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Poster

Session Abstracts

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A decentralized model for large-scale health surveillance

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Introduction

During the last century, researchers have made major advances in biological sciences. The aim of these efforts was to improve the quality of humans' health. Nevertheless, these advances have made biological weapons more accessible to terrorist groups. Monitoring a large-scale environment efficiently to detect biological attacks is vital to alleviate their consequences and save human lives.

Traditional health surveillance systems depend on the manual collection of the data provided by various sources such as hospitals, emergency rooms, and pharmacies to analyze abnormal health patterns over the time. Despite their simplicity and cheap cost, these systems are not adequate for the fast detection of biological threats and are meant for after-event investigations. To facilitate the rapid detections of such threats, researchers proposed several health-monitoring systems. In these systems, surveillance is accomplished by automatically analyzing bio-related syndromes gathered from various sources such as hospitals, medication sales, and laboratory systems. ESSENCE [1], BioSense [2], and RODS [3] are examples of real-life health surveillance systems. Nonetheless, accessing patients' private data represents a major challenge to these systems. In addition, there is need to expand these systems to consider global information exchange.

In this paper, we present an agent-based decentralized model for large-scale health monitoring systems. Experimental results show the effectiveness of this model in detecting biological attacks.

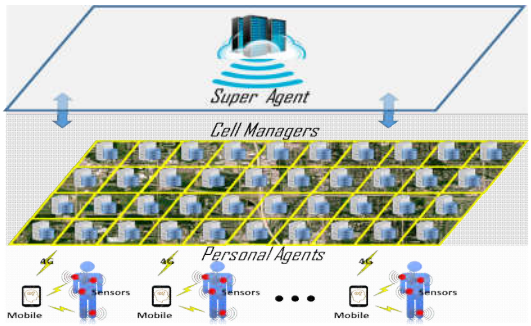

Figure 1. Architecture of the decentralized health surveillance system.

An Agent-Based Decentralized Model for Health Surveillance Systems

The proposed model is defined as a hierarchical multi-agent system (Figure (1)). At the lower level, monitored humans are equipped with wearable sensors. These sensors continuously measure the human's vital signs and send the readings to the *Personal* agent that is deployed on a smartphone.

In addition to collecting the received vital signs, the personal agent performs an initial processing on the gathered data and sends the initially processed information to its *Cell Manager* agent. The received data within the cell are aggregated and processed according to the cell manager local knowledge.

The cell manager proceeds to send the locally processed data to the *Super Manager* agent that combines the received data to form a global view of the environment to detect potential threats.

Threat detection technique

To monitor a large-scale environment efficiently, the environment is partitioned into a set of smaller areas named cells. Monitored humans might traverse several cells and their vital signs change to abnormal state after they cross an infected area. The time needed for abnormal signs to appear depends on the immune level of the infected human. Given this information, we are interested in an efficient technique to identify the set of contaminated cells. The likelihood for a cell of being contaminated can be determined by evaluating the similarity between the traversal information of a specified cell and the state of vital signs. As the traversal information of a specified cell is more similar to the infection style in the vital state, the specified cells is more likely to be contaminated. To evaluate the similarity, we can use one of the existing similarity coefficients. In our case, we opt to use the Jaccard coefficient. The higher the similarity, the higher the probability of being contaminated.

Case study

We have implemented our model using DIVAs 4 [5], a framework for the rapid development of agent-based simulation systems. Using DIVAs, we built a virtual city partitioned into a 100 cells and populated with a 1000 simulated humans. As the simulation started, we triggered a biological attack at the center of the city that infected cells 45, 46, 55, and 56. We execute the same scenario 10 times and recorded the cells with the highest probability of being contaminated in Figure (2). As shown in the results, our model was able to identify all of the contaminated cells as the most suspicious cells.

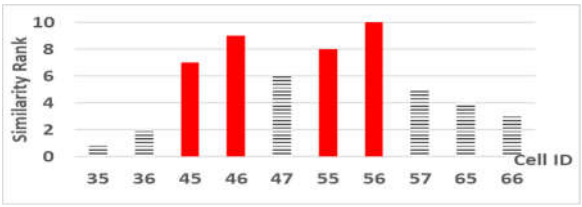

Figure 2. Architecture of the decentralized health surveillance system.

Conclusion

In this paper, we presented an agent-based model for large-scale health monitoring systems. We have implemented this model using DIVAs 4, a framework for the development of agent-based simulation systems. The results show that the proposed model successfully identify infected.

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Seebeck coefficient of thermopile made of nickel-coated carbon fiber

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Thermoelectric has attracted a lot of attention because of its considerable potential to be utilized as a renewable and sustainable energy source. Since 2001 research on harvesting and converting heat into electrical energy in a wearable thermoelectric generator has been conducted [1]. A number of studies on the thermoelectric generator (TEG) by way of harvesting body heat have been reported [2–6] but the TEG they used were made of inflexible materials and non-textile materials. Some papers reported the energy harvesting of the human body using different structures of textile-based TEG [7–9], however, none of these studies used the thermopile principle made from a single yarn.

Nickel-coated Carbon Fiber (NiCF) and Carbon Fiber (CF) are good candidates for fabricating a textile-based thermoelectric generator because they can be inserted in a fabric structure [10]. In this paper, the term NiCF corresponds to Nickel-coated Carbon Fiber in the form of multifilament yarn. The objective of this work is to fabricate a textile-based TEG from a single yarn i.e. NiCF in a textile fabric by means of the etching process to form a series of CF-NiCF junctions in order to obtain a thermopile and study its Seebeck coefficient.

In this experiment, NiCF yarn from Toho Tenax Germany GmbH (Tenax®-J HTS40 A23 12K 1420tex MC) was used. The NiCF was manually inserted into the polyester fabric by means of a needle to form a pattern as shown in Figure 1. The image in Figure 1 is an etched sample with nine interconnected rows of NiCF forming 36 pairs of CF-NiCF junction. Each row was 8 cm in length and each float of the yarn was 1 cm. The distance between rows was 1 cm.

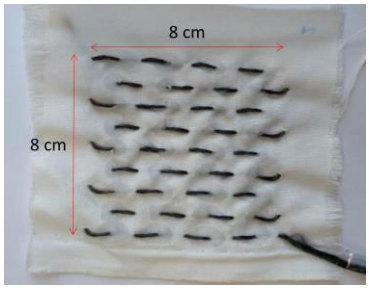

Figure 1. A textile thermopile sample having 36 pairs of CF-NiCF junction.

Then, this NiCF was covered with a polymer called Lurapret® D579 dropwise on the half part of the float yarns on both sides of the fabric as shown in Figure 2. Next, the sample was dried in the oven at 130°C for 15 minutes. Then, the etching process was performed according to the literature [10] where the sample was dipped in 10% H_2O_2 + 37% HCl (1:1) for 30 minutes without heating, rinsed with running water and air dried for 24 hours (minimum) before use. This process allows the etching chemical to remove the nickel selectively from the NiCF where the nickel was not covered with Lurapret® D579. In this way, a textile-based TEG from a single yarn containing CF-NiCF junctions was obtained.

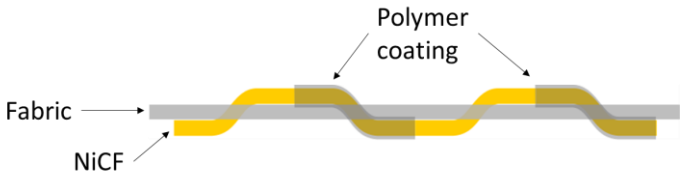

Figure 2. Illustration of covered and uncovered area of NiCF with polymer before etching.

The output voltage of the sample was measured with a nanovoltmeter NV 724 at different temperatures. From the gradient of the voltage and temperature difference graph, the Seebeck coefficient was obtained.

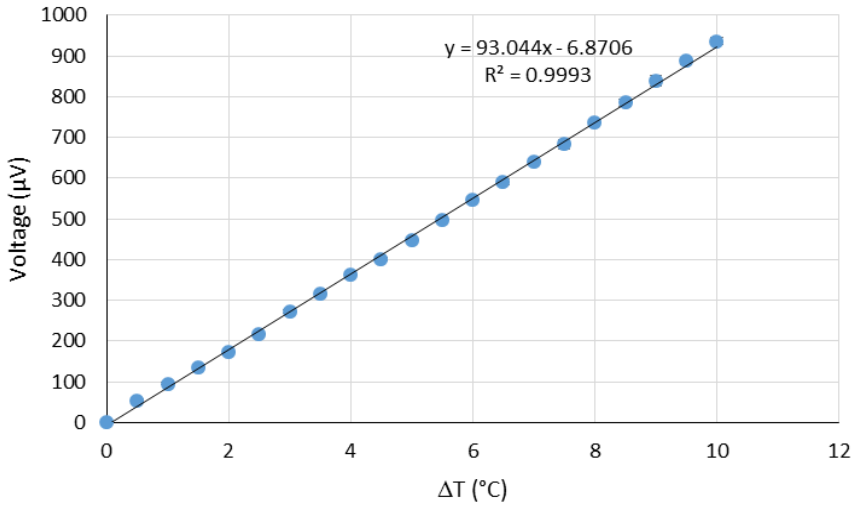

Figure 3. Graph of voltage versus temperature difference from 36-pair CF-NiCF junction after the etching process.

The Seebeck coefficient resulting from 36-pair CF-NiCF thermopile is 93.04 µV/K as presented in Figure 3. The result is lower than the theoretical calculation i.e. 648 µV/K where the single thermocouple from CF-NiCF is around 18 µV/K [11]. This indicates the junctions are not at full potential when constructed as given.

Conclusion

In this work, a 36-pair CF-NiCF thermopile from single NiCF yarns has been fabricated using etching technique and can generate a Seebeck coefficient of 93.04 µV/K. This proofs that it is possible to create a flexible thermoelectric generator from a conductive textile yarn. The results were far from the theoretical maximum.

Based on this finding, other techniques to fabricate a CF-NiCF thermopile in order to obtain a higher Seebeck coefficient are required.

Acknowledgments
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A Mutual Debt Cut Algorithm for a Group of Countries

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Abstract:

In the recent years the financial debate has focused on the national debt of the countries. These debts consist of different debts to banks, institutions and other countries. In the current work we investigate a method for a mutual national debt cut amongst a group of countries using as a deposit capital equal to the minimum of the debts within the group. The only condition is that all countries own and possess debt within the group. The deposit capital is circulated to repay the debts. The algorithm introduced in this paper is based on a simple transfer table. The advantage of the algorithm is that it does not based on actual financial resources but only on countries will for cooperation. The deposit works in a catalytic way and thus it can be consider as "ghost capital".

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Virtual method of predicting the accuracy of pattern blocks

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Abstract. Main purpose of this study is to develop the virtual method of predicting the misfit based on new obtaining relations between pattern blocks and body features. In our research, digital twin of female body in CLO3D was used. 3D-2D pattern block flattening technology was used to obtain the body prototype of avatar. The ease value of main structural parts for blouse pattern blocks and the proportions of ease value were obtained by respectively overlapping the blouse pattern blocks with the body prototype. Pattern blocks were analyzed and evaluated in terms of the proportions of ease value. New method can be used to analyze and predict the quality of blouse pattern block effectively and improve the efficiency of virtual garment design.

Keyword: virtual try-on, digital twin, blouse, pattern block, misfit, predicting, accuracy, avatar, flattening technology

1. Introduction

With the improvement of people's living standard, people are no longer satisfied with the warmth of clothes, but more concerned with the comfort and fit of clothes. The fit and comfort of clothing depend on the accuracy and quality of the pattern block. At the same time, the structural design of clothing pattern block is an important part of the whole process of clothing design, and the structural design of the pattern block requires professional experience and skills of the patternmaker, and it takes a lot of time to complete the drafting of the pattern block. Therefore, the technical level of the patternmaker greatly determines the correctness of the pattern block and further affects the comfort of the clothing[1]. And then, with the development of 3D virtual-reality technology, there are many manual of pattern block making and some of them aren't good for the customization in virtual reality. In the well-known virtual-reality technologies such as CLO3D, Lectra3D, OptiTex, and V-Stitcher 3D are shown own structural problems, such as shoulder slope is not consistent with human body, unreasonable distribution of ease to bust girth and waist girth, and so on[2]. These problems not only will cause clothing misfit for the customers, but also will cause learning problems for many garment design amateurs or junior garment pattern-makers.

The aim of this research was to create a new method of detecting the blouse pattern block by finding the new relations of sizes of blouse pattern block, on one side, and measurements of avatar, on the other hand.

2. Methods of research

2.1 Blouse pattern blocks

In our research in order to lay the foundation for detecting the pattern block 122 blouse pattern blocks were collected from Chinese manuals and journals. All pattern blocks were drafted in ET CAD system and were classified as X, H, A style[3]. Then blouse patterns were subdivided into slim, regular, and loose types in according to fit. Thus, the blouse pattern block database was obtained.

2.2 Avatar for the experiment

Body type was 160/84A (girth, cm: bust 84, waist 68, girth 90, neck 37, shoulder width 32.6cm, back length 36.2 cm, distance between SNP and SP 9.7cm and between FNP and front waist 33 cm). It were used for obtaining of the avatar by 3D CLO virtual try-on software.

2.3. Prototype of avatar using 3D to 2D pattern block flattening technology

In order to obtain the bodies prototype, we used 3D pattern block making technology in CLO3D software. The 3D avatar surfaces were flattened into 2D garment patterns. The general scheme of the flattening process is: (1) As figure 1 shows, according to the features of the avatar and the shape of garment prototype, the lines of front and back were drawn on the avatar directly. (2) As figure 2 shows, the surface of the garment prototype based on avatar was obtained by using the flattening tool, and the 2D pattern block of the garment prototype after flattening was obtained at the same time[4].

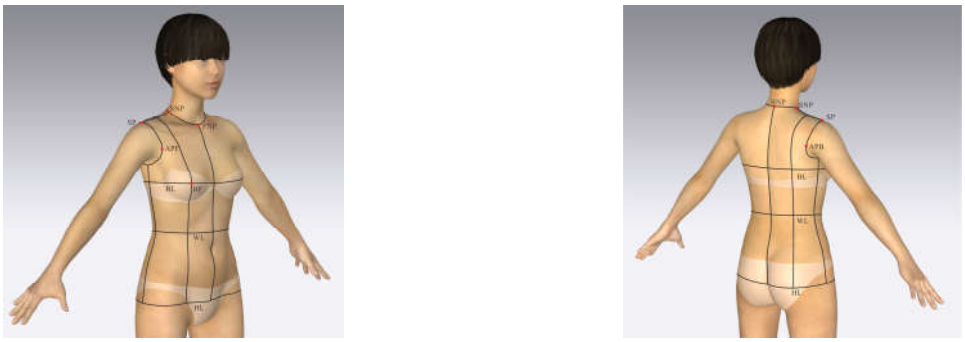
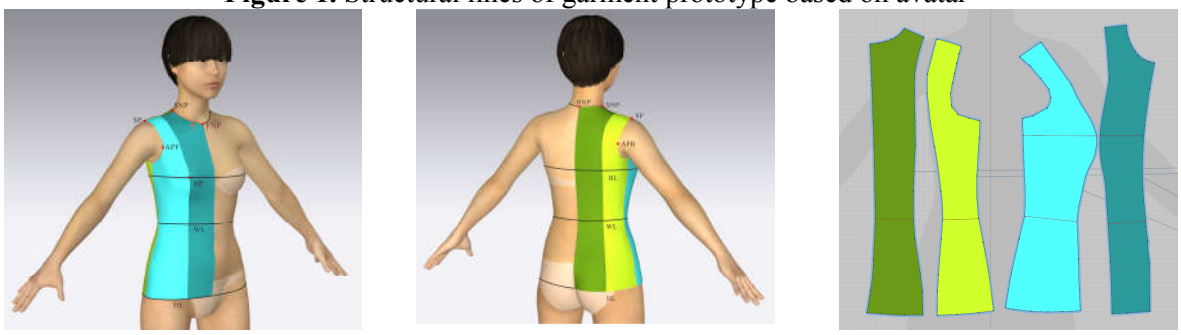


Figure 1. Structural lines of garment prototype based on avatar



(a) (b)

Figure 2. Garment prototype based on avatar (a) and flattened 2D pattern blocks (b)

In order to ensure the accuracy of the flattened 2D pattern block, the lengths of the key structural curves of the 2D pattern blocks after flattening and the main structural curves of the 3D clothing surfaces and the size of each important structural part were compared respectively, such as the lengths of armhole curves, the length of bust line, and so on. And the test results indicated that the 3D-2D flattening results are precise, which can be used in blouse pattern block checking[5].

2.4. Predicting the accuracy of blouse pattern blocks

As figure 3 shows, 122 blouse pattern blocks were respectively compared with the garment prototype based on avatar. Secondly, the ease amount of the key parts of the blouse pattern block were obtained by measuring the difference value between the important parts of the blouse pattern blocks and the garment prototype. Thirdly, the proportions between the ease allowance of each important part of blouse pattern blocks with good fit were obtained by using SPSS data analysis software, and the interval of the ease amount in each important part were also obtained at the same time. Based on this, a "avatar-blouse" prediction system for the accuracy of blouse pattern was established to predict the accuracy of pattern blocks.

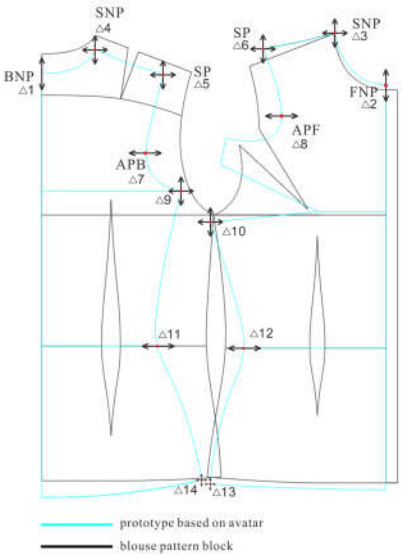


Figure 3. The scheme of overlapping blouse pattern blocks and garment prototype

3. Discussion and results

As figures 4 and 5 show, the blouse pattern blocks were compared with the body prototype respectively by using the method showed in the Figure 3. As shown in figure 4, the ease allowance of each important part of blouse pattern blocks were obtained by overlapping blouse pattern blocks with the garment prototype. Then, the proportions of the ease allowance for each key structural part were obtained by computation. And then by comparing the proportions of the ease allowance with the proportions in the "avatar-blouse" prediction system we have established, we found that the proportions of the ease allowance for the blouse pattern block are rational, and the ease allowance of each key structural part is within the range of each allowance. According to the analysis results, we predicted that the blouse pattern blocks are fit. At the same time, as shown in figure 5, the blouse pattern blocks were analyzed by the same way, and we found that the proportions of the ease allowance in shoulder line, neck line and the back part are too large and not consistent with the proportions in the "avatar-blouse" prediction system. Then we predicted that the blouse pattern blocks are misfit. We further used CLO3D virtual try-on software to check the prediction results. By observing the effect of virtual try-on, we found that the shoulder slope of the blouse pattern blocks do not in accordance with the human body, and the ease allowance of neckline is too large, as shown in figure 5. Thus, the rationality and validity of the method for predicting the accuracy of blouse pattern block are further verified.

Figure 4. Examples of pattern blocks with good fit and their presentation in avatar

Figure 5. Examples of pattern blocks with misfit and their presentation in avatar

4. Conclusions and future research

In this study, the body prototype was obtained by using 3D-2D flattening technology. And we obtained the ease allowance of blouse pattern block by overlapping pattern blocks and body prototype. And then we developed the prediction system of "avatar-blouse" to evaluate the blouse pattern blocks based on the proportions and intervals of ease allowance. This approach allows us to predict the accuracy and quality of blouse pattern blocks without making the sample. And then, we can alter misfit problems of the pattern block in terms of prediction results. It will be possible to improve the garment production efficiency and the virtual technology.

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The Branding of Ethical Fashion and the Consumer: A Luxury Niche or Mass-market Reality?

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ABSTRACT

This article seeks to address the branding and marketing of ecofashion or ethical fashion, juxtaposing the experiences of today's, often confused, fashion consumers, against the promotional methodologies used by, sometimes equally confused, fashion brands. Looking at the rise of ethical fashion, this article takes into consideration the factors that have influenced this. In addition, the lifestyle and societal indicators that effect consumer behavior in relation to purchasing ecofashion are also investigated. Further to this theoretical discussion, this article concludes with a reflection on today's practical manifestations of the branding and promotion of ecofashion, and the challenges ahead that both fashion brands, and consumers, face in the continuation and sustainability of ecofashion.

KEYWORDS: ecofashion, ethical, branding, marketing, lifestyle, consumer

Study of Properties of Arselon Spun Yarns

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Arselon is a polyoxadiazole heat-resistant fiber produced at JSC "SvetlogorskKhimvolokno" (Belarus). Arselon properties is very similar to the properties of various meta-aramid fibers. The staple fiber Arselon is a basis for spun yarns and nonwovens, which further can be processed into many kinds of products for thermal application. Its oxygen index (LOI) is 30 %, temperature of the use is 250 °C.

Manufacturer indicates the following applications of Arselon:

- Heat resistant spun yarns and fabrics (protective apparel, gloves, home and office textile);
- Woven and non-woven filtering materials, bag filters (for metallurgy, cement, asphalt);
- Composites (sealing, sliding bearings, packaging).

Despite of these features of these fibres before 2017 Belarusian mills produced only one kind of Arselon spun yarn. It was carded yarn 29,5 tex×2 (Ne 20/2). The aim of the presented research was the evaluation of Arselon yarns count on their properties. Development of wide range of Arselon yarns will create the base of new textile products such as woven and knitted fabrics and goods from them.

For research, Arselon fibers have the following properties: linear density was 162 mtex, length 36 mm. Cased on these data it is possible to make the conclusion about possibility to use machinery of short-staple fibers processing for manufacturing of Arselon yarn.

Samples of ring-spun carded yarns were produced using spinning machine G35 (Rieter). For 2-ply Arselon yarns manufacturing twisting machine Geminis S261 (Savio) was used. For obtaining yarns with the highest attainable properties during our research on each stage of the technological process experiments were carried out.

The yarn count range was from 16 to 29 tex (Ne37 – Ne20). Mechanical properties of ring-spun yarns and results of their testing using Uster Tester 5 are presented in table 1. Experimental data presented on the table 1 shows that breaking tenacity and elongation of Arselon ring-spun yarn increase with rise of its linear density.

For coefficient of variation CVm (%) following regression equation was obtained:

$$CVm = \frac{66,3}{\sqrt{T}}. \quad (1)$$

In formula (1) T is the linear density of yarn (tex).

Obtained equation (1) for evenness CVm calculation looks like Martindale determined the following formula for the limiting irregularity. A similarity of these formulas indicates the stability of the technological process of Arselon yarns manufacturing. Using equation (1) and Martindale formula we found that the whole range of Arselon yarns count index of irregularity is about 1,65.

Minimal linear density of yarn was determined which satisfies the following criteria:

- breaking tenacity must be not less than 16 cN/tex;
- coefficient of variation CVm must appropriate Uster® Statistics Percentile not higher than 50 %.

Table 1. Properties of ring-spun Aselon yarns

Property	Value				
Nominal linear density (tex)	16	20	22,2	24	29,5
Actual linear density (tex)	15,8	19,4	21,6	24,1	29,5
Breaking force (cN)	297,0	364,7	438,5	503,7	601,8
Breaking tenacity (cN/tex)	18,8	18,8	20,3	20,9	20,4
Coefficient of variation of breaking force (%)	10,8	12,1	10,7	10,9	9,1
Elongation (%)	12,78	14,0	13,9	15,6	15,1
Coefficient of variation CVm (%)	16,67	14,68	14,31	13,15	12,21
Thin places (-50 %) per 1 km	114,2	33,2	101,4	4	10,8
Thick places (+50 %) per 1 km	174	64,2	53,2	29,8	13
Neps per (+200 %) 1 km	259,2	168,2	144,4	49,2	26,2

All investigated samples of yarns satisfied the requirements for yarns strength. For yarn 16 tex coefficient of variation CVm exceeds limit USP 50 %. So, we cannot recommend use developed technology for producing Arselon yarn with linear density less than 20 tex.

Analysing properties of 2-ply yarns the following conclusions were drawn:

- the breaking force of 2-ply yarn increases almost directly in proportion to its linear density, while the breaking tenacity in the investigated range changes insignificantly, rise of yarn linear density leads to its elongation increasing, to reducing irregularity and the number of different faults;
- breaking tenacity of 2-ply yarns 16 tex×2 and 20 tex×2 by 20 % higher than breaking tenacity of corresponding single ring-spun yarns;
- yarns winding and assembling lead to significant reducing the number of their faults. Thin places are almost eliminated, thick places and neps number reduced by more than 3 times.

Conclusions

1. Developed technology allows manufacturing Arselon ring-spun yarns 20 – 29,5 tex of acceptable quality. Coefficient of variation CVm of these yarns appropriate USP not higher than 50 %. It is proven that index irregularity of the yarns for whole range is 1,65 that can be used for Cvm prediction for yarns of other linear densities. For yarn of linear density les that 20 tex it was recommended to correct technology on the further stage of research.

2. Winding and assembling lead to significant reducing the number of frequently-occurred faults of 2-ply yarns. Thin places are almost eliminated, thick places and neps number reduced by more than 3 times. Breaking tenacity of 2-ply yarns 16 tex*2 and 20 tex*2 by 20 % higher than breaking tenacity of corresponding single ring-spun yarns.

3. The developed range of Arselon yarns is the base for creation of new textile products such as woven and knitted fabrics and goods which can be made of them.

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1. Option for the presentation: ***Poster****.*
*2. Option for the topic****: Materials Engineering.***

Evaluation of aloe vera extract loaded polyvinyl alcohol nanofiber webs obtained via needleless electrospinning

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Extended abstract
Aloe vera is widely known for its health benefits. Since ancient times people used it topically to treat skin problems and ingested to heal digestive ills. Nowadays there are plenty of consumer products available in different forms- gels, creams, drinks etc. [1] Although, there are concerns regarding possible toxicity of orally administrated aloe vera [2] , the topical applications are considered as safe unless a person has allergic reaction to the plant itself.
To improve topical effectiveness of the biologically active ingredients, researchers worldwide tested the possibility of integrating aloe vera extract in nanofibers [3] . Electrospinning equipment with a syringe is the most common device mentioned in the published papers therefore in this work researchers used syringeless (needleless) electrospinning method (Nanospider™ LAB 200 (Elmarco, Czech Republic)) to evaluate differences in morphology, mechanical and bioactive properties of the nanofiber mats obtained by distinct techniques. Needleless electrospinning compared to the conventional syringe-based system has several advantages- high scalability, productivity, web and fiber diameter uniformity, wide choice of polymers and substrates, as well as economical operation and easy maintenance [4] .
As shown in Table 1., several samples of aloe vera extract and polyvinyl alcohol (81365 Aldrich Mowiol® 18-88 Mw ~130,000) were prepared using magnetic stirrer, both dissolved in distilled water.

Table 1. Samples of prepared polyvinyl alcohol (PVA) and aloe vera liquid extract (AV) spinning solutions

Composition	AV content wt%
PVA (10 wt%)	0
PVA (10 wt%) and AV	3; 5; 10; 15

Electroconductivity and viscosity were measured before electrospinning as the both values show the possibility of obtaining nanofibers before the production. It is known that for the solution to be spinnable, viscosity value must be 100-2000 millipascal-seconds (mPa-s) [4] . Viscosity parameters of the spinning solutions were in the range from 429 to 549 mPas·s compared to pure 10% polyvinyl alcohol (PVA)- 597 mPas·s and aloe vera extract (AV)- 0,7 mPas·s. Conductivity varied from 527 to 770 μS/cm (PVA- 390, AV- 1084 μS/cm) depending from AV wt% concentration. AV 15 wt% and PVA solution did not form quality web. Authors conclude that the ratio of conductivity 942 μS/cm and viscosity 395 mPas·s does not maintain the stability of production process.

Morphology of the nanofiber mats was evaluated and fiber diameters measured on atomic force microscope (Figure 1.) Dimension Edge Veeco (Bruker, USA). 100 measurements of each sample were taken. The results show that the value of diameters tend to decrease with added AV concentration. While average diameter size of syringe electrospun nanofibers were 123 nanometers (10% PVA and 5% AV powder) [5] , 10% PVA and 10 wt% AV composite nanofibers obtained by needleless electrospinning have average value of 676 nanometers.

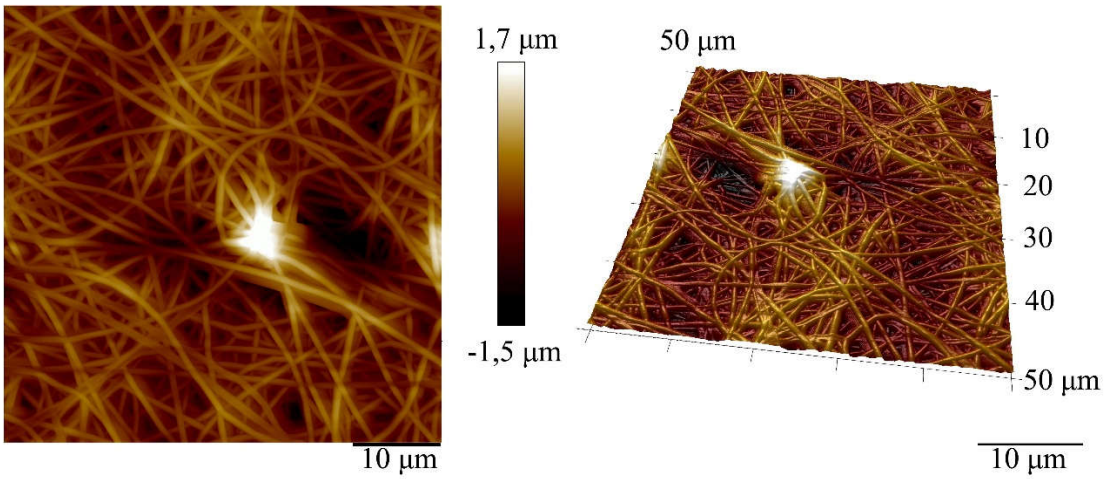

Figure 1. Morphology of PVA+10wt% aloe vera liquid extract nanofiber mat

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Electrical connection issues on wearable electronics

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Abstract

The drive for integration of electronic components into textile substrates has been a major aspect of research into production of smart textiles [1, 2, 3, 4]. Electronic components as such, are rigid, inflexible, do not easily follow body movements and can cause hypersensitivity of the skin upon prolonged contact due either to the presence of irritants or the rigid nature of the materials. Another important disadvantage of electronic components, in wearable applications, is that while textiles and textile like materials can withstand the usual cleaning/ care treatments, those same treatments can have detrimental effects on the transmission lines and on any exposed electronic parts [5, 6, 7].

This paper investigates a method for the protection of transmission lines made by conductive yarn seams on specimens containing both electronic and textile elements integrated on a textile substrate as well as the protection of the electronic parts. The reliability and durability of the specimen is determined by the measurements of the value of an electrical resistance located on a rigid PCB, after repeated wash cycles.

A rigid PCB containing a 10Ohm resistance is soldered onto a flexible PCB and the resulting combined specimen is sewn on to a single jersey knitted textile substrate (Viscose FR – Nomex) with conductive thread (Shieldtex 234/34-2 ply HC) which is silver coated polyamide. The conductive thread plays the role of a transmission line between the PCB and a pair of EKG textile based sensors which act as electrodes (Figure 1). The rigid PCB is encapsulated in silicon to protect it. Moreover, the transmission lines are covered with TPU tape to minimise the effect of the washing cycles.

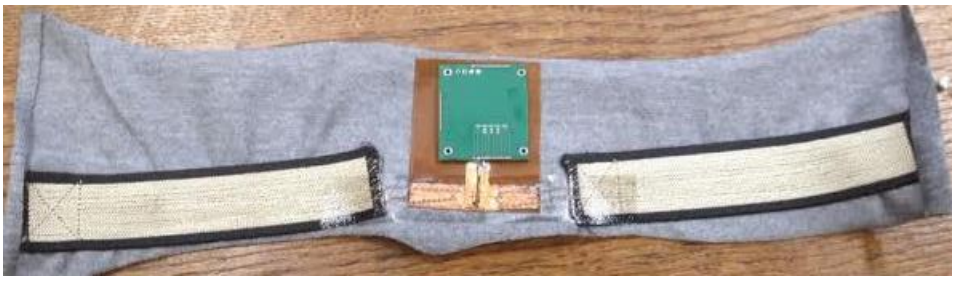

Figure 1. Test specimen before encapsulation of the rigid PCB

The specimens are washed for a total of 50 wash cycles in a laboratory washing/ dying machine (Ahiba/ IR) using ECE Non-Phosphate Reference Detergent A at 40 ^{0}C [8, 9]. The change of resistance of the whole system is investigated at first after every wash cycle and on completion of the 10th wash cycle, after every 5th wash. The increase of the resistance of the specimens after the 50th wash cycle equals about four times the value of the original resistance, measured on the pristine specimen. The results show that TPU and silicon usage are promising methods for the protection of electronic devices on textile structures.

Acknowledgments
The research, described in this paper, relates to the project, which has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie grant agreement no. 644268, project title: Welding of E-Textiles for Interactive Clothing-E-TexWeld.

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Options indication
1. Indicate your option for the presentation: ***Poster****.*
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The impact of wear on mechanical properties of roving

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The paper deals with the influence of mechanical wear on the resulting mechanical properties of roving. The paper deals with the scraping of roving from inorganic fibers. Glass, carbon and basalt roving are used for this experiment. Rovings are mainly used for the production of composites. The preparation of the roving for processing into composites includes their coiling of the supplied large coils on the coils used in the manufacture. With this rewinding, mechanical damage to roving can occur, which could result in loss of strength. The aim of this work is to determine whether the values of the mechanical properties change depending on the wound generated during winding.
For this purpose, a special Cycle Abrasion Apparatus has been developed to simulate wiping during winding. The work is first aimed at finding the optimal measurement procedure on the Abrasion Apparatus. Further, the results of weight loss, loss of strength, particle removal and measurements on the Zweigle instrument are processed.

Description of used material
It was focused on carbon-fiber, basalt and glass (GF-glass fibers) in the form of roving, which are mainly used in the production of composites. The mechanical properties of several types of fibers from different manufacturers were selected and tested. These are in particular carbon fibers from four different manufacturers, glass fibers and basalt fibers.

Measurement description Apparatus
For measurement of roving we have specially built an abrasive equipment. It consists of a pulley and a large wheel that are powered by a motorcycle. It also has two pulleys that are firmly attached. The fibers are guided over the wheel and between the pulleys. After abrasion, roving was captured in frames and subjected to a tearing test.

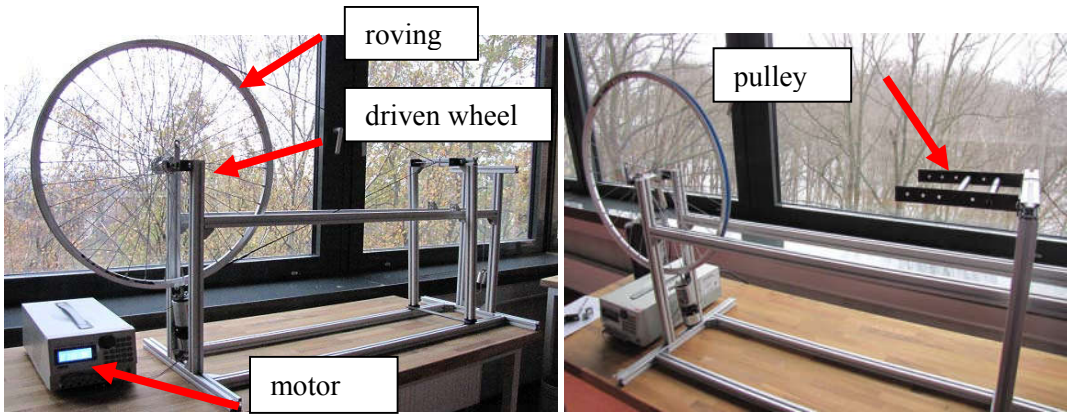

Figure 1. Apparatus for simulation of wear of roving

Measurement description Zweigle

The planes were scraped off by roller-coated sandpaper, which rotated when moving, see picture. The roller traveled in a certain section under roving back and forth, that is, in the cycle. Due to the wicking of the separated tear-off fibers on the roller, the abrasion to the entire roving layout was not possible and only cycling was selected.

Results

As a result of the wicking of individual fracture fibers on the pulleys, there was a greater serious drop in some roving. Part of the measurement was to determine the lengths of the contaminated particles during device measurements. Particle collection was performed in the three most undesired places under the Aparatarium. For the wear of roving, the Apparatus for abrasion proved to be the most suitable way of rubbing.

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Development of the calculation method of polymer compound mass to be applied onto the textile garment pieces

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Abstract. The article is dedicated to the development of calculation method of a base line mass of a polymer compound to be applied onto the textiles with an added performance of friability relative to each other. The method of strengthening of the yarned joints of products from the range of fabrics of sparse structures is being considered. The obtained results of the research made possible to reveal the negative influence of such indicators as the friability and spread ability of the yarns on the quality of yarn joints (spread ability and friability of yarns in the fabric, the tensile strength, stiffness, etc.) and the product as a whole, which make possible to use progressive processing methods during the selection of garment production technology. To ensure the required quality and reliability of yarned joints of garments made of highly expandable fabrics, the studies have been carried out. At the same time, as a control, a fabric was chosen without applying a polymer and another alternative variant was chosen as well, using the liquid-phase polymer compositions along the seams. The control and alternative variants of the samples were subject to comparative assessment according to the criteria of tensile strength, resistance to friability, flexural rigidity, air permeability and resistance to washing. As a result of the studies, the rational parameters of the technological conditions of applying the liquid-phase polymer composition onto the joints of the garment components were established to improve the performance properties.

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Options indication: Poster

Design of Fabric Comfort Index

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Abstract

For a long time, clothing comfort has been estimated by the organoleptic method. The producers and users of textile products try to formulate in words the impression of touching the flat textile product. The thermal comfort of man depends on combinations of clothing, climate, and physical activities and this has been widely used in the clothing industry and the heating-ventilation industry.

Clothing Comfort is a subjective multicriteria phenomenon that requires the simultaneous satisfaction of several criteria. In this study, we try to represent objectively the mechanical comfort components to simulate the consumer comfort perception.

The modelling method proposed in this paper permits to obtain mechanical comfort indexes for fabric that can be interpreted like an indication to foresee if the wished comfort is satisfied or not. The proposed indexes take into account the consumer requirement and the importance of each selected property affecting the mechanical comfort. In this study, the conceived indexes were used to compare the mechanical comfort of linen and denim fabrics.

Finally we tried to represent graphically by the mechanical comfort diagram the mechanical comfort performance of the studied fabric samples according to the mechanical comfort indexes. The proposed mechanical comfort zones help choosing the adequate fabric according to the performance comfort.

Keywords— *Tactile comfort, clothing comfort, comfort indexes, desirability functions.*

Pressure Comfort of Sock Welts Produced on Single Cylinder Sock Machine

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1. Introduction

Consumers have become more conscious about every piece of clothing they buy due to easy access to information with the help of technology. Therefore, they are demanding high quality, more comfort and low price. Recently pressure comfort, which is one of the components of clothing comfort, has prominently been researched. Pressure exerted on the body by garment depends on shape of the body, fiber type and fabric structure [1]. Wear trials conducted by Momota et al. [2] and Tsujisaka et al. [3] revealed that pressure values of 10 mm Hg and 2.02 ± 0.29 kPa (~15 mm Hg) respectively are felt as comfortable. Wu and Li [4] stated that clothing pressure affects integumentary, circulatory, respiratory and other physiological systems of human body. Therefore, in this study pressure comfort of sock welts produced on single cylinder sock machines were investigated.

2. Materials and Method

All samples were knitted on Da Kong Sock machine (E14, 156 needles, $3^{3/4}$ ") using Nm 50/1 acrylic yarn. Two types of welts, two types of knit structures and two types of welt heights were used (Table 1). Welt types and knit structures are given in Figure 1. Mock rib and mock pique structures of accordion welts were produced by laying elastomeric yarn in the same or alternate needles. Single jersey welt has been sold in market recently and was added to our study to test whether it provides lower pressure.

a b c

Figure 1. Welt types and knit structures (a. accordion welt – mock pique structure, b. accordion welt – mock rib structure, c. single jersey welt

Welt pressures were measured with Kikuhime pressure monitoring device and MST Professional 2 – Medical Stocking Tester. As in TSE CEN/TR 15831:2010 standard [5], leg circumference was taken as 30 cm for point B_1 (calf area) for both devices.

PASW Statistics 18 programme was used to evaluate test results.

3. Results and Discussion

Table 1. Welt characteristics and mean pressure values.

Welt Type	Knit Structure	Welt Height	Mean Pressure with Kikuhime device	Mean Pressure with MST Professional 2 device
Accordion	Mock Pique	3 cm	21,1 mm Hg	9,1 mm Hg
Accordion	Mock Pique	6 cm	20,5 mm Hg	12,6 mm Hg
Accordion	Mock Rib	3 cm	19,2 mm Hg	10,5 mm Hg
Accordion	Mock Rib	6 cm	20,1 mm Hg	13,6 mm Hg
Single jersey	-	-	6,8 mm Hg	5,3 mm Hg

To determine the statistical importance of variations of both devices' measurements, Independent Samples T Test method was applied. According to the results there was a significant difference between measured mean pressure values (p=0,000). Additionally, a strong positive correlation (p=0,822) was found between the results of both devices.

4. Conclusion

Results indicated that the difference between mean pressure values measured by these devices was significant. In order to do measurements with the Kikuhime pressure monitoring device, the socks were placed on a special metal ring that does not have the flexibility like a human skin. Therefore, despite the existence of a strong correlation between the two devices, it was seen that MST Professional 2 Medical Stocking Tester device could simulate human body more correctly.

When the test results and statistical analysis were evaluated, single jersey welt was found as the most comfortable in terms of pressure comfort. However, this type of welt can easily get loose due to its weaker structure resulting in a short lifetime. The strength and laundry performance of this type of welt may be investigated in a further research.

If MST Professional 2 – Medical Stocking Tester's results are considered, it can be seen that mock pique welt with 3 cm height provides more comfort, when single jersey welt is put aside.

Acknowledgement

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Development of fibrous materials for shielding of electromagnetic radiation

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At present materials (including textile ones) with electrophysical properties that allow to screen electromagnetic radiation are of great interest. They are necessary to carry out protection of the personnel of radar stations, to reduce the influence of undesirable sources of electromagnetic waves, to develop special-purpose equipment and radar cover means. Such effect can be achieved by various methods. One of them is the introduction electrically conductive fillers such as carbon materials in the form of carbon black, carbon nanotubes, graphite, carbon fiber, etc. into the polymer base of textile fibres.

In order to analyze the possibility of creating such textile materials, a study was made into the effect of finely dispersed carbon additives on the process of forming polyacrylonitrile (PAN) fibers. Carbon nanotubes (CNT) and technical carbon (TC) were used as additives. CNT consisted of nanocones with a diameter of 10 to 60 nm, connected in chains up to 1000 nm in length. TC contained up to 50 % of particles of 30-60 nm in size and had a specific adsorption surface of 84 ± 4 m^2/g. The choice of polyacrylonitrile fibers is due to the fact that they can be obtained from the solution, which makes it possible to achieve a high degree of dispersion of carbon nanomaterials.

Two methods were considered for the preparation of polyacrylonitrile fibers modified with carbon nanomaterials (CNM):

- introduction of highly disperse carbon additives at the stage of synthesis of the fiber-forming copolymer of acrylonitrile (AN), methyl acrylate (MA) and 2-acrylamide-2-methylpropane sulfonic acid (AMPS);
- introduction of additives into the spinning polymer solution.

The polymer synthesis was carried out by homophase copolymerization in dimethylformamide (DMF). The molecular-weight characteristics of the obtained polymer samples were evaluated using a viscometric method. Polyacrylonitrile fiber was formed from spinning solutions by a "wet" spinning method. The evaluation of the physico-mechanical properties of the fibers was carried out in accordance with the current standards.

A study of the synthesis of acrylonitrile copolymer at temperatures of 70-80 °C showed that the introduction of CNT into the reaction medium slows down the process. An increase of the induction period of synthesis in the presence of CNT was also observed. The kinetic parameters and temperature coefficients of the synthesis process of the fiber-forming poly [AH-co-MA-co-AMPS] were determined both in the presence and absence of CNT.

A decrease in the temperature coefficient of the polymerization rate has been established. The lower intensity of synthesis of the fiber-forming poly [AN-co-MA-co-AMPS] in the presence of CNT is probably due to the fact that they can "sorb" free-radical particles. This reduces the effective concentration of radicals in the reaction medium. This assumption is confirmed by the fact that the addition of CNTs to the reaction medium leads to an increase in the value of the intrinsic viscosity. This does not contradict the theory of free radical processes. Another possible reason for the substantial increase of the intrinsic viscosity of dilute solutions of copolymers of AN which are synthesized in the presence of CNTs can be the presence of branched high molecular weight particles or "star-type" macrochain associates. They can be formed as a result of initiating the growth reaction of polymer chains on free-radical centers, which are sorbed by CNT. As a result, CNT particles must be in the center of such associates. The presence of such macromolecules has a very negative effect on the spinnability of polymer solutions and the physico-mechanical properties of the finished fibers. Thus, the creation of materials filled with carbon additives by introducing CNT into the reaction mixture at the synthesis stage can't be realized.

To investigate the process of modification of PAN fiber by introducing CNT into the spinning solution it was necessary to develop the way of dispersing carbon additives in the liquid phase. It was found out that ultrasonic treatment is the most effective way of CNT dispersion in the solution. In this case, the dispersion process must be carried out according to a certain procedure. It has been established that the effective viscosity and anomaly of the viscosity properties of spinning solutions with CNT is higher than those without CNT. This can be explained by the influence of a highly dispersed carbon additive on the supramolecular structure of the spinning solution.

To assess the effect of the content of carbon additives of different morphology on their physico-mechanical properties of fibers, samples of model fibers were obtained by wet spinning from polymer solutions in DMF.

Further, the fibers were stretched in a plasticizer bath, dried and stretched again. As a result, filament samples were obtained at each stage of the technological process. This make it possible to evaluate the effect of highly dispersed carbon additives on the formation of the structure of modified fibers and their properties. The tensile deformability, tensile strength, elongation at break and other mechanical properties of model fibers were determined.

It was found out that:

- maximum increase in strength is noted for PAN fibers modified with 1 % (w.) of CNM;
- the strength of PAN fibers modified with 1% (w.) CNM after plasticization drawing exceeds 45 cN / tex, which is more than 20% higher, as compared to unmodified fibers;
- the strength of PAN fibers modified with 1 % (w.) CNM after the second (thermal) drawing was more than 77 cN / tex, which is 15 % higher, as compared to unmodified fibers,
- there is no fundamental difference in the effect of CNT and TC on the process of obtaining PAN fibers by the wet spinning method and their mechanical properties.

Thus, in order to develop the technology for the production of textile materials based on polyacrylonitrile fibers for shielding electromagnetic radiation, various methods for introducing carbon nanodispersed additives with different morphologies into the polymer substrate have been studied. The influence of these additives on the structural and mechanical characteristics of modified fibers is shown.

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Options indication
1. Option for the presentation: ***Oral, <u>Poster</u>****.*
2. ***Topic*** *10 Textile Engineering (or Materials Engineering?)*

On the Thermal and Pressure Characteristics of Sport Compression Garments

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Sport is one of indispensable activities of daily life and it is becoming a more common living standard with increasing worldwide interest day by day. The sportive activities that constitute the basic building block of the healthy lifestyle dominated in our time have triggered the development of a unique production market. Textile products that are used in sports need to carry many features apart from casual wear. Generally, desired properties are comfort, freedom of movement, breathability, easy care, durability, body fit and lightness [1].

In addition to the "required performance characteristics" in sport textiles, the other important topic is "athlete's health". As it is known, the human body is influenced by both the environmental factors and the risks in sport activity. Environmental factors occur usually with the effects of nature, such as weather conditions, cold and hot climates and sport field [2]. Risks of sportive activity are the extreme forces applied to the body during sports, such as various muscle and skeletal soreness, collision and falling. Especially in sports such as athletics, football and basketball, which require a high level of energy, the muscles are exposed to various difficulties.

Products with compression effect have both a performance boosting function and a protective function that allows the muscles to work more regularly. Compression products support the muscles with extra forces that are created from outside, tightly wrap the muscles to prevent more energy from vibrating and accelerate blood flow [3]. In addition to these effects, the use of compression products during pre-sports or during sports also increase muscle temperature. The warming of the muscles prolongs the muscular length for making the desired movement easier and the muscular reaction time is shortened in the nerves that control the muscles. Thus, the risk of muscle injury reduces.

During sport, the body produces excessive heat that will affect athlete's health and durability. Therefore, the body should be in thermal balance to eliminate heat-load. In terms of thermal comfort, a successful product should transport heat, vapour and liquid sweat to the outside as fast as possible and help to control the body's thermal balance. In addition, the sport product must perform different tasks depending on the ambient temperature [4]. In hot environments, the body loads more heat and therefore the textile garments must have higher air permeability and sunlight reflective properties. In cold weather, it is ideal to have higher thermal insulation and windproof.

In this study, various knitted fabric structures were designed to help preventing muscular difficulties in sports. The goals were compression effect that could support muscular systems and thermal insulation to warm muscles before or during sports. The samples, containing channels (corded effect) in widthwise direction, were produced by jacquard knitting technique. The effects of channel size and quilted inlay design were investigated in terms of pressure behaviour, thermal resistance and water vapour permeability. Increasing of channel size and adding inlay yarns improved thermal and water vapour resistance, also significantly affected pressure characteristics of samples.

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Options indication
1. Option for the presentation: ***Poster presentation***
2. Option for the topic: ***Textile Engineering***

AN INNOVATIVE METHOD FOR REDUCING WATER USE IN PROCESS AFTER DYEING

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Title of the abstract

Textile industries consume large volumes of water and chemicals for wet processing of textiles[1]. Textiel wastewater damage the environment as they contain high concentrations of organic and inorganic chemicals. There is also a lot of waste water and energy consumption while processes. Reactive dyes react with cellulose to establish covalent bond and are water soluble[2]. Because of these properties and low fix rates, they cause high levels of dyes in waste water. Reactive dyes which are not totaly fixed to the fabric throughout the dyeing process. Washing is required to remove un-fixed dye from the fabric, The control of water pollution has become of increasing importance in recent years. The control of water pollution has become of increasing importance in recent years. The release of dyes into the environment constitutes water pollution[1]. Since conventional treatment methods are insufficient for purifying dyehouse wastewaters, new treatment technologies are developed and applied for its treatment. Nowadays, removal of dyes methods are often very costly and have many problems. For this reason, effective and economical alternative treatment methods are needed in removing large amounts of dyes from waste water[4].
In this study, it is aimed to reduce the number of washing treatment after direct and reactive dyeing. It is planned to develop filters made from cationic fibers while the use for after treatment processes. When experiments are done, we observed that non-hydrolysis of the dyes trapped into the developed filters. As a result of these study, the wastewater likely to show better results such as; less energy and, less water consumption has been achieved.

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Options indication

Poster presentation
10. Textile Engineering

ENVIRONMENTAL DURABILITY OF EXTERNALLY NATURAL FABRICS REINFORCED POLYMER CONCRETE

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Abstract:

The quick emergence of composite since their invention due to their high specific properties do not gainsay the health problems associated to the use of synthetic fibers as reinforcing agent of almost all commercially available polymer composites. To avoid those hazardous effects, the current global tendency is the incorporation of lignocellulosic fibers instead of these mineral ones owing to their biodegradability, low cost and density, renewability and aspect ratio in addition to their high mechanical properties. Recently, there has been an increase interest in the use of bio-composites due to environmentally aware consumers to preserve the world [1]. Natural fibers are low-priced and sustainable natural resources. With increasing environmental protection consciousness, natural fibers as a relatively new group of environmental friendly materials are in considerable demand in recent years by unifying technological, economic and ecological aspects [2].

A new material's concept currently applied in Algeria and in many other countries, based on an externally GFRP polymer concrete, proved its efficiency in piping systems. We have already presented the concept of BPREX combining the polymer concrete with Glass fiber reinforced laminates. The design merging composite materials with polymer concrete in laminate form is used to get the most out of these two materials in the same time such as: more economic final material with high mechanical properties in tension also in bending in addition to a better durability properties. The applicability of this new concept in civil engineering in addition to its durability tracking in harsh environment was previously studied [3].

The aim of the present work is the substitution of glass fabrics and short fibers reinforcing the polymer materials in the current material concept by natural fibers and fabrics made up of jute. Keeping the same concept would ensure high level strengths and manufacture easiness in addition to the most important aim which is getting a more eco-friendly material and so, to have a compromise between sufficient performances and environmental protective aspect. The material constitution is shown on the figure below:

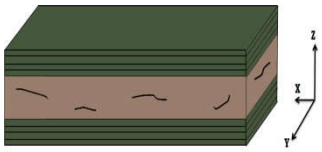

Figure 1. The concept of BPREX developed during our current project; two skins made of JFRP and an SFR polymer concrete core.

Where: JFRP: Jute fabric reinforced polyester resin

SFR polymer concrete: Short fibers reinforced concrete

To assess the possibility of using this new concept reinforced with jute fabrics in civil engineering applications, we carried out tensile and interlaminar shear strength tests upon specimens cut from its laminates. Then, in the second part of this research work, because durability properties of materials are crucial for its consideration as sustainable construction material, mechanical properties durability of this new material was followed up through its immersion in a harsh environment simulating theoretically 56 years of aggressive exposure as recommended by Francesco Micelli et al [4]. The obtained results evidence high tensile and ILSS properties. On the other hand, the residual tensile and ILS strengths allow the consideration of this new material's concept reinforced with natural jute fabrics as suitable for civil engineering applications for non-bearing load elements.

Key words: natural fibers, BPREX, eco-friendly laminate, SFR polymer concrete, environmental durability.

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Stress relaxation of three-dimensional warp-knitted fabrics in compression

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Abstract
The typical fabric structures (woven or knitted) in textiles can be considered essentially 2 dimensional surfaces as the thickness of the fabric structure is negligible compared with the length and the width of the fabric piece. Nevertheless, there exist textile structures where the thickness is significant, and that thickness is the added value characteristic of the structure. These 3D knitted, or woven fabrics or spacer fabrics as they are also called, are used in applications where there is requirement for added "padding" or thickness and they tend to replace materials like polyurethane foam which has historically been use for such applications. These applications include automotive interiors, personal protective equipment, medical textiles, and construction. Combining satisfactory behavior in compression with advanced mechanical properties, breathability and air permeability 3D with acoustic properties spacer fabrics have been extensively studied [1–6]. 3D knitted spacer fabrics are three-dimensional knitted fabrics consisting of two layers of outer fabric that are connected by a layer of, usually, monofilament, synthetic fibres (Figure 1).

Figure 1. View of a 3D spacer fabric from the side.

While the behavior of 3D warp-knitted spacer fabric in compression has been investigated and modeled so that the typical compression stress strain curve has been determined (Figure 2) [7–11], the mechanical behavior of the fabrics regarding time dependent deformations has not been yet investigated

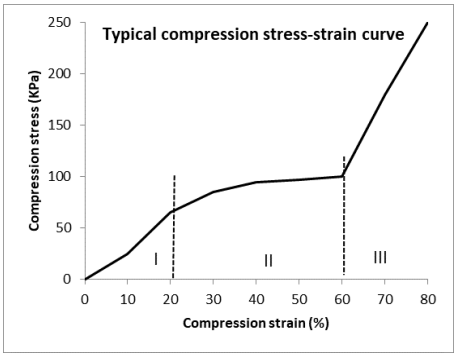

Figure 2. Typical compression stress strain curve of 3D spacer fabric where the three distinct areas are visible.

In this research project four 3D warp knit fabrics (Table 1) where subjected to consecutive compression deformation cycles of 1mm. Each cycle of deformation was held in place for 4 mins. During the consecutive cycles the load that developed on the specimens was recorded.

Table 1. 3D sample characteristics

Sample	Composition	Weight (g/m^2)
51100120	100% Polyester	900
50100130	100% Polyester	1120
54100110	100% Polyester	1030
53100130	100% Polyester	850

The load results were plotted over time and the resulting graphs were analysed with regards to the behaviour of the material. Firstly, stress relaxation phenomena were investigated in accordance with the exponential laws described in the literature. For all four samples there was found little agreement of the results to the behaviour described in the literature. Then the case of the bending of viscoelastic bend beams, was investigated. This approach was applied to the behaviour of the interconnecting monofilaments during the deformation cycles. This approach showed good agreement with the behaviour of the 3D samples (Figure 3).

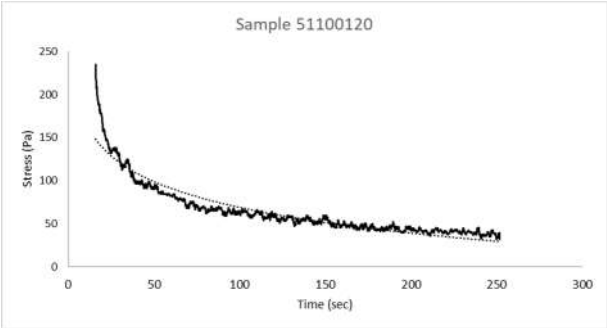

Figure 3. Strain degradation over time with trendline visible.

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The effects of different knitting structure of conductive yarns on electromagnetic shielding effectiveness

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Recently, increasing number of studies are performed on protective fabrics containing metal wires for electromagnetic shielding purposes. In the present paper, the hybrid fabrics in several knitted structures made by using hybrid conductive yarns having the same diameter. The conductivity, as well the electromagnetic shielding effectiveness (EMSE) were measured. The variations in EMSE as well as reflection, absorption, and transmission and in other physical properties of knitted conductive fabrics were investigated considering wire content and knitting structure. It was seen that an increase in the wire content significantly increased the conductivity. It is observed that fabric samples, have shown good electromagnetic shielding performances in high frequency band, namely industrial, scientific and medical band. Also, when the yarn density has been increased, the decrease in the electromagnetic shielding effectiveness of fabric samples, which have been positioned the same way, is observed.

Keywords: conductivity; electromagnetic shielding effectiveness; knitted fabric;

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Inventory management concepts and techniques

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Inventory management has become one of the key elements of the supply chain management and can greatly affect the performance of a business. The textile industry is no exception. Traditional approaches in decision making based on manager instincts and hunches are no longer enough in the today's increasingly competitive environment. Small to medium sized family owned textile businesses are usually prone to this way of thinking.
This paper discusses some basic concepts and techniques for classifying inventory, controlling inventory levels, avoiding stock outs and increasing customer satisfaction. It also discusses the importance of forecasting demand and uses the Root Mean Square Error (RMSE) as an effective measure of the forecast error, which later becomes a basic driver for inventory management. It addresses the Service Level (SL) as a performance metric and emphasizes on the importance of Safety Stock (SS). Finally, it discusses the use of the Reorder Point (ROP) as an efficient indicator for triggering production replenishment and proposes a simple technique for prioritizing production orders.

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Evaluation of the ultraviolet protection factor (UPF) offered by various knit fabric structures

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Abstract. Public awareness regarding the risks of prolonged skin exposure to the sun light and more specifically to the UV spectrum part is increased during the last decades. Clothing is the most natural and suitable way of protecting the human body, thus the market interest in clothes that can offer adequate UV protection is growing continuously. Previous research have revealed the main factors that influence the ability of fabrics to block harmful UV radiation. However, the variability of these factors and the versatility of their combined effect make UV protection factor prediction difficult and hence the design of fabrics with high performance against UV radiation becomes a complicated task. Hopefully, the most critical and predictable among all the various factors is the fabric structure itself. Expectedly, closer and tighter structures offer higher UV protection. Due to this fact, the majority of previous research concern woven structures which generally are less porous and offer a higher UV protection. However, the possibility to obtain knitted fabrics with adequate UV protection factor is of great interest, since knitted fabrics are more appropriate for sports as well as for casual summer fashion garments. Current literature regarding the UV protection factor of knitted fabrics is very limited and concerns mostly fabrics produced in machines of relative large gauges. In the present work the UV protection factor of various typical weft-knitted structures, produced in a flat knitting machine with 7 gauge and by using grey 100% Organic Cotton yarns, Ne 30/2, 330 TPM is studied. The yarn has been selected due to the increasing market interest for Organic Cotton products and has been offered for the purposes of this research by the Greek cotton industry VARVARESSOS S.A.