of ensuring radio-electronic equipment (REE) electromagnetic stability is because under the influence of electromagnetic impulses (EMI), overvoltage impulses are induced in the circuits, which can have a serious damaging effect on the elements of the REE [1]. Semiconductor devices are particularly susceptible to damaging effects of EMI thanks to properties of the p-n junction and to the specific heat conductivity of semiconductor materials. With a decrease of semiconductor device structures size, the level of their damage is reduced and for integrated circuits is from 10^{-3} J to 10^{-7} J. To ensure the protection of electrical circuits, practically the REE protection elements from EMI are used. The most important property of them, is their ability to reduce resistance R_e from $5 \cdot 10^4 - 10^{10} \Omega$ for a short time τ_{sw} (switching time or response time) to a value significantly lower than input resistance of the protected REE, when the voltage U_i in the circuit exceeds the threshold voltage U_t , called the switching threshold [2]. The most widely used restrictive silicon diodes, since they have τ_s at a level of 1 nanosecond. However, they can shunt a limited amount of energy and have an interelectrode capacitance at a level of 20 pF, which limits their application for the microwave REE protection. Therefore, in order to create protection elements for microwave REE should be perspective, to carry out research aimed to creation EMI protected elements on the base of cadmium telluride thin films.

Experimental technique

For deposition base layers of cadmium telluride on $10\text{cm} \times 10\text{cm}$ substrates from electrolytic polished molybdenum foil, we used industrial vacuum unit and method of thermal vacuum deposition from 99.999% purity powder with a particle size of 10 μm . The thickness of the deposited layers of cadmium telluride, which was set by the deposition time, was 3-10 μm . The crystalline structure of cadmium telluride layers was investigated by X-ray diffractometry. The switching characteristics of the samples were studied on a test bench with subsequent stress impulses parameters: amplitude U_i from 100 V to 1400 V with a duty ratio of $2 \cdot 10^{-7}$, rise time of the pulse to the amplitude value was 2.5 nanoseconds, impulse voltage decreased exponentially to 0.5 in a time of 100 nanoseconds. To connect to a coaxial line with a wave impedance of 50 Ohm, film CdTe samples were placed in modified bodies of microwave diode with interelectrode capacitance at 10^7 Hz is only 0.2 pF.

Results and their discussion

The morphology of the cadmium telluride films surface, studied with the Philips CM30 raster microscope, indicates that the grain size in the cadmium telluride layer is 1 μm (Fig. 1a). The qualitative form for typical oscillogram of the experimental stress diagram on film samples is shown on Fig. 2b (curve 1). This figure also gives a qualitative view for typical oscillogram of the voltage impulses acting on the samples. Experimental data analysis shows that with CdTe thickness increase from 3 μm to 8 μm , an increase in the operation threshold from 70 V to 105 V is observed. The maximum residual voltage on the sample varies from 12 V to 40 V, the minimum - from 5 V to 20 V.

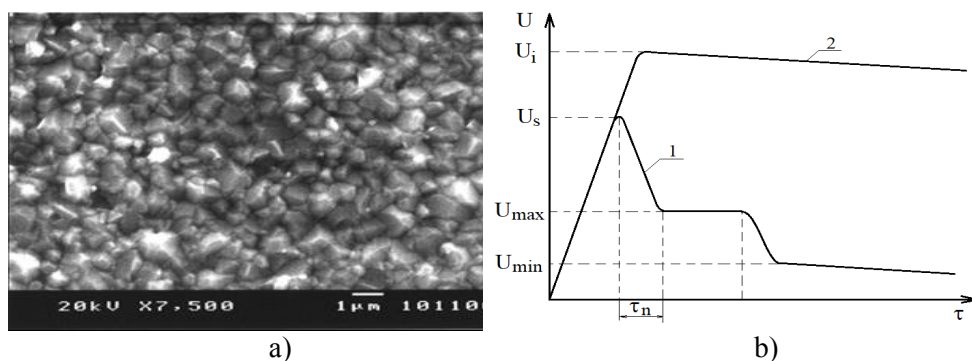


Figure 1. Surface of CdTe films with 4 μm thick (a) and typical oscillogram of the experimental stress diagram on cadmium telluride film samples (b).

The established switching time of the samples does not exceed 2 nanoseconds. All the test samples working without failure during 20 times. We apologize that in the investigated CdTe films, the effect of a monostable switching to a high-conducting state from low-conducting state is observed, as a result of the ionic subsystem reversible instability which realized during melting of semiconductor layer. The heat source for such monostable switching is the Joule heating of cadmium telluride layer by high-density current, which flow in the initially high-resistance material. According to [3], after heating to 800 °C, the CdTe specific electrical conductivity increases exponentially. Cadmium telluride melting due to the crystal structure rearrangement leads to electrical conductivity abrupt increase by more than an order of magnitude [4]. Based on crystal structure investigations we propose a mechanism for monostable switching in cadmium telluride film layers, which is the formation of molten high-conductivity channels in [111] direction oriented grains with columnar structure under the electromagnetic impulse action. The established failure-free operation of the protection elements based on cadmium telluride films up to 20 cycles of impulse action is a result of congruent CdTe melting, which ensures the stoichiometry preservation in switching layer after the high-frequency electric impulse action.

Conclusion

We have found that CdTe layers with a thickness from 3 to 7 μm placed in the body of microwave diodes under the action of electric impulses duration up to 1 μs had a switching time no more than 2 nanoseconds and capacity up to 2 pF. As a result such films can be used as a base layers in order to creation EMI protection elements for ultrahigh-frequency radioelectronic equipment.

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Options indication

1. *Oral.*

2. *topic: Electronic Engineering*

Textile-based pressure sensors for step detection: a preliminary assessment

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Introduction

Position estimation based on the Pedestrian Dead Reckoning (PDR) technique suffer from cumulative error due to the drift on the inertial sensors measurements. Typically, to prevent the exponential growth of the error on the position estimation, the PDR-based systems apply the zero-velocity update (ZUPT) technique. This technique takes advantage of the human gait to minimize the drift impact and correct the position estimate. I.e., every time the foot is in touch with the ground (stance phase), the inertial sensors readings are considered drift and the pedestrian position is corrected based on the magnitude of those readings. However, the ZUPT technique relies on the definition of thresholds on sensors' readings (e.g., stance duration, acceleration and angular velocity magnitudes) [1]. These thresholds make the performance user- and motion-dependent, characteristics that are undesired in Indoor Positioning Systems (IPSs) for emergency responders [2].

In this paper, we study the viability of embedding textile-based pressure sensors on a sock to detect the stance phase. Besides improving the stance detection of the conventional ZUPT methods, the proposed solution is wearable, comfortable, easy-to-use, and cheaper than solutions with pressure sensors embedded on the insole [3].

Materials and Methods

Figure 1 shows the sketch and the fabrication details of the pressure sensors developed. The sensors are produced in three layers: the top and bottom layer are made with conductive materials (fabric and yarn knitted on the sock), and the middle layer is a piezoresistive substrate. The sensing element is placed on the sock's heel and conductive leads connect the sensor to the acquisition device (placed on the user's ankle). Three different sensor configurations were tested, they differ on the piezoresistive element (EeonTex™ LG-SLPA and velostat) and the conductive materials (Satatex Techniktex P-130 and a silver coated yarn from Elitex) used.

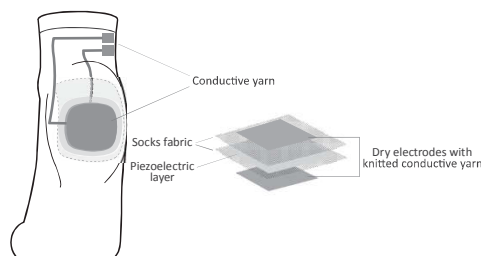


Figure 1. A sketch of the three layer textile-based pressure sensor with the conductive leads. During the stance phase, the heel presses the piezoresistive material and the sensor's resistance decrease. In the swing phase, the pressure between the heel and the footwear decreases and the

resistance of the sensor increase. This resistance variation allows the step detection and higher its variation better the stance phase can be detected.

Results and Discussions

To assess the viability of each sensor configuration for stance detection, a user performed five consecutive steps and then stopped with the heel on the ground. This test was repeated three times for each sensor configuration. Figure 2 shows the results of the tests performed. As can be seen in the figure, the best results were obtained for the following sensor configuration: Elitex yarns as conductive materials and EeonTex™ LG-SLPA as the piezoresistive element. For this sensor configuration, the resistance variation for the two gait phases was bigger than 150 k Ω . The worst result was obtained with the velostat as the piezoresistive element. Additionally, for all the sensor configurations, the resistance when the heel is pressing the sensor is very stable and its magnitude after the five steps is very close to the initial value.

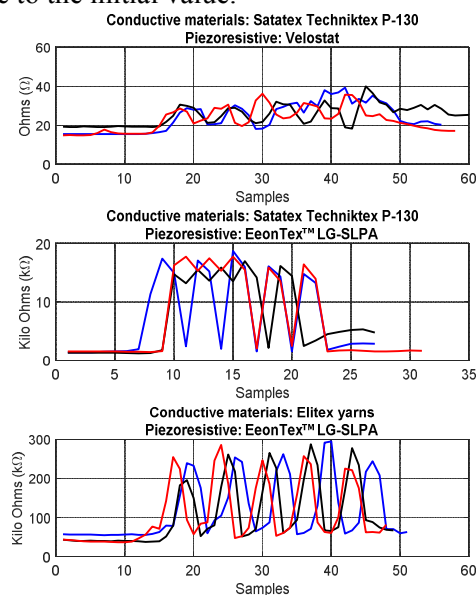


Figure 2. Results obtained for each textile-based pressure sensor configuration.

Conclusions

As demonstrated in this paper, the steps can be easily detected by means of a textile-based pressure sensor integrated on a sock. From the three configurations evaluated, the combination of Elitex yarns as conductive materials and EeonTex™ LG-SLPA as the piezoresistive element provided the best results. As future work, more sensor configurations will be tested and the sensors will be fully characterized. Additionally, another multimeter must be used to measure the sensor's output as the sampling rate of the selected multimeter is insufficient.

Acknowledgments

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Options indication

*1. Indicate your option for the presentation: **Oral**.*

2. Textile Engineering

Studies on manufacturing of pajamas for patients with burn wounds of high surface

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Paper carries out the manufacturing of pajamas made of different knitting structures. One emphasized on criteria necessary to fulfil the medical requirements according with patient critical condition. Considering burns wounds of 3rd degree one has in view the need of thermal insulation (the remaining skin surface does not cover up the ability of thermal insulation and patient is confronted with hypothermia), keeping sepsis condition liquid feeding and a specific pharmacodynamics therapy. The paper has in view two lines one is to obtain a pajamas based on high comfort for hyper sensitized and damaged skin made by means of specific knitting systems and secondly to promote on inner surface of pajamas a specific biomaterial able to speed up healing and fast recovery of burn wound . There presented detailed on progress research obtained on a specific biomaterial and on main lines to obtaining a clothing system able to promote a medical therapy.

Experimental Interactive Luminous Ballet Outfit

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Introduction

In dance shows, notably classical ballet, the costumes are considered as an important element for the success of the performance [1]. The costumes contribute to the transmission of the narrative of the show and the identification of the characters within the plot. Like the scenography design, its design expands the media related to the performance and atmosphere of the show.

The textile surface design and the shape of the suit traditionally constitute the material elements of the garment that promote communication. However, with the exponential increase in production capacity, consumption and competition, the design thinking and the culture of innovation become intrinsic concerns to the scenario of this segment. As a result, textile designers are continually striving to develop new concepts in the segment [2], and some of them seek to break paradoxes through transdisciplinary experiments involving design, engineering, electronics, fashion and art.

Wearable technologies, e-textiles, electronic textiles and smart fabrics are terms that indicate the application of electronic and other technologies, aiming to offer additional functions to worn objects, e.g. clothing and accessories [3]. The advance of researches in this area is growing and has close relationship with the wide development of computing, its miniaturization, democratization and multiple applications at individual and customized levels.

This article aims to present the development of an experimental product design based on interactive surface design, which proposes the broadening of dance communicability by the design of clothing in technological scenarios. Integrating, by means of sensors located in the shoes, the movements of the dance to the aesthetic and luminous answers on the surface of the costumes.

Materials and methods

Three parts make up the interactive outfit: the costume itself, the central controller with the LEDs and the sensing pointe shoes.

The central controller uses an Arduino Nano, a three-axis MMA7361L analogue accelerometer module and the nRF24L01+ communication module to receive force information from the shoe modules. WS2813 programmable LED strips are distributed over the textile support. The pointe shoes are devised with flexible piezoresistive force sensors to detect the “en pointe” position. This information is sent to the central controller using an nRF24L01+ and an Arduino module.

Interactivity is implemented through chromatic variations and brightness, related to the movement intensity, with a sense of directionality of the movement gained by lighting the individual LEDs according to the movement direction. When the “en pointe” position is detected, the performance is “rewarded” with an intense glitter effect.

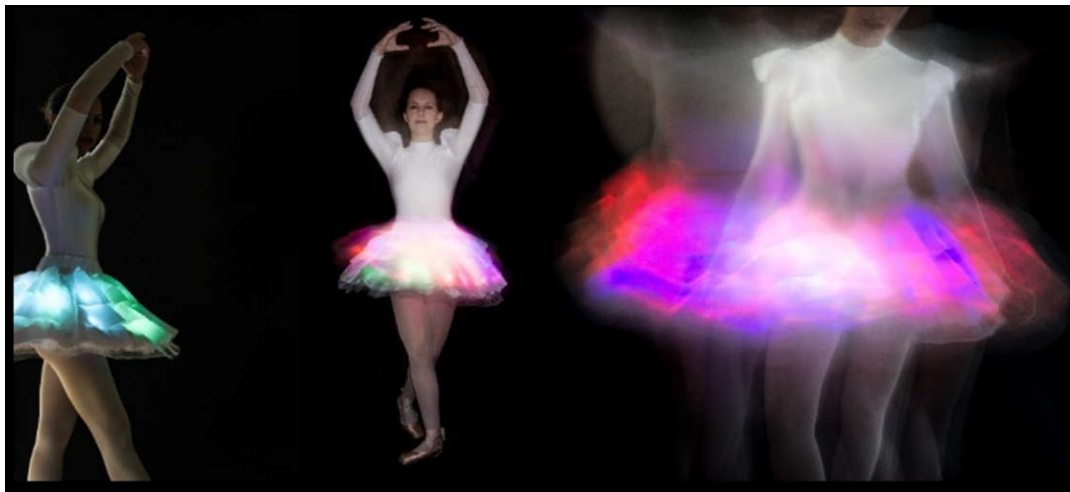


Figure 1. Ballet outfit reacting to motion

Results

Extensive tests carried out by a ballerina have shown that, after an adaptation phase, the dialogue between the music, the ballerina and the light interactions becomes a new, enriching experience both for the performer as well as for the public. Selection of adequate music and performances to maximise the visual results is a fundamental requirement. This paper will describe and explore the results and personal experiences.

Conclusions

The interactive outfit created has pleased all of the participants in this experiment, and it leaves much potential for further exploration. Besides the artistic possibilities, other applications are pictured. The pointe shoes may, for example, be used to help trainees correcting the position of their feet, using modified sensors able to measure position and pressure distribution of the tip in contact with the floor. For a commercial product, further miniaturization of the electronics and a more robust integration of the LEDs is necessary.

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Options indication

*1. Indicate your option for the presentation: **Oral**.*

2. Garment Engineering

Shape memory clay flaps assisted body cooling fabrics

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Mechanical responses of inorganic clay to external stimuli have been rarely implemented into devices that interact with the human body. We demonstrate that the hygroscopic and free swelling behaviours of bentonite nanoclay (BNC) were engineered to design wearables, which give multifunctional responsiveness to human sweat. By printing BNC composite on flaps of fabrics, they can reversibly change shape within a few seconds in response to environmental humidity gradients. Body's need for cooling is facilitated through controlled ventilation by opening and closing of these clay printed flaps. This study provides a background for developing new shape memory polymer composites for many applications in garment industry.

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Options indication

1. Indicate your option for the presentation: ***Oral.***
2. Indicate the option for the topic: ***Textile Engineering***

Study on the body girth dynamic size for wetsuit ease design

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Abstract: The aim of this exploration is to research on how the body measurements change under deformation during diving. We measured 31 body measurements of 57 females in six postures including four postures on the land and two postures under the water. We compared the body measurements, especially focused on the differences between standing and laying prone postures. It will help designers to find the reasonable dynamic ease and apply it to the pattern block design of wetsuit.

Keywords: wetsuit, body measurement, dynamic postures, ease allowance, pattern block

Introduction

The divers work under water with different dynamic postures [1], so, skin deformations should be taken into consideration for ease allowance calculating [2]. If the wetsuit is too loose, the water will invade diver's insulation system, if the wetsuit is too tight, the diver meet the difficulties to swim, because the compression wetsuit will be influenced [3]. To minimize the flowing water between the skin and clothing during diving process, which mainly depends on diving suit's pattern structure, fabric insulation performance and special craft [4], a dimensional change of body in dynamic positions is a complex issue that cannot be considered only from the aspect of basic anthropometric measurement, but the body morphology parameters must be taken into consideration [5]. Some researches about wetsuits only focused on the body standing postures [6]. Our research focuses on the girth under dynamic changes and the corresponding ease values on laying prone postures underwater.

Experiment steps

- Firstly, we used a non-elastic fabric to test the maximum decrease 11 body girths to simulate the maximum squeeze change. Then we obtained the E_M (average ease for wetsuit affected by the maximum acceptable materials elongation on body) and Δ_G (the body girths maximum decrease values, which can be used to calculate the average material elongation when the body girth is decreased per 1%).
- Then we used body surface drawing line method to record body size changes of 31 body sizes of 57 female bodies when postures (based on some typically diving actions) change. The subjects completed two standing and two laying prone postures on the floor and two laying postures under water. We used next abbreviations P0, P1, P2, P3, P4, and P5 to describe each posture.
- Besides, we chose the Chinese body type A as example, and used software 3DClo to change and adjust the sizes of virtual twin. We joined the body front and profile together of "P1&P0, P2&P0, P3&P0, P4&P0, P5&P0" to compare the outline contour.
- Finally, we applied basic zero ease in wetsuit pattern to obtain a new pattern block.

Results

The differences of BG, WG, HG, TG, and SL are shown in Table 1. The maximum difference of BG_F, WG_F, HG_F (and BG_B, WG_B, HG_B) took place between the postures P4&P0. In the circumstance of hands up (set in the same breathing state), the bust line move upward, the side seam moves forward, the abdomen bulge, the hip, and thighs changed a little, as shown in Table 1.

Table 1. The average differences between body measurements for body type A, %

	P1&P0	P2&P0	P3&P0	P4&P0	P5&P0
	BG (BG _F , BG _B)	WG (WG _F , WG _B)	HG (HG _F , HG _B)	TG	SL
P1&P0	-1.1 (-2.2/1.1)	-0.6 (-0.6/0)	0.1 (0.2/-0.1)	-0.1	3.9
P2&P0	2.9 (-3.8/6.7)	-1.4 (-1.2/-0.2)	-1.7 (0.7/-2.4)	-0.1	4.3
P3&P0	2.7 (-4.0/6.7)	-1.3 (-1.2/-0.1)	-0.7 (-0.2/-0.5)	-0.5	4.6
P4&P0	1.8 (-4.6/6.4)	-1.8 (-1.4/-0.4)	-2.3 (0.9/-3.1)	-0.2	4.4
P5&P0	1.6 (-4.9/6.5)	-1.4 (-1.3/-0.1)	-1.0 (1.0/-2.0)	-0.2	4.6

*Postures on the floor: P0 is basic static standing posture, P1 is standing and hands up, and P2 is laying prone. Postures under water: P3 is laying prone and legs curl on the floor, P4 is the same as P2, P5 is the same as P3

The minimum negative values are applied to fit the human body and satisfy the dynamic change, but, the positive values (such as BG_B) are not considered as additional ease. Therefore, we proposed a ratio of material compressed capability as $R_C = (E_M / \Delta G)$. Through calculations, we obtained the minimum design ease to BG as 0, to WG as -1.3%, to HG as -1.1%, to TG as -0.2%, and to SL as 4.4% to meet the dynamic changes of the human body. When we stretched four kinds of fabrics to the max length, the elongation was less than 3 %. Finally, we applied the zero ease to pattern block. As Figure 1 shows, the difference between two patterns is obvious.

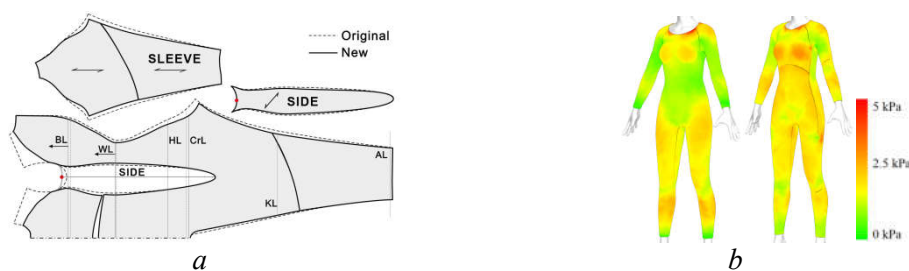


Figure 1: Pattern blocks and virtual try-on: a – original basic pattern with zero ease (in dot line) and new (in solid line) patterns; b – virtual try-on of body type A (average BG=81.5, WG=65.7, HG=90.4, cm): left - original basic pattern, right – new pattern

Conclusion

Under this study with different dynamic postures, we established the relations between their size change which provides the possibilities for complex studies of body measurements in dynamic conditions.

According to this experiment, those results can predict how dynamic postures influence the body sizes, which can be connected with the pressure on soft tissue, tensile property of materials and parameters of pattern block, and further applied to solve the problems under wetsuit pattern block design.

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Options indication

1. **Oral**

2. **Topic: Garment Engineering**

Development of a Methodology of the Product Line Matrix Formation of the Enterprise Fabricating Clothes Commentation

Klochko Inna

A product line policy of the enterprise fabricating clothes at the present stage has to consider the factors connected with specific features of a consumer. Appearance of a person defines dimensional characteristics of clothes, a form (silhouette) and color appearance. Features of the identity of a consumer are shown in his lifestyle and connected with him style preferences in clothes, a choice of these or those composite and product line decisions. The practice of the formation of clothes of a modern person is connected with a tendency to the rational capsular wardrobe creation. Such approach allows in the course of the design of an industrial collection, on one hand, to consider features of production, and on the other hand, to create prerequisites for real customization.

Thus, a problem of the formation of a product line policy is closely connected with a problem of the study of the enterprise target audience. An analysis of the target audience gives a chance to define the basic data for the formation of a product line matrix of the enterprise. A product line matrix is a document, which is a tabular form, in which according to the hierarchical principle (from a category to a unit of a commodity stock account) a company range is reflected and there is the information with certain characteristics of a range during a concrete period of time.

The present research has offered to consider the following major factors when forming a rational product line matrix of the enterprises fabricating clothes:

- A consumer's lifestyle, a degree of his addiction to fashion;
- The segmentation of consumers on style figurative groups to style preferences;
- A degree of satisfaction with the individual wardrobe in a consumer group;
- The capsular structure of the client wardrobe and, as a result, the capsule essence of a product line of the enterprise and its continuity in relation to the previous collections;
- The existence in the wardrobe of a consumer of universal products which are coherent between the main capsules;
- A color type of a person's appearance as one of the criteria of the definition of a collection number coloristic palette of the enterprise product line matrix.

Such approach demands the existence of stable communicative relations between a consumer and a producer. A lifestyle and a consumer's individualization are the elements of an individual image and form consumer preferences in a concrete target group. In turn, the segmentation of target groups from positions of socioeconomic factors which influence a choice

and decision-making on purchase by a consumer, allows connecting the audience's choice to a certain price segment. From this point of view it is expedient to consider preferences of the target audience through a prism of the known brands - standards.

As a result of the research conducted by the authors it is possible to point out the main stages of the formation of a product line matrix of the enterprise:

1. An analysis of analogs (brands-standards):

- The definition of the target audience.
- The formation of check-sheets (№ 1 - selection criteria of a suitable analog, № 2 - criteria of an analysis of a collection of a brand - standard).
- Standard brand choice.
- The testing/research/analysis of a collection of a brand - standard on commodity groups.

2. An analysis of commodity groups on the basis of the results over the last seasons and the enterprise work on trend watching.

3. The definition of a percentage ratio of commodity categories:

- The definition of a percentage ratio of commodity categories depending on the results of sales over the last season.
- The definition of a percentage ratio of commodity categories depending on a color type of consumers' appearance.
- A comparison of the available data with data of a brand-standard.

4. The formation of a product line matrix.

Moisture Management and Drying Properties of Double Face Knitted Fabrics

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The human body is in constant interaction with its surroundings and it tries to maintain a balanced temperature around 37°C. If the thermal equilibrium condition deteriorates, the body will attempt to lose or gain heat. The increment or decrement of the body temperature due to environmental changes or activity levels is controlled by hypothalamus. In the case of heat increase, the basic responses are to accelerate the blood flow in skin vessels (vasodilation) or the output of water vapour and liquid sweat on skin surface for reducing inner temperature of body (sweating) [1]. Although the sweating process is one of most important weapons for thermal regulation system, it is also a potential cause of discomfort feeling. Particularly, textile garments allow very little microclimate areas on skin, which prevents quickly dispersing to atmosphere. Also wet textile surface by absorbing liquid cools faster than skin and causes irritating cold feeling at the time of contact. Therefore, the properties expected from a comfortable textile product are to allow efficiently the transportation of heat and moisture in the condition of thermal imbalance, to remove quickly the liquid sweat with capillary effect to outer surface and to spread it to a wide area on fabric [1,2].

It is very difficult for a conventional textile product to fulfil these complex functions. For example, hydrophobic fibres quickly spreads the moisture which leads to faster drying, however wet feeling can not be prevented. On the other hand, highly hygroscopic fibres have good moisture absorbency, but weak drying efficiency [3]. Therefore, the thermoregulation effect of double face fabric structures formed by combining different layers with different properties is thought to be better than single layer structure. Due to this synergistic effect of different moisture transfer mechanisms of each type of fibres within double face composite fabric structure, highly comfortable products are expected to be obtained, especially for sportswear and inner garments. This study aims to reveal the effects of the combination of different yarn types on moisture management and drying characteristics of the resultant double face knitted fabrics. For this purpose, various double face interlock knitted fabrics were produced using polyester, cotton and viscose yarns as shown in Table 1. Moisture management properties were tested by MMT (SDL Atlas) and drying properties were investigated through water drop method.

Table 1. Produced fabrics

Notation	Face side	Back side
PES-PES	Polyester	Polyester
CO-CO	Cotton	Cotton
CV-CV	Viscose	Viscose
PES-CO	Polyester	Cotton
PES-CV	Polyester	Viscose

According to the MMT test results, moisture spreading speed and spreading radius of PES-CO and PES-CV samples were found to be higher compared to other fabrics composed of one type of yarn.

As expected PES-PES fabrics dried faster than CO-CO and CV-CV fabrics. The results of the fabrics including different yarns on both sides (PES-CO, PES-CV) revealed that, when wetting occur on the hydrophobic surface, a faster drying was achieved compared to wetting on hydrophilic surfaces (CO or CV). Moreover, it was observed that PES-CO samples showed excellent drying behaviour which has the lowest drying time among all tested fabric, even PES-PES fabrics. This situation showed that there is a strict interaction between moisture spreading capability and drying properties.

These results proved that, the sweat on skin is rapidly transmitted to the outer surface through the inner layer which is composed of hydrophobic yarns due to high capillarity by double face interlock knitted fabrics composed of different types of yarns on each side.

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Options indication

1. Option for the presentation: **Oral presentation**
2. Option for the topic: **Textile Engineering**

Sustainability: a vision for the circular economy in the fashion industry

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In view of the environmental and economic issues governed by an open loop take-make-dump model where resources become wasteful at the end of their life, there is a need to find alternatives for waste reduction and the use of virgin raw materials in new production cycles, and consequently reduce negative environmental impact [1, 2].

This study aims to examine in the literature how the Circular Economy (CE) can guide the fashion industry towards sustainability and identify opportunities for companies. The CE is a concept that promises to support sustainable development and environmental relief, human health, and social problems caused by rapid economic growth, thus highlighting the relevance of exploring the concept of circular economy within the context of fashion design and textiles [1, 3]. In this scenario, the circular economy (CE) has emerged as a solution to the ubiquitous challenges posed by economic growth and sustainability [1] and is encouraged to be used in various sectors for the reduction of industrial waste, and return of products and aftermarket materials and powders - consumption. Also, it is essential to consider waste disposal, a serious problem faced by society, which presents a challenge for researchers seeking alternatives to this issue.

The fashion industry is currently undergoing a radical change in the global sustainability paradigm driven by the growing negative and social environmental impact of fashion production and consumption [4]. The CE meets the desire to minimize the environmental impacts generated in the processes for which alternative solutions, new business models, or a rethink about new systems are required for business growth opportunities and economies that are more competitive [5, 2].

Of particular note is the concern with textile materials, the main raw material for the development of clothing products, which is strongly linked to the environmental issues involved in clothing manufacturing and environmental impacts. Moreover, the overall production of textile fibers, the consumption of textiles and the quantities of textile waste are constantly increasing [6].

This study was based on the literature and analysed with the help of VOSviewer and NVivo software, focusing on the Circular Economy. The study employs qualitative methods and aims to obtain information and understanding of the problem and the systematic search for data that still need to be discussed. Following the principles of qualitative research, theoretical analyses will be made that will result in deductions about the importance of implementing the circular economy in order to guide the fashion industry towards sustainability.

Finally, it is understood that there are few studies in the literature that specifically address this subject, though it is a comprehensive field for research that can provide advances for companies and the society in general. It is emphasized that this study will provide knowledge about the circular

economy focused on the fashion sector and the activities initiated frequently by the companies in the sector.

Acknowledgments

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Options indication

1. Indicate your option for the presentation: **Oral**
2. Indicate the option for the **topic: 5. Garment Engineering**

Application of Innovative Technologies in Fashion Design Education

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Introduction

The fashion design education requires high level of visualization of the study process. The application of the innovative educational and design technologies offers quality improvement of higher education in fashion design by interactivity, flexibility and dynamics. The paper presents the application of the innovative technologies in education in Fashion Design subjects, which are included in the Bachelor and Master programs of Design, Technology and Management in Fashion Industry at Faculty of Technics and Technologies, Trakia University, Bulgaria.

Application of Innovative Educational Technologies

Document cameras in combinations with interactive white boards are used in education in subjects in the fields of traditional fashion design and pattern making, especially for visualization of different hand techniques for fashion and textile illustrations, and traditional hand pattern making.

The interactive white boards are used in education of work with specialized software as 3D design, CAD systems, and raster and vector graphics applications.

The application of interactive white board and document cameras leads not only to additional visualization. With the help of these educational technologies full or parts of lectures are recorded in videos, which are available for students at the e-learning system.

The last novation, which we use in fashion design education, is augmented reality. Certain topics in textbooks and manuals of fashion illustration, design theory, fashion design and pattern making are with added augmented reality markers and the study material is additionally visualized with 3D models seen on the displays of students' mobile devices. For example, Figure 1 presents the adding of a 3D model of a lady's body, which helps the education in a theme of Pattern Making of Ladies' Clothing subject, in which the connections between the forms of the body and the forms of their corresponding place in the constructional base are visualized.

Application of Innovative Design Technologies

3D printer and 3D markers are used in education of fashion design subjects. With their help the students realized projects of design of decorative elements and small accessories, or parts of bigger accessories. 3D printing and modelling with 3D markers help with 3D forms and models the education in some themes of Design Theory and Fashion Design subjects. For example 3D hard models of clothing are made for presentation of different types of silhouettes.

Our partners from the business help us with digital textile printing and our students have possibility to realize parts of their project, which they at first have realized with the help of graphic software and free and internet applications for visualization.

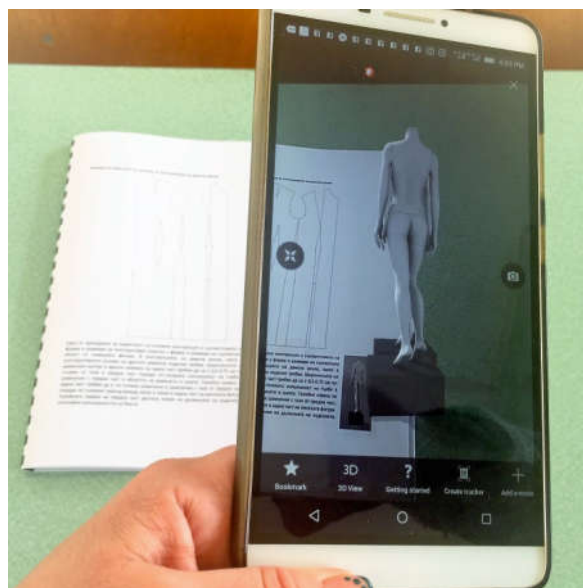


Figure 1. Application of augmented reality in education of Pattern Making of Ladies' Clothing subject.

Conclusion

According to the examinations results and studying student opinion it can be concluded that application of presented innovative technologies in fashion design education provide easier and more accessible learning of the study material, acquiring more knowledge in a short time, developing the students' creativity, creative thinking and skills, and generally their application can lead to an increase in the quality of education.

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Options indication

1. **Poster presentation.**

2. **Conference topic: Garment Engineering**

Calculation of the body measurements after analyzing the historical pattern block

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Purpose

The trends of contemporary fashion design are considerably referring to the historical costumes. Regarding the relevant records of pattern block drafting methods of historical costumes, although the patterns and their concrete indexes are accessible, the anthropometric features of the corresponding historical wearer are uncharted. The purpose of this research is to employ the 2D CAD and 3D virtual try-on technologies to reconstruct the historical costumes to calculate and assess the anthropometric measurements of the historical wearers, validating by the results of virtual system “historical costume – body”.

Design/Methodology/Approach

To reconstruct the body measurements, we should have as minimum two objects: first, the realistic picture of costume, second, the pattern block of costume. The both and the pattern manual consist the information about inside underwear^{[1][2]}, fabrics, craftsmanship^[3] which influence on outline shape of costume. Fig.1 shows the full-skirted coat, 1740s, with historical pattern blocks were taken as the example to reconstruct one in 3D Clo^[4].

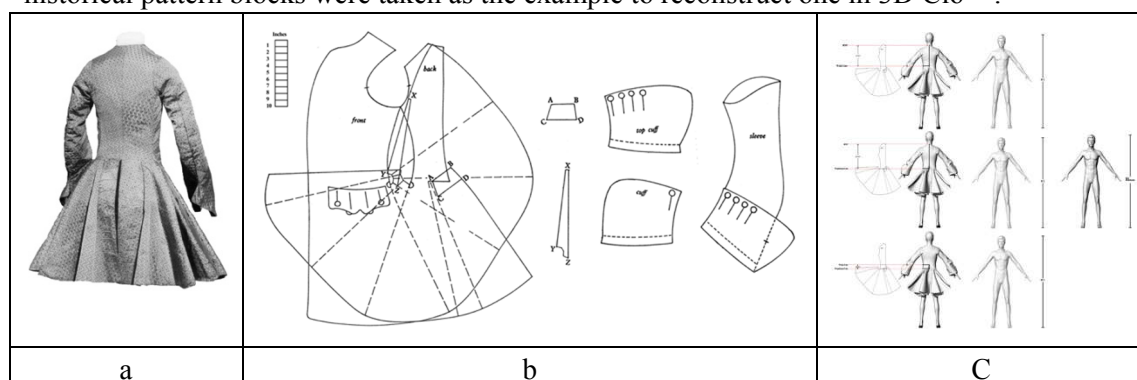


Figure 1. Men's full-skirted coat, 1740 (a), pattern block (b) and virtual system "body-coat" (c) Adapting the height of avatar during virtual try-on

Figure 2 shows the steps should be done to calculate the body measurements hidden in the historical pattern block and costume' picture.

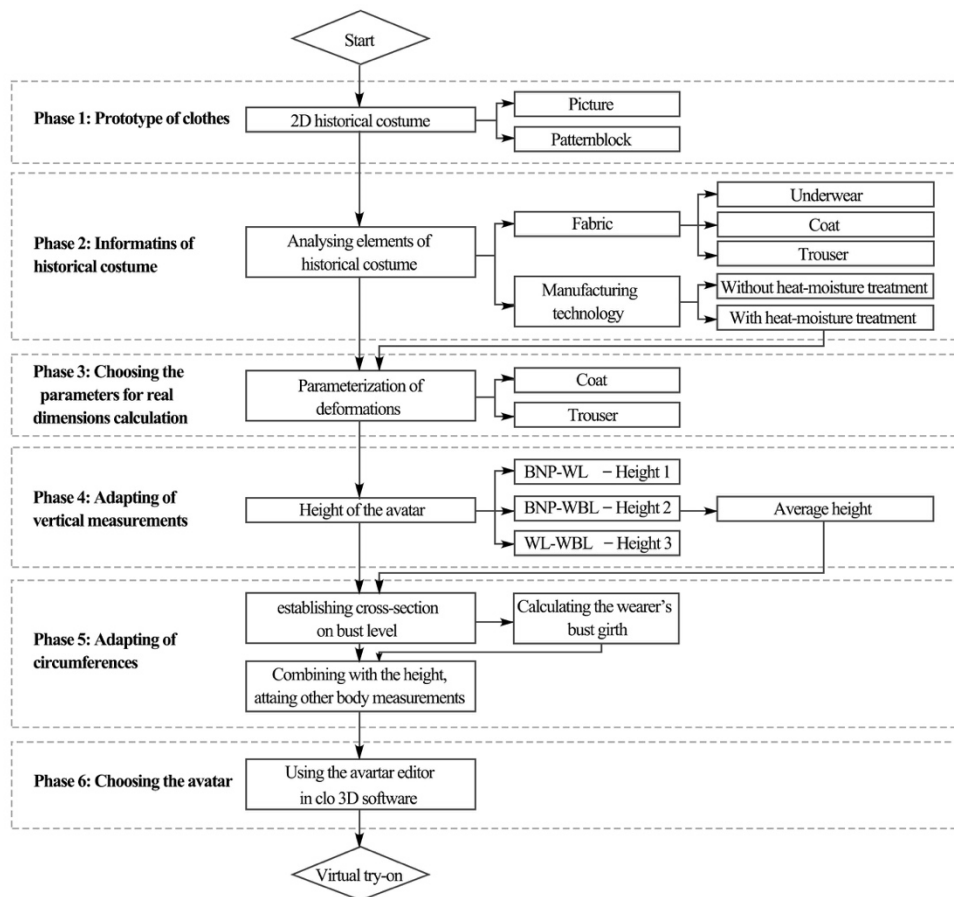


Figure 2. Flowchart of this research

Results

After sketching the parts of historical pattern blocks in equal scale, we established the algorithm of most important anthropometrical points and levels finding (such as BNP, waist level WL, waist level of back WBL) by combining the historical pattern block and body scanning technology.

Fig.1c shows the virtual system "body - coat" which was obtaining after generating the digital twin of historical male and virtual try-on. Digital twin was designed by using several body measurements calculating after deep analyzes of two objects made in parallel. The schedule of body measurements includes traditional values and cross-sections.

Conclusion

Through the observation of historical costume, the reconstructions in virtual environment were proposed. The way and the algorithm how to get the original male body measurements from the historical pattern in accordance with the pattern block parameters, fabric thickness, air gap, etc. were developed. Thus, the detailed anthropometrical database and morphological features were attained accordingly. This research proposed and validated the method of obtaining body measurements from pattern blocks and picture of historical costumes and virtual try-on technologies. This approach will be helpful to accurately exhibit the features of historical costumes for researchers of historical costumes and digital museum.

Keywords: historical costume, pattern block, 3D reconstruction, CAD, body measurements

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Options indication

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Release characteristics of Naproxen loaded poly (vinyl alcohol) nanofibers

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The use of electrospun fibers as drug carriers is promising in the future of drug-delivery applications, especially for pain-related topical administrations. Non-steroidal anti-inflammatory drugs (NSAIDs) are used for controlling pain and inflammation in rheumatic diseases. The present contribution reports the use of mats of electrospun poly (vinyl alcohol) (PVA) nanofibers as carriers for delivery of the model naproxen (NAP). NAP is a type of NSAIDs commonly administered for the treatment of pain, inflammation and fever [1]. The release mechanisms of drug-loaded electrospun PVA nanofibers are based on the diffusion of the drugs through the swollen PVA fibrous matrix and the release due to partial dissolution of the matrix [2-4]. Control over the release characteristics of the drugs can be provided through partial crosslinking of the PVA fibrous matrix [5].

In this study polycarboxylic acids; 1,2,3,4 butanetetracarboxylic acid (BTCA) and citric acid (CA) were used to crosslink the PVA nanofibers. The amount of NAP was 10wt% (based on the weight of PVA) and the amounts of BTCA and CA were fixed at 20% (w/w of PVA). Cross-sectionally round and smooth fibers were obtained. The average diameters of these fibers ranged between 228.8 and 291.6 nm (Figure 1).

The total immersion of the NAP-loaded electrospun PVA fiber mats in the phosphate buffer pH 7.4 (37°C) (PBS) was used to obtain the cumulative release of the NAP from the PVA nanofiber samples. Crosslinking enhanced the protection of mat structure against dissolution in PBS and slowed down the release of NAP from the drug-loaded nanofibers. The total amount of the drug released from the NAP/PVA-BTCA and NAP/PVA-CA nanofibers were 93% and 78% respectively within 60 min whereas non-crosslinked NAP/PVA nanofibers released all of its drug content within 45 min for 10 h collected fibers. In case of 20 h collected fibers NAP/PVA-BTCA and NAP/PVA-CA nanofibers released 50% of the NAP content in ~3 h and released 74% and 70% of NAP content, respectively, after 8 h. NAP release reached 77% for NAP/PVA-BTCA nanofibers and 76% for NAP/PVA-CA nanofibers after 24 h.

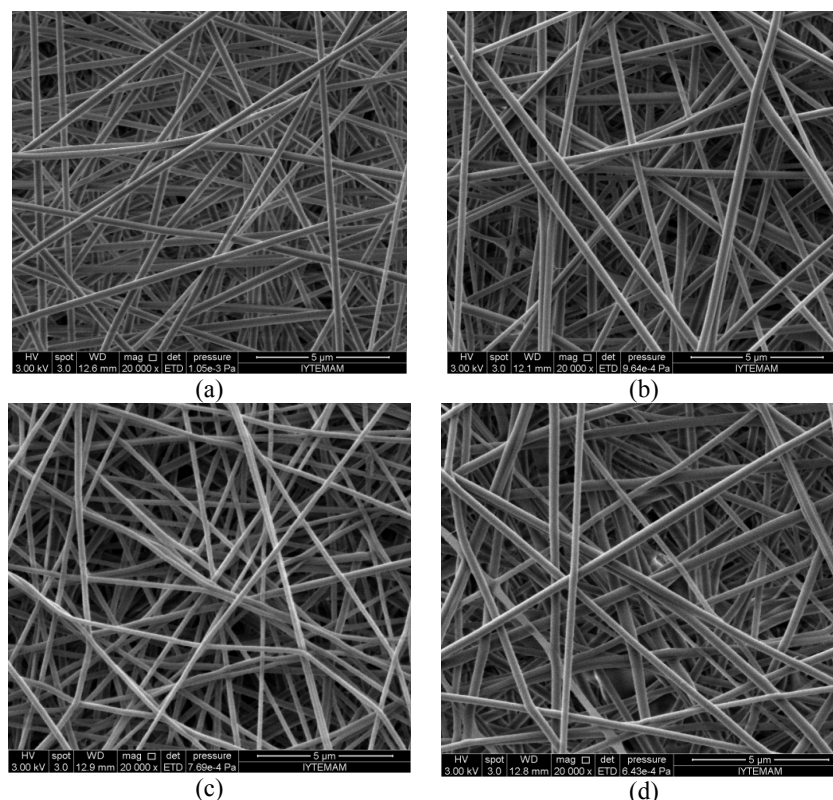


Figure 1. SEM Images of 10h produced (a) neat PVA, (b) NAP/PVA, (c) NAP/PVA-BTCA and (d) NAP/PVA-CA nanofibers

Acknowledgments

The authors also would like to thank “Pharmaceutical Sciences Research Centre (FABAL), Faculty of Pharmacy of Ege University”.

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Options indication

1. For **Oral** presentation
2. For the Textile Engineering

Copaíba essential oil nanoencapsulation: production and evaluation

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Introduction

Many textile products that demonstrate cosmetic functions, such as moisturizing, anti-aging, anti-cellulite, among others, are available at the market nowadays. Those materials are titled as cosmetotextiles since 2006, when it was officially pronounced by the *Standardisation of Textiles and Clothing Industries (BNITH)* and, among those, the most highlighted are the health and care designated [1].

Into this scenario, we researched the emergent technology textiles products, destined to offer solutions into the postpartum cicatrization period. After market analysis into this sector, we noticed the absence of functional care properties textile products, with antimicrobials and moisturizers capacities, helping the healing process of the cesarean area.

Thus, we started experimental research in the laboratory to propose woman's underwear/lingerie with ergonomic patterning, developed to solve the specific puerperium period needs: comfort (Ergonomics), moisturizing and cicatrization quality, within market viability. For that characteristics achievement, we studied the nanocapsules production by simple coacervation technique using the referred essential oil, in order to impregnate onto the underwear's lining, which is in constant contact within the surgery's region.

Materials and methods

Based on Strategic Design Methodology, we developed an ergonomic study by physical and psychological (tactile and visual sensory) nature. The product materials are polyamide with elastane knit (88% and 12%, respectively) and cotton knit (100%), the last one, considered the best for the nanocapsule's impregnation.

Regarding the nanoencapsulation technique, we used the simple coacervation method, as being the most indicated [2,3]. We have prepared a solution containing 0,25g of chitosan and 100ml of CH₃COOH 0,17M. Then, we put this blend under stirring, to room temperature, by 60 minutes, on 300-rpm speed. We filtered the blend and followed by 30 minutes on the Ultrasound. After, we adjusted the pH to 4,5 in a NaOH 0,17M solution. Following, we prepared a solution of Sodium Tripolyphosphate (TPP) 1mg/mL with saline by stirring for 30 minutes, on 200-rpm speed. For the oil synthesis we used 0,3g of oil, 0,15g of nonionic detergent and 30mL of chitosan blend by magnetic stirring by 30 minutes, on 300-rpm speed on room temperature. Nextly, we dripped 10mL of TPP solution (1 drop per second) on the reffered blend and took to magnetic stirring for 60 minutes, on 1000-rpm speed. The resulted solution was centrifuged by us for 10 minutes on 5000-rpm speed. After the stirring, we proceed to drying during 24 hours on a 20°C conservatory. After this period of, we repeated the centrifuged and drying processes once in a day for two days [4].

Then, we evaluate the nanocapsules by the scanning electron microscopy (SEM) method. We used the *Nova nanoSEM 200* electronic microscope, within 10kV variable voltage acceleration. Then, we analyzed the samples by magnifying from 10.000 to 15.000 times. The thermal stability was made by thermogravimetric analysis; the test was obtained on Hitachi model 7200 equipment operating at a heating rate of 10 ° C / min and a nitrogen atmosphere of 200ml / min in the temperature range (0-900 ° C).

Results

By analyzing on the SEM method, we noticed that the nanocapsules has been formed within 738,5nm to 971,5nm diameter variation, noting also the presence of a regular sphericity, as shown on figure 1a.

By analyzing the STA graphic, we noticed that 219,5°C is the fusion temperature, 11% initial mass loss on 150°C and 26,8% after mass loss starting on 500°C.

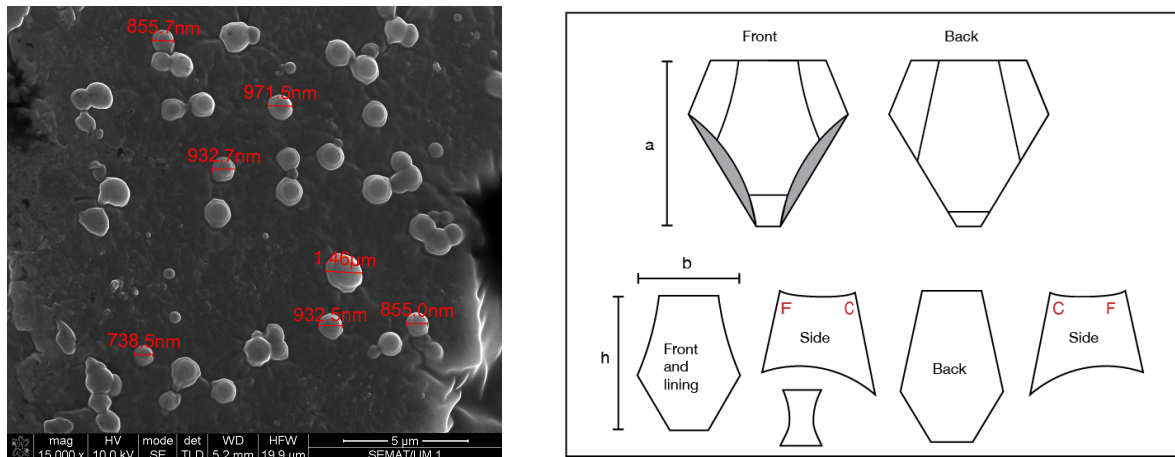


Figure 1: (a) Nanocapsules SEM; (b) Underwear's Design and Patterning

Concerning on the product, afterwards the nanocapsules production we developed the underwear patterning with cutouts determined by the nanocapsules application area, providing the scar area region full coverage, indicated as “Front” and “Lining”, on figure 1 b.

Conclusion

The developed product corresponds well to the need presented in the modeling and aesthetic requirements, its viability as cosmetotextile has great potential due to the application characteristics of the active principle, once it presents the cicatrization and moisturizing technical features. We verified by the SEM method that nanocapsules has been developed. Besides that, the underwear's patterning is attending the ergonomic needs of the puerperal period and the decrease of impregnation costs because the active principle is focused only on the healing need area.

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Options indication

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Experimental studies at molecular level on the protective textile materials' response under extreme conditions

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The study of structural alterations at molecular level of synthetic textiles under high deformation rates and strains may be valuable with respect to both the development of novel protective materials and the designing of future protective fabrics. In view of the increasing necessity for body armours against bullets, knives and high speed fragments, this work attempts to investigate one of the critical factors that play an important role of the overall response of the fibers to the penetrating objects, the segmental orientation of the polymeric materials constituting the fibers. To this end we borrow knowledge and methods already known for decades for ceramic and other types of materials. We thus take into account that the material's performance in the Mescall zone i.e. the region in close proximity to the advancing projectile, is decisive for the penetration characteristics. [1, 2]

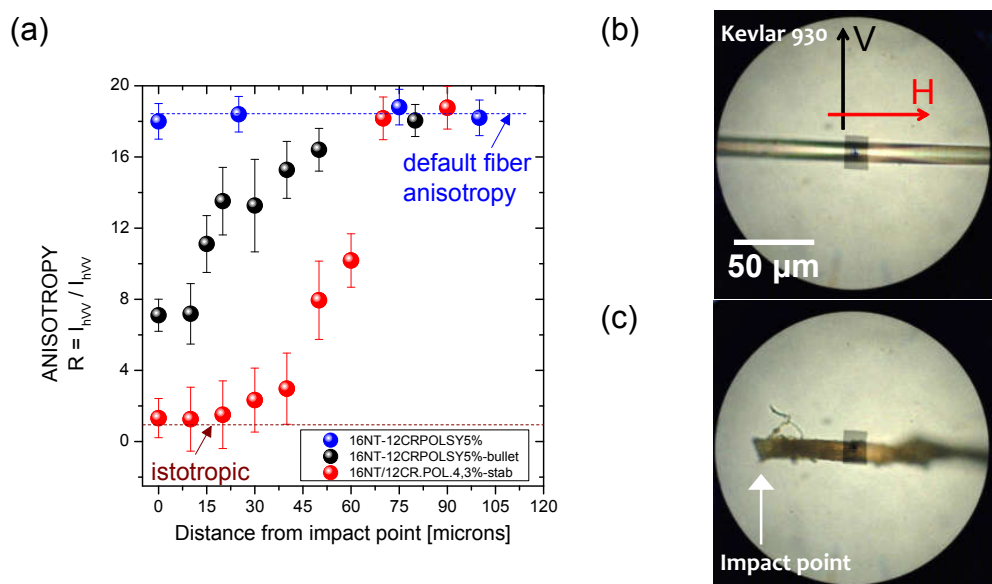


Figure. (a) Distribution of anisotropy (R values from polarized Raman spectra) along the fiber for: the default fiber (blue), a fiber from the bullet tested panel (black) and a respective one from the stab tested panel (red). Highly anisotropic $R \sim 19$, isotropic $R = 0$. Micro-photograph of a: (b) default anisotropic fiber ($R \sim 19$). (c) Fiber from a bullet tested panel ($R \sim 7$ at the impact point).

Furthermore, we introduce polarized micro-Raman spectroscopy in order to monitor the progressive loss of segmental orientation [3] from the unaffected part of a fiber towards the impact “point”. The fibers were carefully obtained from various test-panels (consisting of neat or treated Kevlar fibers)

which experienced different bullet and knife test protocols. In several cases complete loss of segmental orientation at the “point” of impact were measured implying complete “amorphization” of the initially highly anisotropic material. [4, 5] Differences were observed for different types of projectiles (bullet/knife) which may be attributed to different mechanisms associated to the energy dissociation in each case. Quantification of the latter may provide clues for the improvement of anti-ballistic and anti-stab performance.

Acknowledgments

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Use of DMDHEU with Novel FR Chemical for CO/PET Blends

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Reducing the flammability of textile fibers and fabrics has been one of the major challenges facing the scientific and industrial researchers. Flame resistance is a desirable property that can be imparted to fabrics by means of chemical finishing. Due to the fact that conventional organo halogen-based flame retardants are getting banned more and more [1-4], several halogen-free substitutes have been developed, for instance, polyphosphates, organic phosphates, or nitrogen compounds [5-6]. In this context nitrogen and phosphorus containing chemicals are especially in importance, because of their P–N synergistic effect in flame retardant applications [7]. Using crosslinkers in FR systems is an option to lead better bonding properties of FR agents on textile fibers. N-methylol reagents, such as DMDHEU (dimethylol dihydroxyethyleneurea), have long been used in the textile industry as the crosslinking agents for cotton to produce wrinkle-resistant cotton fabrics and garments [8]. Few studies have indicated that it was also suitable as a crosslinker for flame retardant agent on cotton fabrics [9-10].

In our previous research, a novel polymeric flame retardant with phosphorous-nitrogen synergism was synthesized by polyvinyl alcohol (PVA), hydrophilic polyester resin (PR), phosphoric acid and dicyandiamide (DCDA). Cotton, polyester and CO/PET blend fabrics were treated via pad-dry-cure process with this synthesized chemical. PVA (PR)-P-DCDA showed that it is an effective flame retardant on the fabrics and at larger scale, Eksoy Chemical Company commercialized under the name Fire-off EBR [11]. In this study, a new FR finishing system based on Fire-off and a binder, DMDHEU were developed in order to improve durability for cotton part of the blend. CO/PET fabric samples (292 and 300 g/m²) were treated Fire-off and Fire-off/DMDHEU FR systems. Flammability characteristics, thermal stability and chemical structure of treated fabrics were investigated by LOI, Micro Cone Calorimeter (MCC), DSC and FTIR, respectively. The wrinkle resistance properties of untreated and Fire-off/DMDHEU treated fabrics were also evaluated.

Table 1 shows MCC and LOI test results of untreated and treated cotton and CO/PET fabric samples. It is seen from the Table 1, Fire-off treatment leads an increase in LOI values of CO/PET fabrics from 18.6 to 26-27, whereas Fire-off/DMDHEU system increase LOI values of CO/PET samples up to 27.2. When compared Fire-off and Fire-off/DMDHEU treatments in terms of heat release and mass loss, it is seen that addition of DMDHEU in finishing bath leads more decrease in HRC, PHRR and mass loss of CO/PET fabrics, which indicate this FR system imparts better flame retardancy on CO/PET blends. These results are also in line with DSC and LOI test results.

Table 1. FR evaluation of untreated and treated CO/PET fabrics.

Fabric Type	Treatment	HRC (J/k K)	PHRR (W/g)	T max (°C)	THR (kJ/g)	Mass loss (%)	LOI
50/50% CO/PET-292 g/m ²	-	196.33	181.27	379.13	16.27	90.98	18.8
50/50% CO/PET-292 g/m ²	Fire-off	136	123.53	437.77	13.53	83.63	27.0
50/50% CO/PET-292 g/m ²	Fire-off /DMDHEU	141.67	129.9	438.63	13.87	81.94	27.2
35/65% CO/PET-300 g/m ²	-	224.33	206,77	452.2	17.1	90.32	18.6
35/65% CO/PET-300 g/m ²	Fire-off	185.33	170.9	440.27	14.83	84.27	26.0
35/65% CO/PET-300 g/m ²	Fire-off /DMDHEU	178	163.83	442.9	14.5	83.34	27.2

Consequently, Fire-off/DMDHEU system is a more effective nitrogen provider than Fire-off alone to enhance the flame retarding performance of the treated CO/PET fabrics through phosphorus–nitrogen synergism, therefore the presence of DMDHEU in the flame retardant finishing system increases the flame resistance of the treated CO/PET fabric. In addition, DMDHEU does not significantly change the wrinkle recovery of fabrics when used with Fire-off.

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Comparisons of the photochromic behaviour of dyes in solution and on polyester fabric applied from supercritical carbon dioxide solvent

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ABSTRACT

Photochromic textiles are of considerable interest because of their important applications in smart and functional materials due to their interesting dynamic color changing effect when irradiated with light of certain wavelength. The use of resource efficient processes, such as digital inkjet printing and supercritical carbon dioxide (scCO₂) dyeing techniques enables an economic production of those high-end functional products with high material costs. In this study, photochromic polyester fabric has been prepared by applying two commercially important photochromic dyes based on Spirooxazine (SO) and Naphthopyran (NP) dye classes using scCO₂ dyeing technique and a comparative investigation of the photochromic behavior of these dyes in solution and dyed on polyester fabric has been performed. Dyeing of polyester fabric was carried out by adopting the optimum dyeing conditions developed for disperse dyeing of polyester in scCO₂. The properties of scCO₂ dyed photochromic fabrics were compared with the same properties of the same dyes in a non-polar solvent, hexane. The conventional color measurement and a specially designed online color measurement system capable of simultaneous UV irradiation and color measurement were used to evaluate the photochromic performances. Both the photochromic dye types in textile and in solution showed a significant reversible color changing properties when exposed to UV light and revert to their original color when the UV light is removed. The scCO₂ dyed polyester fabrics exhibited similar level of color build-up while contrasting behaviour was observed in terms of color changing rates compared to their behaviour in solution. In this initial part of the investigation, all factor levels, the solvent, and the substrate type were kept constant.

Keywords: supercritical CO₂ (scCO₂), dyeing, polyester, photochromic, spirooxazine, naphthopyran

Options indication: **ORAL**

Topic: TEXTILE ENGINEERING

Hydrodynamics of Hot Water Flow on Fabrics and Its Influence on Thermal Performance of Fabric Systems

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Introduction

Firefighters and industrial workers can be exposed to emergency conditions in their occupational environments. They may sustain burn injuries which can be caused by exposure to hazards such as exposure to hot liquids and pressurized steam used extensively in industry. Protective clothing is the only barrier between the skin and these thermal hazards. The flow of hot water on protective clothing may cause heat to be transferred through the protective clothing and cause skin burn injuries. As such, the understanding of the hydrodynamics of the hot liquid flow on fabrics provides a useful tool in understanding of local heat transfer caused by hot liquid flow on the fabric. Hydrodynamics of liquid flow on horizontal and inclined surfaces, and jet impingement heat transfer have been subjects of extensive research (e.g., [1-3]). However, hot liquid impingement on the surface of a fabric is different from hot fluid impingement onto a smooth rigid surface. Due to the interaction of water with fabric surfaces and the fact that water could penetrate the fabric structure, different features are expected in liquid flow patterns on fabrics. In this study, the hydrodynamics of a hot water jet impinging on fabric systems and the parameters which influence heat and mass transfer through the fabric system were studied, along with their effects on the thermal performance of the fabric.

Experimental

The fabric systems selected for this study represent thermal protective garments worn by firefighters and other workers. A modified apparatus (based on ASTM F 2701-08, Evaluating Heat Transfer through Materials for Protective Clothing upon Contact with a Hot Liquid Splash) was employed [4]. Fabrics were placed on a flat skin simulant plate with dimensions of 404×253 mm and exposed to water from a nozzle with 10 mm diameter. Twenty nine heat flux sensors which were mounted in the skin simulant plate, were used to observe the effects of the flow of hot liquid on thermal performance of the fabric systems. The data acquisition system recorded the temperature every 0.1 s, and the transmitted and discharged energy during and after exposure. A bio-heat transfer skin model was employed in conjunction with Henriques' Burn Integral to predict second degree burn time [5]. A Canon digital camera and an FLIR InfraCAM SD thermal imager were used in order to take images of the water flow patterns and to investigate the temperature profile on the surface of fabrics.

Results

Hot water was heated to a pre-set temperature and was sprayed on the fabric systems which were mounted on the sensor board and were taped flat. The water leaving the nozzle hit the fabric and flowed on the surface in a thin layer and spread radially from the stagnation point. This region is referred to as the supercritical region in this study. As the radius of the supercritical region increases, the velocity of the liquid and Froude number decrease, the liquid film decelerates and gains potential energy which is followed by a sudden increase in the fluid height. This phenomenon is termed a hydraulic jump. Analyses of the transmitted energy to the skin simulant as well as the predicted area of second degree burn reveal that the development of the hydraulic jump causes a significant decrease in the water temperature and heat transfer to the skin simulant. Therefore, the determination of the position of hydraulic jump or the area of the subcritical zone is a crucial factor in the evaluation of thermal performance of the fabric systems exposed to water.

The sudden change in the liquid height and the location of the jump depend on a local balance between fluid momentum and hydrostatic and surface tension forces [3]. As such, surface roughness affects the shape and location of the jump. Analyses of the supercritical region area and the transmitted energy during exposure reveal that the increase in the roughness of fabric in the stagnation and supercritical regions affects the velocity of water in these areas. This results in a more unstable jump and a decrease in the amount of transmitted energy to the skin simulant plate. It appears that hot water flow rate and temperature, nozzle-to-plate separation, fabric thickness, fabric density and surface finishing and the resistance to water vapor diffusion affect the fluid momentum and hydrostatic and surface tension forces which influence the position of the hydraulic jump on the surface of the fabric.

In addition, fabrics usually have a porous structure and the jet of water can penetrate through the fabric. Enhancement of the resistance to water penetration through the fabric system reduces water penetration within the structure of fabric system. This phenomenon caused the thermal energy to be transmitted at a slower rate and a reduction in heat transfer to the skin simulant during exposure. For fabrics with excellent resistance to water penetration, when a hot liquid jet hits the fabric at the stagnation point, the water bounces on the surface of the fabric and some peaks in the absorbed energy curve are created in the supercritical region. However, in the permeable fabric, where the water penetrates into the fabric at the stagnation point, the peak of the absorbed energy is located in the stagnation region because the penetrating hot water may hit the skin simulant and the liquid sheet does not bounce on the surface of fabric.

The fabric may also gain thermal energy after the exposure. After the termination of exposure to hot water, the stored energy in the fabric discharges to the skin simulant and lowers the thermal performance of the fabric system. The discharged thermal energy was observed to be higher for the portions of the fabric that were positioned underneath the hydraulic jump and downstream from the flow in horizontal orientation.

Analyses of the area of the supercritical region, the transmitted and the discharged energy during and after exposure, and the predicted area of second degree burn confirm that that fabrics with excellent water surface resistance and excellent water penetration resistance (e.g., water penetration resistant fabric with hydrophobic surface) are predicted to provide the best performance when exposed to hot water among the studied fabric systems.

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Negative Pressure Waves in Fluid Systems – Natural and Technological Phenomena

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Negative pressure effect is known to be one of the metastable states in which liquids can be extended up to a certain limit. It appears in many thermohydrodynamic, geophysical and biophysical processes in the Nature and technological systems. E.g., it is a proved scientific fact that plant juice rises up the trees mainly due to negative pressure [1].

The goal of our investigations was to obtain negative pressure in real impure, unclean, heterogeneous liquid systems. The main idea here was reaching the negative pressure due to the sudden character of extending efforts. On this base long-term experimental work has been done to create impulsive negative pressure in real heterogeneous compound liquid systems, such water, oils, solutions and to use the phenomenon of negative pressure for raising the effectiveness of various technological processes.

Figure 1 represents the typical variation of pressure with time in crude oil ($\rho=934\text{kg/m}^3$) stream in two mentioned test points under the initial values of pressure and temperature $P_0=0.7\text{MPa}$, $T_0=298\text{K}$. As one can see the generated negative pressure appears for a short time, reaching the maximum value of -1.5 MPa during of 0.04 sec . Nevertheless it leads to the significant overheating of the liquid and to spontaneous steam generation and gas emission.

The analogous results have been obtained for a tap water, clay solutions.

The important result of the investigation is the possibility of generation negative pressure waves in real liquid systems. As one can see from the Figure 1, the starting phase shift between the pulses of negative pressure in two tested points is about 0.03 sec , i.e., the negative pressure as a single wave spreads with an acoustic sound velocity. The wave of negative pressure is like a turned soliton wave with one hump that is negative. It is a rather conservative wave, which mainly keeps its shape reaching the second sensor almost without loss.

On the basis of received results the method of artificial creation of negative pressure waves has been created. The essence of the method is that negative pressure waves can be generated by means of discharge in hydraulic systems when the drop of the pressure takes place during the characteristic time much less than that of pressure relaxation in the system. The greater is the volume of hydraulic system and the higher is the depression of the pressure, the more intensively the negative pressure wave may manifest itself.

The new approach to generation of the negative pressure waves in impure, unclean fluids has allowed the creation of principally new energy saving technologies and installations to increase the effectiveness and efficiency of different production processes. It was proved that the negative pressure is one of the main factors causing hard troubles in some technological and natural processes. Received results emphasize the necessity to take into account the role of the negative pressure as an energy factor in evaluation of many transient thermohydrodynamic processes in the Nature and production systems.

Obtained results indicates the importance of negative pressure effect as an energy factor, its role in environmental and technological processes, and the great profit that can be received from practical adoption of this remarkable phenomenon.

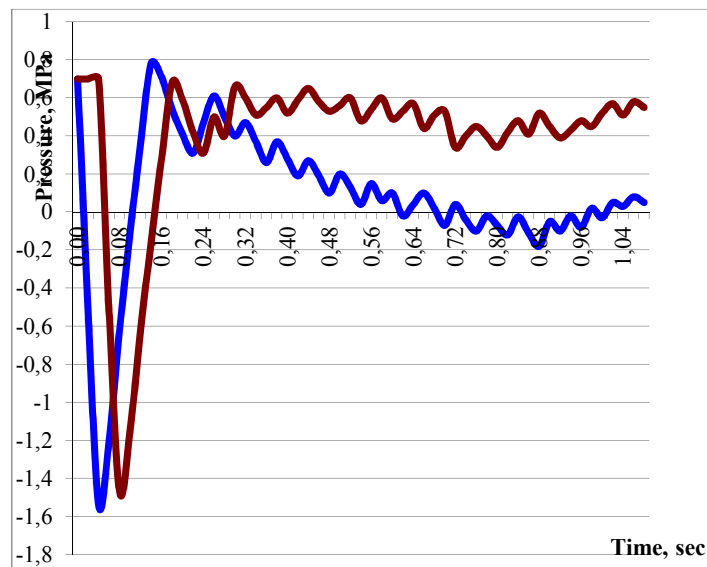


Figure 1. Variation of pressure in two test points of a stream

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Numerical Investigation of Swirl Flow Effect on Heat Exchanger Efficiency According to Different Inlet Position and Reynolds Number

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Abstract. The aim of this investigation is to determine the configuration that will enable the micro heat exchanger system to be more efficient. Heat exchangers are devices that can be used for exchanging energy with the flow, which can have a wide variety of uses and different configurations; therefore, studies are carried out in order to increase the efficiency of the heat exchanger. In this study, heat transfer capacity and system efficiency of the swirl flow were investigated using CFD as compared to the parallel flow micro heat exchanger. The air drawn by the fan is aspirated through the holes and enters the passage between the two coaxial cylinders. The air that enters into the system, impinges on the inner heat exchanger tube thereby enhancing the heat transfer rates. The main variables of the pertaining flow physics are Reynolds number and the location and orientation of the inlet holes. The boundary conditions were determined according to the fan capabilities and power of resistance. The positions and types of the holes were adjusted to allow for axial and tangential impact to heat exchanger tube surface, and the holes were also located in to obtain the best contact angle. CFD simulations were carried out with ANSYS Fluent and laminar viscous model was used with coupled algorithm. The positive effect on the heat transfer of laminar flow were observed at various Reynolds numbers and at different swirl flow conditions as compared to flow that is moving parallel to the axis of symmetry.

Computer based approximate and Mathematical solution of one kinematics problem related to a nonlinear differential equation

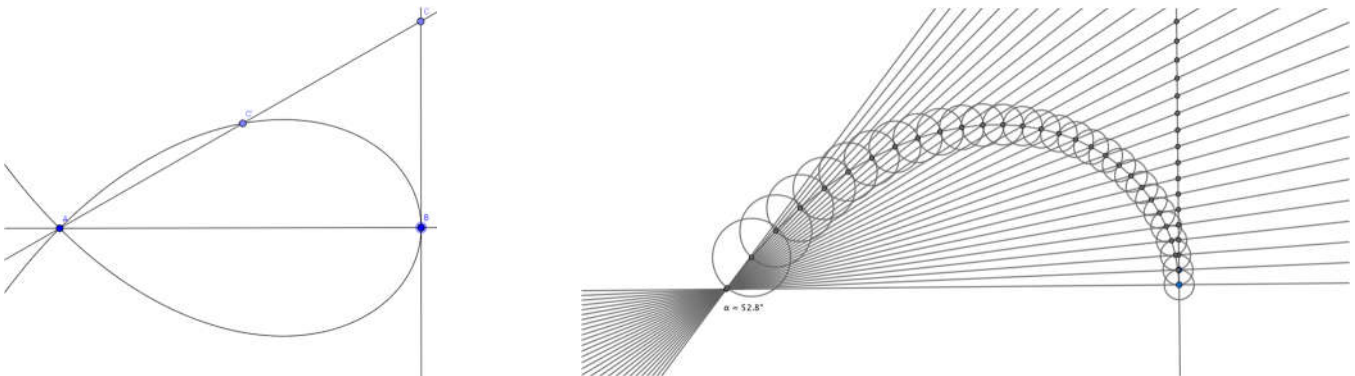
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Abstract: In the work a nonlinear differential equation arising from a kinematics problem was discussed. This engineering problem is similar to the kinematics problems discussed by Wilder Ch.E. in his paper “A discussion of a differential equation” The American Mathematical Monthly, 38(1) (1931) 17-25. The problem of Wilder is the following: “An automobile moves along a straight road with a constant speed (v) while a man in a field beside the road walks with a constant speed (u) along such a path as to always keep a tree between him and the automobile. Determine his path.” It is known that the involved differential equation

$$(y')^2 + y^2 = \frac{k}{\cos^4 x} \quad (k=\text{const})$$

can be reduced to Abel’s differential equation of the first kind. We did not know about Wilder’s result and came to the same problem through a different approach. Our problem is the following: “Suppose that point C in Cartesian coordinate system moves vertically with constant speed from initial position at $B(0,1)$. Another point C' on the segment AC , where $A(0,0)$ is the origin of the coordinate system moves with same constant speed. What is the shape of the curve drawn by C' ?”



We solved the problem using an elementary geometric method which determines approximation of the solution curve. We used ancient tools of geometers: compass and ruler to construct approximate shape of the curve defined by this differential equation. It is surprising that these two traditional instruments are sufficient to find the shape of this complicated curve. To implement this solution we used dynamic geometry software GeoGebra. At the end of the work we discuss some generalizations and give some other elementary examples. We found also nontrivial examples of pairs of functions which satisfy the same differential equation

$$(y')^2 + y^2 = \varphi(x)^2$$

for various choices of the function φ .

Talent Assessment in Software Development Firms

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Developing talents in a firm starts by the acquisition of the right candidates. The firm should have a well-defined process to acquire highly talented people. Software development companies constantly look for fresh graduates for strategic and economic reasons. Fresh graduates usually require intensive training to pick up on the pace of the new job requirements. Several software development companies started conducting in-house training for carefully selected candidates who passed a comprehensive placement test followed by a technical interview. At the end of this training, only highly qualified trainees will be hired for full time positions.

Though talent acquisition is a big problem to the companies, the development of their talents is at a higher concern to the decision makers. Employees should sustain a competitive level of knowledge and expertise. This opens new horizons to the firm by discovering new markets based on the skillset of its employees. Talent development means that the employees should continue to advance their careers by gaining new skills and knowledge and be up-to-date with the latest technologies in the market. In order to be competitive and capable of handling new challenges, we always need to have the required talents available. The lack of talented resources will have a direct impact on the turnover rates as resources with obsolete skills shall be forced to leave if they cannot keep up with the learning pace. On the other hand, scarce innovative and skilled employees will look for new workplaces especially when their current employer is incapable of sufficing their needs as they look for more challenging opportunities. Therefore, continuous talent development is becoming a necessity for each company in order to stay and grow in the market.

A talent development plan should be aligned with the company's objectives. Therefore, building the right plan should be carefully studied. In the following, we throw some ideas that could be integrated in software development companies' processes for developing the talents of their current employees.

- The company should avail all needed sources of information and learning material – Thanks to Google for this, but, we think the company should also have the latest useful material and books available when necessary. This can be achieved by building an online library at the firm. The employees themselves will be part of developing this library by adding the material and books they found useful. Moreover, this library should contain the list of pilot projects, developed by the employees in their learning process, to be set as a preference for other employees.
- The normal culture in the company should be 'I need to have a mentor'. Communication between mentors and mentees should be available and facilitated. Employees undergoing talent development should be mentored by the senior level employees in order to encourage, motivate, and assess their learning progress.
- At the beginning of each year, the employee should have a one-on-one formal meeting with his manager (or senior as some companies tend not to have a manager title) where they will discuss

the weaknesses and areas of improvement (skills required by the company) and the new desired skills by the employee. The mentor should advise the employee where to focus in order to be aligned with the company's strategies and objectives.

- The company should also conduct a survey periodically (annually, semi-annually or quarterly) where the employees will be asked about their preferences on the skills they would like to gain and the courses they are interested in. The outcome of the survey should not be applied immediately but should be used for future planning (following year). People tend to forget what they were thinking of if it was not documented. Therefore, we think such a survey should be very useful in recording all the potential ideas, needed skills, etc.
- The learning process could be improved by having employees coach each other. Senior technical resources can always guide in the process of talent development and can provide the right feedback on each employee's technical abilities.
- The best way a person can gain new skills is by 'getting his hands dirty'. Therefore, asking the employees to come up with new ideas where they can apply and implement the new knowledge is an excellent strategy to make sure that they are ready to drive when new projects rise in the horizon.
- Another way is by applying Stretch Tasks. These kinds of tasks will force the employees to acquire the knowledge they are lacking much faster. Stretch tasks could be part of an ongoing project. However, this should be handled carefully with the severity of the project.
- Employees with best ideas translated into tangible pilot projects will be asked to lead their projects and build up their own teams. This will encourage the employees to innovate and excel as it will reflect directly on their career paths and will make them more engaged and loyal to the company.
- Knowledge sharing. The culture of sharing the knowledge should be the norm at the company. Employees who just delivered a major milestone should share their experience with the rest of the team members and the other teams in the company (daily stand-up meeting may be insufficient). In every project there is something new to be learned. Spreading the new knowledge among the other teams is substantial in building the talent across the company. Moreover, knowledge gained from reading a new book, training course or any other experience should be presented to the interested teams in the company.
- Cross-team collaboration is also important in developing the talents at the company.
- Competition. Setting up a monthly/quarterly challenge where the best pilot project will be awarded. This will motivate the employees to innovate.
- Learning new skills shall be integrated in the annual review process. Employees who gain more knowledge and translate this knowledge in their work should be rewarded.

Finally, losing some of the company's most talented resources is inevitable. However, by applying certain measures, the company can reduce this number by providing the right environment to its employees. Talent retention through talent development is currently the trending approach in major software firms and proved its validity. Outstanding employees always look for competitive remuneration packages and a very challenging and highly skilled environment. Thus, companies should take talent development more seriously as it will have its benefits on all the stakeholders.

Contribution of Azerbaijan to the energy security of the European Union

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Abstract

Despite all progress connected with use of renewable energy sources it is widely known that fossil fuels will remain dominating in short - and medium-term prospects. Presently fossil fuels are made more, than three quarters of a global power mix, and in the next decade the level of their use will probably be the same. Among them there are crude oil and natural gas as widely used and globally sold energy resources which reserves unevenly distributed, are responsible to a large extent for energy security in the world. Therefore the relations between the European Union, one of the largest oil and gas consumers, and Azerbaijan, the supplier of energy whose location isn't really far from the EU attract special attention of many politicians and creators of public opinion in Europe.

The Southern Gas Corridor which ceremony of start of the first stage was held on May 29, 1918 in Baku is one of priority projects for the EU, and provides transportation of 10 billion cubic meters of the Azerbaijani gas from the Caspian region through Georgia and Turkey to Europe by 2020 will be the first real diversification of gas coming in from the East.

At an initial stage the gas extracted within the second phase of development of the Azerbaijani gas-condensate field "Shah Deniz" is considered as the main source for the corridor. At later stage other sources can be attracted to the project.

Gas within the second stage of Shah Deniz field will be exported to Turkey and to the European markets by expansion of the South Caucasian gas pipeline and construction of Trans-Anatolian (TANAP) and Trans-Adriatic (TAP) pipelines.

The project involves two EU member states, Italy and Greece, candidate countries, Turkey and Albania, and Azerbaijan, the EU strategic partner in energy, Four different types of countries were involved: member states, candidate countries, associated partners and future strategic partners.

The EU supported Southern Gas Corridor is directed to curtail Russian energy leverage over Eastern and Southeastern European countries which are heavily reliant on Russian Gas deliveries. It opens up the direct access for the land locked Caspian states, primarily Kazakhstan and Turkmenistan, to the European gas markets.

This article describes development of the energy relations of the EU and the Republic of Azerbaijan. The energy needs and potential of these two partners are investigated and their main interests are defined. The main problems, opportunities and obstacles for power cooperation of the EU and Azerbaijan are discussed, and views of development of their principles of energy policy in the near future are considered.

Hybrid photoenergy installation development

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Introduction

The current problem is the autonomous supply thermal energy and hot water for civilian and military consumers. The most commonly used for this purpose are installations based on solar thermal collectors, which at the same time require an external power source up to 100 W for electronic control components and a circulating pump, which does not allow them to be fully considered as autonomous. One of the ways to solve this problem is to combine in one installation solar panels and heat collectors. Such hybrid thermo-photoenergy installations are usually made from solar cells (SC) based on monocrystalline silicon and their electrical characteristics are much more prevalent [1]. In addition, the silicon based SC, due to the material properties, has an intense absorption of the near-infrared solar radiation component with a wavelength more than 1000 nm. Such absorption is photovoltaically ineffective and leads to parasitic SC heating and decrease efficiency of thermal part such hybrid installation. This necessitates the organization of efficient heat removal from SC to the heat exchanger through intermediate thermo-interfaces, which leads to complication of the installation design. At the same time, the maximum absorption of flexible thin-film SC based on the CdS/CdTe system is concentrated in the range 400-800 nm, and for near-infrared component, they are practically transparent. Therefore, using such SC in hybrid photovoltaic installations will provide free access to the heat exchanger of the longwave solar radiation component, and efficient heat energy generation [2]. Using flexible thin-film CdS/CdTe based SC on the polyimide substrate in the electrical part of the hybrid installation will allow to mount such SC by gluing on a protective glass directly on the standard solar thermal collectors photoreceiving surface. Therefore, the development of an autonomous hybrid photoenergy installation based on flexible CdS/CdTe based SC, adapted for the mounting directly on the protective glass of standard solar thermal collectors, is perspective.

Results and their discussion

Calculation of thermal conductivity for flexible cadmium telluride based SC, formed on a polyimide film with 7 μm thickness, showed that taking into account polyimide thermal coefficient conductivity at the level 0.14-0.20 W/(m·K), it is possible to obtain the temperature difference in the thin-film SC at the level 0.6-0.9 °C [3]. The high thermal conductivity of copper collector allows providing a transverse temperature gradient no more than 1.0-1.5 °C and as a result of system thermal resistance optimization it is possible to achieve an excess of SC temperature over the coolant temperature at 2.5 °C. Optical studies have shown that the CdTe based flexible SC absorption coefficient in the visible range (400-800 nm) is 10^{-5} cm^{-1} , and the reflection coefficient in the infrared spectrum does not exceed 7-8% (Fig. 1a), which allows to abandon the selective coating using in the collector design. To find the optimal balance between thickness of the plate and the fluid flow velocity, the heat transfer uniformity and the system cost were carried out a series of model experiments. The plate thickness varied in the range from 0.5 mm to 5 mm with 0.5 mm increment, and a flow rate from 0.2 m/s to 1 m/s with 0.2 m/s increment. The problem is that in order to achieve an optimum coolant flow rate which is more than 0.6 m/s, it is necessary to use a powerful circulating pump.

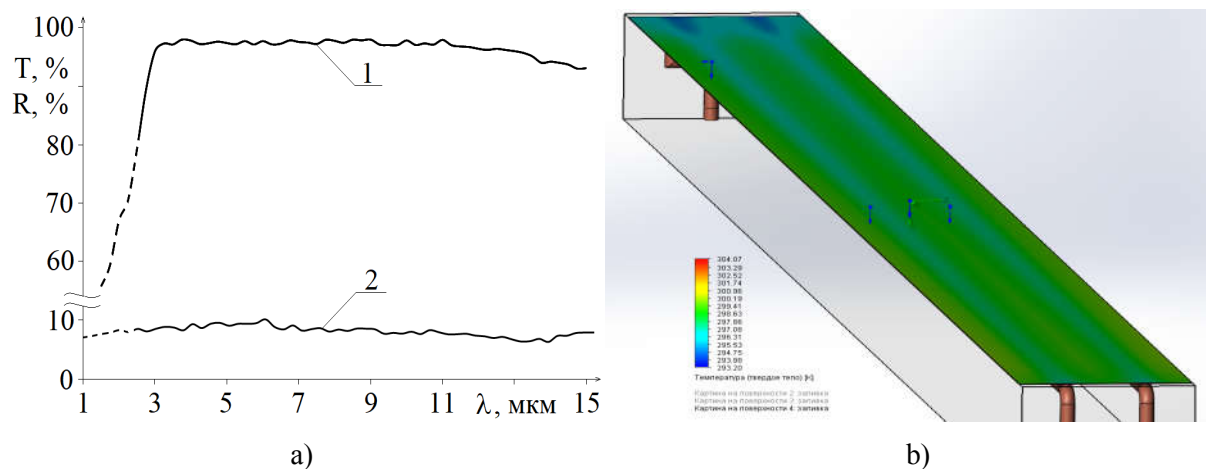


Figure 1. Spectral dependences of the transmission (1) and reflection (2) coefficients for CdS/CdTe based SC (a) and temperature distribution on the surface of improved solar collector with 0.5 mm thick plate for coolant flow velocity 0.4 m/s (b)

This will lead to inexpedient electric energy consumption and impossibility to autonomous installation creating. With increase of collector plate thickness up to 2 mm it will have a very large mass and cost. Proceeding from this, we propose to improve solar collector plate design by the way organizing heat exchange between the plate and the system through two tubes instead one pipe, as it realized in most part of solutions [3]. The simulation showed that two-tube system completely satisfies to conditions for its use in a tandem with thin film SC (Fig. 1b).

Conclusion

As a result, a more even heat distribution should be achieved without using high velocities of the coolant flow and large thicknesses of the collector plate. This will lead to some increase in the complexity of hybrid installation manufacturing due to the denial from standard collector plate, but will allow developing hybrid photoenergy system with maximum efficiency [4].

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Options indication

1. *Oral.*

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Photochromic textile materials

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The need for functional textile products is increasing with change of the properties expected from textile products and the development of technology. Within this scope, smart textiles which perceive and respond to any effects in the environment are getting more attention in recent years. Photochromic materials which are one of the smart textile materials can change their color reversibly with the change of ultraviolet (UV) light intensity in the environment [1, 2]. Photochromic textiles have potential applications for fashion or functionality purposes in textile industry. In this study, usage possibilities of photochromic dyes in textile industry, problems experienced in the applications and the solution possibilities have been evaluated.

The use of photochromic dyes in the textile field is based on the 1990's, but today there are some examples of commercial use [3, 4]. Photochromic dyes can be added in the polymer matrix during the production of synthetic fibers and so, photochromic yarns can be obtained (Figure 1) [5]. Photochromic t-shirts can be also commercially produced by printing method (Figure 2) [4].



Figure 1. Photochromic yarns before and after UV irradiation [5].



Figure 2. Photochromic t-shirt before and after UV irradiation [4].

Beside industrial textile applications of photochromic dyes, academic studies on photochromic textiles have also increased in recent years. In these studies, several problems have been encountered due to the sensitive structure of photochromic dyes and their low water solubility [6-11]. The technologies such as encapsulation, sol-gel and electrospinning can be used to solve the problems in the textile applications of photochromic dyes [12-14]. The aims of these technologies are to provide the homogeneous distribution of the photochromic dyes in the solvent or carry the dyes in the polymer matrix. Thus, the use of photochromic dyes in textile materials can be improved with these alternative methods.

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Options indication

1. For **Oral** presentation
2. For the Textile Engineering

Biological synthesis and characterization of zirconia nanoparticles using *Averrhoa bilimbi* and evaluation of their antimicrobial activities

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Abstract

Here we report a biogenic green synthesis of zirconia nanoparticles (ZrNPs) using the fruit juice of *Averrhoa bilimbi* as nontoxic and eco-friendly reducing material. The synthesized ZrNPs were characterized using Mass Spectrometry (MS), X-Ray Diffraction Spectrometry (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM-EDEX) and used to evaluate their antibacterial activity. MS results confirmed the presence of oxalic acid, ascorbic acid and citric acid in the *A. bilimbi* juice. The XRD pattern was used to characterize the structure of ZrO₂ nanoparticles which showed that all nanoparticles are tetrahedral. The size range of synthesized nanoparticles was found to be 10 to 50 nm from the SEM images and the EDEX spectrum confirmed the presence of elements, Zr, O and Mg in the nanoparticles. According to the antibacterial evaluation, the nanoparticle did not show any bactericidal or bacteriostatic activities. Therefore, the synthesized nanoparticles are more suitable for the dermatological preparation as an additive.

Keywords: Antibacterial activity; *Averrhoa bilimbi*; Green synthesis; Nanoparticle; Zirconia

Potential roles of fluorine-containing sol-gel coatings against adhesion to control microbial biofilm.

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Abstract

The undesired colonization of submerged surfaces by marine micro- and macro-organisms such as bacteria, diatoms, algae, barnacles, and seaweeds is called biofouling. It has detrimental effects among which on aquaculture systems and oceanographic sensors. Moreover, this natural phenomenon on shipping and leisure vessels causes severe problems for marine industries due to corrosion and hydrodynamic drag, which leads to elevated fuel consumption and higher maintenance costs [1]. In order to reduce both economic and environmental penalties, the primary strategy for combating marine fouling is to use biocide-containing paints. At the same time, environmental concerns and legislation are driving science and technology towards non-biocidal solutions based solely on physico-chemical and materials properties of coatings. From this point of view, advances in nanotechnology and recent knowledge of marine chemistry and biology are improving significant impact on the development of a new generation of surface designs 'bioinspired' by the nature [2]. One approach to the development of novel coatings is to create a 'deterrent' surface that inhibits the initial attachment of the settling stages of microorganisms. Recently, extensive research has been realized on newer anti-fouling technologies using fluoropolymers [3]. Fluoropolymers can be used to form non-sticking surfaces with low critical surface energy, thanks the presence of the exposed CF₂ and CF₃ moieties at the interface. Moreover, since the fluorine atoms results in limited mobility around the backbone bonds, the so obtained stiffness reduce the adhesion of fouling [4]. Furthermore, amphiphilic coatings, which incorporate some of the benefits of both hydrophobic and hydrophilic functionalities, have been developed in order to create an engineered surface with local variations in surface chemistry, topography and mechanical properties. The treatment of materials by sol-gel technique can be an excellent tool to convey new properties to their surfaces, particularly if organic components are incorporated into the formulation. In this composition, the hybrid organic-inorganic materials show the properties of both phases, contributing to the obtainment of an anti-fouling coating with the properties just discussed. In this research, an easy to handle procedure for the preparation of fluorine containing coatings were investigated. The procedure includes the co-condensation of silane coupling agents with epoxide and amine tail-groups, (3-Glycidyloxypropyl)trimethoxysilane (GPTMS) and (3-Aminopropyl)triethoxysilane (APTES) respectively, in combination with two perfluoro silane precursors, namely 1H,1H,2H,2H-Perfluorooctyltriethoxysilane and trimethoxy-(3,3,3-trifluoropropyl)silane, either individually or together. This synthetic approach permits to obtained

stable hydrophobic, non-toxic, anti-fouling coatings that were investigated to study their morphology and chemical structure by different physico-chemical technique.

The anti-fouling properties were evaluated through test on treated glass slides in different microbial suspension in sea water (Gram positive and Gram negative bacteria as well as diatoms) per 24 h at room temperature. During tests, each suspension was maintained in continuous agitation to simulate the natural movement of sea water on the supports.

The anti-fouling efficiency was evidenced by comparing the attachment of cells on bare degreased glass slides (considered as 100% of attachment) with that occurring on the treated slides. Results show that the fluoro-containing coatings have good antimicrobial activities and low adhesive properties towards the studied bacteria. The eventual biocide effect due to the product release in the liquid medium was evaluated by counting the microbial cells before and after the period of incubation; no biocidal effects were observed in the microbial suspension due to the release of toxic compounds.

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The effects of core material parameters on the mechanical properties of double core and single core spun yarns

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Introduction

Comfort and aesthetic appearance are the basic features that consumers expect from their clothes. While improving the aesthetic appearance of the garments is of interest to fashion designers, it is the focus of textile engineers to enhance comfort. For improving body movement comfort in apparel, elastic core-spun yarns can be used to produce elasticity of the woven and knitted fabrics. In these yarns, elastane as the core is covered with staple fibres. On the other hand, bagging which is a three dimensional fabric deformation, is an undesirable appearance of fabrics [1]. The lack of dimensional stability or recovery after prolonged or repeated pressure on the fabrics causes bagging deformation [2]. In recent years, double core yarns have begun to be produced, especially for denim jeans to overcome the mentioned problem.

Core-spun yarns consist of at least two different components; a staple sheath and a filament core [3]. While, double-core (dual-core) yarns made of three components; an elastic polyurethane filament (such as Lycra®, Creora® or Inviya® I-300) and a multifilament (such as Lycra® T400®) are used in the core, covered by a staple sheath. Double-core yarns are used for high quality denim fabrics[4].

Many researchers have been focused on core-spun and elastic yarn properties [5-7]. Sarioğlu and Babaarslan investigated the fatigue behavior of rigid core-spun yarn structure containing PET textured filament yarn (PET DTY) with respect to different filament fineness and yarn count [8]. Celik and Kaynak examined the effects of elastane draw ratio on air permeability of denim woven fabrics [9]. Ertaş et al [10] analyzed the effect of the density changes in the use of the double-core threads used in denim fabrics. Telli et al, focused on the usage of core and double-core yarns containing tungsten for electromagnetic shielding [11]. Qadir et al. investigated the effects of elastane linear density and draft ratio on the physical and mechanical properties of single core-spun yarns. According to literature survey, elastic material parameters in the double core spun yarns has not be investigated previously.

Experimental

In this study, the effects of elastane linear density and on the mechanical properties of double core and single core yarns, spun with different core materials, were investigated. The performance characteristics of the two most widely used elastane types in the market, expressed as elastan A and elastane B, have also been examined. For this purpose 44 dtex, 78dtex and 117 dtex elastane filaments were used in the production of elastic core spun yarns. Besides, 55 dtex polyester (PES) or 55 dtex elastomultiester (EME) filaments were used for accompanying elastane in double core spun yarn production. Sheath material was cotton for all yarn types. Yarn samples were spun in the same yarn

count and twist coefficient (Ne 18, α 4,2) on a ring spinning frame. Yarn samples were conditioned under standard atmospheric conditions, thereafter basic yarn characteristics such as evenness, imperfections, hairiness, breaking strength and breaking elongation, were tested. Yarn uniformity, the IPI values and yarn hairiness were measured on Uster Tester 5, tensile properties were measured with Uster Tensorapid 4. Test results were evaluated statistically with SPSS software. With the aim of determining the statistical importance of the differences between the yarn characteristics, ANOVA (Analysis of variance) was performed. F values were obtained from analysis of variance and their statistically significance were evaluated ($p>0,05$).

Results

The effects of elastane type, elastane linear density and different core materials on the mechanical properties of core spun yarns on the breaking strength and elongation results are given in Figure 1.

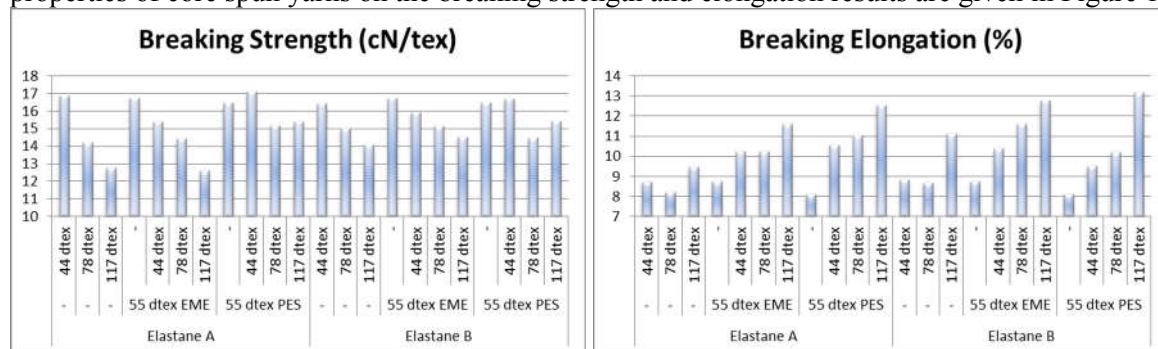


Figure 1. Breaking strength and elongation values of the single and double core spun yarns.

It is found that the breaking strength and yarn unevenness of the core spun yarns were decreased while breaking elongation values increase with the increase of the elastane thickness. For 44 dtex and 78 dtex fineness, elastane A caused higher elongation but lower breaking strength compared to elastane B. On the other hand, 117 dtex elastane B showed statistically the highest elongation values for both PES and EME containing double core spun yarns (Table 2) and also single cored elastic yarns.

Table 1. Student-Newman-Keuls (SNK) post-hoc results for yarn elongation at break (effect of elastane)

1 st core material	2 nd core material-PES						2 nd core material-EME			
	1	2	3	4	5	6		1	2	3
No elastan	8,12						No elastan	8,78		
Elastane B-44dtex		9,52					Elastane A-44dtex	10,25	10,25	
Elastane B-78dtex			10,23				Elastane A-78dtex	10,27	10,27	
Elastane A-44dtex			10,50				Elastane B-44dtex	10,41	10,41	
Elastane A-78dtex				11,08			Elastane A-117dtex		11,64	11,65
Elastane A-117dtex					12,58		Elastane B-78dtex		11,65	11,65
Elastane B-117dtex						13,20	Elastane B-117dtex			12,81
Sig.	1.0	1.0	0.32	1.00	1.00	1.00	Sig.	,058	,174	,151

Double core yarns have been observed to have higher elongation values, independent of the elastane brand and thickness, than single core yarns. In terms of hard core materials, PES containing double core yarns have higher elongation and strength values than EME containing double core yarns, in general.

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1. Option for the presentation: **Oral**.

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