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III[rd] International Congress on Healthcare and Medical Textiles

October 26-28, 2017

Çeşme, İzmir - Turkey

BOOK OF ABSTRACTS

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EGEMEDITEX 2017

3rd INTERNATIONAL CONGRESS ON HEALTHCARE AND MEDICAL TEXTILES

OCTOBER 26 - 28, 2017
İZMİR-TURKEY

Organization
EGEMEDITEX 2017 is organized by Ege University
Faculty of Engineering, Department of Textile Engineering

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EGEMEDITEX 2017
3rd INTERNATIONAL CONGRESS ON HEALTHCARE AND MEDICAL TEXTILES

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PROGRAMME

October 26, Thursday

08.30 – 09.30 **Registration**

09.30 – 11.00 **OPENING CEREMONY**

Opening Speeches

E. Perrin AKÇAKOCA KUMBASAR – Chair of IITAS 2017&EGEMEDITEX 2017 Organizing Committee
Şeref FAYAT – Association of Turkish Apparel Industrialists, Chair of the Executive Board
Emre KIZILGÜNEŞLER – Aegean Exporters' Associations, Coordinator Vice chairman; Aegean Apparel Exporters Union, Chair of the Executive Board
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Muharrem Hilmi KAYHAN – Turkish Textile Employers' Association, Chair of the Executive Board
Süheyda ATALAY – Deputy Dean of the Ege University Engineering Faculty

11.00 – 11.30 **Coffee Break**

11.30 – 12.00 Where Will Textile Industry Produce in the Future? (Last Part)
Işık Tarakçıoğlu
Ege University, Turkey

12.00 – 12.30 Sustainable Competition in Ready Wear Market
Birol Sezer
İstanbul Ready Wear and Clothing Exporters' Association, Turkey

12.30 – 13.00 Today's Turkish Textile Finishing Industry and Its Vision in Next Ten Years
Vehbi Canpolat
Turkish Textile Finishing Industrialists Association, Turkey

13.00 – 14.30 **Lunch**

14.30 – 15.00 Technical Textiles - Trends for New Opportunities with Smart Solutions!
Uwe Merklein
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15.00 – 15.30 Global Organic Textile Standard Ecology & Social Responsibility
Elif Yaraşık
Global Standard gemeinnützige GmbH, Germany 34

15.30 – 16.00 The Global Textile (Machinery) Industry in Disruptive Times
Olivier Zieschank
International Textile Manufacturers Federation (ITMF), Switzerland

16.00 – 16.30 **Coffee Break**

16.30 – 17.00 Why Future Textile Business Models Demand Sustainability?
Sabrina Schmidt
Technische Universität Chemnitz, Germany

17.00 – 17.30 Necessity of Vocational Qualification Certificate in Textile Industry
Gamze Kılınç Ustabaş
Turkish Textile Employers' Association, Turkey

17.30 – 18.00 On the Way to Digital Enterprise: Industry 4.0
Ali Rıza Ersoy
Siemens A.Ş., Turkey

20:00 **Dinner**

October 27, Friday

18.00 – 18.30 Development of a Magneto-Rheological Glove for Hand Rehabilitation Applications
Hasan Aykut Aydın, Özgen Tonay, Barış Oğuz Gürses, Sercan Sabancı, Mustafa Ertekin, Aysun Baltacı, Seçkin Erden
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October 28, Saturday (EGEMEDITEX 2017 SESSION – A)

SESSION III (EGEMEDITEX 2017 SESSION-B)

15.00 – 16.00 **Coffee Break & Closing**

POSTER SESSION, October 27, 2017

OCTOBER 26, 2017

TECHNICAL TEXTILES - TRENDS FOR NEW OPPORTUNITIES WITH SMART SOLUTIONS!

Uwe Merklein
Ib M Consulting – Ingenieurbüro Merklein, Aachen, Germany
uwe.merklein@t-online.de

What are Technical Textiles? Just for industrial application?

Technical Textiles are advanced textiles know for their excellent functional properties and technical performance.

An exciting multidisciplinary field with exhaustive applications in various industries, technical textiles is poised to witness strong growth.

Market today and tomorrow?

The global market is projected to reach US$ 168,3 billion (other sources are talking about US$ 193 billion) by 2020, driven by a robust demand from the construction and automotive sectors. Compared to 2010 (127,2 billion), there is a growth of 32% in 10 Years.

Market for Technical Textiles (2015)

The market has been segmented on the basis of major regions such as North America, Europe, Asia-Pacific, and Rest of the World (RoW), wherein their value and volume has been projected.

The Asia-Pacific region accounted for around 33.13% of the total market share in terms of value in 2014, followed by the North American and European regions at 29.13% and 24.02 %, respectively.

Global Growth drivers?

- **Global growth (Population)** Agrotech, Clothtech,
- **Increasing urbanization** Buildtech, Geotech
- **Strong requirement in living space** Buildtech, Hometech
- **Expanding industrial production** Indutech

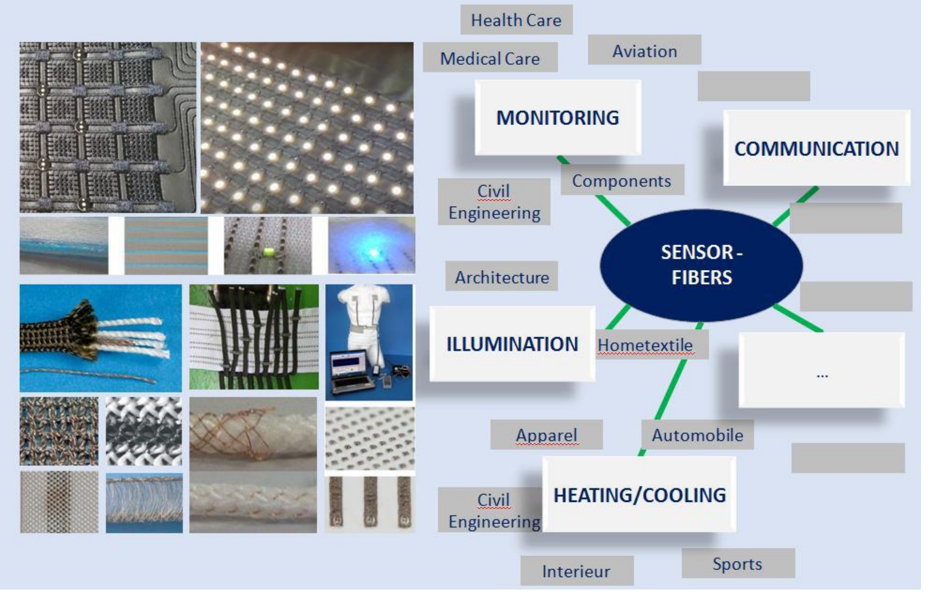
- **Roll out of medicare** (Emerging markets) Medtech
- **Increasing numbers of car manufacturing** Mobiltech
- **Increasing ecological damage -> environment protection** Oekotech
- **Expanding World trade**(Globalization) Packtech
- **Increasing requirement for security** Protech
- **Increasing expanses for sports and recreation** Sporttech

Key Trends (Future)

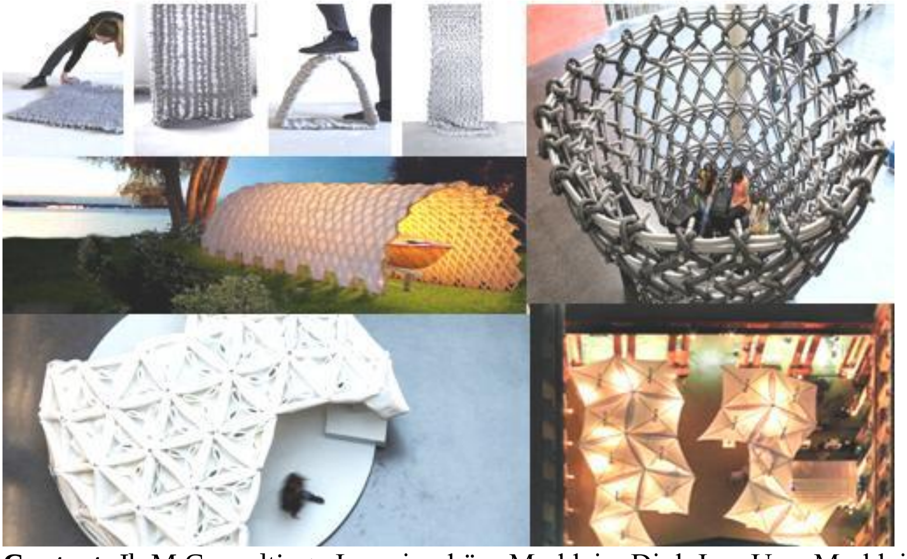
Functionality by material, finishing or in combination with:

- **SMART FUNCTIONS**
- New **APPLICATIONS** (for Apparels, Home textile, Architecture)
- Special **DESIGN** (Furniture, Outdoor, Architecture)
- Additional **SERVICES**
- **Digitalization**

Example for SENSOR FIBERS (Application/Smart Functions)



Just FANCY IDEAS?



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Key Words: Technical textiles, smart, sensor fibers, safety textiles, health care

GLOBAL ORGANIC TEXTILE STANDARD ECOLOGY & SOCIAL RESPONSIBILITY

Elif Yaraşık
Global Standard gemeinnützige GmbH, Augustenstrasse 84 A · 70178 Stuttgart, Germany
elif@global-standard-org

GOTS is comprised of four reputed member organizations, namely OTA (USA), IVN (Germany), Soil Association (UK) and JOCA (Japan), which contribute to the GOTS, together with further international stakeholder organizations and experts, their respective expertise in organic farming and environmentally and socially responsible textile processing.

The Global Organic Textile Standard (GOTS) is recognized as the world's leading processing standard for textiles made from organic fibers. It defines high-level environmental criteria along the entire organic textiles supply chain and requires compliance with social criteria as well.

Key Words: GOTS, organic, process, ecology

OCTOBER 27, 2017

TREATMENT OF DIABETIC FOOT INFECTIONS AND THE EFFECT OF DERMOBOR

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Diabetes mellitus (DM) remains one of the major public health problems worldwide. The prevalence of both type 1 and 2 DM is increasing. In 2013 the number of patients with type 2 DM was 382 million. With this speed, it's estimated that the number will be 592 million people by 2035. Diabetes is considered one of the devastating diseases with high mortality rate. In 2015, of the 56.4 million deaths worldwide, 1.6 million were due to DM. It remains the 7th leading cause of death. Diabetes is also very costly both for the individual and for the health systems of the countries. In 2013, the cost for diabetes and related diseases reached $ 548 billion all over the world.

Diabetic foot infections (DFIs) are one of the most serious chronic complications of DM. Diabetic foot ulcers complicate the disease. They occur more than 15% of diabetic patients during their lifetime (5, 6). Treatment of diabetic foot ulcers (DFUs) and subsequent infections is difficult. The most dramatic end result of DFUs and DFIs are foot amputation. The number has been reaching one in every 30 second in the world. Multiple risk factors can play a role in the occurrence of DFUs and DFIs such as; neuropathy, peripheral vascular disease, traumas, poor glycemic control and cigarette smoking. Multidisciplinary approach is needed for the management of patients with DFUs and DFIs.

Diabetic foot infections are often accompanied by the cardinal manifestations of inflammation such as; erythema, warmth, swelling, tenderness and presence of pus in an ulcer or sinus tract. Presence of gangrene, severe ischemia, or tissue necrosis may remind the existence of a limb threatening infection. Systemic signs such as fever, chills, hypotension, and tachycardia may accompany local signs of infection and indicate an increased severity of infection, like sepsis and septic shock. The most common possible causative microrganisms responsible from DFIs are; Gram positives, Gram negatives and anaerobes.

Clinical signs, epidemiological data and antimicrobial susceptibility results should be taken into the consideration for the choice of antibiotics in the empirical treatment of DFIs. Oral single antibiotic therapy is convenient for mild DFIs. Empiric therapy should cover the activity against staphylococci and streptococci. In patients with moderate DFIs, combination antibiotic treatment covering anaerobes should be utilized. Patients with severe, limb-threatening diabetic foot infections should be hospitalized and combined broad-spectrum parenteral antibiotic therapy should be given.

The treatment of DFIs with local antimicrobial agents depends on several factors. General health of the patient, the process of tissue repair, and description and classification of the wound should be considered when deciding. Generally both local and systemic antimicrobials are using together in the treatment of patients with DFIs. Dermobor gel is licenced as a local treatment agents for DFIs in 2014. It's produced by Yeditepe University, Faculty of Engineering Department of Genetics and Bioengineering.

It contains 0.2% Chlorhexidine digluconate and 3% sodium pentaborate pentahidrate (NaB), Chlorhexidine digluconate 0.2% has strong antibacterial and antiviral effect. This product has not only antimicrobial properties but also has wound closure effect with NaB. We used Dermobor gel in ten patients with DFIs. Seven of them were male and the mean ages of patients were 64.12 ± 12.16. The duration of diabetes mellitus was 15 years. In four patients the causative microorganisms were grown from deep of ulcers taken by sterile biopsy techniques. In six patients the wound area was 10 - 19 cm^2 while in four it was more than 20 cm^2. Most of the patients (n: 6) were moderate and severe diabetic foot infections. Patients with severe diabetic foot infections (n: 2) antibiotics were given parenteral route. Patients with moderate diabetic foot infections and wound culture results positives were used oral antibiotics also. All of the patients received Dermobor gel two times a day. Dermobor gel pomaded around and into the wounds' areas. Granulation tissue formation > 75%, were seen in six patients in 4 - 5 weeks, wound closure has occurred in two patients in 6 - 7 weeks. The treatment has been continuing in remaining four patients.

The pictures of some patients with DFIs treated with Dermobor;

Patient-1	 0 · 18th day · 21th day · 30th day · 35th day
Patients -2	 0 · 7 days - 10th day – 15 days · 16th day · 20th day · 27th day
Patients -3	 0 · 7th day · 15th day · 23th day · 30th day · 35th day
Patients -4	 0 · 8th day-10 day · 30th day · 50th day

In conclusion according to the results of the small number of cases with Dermobor in DFIs, it seems that Dermobor is one of the hopeful choice for DFIs. It acts as both antibacterial and formation of granulation tissue. In moderate and severe DFIs systemic antibiotics should be added to this topical treatment.

BORON-CONTAINING GEL FORMULATION PROMOTES ACUTE AND CHRONIC WOUND HEALING

Fikrettin Şahin, Selami Demirci, Ayşegül Doğan, P. Neslihan Taşlı, Hüseyin Aptik
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The destruction of skin integrity or tissue by biological, physical or chemical causes is the most common and destructive forms of wounds. Acute wounds usually heal within 3-6 weeks without the need for professional treatment modalities. However, chronic wounds are mainly associated with infection and prolonged inflammation, healing impairment and continuous tissue degradation. Any deformation that can occur in skin integrity can leave the human body vulnerable to many pathological conditions such as infection, excessive fluid loss and electrolyte imbalance. Although a vast amount of products have been introduced in the market, claiming to provide a better optimization of local and systemic conditions of patients, they do not meet the expectations of clinicians and patients. Therefore, developing new, safe, self-applicable, effective, and cheap wound care products with broad-range antimicrobial activity has always been an attractive area for scientists.

In this work, a new antimicrobial carbopol-based hydrogel formulated with boron and pluronic block copolymers was developed and evaluated for its healing activity using *in vitro* cell culture techniques. In addition, the preclinical and clinical studies were conducted to determine the effect of a novel hydrogel formulation containing NaB on the acute and chronic wounds healing. The results revealed that while both boron compounds significantly increased MSCs differentiation, and proliferation, migration, vital growth factor, and gene expression levels of dermal cells along with displaying remarkable antimicrobial effects against bacteria, yeast, and fungi, NaB displayed greater antimicrobial properties as well as gene and growth factor expression inductive effects. Preclinical and clinical studies proved that NaB-containing gel formulation enhanced wound healing rate of chronic wounds tested. Therefore, our results suggested that NaB, and its pluronics combination, could be used in dermatological clinics and be a future solution for chronic wounds.

Key Words: Boron, MSCs, wound healing, antimicrobial, hydrogel

'LIFE CARE'- SMART SOLUTIONS FOLLOWING THE MEGA TREND

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INTRODUCTION

'LifeCare' is grown out of these demands from the market, the future Megatrends and the participation in this booming market.

The unique idea is hereby covering the 'LifeCycle' with a combination of Hard- and Software, Fashion and a special application according to the demands of the life period.

ABOUT MARKET OPPORTUNITIES

Health, Care and Safety are the Mega Trends of the future.

More health awareness due to higher demands from jobs or other Life activities, the demographic change with more elder people or more awareness about the safety of children due to the increasing traffic and violence in the streets and schools or more care for our silver generation.

Life Science will be the 'steam engine' of the next decades of years. The market scope is from medical/health applications, health care, protection to wellness.

The following figure gives a good idea about the wide range of application

Figure 1. Fields of application in Life Care (Source: Dipl.-Ing. Uwe Merklein)

The **global medical sensors market** is estimated to reach USD 15.01 Billion by 2022, at a CAGR of 8.5% between 2016 and 2022. People are increasingly adopting home healthcare services owing to the rising costs of medical treatments in hospitals and medical care clinics. With this, the demand for various healthcare devices is expected to increase in the next few years. The introduction of new medical sensors in the global market is expected to contribute toward the growth of the global medical sensors market in the years to come.

Life Care from , Start to Final'!

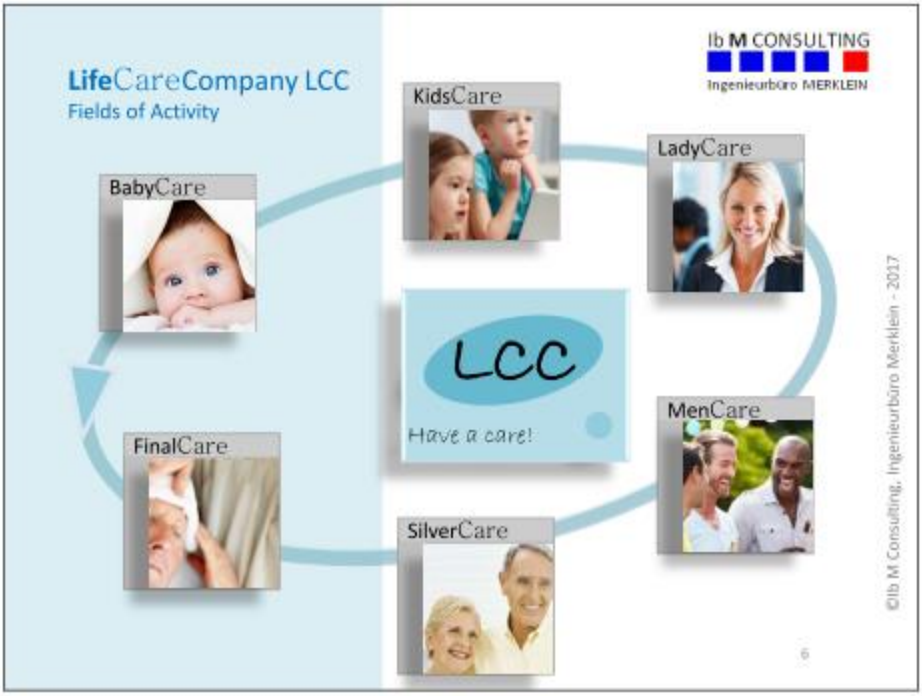
Life Care from 'Birth to Dead' is a logical demand from the market. The life has changed from family care to a more business and leisure time driven way of living.

Missing time and health information are the drivers for more connected and integrated solutions.

The LifeCareCompany LCC was developed as an international platform which follows the trends and demands from the market with innovated solutions from Medical and Health Care Research.

More knowledge, more health awareness and more solutions are the base for the idea of LCC.
LiveCare is a full solution which covers the package of garments, electronic devices and evaluation units for creating a whole picture about the health or care situation of people from baby age to the silver generation.

All important online or offline data's (doctors reports, information, actions or occurrences) can be stored and evaluated to a health or care report for further actions (doctor, more activity or more awareness)



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Key Words: LifeCare, sensors, platform, health care, medical care

ANTIMIC APPLIED ANTIBACTERIAL MEDICAL AND FABRIC WOUND BANDAGE BY SOL-GEL TECHNIQUE

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OBJECTIVE

Since antiquity, various materials such as honeycombs, plant fibers and animal fats have been used as wound dressings for easy healing of wounds [1]. Nowadays, with new polymers and production techniques, it is expected that the wound dressing materials will have unusual properties that rapidly increase the wound healing process. For effective design of functional dressing materials, the type of skin, the duration of wound healing, physical, mechanical and chemical properties of the bandage should be considered. Consequently, the main purpose for the wound to heal effectively is to provide the highest rate of healing and the best aesthetic restoration of the wound and to prevent any infection.

Conventional wound dressing materials that provide passive protection are not suitable for rapid healing of acute and chronic wounds, therefore the dressing materials must be functionalized. Antibiotics, molecular iodine, polyhexamethylene biguanide, heavy metal ions such as nanosilver and long hydrocarbon chain quaternary ammonium compounds can be applied.

Functional bandages which provide active protectiona and not leaving from the applied surface play an important role in chronic wound healing. The most important advantages of using antibacterial functional wound dressing materials are: i) the creation of appropriate physiological conditions for rapid healing ii) the protection of the wound envelope from secondary infection by killing contaminants with active chemical effects, as well as passive physical barrier inhibition with limited efficacy [3].
Antimicrobial textiles can be produced by physical or chemical incorporation of the active substance or by direct application to the textile

product in fabric form. The compounds can be applied to fabrics by picking, impregnating, dipping, spraying and coating methods [4, 5]. The Sol-Gel process used in the study is a widely used wet chemistry technique, in which colloidal suspensions consisting of solid particles in the liquid phase (gel) are gelled to form network structures [6]. It is very important to evaluate the antimicrobial activity of these textile products with appropriate methods and to verify the antibacterial activity with different standards.

In the study, antibacterial efficacy of wound dressing bandages and gauze pads treated with trimethoxysilyl quaternary ammonium chloride with immersion technology was evaluated against *Staphylococcus aureus* and *Staphylococcus epidermidis* bacteria which are normal flora of the skin.

MATERIALS AND METHODS

Antibacterial activity of wound dressings and gauze specimens functionalized with the antimic compound was assessed using standard AATTC 147-2004 (Parallel Streak Method), EN ISO 20645: 2004 (Agar Diffusion Plate Test), AATCC 100-2004 Test Method (Assessment of Antibacterial Finishes on Textile Materials) methods.

RESULTS

Antimic compound treated gauzes and wound dressings bandages showed strong antibacterial activity against *S. aureus* ATCC 6538, *S. epidermidis* ATCC 14990 bacteria with> 5 mm growth inhibition zone according to AATTC 147-2004 method. It has been determined that the functionalized samples exhibit good antibacterial activity against both tested bacterial strains with > 8 mM reproductive inhibition zone according to EN ISO 20645: 2004 standard. According to the AATCC 100-2004 test method, Antimic treated gauzes and wound dressings bandages samples exhibit strong antibacterial activity, with the > 4 log (> 99.99%) reductions at 1 and 24 h contact times against *S. aureus* and *S. epidermidis* bacteria.

DISCUSSION AND CONCLUSION

In the current study, according to different antibacterial activity determination methods, Antimic compound applied gauze and wound dressing bandages showed strong antibacterial activity and the compound applied samples were maintained this antibacterial activity for 24 hours (this time may be longer).

In the control group samples, it was observed that even when there was no antimicrobial agent and no food source supporting the growth, the number of bacteria was maintained. Under normal conditions, it is not difficult to predict that in the treatment of a wound with non-antibacterial bandage materials such as control group, this count will increase due to sources such as blood and tissue debris and secondary infection in the tissue. The fact that passive protection is inadequate and lead to more serious problems in immunocompromised individuals, especially those with diabetics. Destruction of normal flora bacteria at wound area by wound dressing materials with validated antibacterial activity will result in a higher rate of healing and a better aesthetic repair of the wound by reducing the risk of secondary infection.

Key Words: Hygienic textile, antimic, antibacterial, S. Aureus, S. Epidermidis

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THREE DIMENSIONAL BED SHEET DEVELOPMENT REDUCING PRESSURE SORE WITH PROBIOTIC PROPERTY

Gökhan Tandoğan, Kıymet Kübra Denge
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In this study, a three-dimensional sandwich woven fabric structure has been developed to prevent and reduce the pressure sore, which is formed under skin for especially patients who are paralyzed or remain stable. At the some time, it is ensured that human flora is not damaged when an open wound is occured, by applying probiotic finishing.

Fabric, developed within project scope, is analysed for both characteristic specality and air permeability, breathability, moisture, heat pemeability, absorption, tightening resistance and providing softening touch with contacting directly skin. Also it is applied biocide-free probiotic application surface on the improved fabric, and investigated containing or not such harmful and beneficial bacteria.

In the field of medical textiles generally, three dimensional sandwich constructions are developed in knitting or nonwoven form. In this project, these structures are developed with weaving technology, also silver ion wiil not be used, because of biocide structures which is found in silver ions killing beneficial bacreia. Instead, fabric test methods is investigated for probiotic application for usage methods of developing fabric, an hospital and clinical platform and reducing pressure sore, some collaboration with wound core units has been done.

Key Words: Pressure sore, medical textile, technic textile, probiotic fabric, three dimensional fabric

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SMART AUXETIC WOUND CARE SCAFFOLDS

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AIM

Fabrication and characterization of smart nonwovens for wound care is the primary focus of this study. It is concluded from achieved results that smart nonwoven wound care scaffolds approve their candidature over conventional ones.

LITERATURE REVIEW

Non wovens have a variety of uses including biomedical applications such as wound dressing, tissue engineering, implants, prostheses and filtration. The development of smart auxetic materials started in 1987 when first auxetic foam was fabricated by Roderic Lakes [1]. Also though auxetic cellular structures in the form of two-dimensional silicone rubber or aluminium honeycombs having negative Poisson`s ratio were first found in 1982 [2]. Fabrication of polymeric and metallic foams with Poisson’s ratios –0.7 and –0.8 was reported by authors in [3-5]. They possess enhanced mechanical properties and deformation mechanism over the conventional foams such as more resilient [6-7] increases comfort, dome-like shape on bending [8], three times more harder to indent [9]. Theses improved mechanical properties can provide more cushioning, comfort, optimal support for the ‘doubly curved human body [10], and promote their candidature for the people with disability, implants like hip and knee replacement while their ability of absorption offer potentials in wound dressing applications body [11]. Studies and experiments demonstrated that smart materials with negative Poisson’s ratio known as auxetic materials have already impact in biomedical (but not limited to) applications.

MATERIAL

Polyurethanes are used in a variety of biomedical applications such as ligament replacements, heart valve prostheses, vascular graft and breast prosthesis. Auxetic polyurethanes (PU) foams offer a huge potential in biomedical. Therefore, after a literature survey auxetic PU foam is selected to study for auxetic wound care.

METHOD

Auxetic Polyurethanes foam samples were developed foam using compression, heating, cooling and relaxation from conventional PU Foam to study indentation, absorption capacity and mechanical strength for wound care applications.

CONCLUSION

It was observed from results that smart foams promote their candidature for wound care application through enhanced absorption capacity, indentation resistance and mechanical strength.

Key Words: Auxetic materials, wound care, absorption capacity, indentation resistance

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THE USAGE OF MICROCAPSULES CONTAINING VARIOUS OZONATED OILS IN THE PRODUCTION OF ANTI-BACTERIAL TEXTILE SURFACES

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Abstract

In this study, the various ozonated oils were microencapsulated to enhance antibacterial textile surfaces. With this aim, the olive oil, the fish oil, the pistachio oil, the walnut oil and the germ oil were ozonated then microencapsulated by simple and complex coacervation methods. The produced microcapsules were appliqued onto non-woven by means of impregnation. The ozonated oils were characterised by FT-IR and GC (Gas Chromatography), the produced microcapsules were characterised by SEM, FT-IR. In additional, the antibacterial activity of non-woven containing ozonated microcapsules against to *E. coli* was tested according to ASTM E 2149-01.

1.INTRODUCTION

At the present time, the ozone (O_3) is implemented to treat many illnesses such as cellulite, burnt, ulcer, chronic wounds, immune system illnesses etc. The ozone is used both directly and ozonated vegetable oils in treatment of illnesses. In comparison with ozone gas and the ozonated water, the ozonated oils have an advantage that the ozone is bonded to oil via unsaturated fatty acids. In this way, the ozone could be stored as ozonide so its effect goes a long way (Sancar Beşen, 2016a; Sancar Beşen, 2015; Sancar Beşen, 2016b). The ozonides, which show anti-bacterial and anti-fungal activity, carry O_2 into lesion without sparking off skin irritation (Öcal, 2013). The microencapsulation is a preferable method to applique ozonated oil onto textile surfaces.

The microencapsulation is a caging method that liquid or solid particles, which are located small droplets, are hindered in a thin film. The microencapsulation is formed by many methods such as in-situ polymerization, interfacial polymerization, coacervation, spray drying etc. (Sancar Beşen, 2016; Karthikeyan, 2014). Of all microencapsulation methods, the coacervation methods which are simple and complex coacervation method are common to encapsulate oils (Özyıldız, 2012).
In this study, the olive oil, the fish oil, the pistachio oil, the walnut oil and the germ oil were encapsulated via simple and complex coacervation methods. It was examined antibacterial non-woven surface production facility by appliqueing microcapsules containing various ozonated oils onto non-woven surface.

2.MATERIAL AND METHOD

2.1 Material

The olive oil, the fish oil, the pistachio oil, the walnut oil and the germ oil were ozonated by ozone generator which generates 25g ozone in an hour.

For the microencapsulation production Arabic gum and gelatine (Type B) were used for forming wall of microcapsules.

As for producing antibacterial textile surfaces, 100% cotton hydrophile non-woven fabric was used, which was exposed to pre-treatment.

2.2 Method

For ozonated oil production, each of oil samples (100ml) were ozonated for two hours. Afterwards, the ozonated oils were microencapsulated by simple and complex coacervation. The arabic gum and the gelatine were used as wall materials, olive oil, fish oil, pistachio oil, walnut oil and germ oil were used as active ingredients. Besides, the pure oils were microencapsulated to compare antibacterial activity of microcapsules containing ozonated oils. The prepared microcapsule solutions were applied onto non-woven by impregnation and then dried at room temperature.

The ozonated oils were characterised by FT-IR and GC (Gas Chromatography), the produced microcapsules were characterised by SEM, FT-IR. In additional, the antibacterial activity of non-woven containing ozonated microcapsules against to *E. coli* was tested according to ASTM E 2149-01.

3. RESULT AND DISCUSSION

The FT-IR spectrum of pure and ozonated olive oil and optical microscope images of microcapsules containing ozanated olive oil are given Figure 1 (a) and Figure 1 (b) respectively.

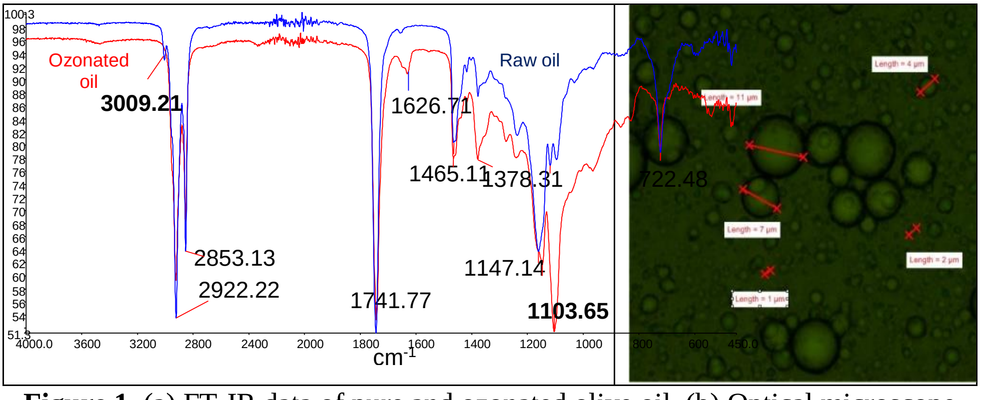

Figure 1. (a) FT-IR data of pure and ozonated olive oil, (b) Optical microscope images of microcapsules containing ozonated olive oil

The FT-IR data from pure and ozonated olive oil showed that the stress intensity of the =C-H bounds (≈3009 cm^{-1}) diminished via ozonation, while stress intensity of the C-O bounds (≈1105 cm^{-1}), which indicates existence of ozonide, significantly increased. In the light of FT-IR data, it could be said that ozone interacts with unsaturated fatty acids in oils and attached oils.

In Figure 1 (b), the optical microscope image of microcapsules showed that ozonated olive oil were microencapsulated accomplishedly. In additional, it was seen that the range of microcapsules size are 1-20 µm.
The gained fatty acid ingredients data from GC of pure and ozonated olive oil showed that the total ratio of oleic and linoleic acid, which are unsaturated fatty acid, significantly diminished from 82% to 27.5%. Because of that ozone interacts with fatty acids.

4. CONCLUSION

In the end of this experiment, it was clearly seen that all used oils were ozonated and microencapsulated accomplishedly. The produced microcapsules were applied onto non-woven. Moreover, the non-woven samples were gained high anti-bacterial activity by microcapsules containing various ozonated oil.

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BACTERIAL CELLULOSE BASED MATERIALS AND BIOMEDICAL APPLICATIONS

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Bacterial cellulose (BC) is a natural polymer produced by some bacteria such as Acetobacter xylinus and Acetobacter hansenii. Bacterial cellulose consists of a three-dimensional network of microfibrils containing glu¬can chains that further aggregate to form cellulose ribbons. These ribbons (nanofibers) subsequently generate a web shaped network structure with plenty of empty spaces between the fibers which have imparted BC with unique properties including high mechanical strength, high degree of polymerization, improved crystallinity, high water holding capacity, slow water evaporation capability, broad chemical modifying ability, a highly pure nano-structured fibrous network, a high wet tensile strength, and biodegradability. BC has a variety of applications in biomedical, cosmetic, paper-making, food and textile industries. Biomedical applications of BC include wound dressing materials, scaffolds for tissue engineering, medical pads and dental implants. Being similar to human skin, bacterial cellulose can also be applied as skin substitute in treating extensive burns.

BC and their composites have received substantial interest owing to their unique structural features and impressive physical, mechanical properties in recent years. This paper reviews the bacterial cellulose based materials which can be utilized for biomedical applications.

Key Words: Bacterial cellulose, biomedical, wound dressing

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THE EFFECTS OF SILVER BIOCIDE EMBEDDED IN TITANIUM DIOXIDE CRYSTAL ANTIMICROBIALS ON THE PHYSICAL AND MECHANICAL PROPERTIES OF COTTON AND COTTON/ELASTANE FABRICS USED FOR CLOTHING

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Abstract
In this study, three types (plain, twill and basket) of cotton and cotton/elastane woven fabrics used for clothing were treated with 0.5% silver biocide embedded in titanium dioxide crystal, with pH7, solution using pad-dry-cure method with a wet pickup of 80%. Then tensile strength (strip and grab method), stitch strength and tear strength tests were conducted and the results were compared with control samples. Basket weaves showed the lowest tensile strength and the highest tear strength and a small significant decrease was observed for all treated samples. All treated samples showed a good antimicrobial activity.

Key Words: Silver, antimicrobial, cotton, elastane, woven, tensile, tear, stitch, clothing

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THE EFFECT OF ULTRASONIC WELDING PARAMETERS ON THE ELECTRO-CONDUCTIVE PERFORMANCE OF TEXTILE TRANSMISSION LINES

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The new field of science dealing with implementation of electronics to textiles in combination with informatics is known as e-textiles . Comprehensive investigation on the development of e-textiles through welding technologies with respect to sensing performance and preserving textile aspects is expected to provide a new scientific way for design and development of interactive clothing. Since the use of welding technology is expected to be convenient technique for construction of reliable and durable transmission lines as well as for fully integration of electronic components (different sensors, actuators, microprocessors, data transmission and power supply systems) to textile structures, it may represent a great challenge and significant contribution to the sensor and actuator integration knowledge to textile structure. In addition, intelligent textiles/interactive clothing/wearable electronics is a recently developing area and there is still many to be invented, therefore possible successful implementation and integration of electronics to textile structures by proposed welding techniques are expected to be significantly valuable for smart textiles researches.

In this study, ultrasonic welding technique was be used to integrate conductive yarns to textile materials in order to develop transmission lines. Nucleus Rotosonic V4E ultrasonic machine was used.The machine is seen in Figure 1. For different materials in order to obtain excellent fusion the amplitude,pressure and speed of the ultrasonic sewing can be changed and seen on the screen of the machine. In lorder to manufacture textile transmission lines 10 different conductive yarns were welded to polyester fabric by changing 3 welding parameters.after welding electro-conductive performance and signal to noise ratios were measured.

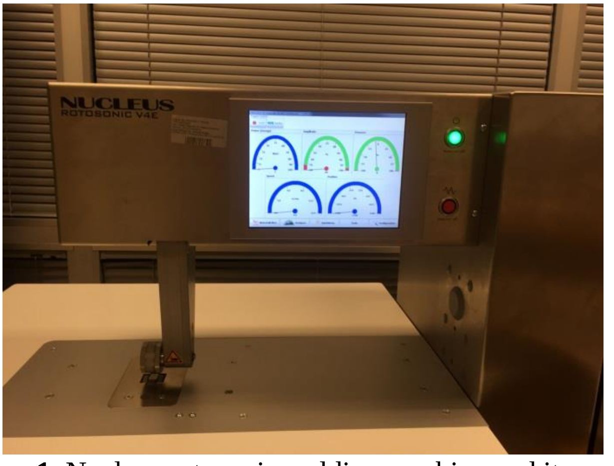

Figure 1. Nucleus rotosonic welding machine and its screen

It was found that welding parameters are extremely important for obtaining good electro-conductive properties for textile transmission lines.the results were statistically analysed.The obtained results based on conductivity and signal to noise ratios are really promising for the manufacture of e-textile transmission lines by ultrasonic welding.

ACKNOWLEDGEMENTS

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Key Words: Ultrasonic welding, conductivity, transmission lines, e-textiles

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RHEOLOGICAL PROPERTIES AND WATER ABSORPTION CAPACITIES OF CELLULOSE REINFORCED HYDRGOELS

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Hydrogels are water-insoluble, three dimensional networked polymers that can absorbed large amount of water. These materials have similarities with living tissue with its porous structure, softness, elasticity, and stimuli-responsive characteristics [1]. Therefore, there possess potential for use in biomedical field. Currently, hydrogels have been used for manufacturing contact lenses, hygiene products, tissue engineering scaffolds, drug delivery systems and wound dressings [2]. However, low toughness and poor mechanical strength especially in the swollen state limit their wider applications [3]. It his regard, this study explore the use of cellulose fibers as reinforcement agent to an acrylamide based hydrogel[4] Cellulose fibers obtained from Whatman® filter papers were incorporated into 2-acrylamido-2-methylpropane sulfonic acid (AMPS)/N,N-methylenebisacrylamide (MBAAm) hydrogels. The effect of cellulose and MBAAm amount on reological, mechanical and absorptive properties were comparatively analyzed[5]. It was found that the physical appearance of hydrogels turned from clear to opaque depending on the fiber amount. Surprisingly, the water absorption capacities of the hydrogels significantly improved with increased cellulose fiber amount. Rheological analyses revealed that brittleness of the hydrogels could be reduced with selection of optimal fiber amount.

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Key Words: Hydrogel, cellulose, AMPS, water absorption, rheological properties

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DEVELOPMENT OF A MAGNETO-RHEOLOGICAL GLOVE FOR HAND REHABILITATION APPLICATIONS

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The aim of hand rehabilitation is to make hands acquire physical abilities which have injured, operated or exposed to illness and maximize their functional capacities. In this work, it is aimed to develop an electromagnetic device for rehabilition of insufficient or weak muscles with basic isometric exercise movement in which magneto-rheological fluid (MR) is used. The rehabilitation of upper extremities is performed by isometric exercise movements under the control of the physiotherapists. During rehabilitation, specialists use precise and stable force-reducing systems that reduce the inertia and impedance of the upper limbs. These systems increase patient safety [1]. In addition, the most important feature of rehabilitation devices is that the magnitude of the resistance force during exercise can be changed. In this study, a rehabilitation device was designed, in which the magnitude of the resistance force can be varied by the magnetic field applied to the glove in the magneto-rheological. In literature, there are many studies about magnetorheological fluids in different applications [2-4]. MR fluids; they act like Newtonian fluids in non-magnetic field conditions. In these conditions, the magnetic particles are randomly distributed in liquid phase. When a magnetic field is applied, the magnetic particles are polarized and repositioned in a straight-line parallel to the direction of the magnetic field. In the meantime, the viscosity of the fluid increases by 105-106 times in a short period of time like milliseconds and the liquid starts to act like a solid substance. As the magnetic field increases, the fluid becomes almost a viscoelastic solid. When the application of the magnetic field is terminated, the fluid returns to its original state at the same speed. The energy required to return the fluid to its original state increases with the intensity of the applied magnetic field, and the fluid viscosity changes with the intensity of the magnetic field [5,6].

In this study, it is aimed to control rheological properties of MR fluids with applied magnetic field. Thus, exercise movements that strengthen the hands and upper limbs that need to be rehabilitated can be done in a container filled with magnetorheological fluid. Strengthening hand and finger movements with the use of solidification or softening of the liquid can provide increased muscle power and functional movements. Preventing muscle weakness, controlling erymenia, reducing joint stiffness, and stimulating bone and joint healing are also aimed with this treatmentDuring the design stage, the gloves are manufactured by using a fully automatic glove machine (Figure 1.a) at a 20cm wrist-elbow distance and in a special form (Figure 1.b). The gloves produced were immersed in an iron dust/silicone mixture and homogenized with mechanical stirrer in iron dust (0.2 micron), liquid silicone MM240TVACC (A and B components, 1:10 mass ratio, with curing time of 12-24 hours). The gloves were cured by passing over a teflon coated aluminum hand profile. The MR fluid-filled MR fluid box is having been made of transparent material to enable observation. The iron dust/silicone coated glove produced in the previous phase was also added to this setup (Figure 1.c). It is known that carbon fabric and polymeric composites have electromagnetic protection (EMP) effect. From here, to confine the MR fluid box, an additional box was produced from the carbon/epoxy composite material. For this aim, all the body of the box was formed with aluminum profiles. Then, composite plates were produced to make the surface of the box (Figure 1.d).

(a) (b) (c) (d)

Figure 1. (a) JOMDA GD fully automatic computerized glove machine (b) Iron dust / silicone coated gloves (c) MR fluid box system (d) Produced carbon / epoxy composite plates

It is aimed to create uniform magnetic field in the working space with the produced EM device. Through the uniform magnetic field, the rehabilitated area along the working surface will be exposed to an equal resistance. Considering the viscosity change due to the magnetic field density of the magnetorheological fluid, the density of the desired magnetic field in the working space was determined as 0.2 T [7]. (But the viscosity of the liquid can be adjusted according to state of hand development.) To determine an optimal design, , the finite element analysis is performed by using Taguchi design. Magnetic field analysis and thermal analysis were carried out by using COMSOL software. The optimal current, wire thickness, winding type and number of coil were decided by evaluating analysis results In literature the uniform magnetic field can be generated by three different types of windings: helmholtz coil, square coil pair and saddle coil [8]. Number of ampere laps and cross-sectional areas of all the windings examined were created and analyzed equally. Comparisons of the windings with the finite element analysis and analytical solution show the correctness of the finite element model generated. On the continuation of the work, a new model was created as an alternative to these windings and the results of the finite elements analysis were compared (Figure 2). Production was achieved with the comparison results obtained. The new model's arms were designed for increasing magnetic interference and reducing thermal load.Thus, winding diameter has reduced, and thermal load and windings weight are reduced.

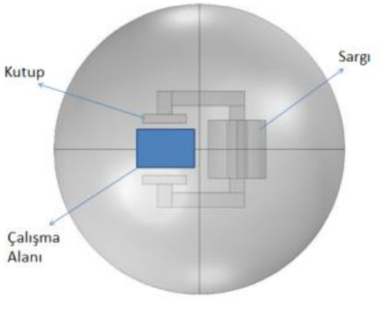

Figure 2. New model

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EXTRACTION AND CHARACTERIZATION OF BIOCOMPATIBLE AND BIODEGRADABLE WOOL KERATIN BASED FILMS

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Currently, biocompatible and novel materials such as regenerated protein materials have been increasingly focused by researchers. Keratin is one of the most abundant proteins, being the major component of hair, feathers, nails and horns of mammals, reptiles, birds and it can be obtained by means of extraction [1,2]. It has been demonstrated through studies that having adhesive amino acids sequences keratin offers potentials in biomedical applications such as tissue engineering [3,4]. Keratin resources offer economic and environmental friendly behavior [5,6] and potentials in many applications in different field and in a variety of forms. For example, wool Keratin (WK) in form of solutions, powders, films, gels and filaments, is one of the promising candidates due to their biocompatibility and biodegradability [7].

The main focus of present study is the fabrication and characterization of keratin films. For this purpose keratin was extracted from wool fiber. The chemical and structural characteristics of keratin extracted from aqueous solutions are studied using FT-IR, TGA, UV-vis with the aim of investigating structural changes due to the different pH and methods. The concentration of the corresponding solutions is compared by UV-vis spectroscopy. Thermal properties were investigated by thermogravimetric analysis. Also, absorption of wool keratin peaks is studied through FT-IR spectra.

Key Words: Wool fiber, extraction, keratin film, biodegradable film

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INVESTIGATION OF RELEASE CHARACTERISTICS OF NAP- AND NAP/CD INCLUSION COMPLEX-LOADED TPU NANOFIBERS

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Thermoplastic polyurethanes (TPU) are a widely used class of polymer, which have good biocompatibility and high mechanical properties and can be easily electrospun [1-3]. Naproxen (NAP) is a type of non-steroidal anti-inflammatory drug commonly administered for the treatment of pain, inflammation and fever [4-6]. Cyclodextrins (CDs) are one of the most promising materials for the development of products with advanced properties due to inclusion complex formation ability with a wide variety of substances [7]. In this study the electrospinning of NAP- and NAP/CD inclusion complexes-loaded TPU nanofiers for a topical drug delivery system and the effect of the mat thicknesses on release profile have been investigated. It was observed that shorter collection periods caused shorter diffusion paths, which resulted in a faster burst release of the drug. Additionally, a higher initial drug loading resulted in a higher drug release rate because of the channels formed by the drug that had previously leached from the matrix [8]. On the other hand, the inclusion complex loaded TPU mats exhibited significantly faster release profiles than NAP loaded TPU mats [9]. Overall, due to the highly porous structure of the electrospun fibers, the NAP- and NAP/CD inclusion complexes-loaded TPU electrospun nanofibers could be a promising formulations for NAP delivery from electrospun mats and an innovative drug delivery system.

Key Words; Thermoplastic polyurethane, naproxen, cyclodextrin, drug release, nanofibers

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MAIN REQUIREMENTS OF THE KNITTED FABRICS DESIGNED FOR FOOTWEAR LININGS

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The interaction between foot and footwear is achieved by linings, which much provide the product with comfort, durability, softness or protection. During wearing, linings must protect the foot skin against the direct contact of the foot with the semi-rigid footwear components. A lining must prevent an upper from distortion and ensure the stability of the spatial form, maintaining thus, the products' aesthetic look over time. To assure feet comfort, the footwear linings material should have: good hygienic properties (absorption capacity, air and water vapour permeability, capacity to remove static electricity, high resistance to stress and strain, good resistance to perspiration and good dyeing resistance [1, 2].

This paper presents an overview of the author's research, concerning the flat weft interlock and spacer knitted fabrics, produced for footwear linings generally and for diabetic feet shoes particularly. The study revealed that the knitted footwear linings are complex products, necessary to meet simultaneously some important requirements, which have been measured and analysed [3, 4].

For their preparation were used 100% cotton yarn obtained by the two processes, cotton blended yarns with Seacell, bamboo and silver, in different percentages. Bamboo fiber it's characterized by its good hygroscopility, permeability, soft feel, natural anti-bacteria, biodegradability, breathability and coolness. SeaCell Active® is kind to the skin and has been enriched with silver. Silver has been known to have antibacterial properties. Knits were finished and antibacterial treated, after finishing it was obtained a reduction of (99-100)% of bacteria Staphylococcus aureus and Klebsiella pneumoniae.

To date, most studies have been focused on sandwich warp knitted fabrics, while the weft knits sandwich were not sufficiently investigated. It is known that the weft knits have low abrasion resistance and an accentuated trends unravelling, as disadvantages. In order to prevent these effects, interlock weft knits were produced, as well as sandwich fabrics, which present a better compression resilience, due to their thickness and surface characteristics.

Research carried on the physico-mechanical properties of knitted fabrics have generally concluded that the structures with double face are proper as shoe liners, due to their adequate thickness, good extensibility and strengths, required to be manufactured together with the leather. They demonstrate a good friction coefficient, necesary to prevent the feet friction inside the shoes. The differences between samples are given by the yarns combination used on the two sides, and by the fabric parameters with relevant influence on their properties: thickness, porosity, square mass. The best perfomances shown the interlock fabrics made of blended yarns from Cotton/Seacell and Cotton/Bamboo fibers. Interlock fabrics from Cotton/Silver have a good moisture management, directly related to the Silver percentage.

In terms of the related footwear standards, the fabrics with optimum characteristics should be highly extensible, should have a minimum of 0.7 friction coefficient and 2N/mm^2 tensile strength, a tensile elongation ≥ 80% and high water vapour permeability.

Within the complex analysis of knitted fabrics for footwear linings, the primary selection should be made in accordance with their extensibility and friction coefficient, as eligible conditions for the subsequent footwear production stages and wear requirements. According to these, all spacer fabrics and interlock fabrics produced with Cotton/Seacell and Cotton/Bamboo blended yarns are appropriate fabrics for shoe linings. The results show that spacer fabrics have more appropriate structure for shoe linings as compared to interlock fabric from frictional properties point of view. The spacer fabrics produced with Cotton/Seacell blended yarns are suitable for cold climate conditions with high thermal resistance, air and water vapour permeability and give warmer feeling with low thermal absorptivity values [3]. All fabric structures produced by using Cotton/Silver blends provide the optimum performance parameters for footwear linings [4].

Key Words: Footwear linings, diabetic feet, weft flat spacer knitted fabrics, properties.

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AN INVESTIGATION ON THE COMFORT PROPERTIES OF TEXTILE LAMINATES FOR FOOTWEAR LININGS

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Footwear upper can be partly or completely lined in order to improve its appearance and to increase comfort and durability [1, 2]. A function of a lining is to serve as a buffer zone between the footwear and the foot. It needs to be breathable and to absorb and transport of moisture away from the foot, additionally it helps to prevent staining of the upper material [3].

Comfort is accepted one of the most important factors for footwear quality. Comfort has been associated with fit, additional stabilizing muscle work, fatigue, and damping of soft tissue vibrations and plantar pressure distribution. Moreover, comfort of footwear depends on the properties of upper materials, like softness and flexibility [4, 5]. Besides these characteristics, air and water vapour permeability and absorption capacity are the other most important properties for comfort of the footwear [2, 6, 7].

Linings are produced by using different constructions (woven, terry loop and knitted fabrics) and materials such as leather, nylon, shearling, cotton and rayon fabrics and also contemporary materials (mainly developed for the sports footwear industry: i.e. Gore-tex®, Sympatex®, Cambrelle® etc.) [1].

In order to maintain comfort of the feet over a long period of time, one of the material to incorporate on fabrics is polymer layer, such as breathable membranes that are polymers films that exhibit a good permeability, allows for the water vapour go out but still impermeable to liquids. Two types of breathable membranes (hydrophilic or microporous) are commonly used for textile laminates production. The hydrophilic membranes are nonporous membranes in which the water vapour is transmitted by a molecular mechanism. The micro-porous membranes have millions of micropores per square inch. These micropores are small enough to not permit the passage of liquid water but allow for the passage of molecules of water vapour (20,000 times smaller than liquid water and 700 times larger than a water molecule) thus permitting breathability skin [8]. The microporous membranes from polytetrafluorethylene (i. e. Gore-Tex) or polyurethane (i. e. Porelle, Seyntex) and hydrophilic membranes from polyester (i. e. Sympatex) or polyester/polyamide blend (i. e. Tepor) are used. Often these membranes are joined with protective layer from polyamide or polyester woven, knitted or nonwoven fabrics [7]. Such laminates are engineered to meet specific requirements in lining materials for military, medical, industrial, sports and leisurewear footwear [5,9].

In this study, it is aimed to analyze the comfort properties of textile laminates used in footwear linings. For this purpose, the comfort characteristics such as air permeability (TS 391 EN ISO 9237), water vapour permeability (TS EN ISO 20344), thermal resistance and thermal absorptivity of four footwear lining laminates were measured and investigated. Main characteristics of the investigated footwear lining laminates are given in Table 1.

Table 1. Main characteristics of the investigated textiles laminates

Code	Laminated Layers	*Weight (g/m^2)*	*Thickness (mm)*
L1	1- Warp knitted fabric (72%PA, 28% PES), 2- Nonwoven, 3- EPTFE* microporous membrane, 4-Warp knitted fabric (100%PA)	335	1.96
L2	1- Warp knitted fabric (72%PA, 28% PES), 2- Nonwoven (thick), 3- EPTFE* microporous membrane, 4-Warp knitted fabric (100%PA)	462	2.94
L3	1- Nonwoven fabric (PA), 2- Nonwoven fabric (PES), 3- EPTFE* microporous membrane, 4- Warp knitted fabric (100%PA)	360	1.81
L4	1- Nonwoven fabric (PA), 2- Nonwoven fabric (PES), 3- EPTFE* microporous membrane, 4- Warp knitted fabric (100%PA)	369	1.93

EPTFE: Expanded Polytetrafluoroethylene

The results indicate that thermal comfort characteristics of the multi-layered materials strongly depend on their specific structure and also on fabric characteristic.

Key Words: Footwear lining, textile laminates**,** water vapour permeability, air permeability, thermal resistance

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COMPRESSION CHARACTERISTICS OF WARP KNITTED SPACER FABRICS

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Most common definition of pressure sores is tissue lesions occurred on skin surface and skin tissue with the effects of pressure, friction, shear and other factors during long term lying or sitting positions. These extrinsic factors cause damage particularly body surface which is over a bone prominence. Therefore 95% of the pressure sores are commonly shown on lower body such as sacrum (36%) and heels (30%) [1]. Geriatric and immobile patients are in a very high risk group. Concerning the physiological and psychological effect, the pressure sore is one of most costly disorders after cancer and cardiovascular diseases [2].

Pressure is the most important factor for occurring pressure sores. Under a pressure force soft tissues between a bone part and hard surface are squeezed during a long time and this effect causes the cell deformation in tissues. In case of continuing pressure, tissue necrosis and ulcers are occurred on these body surfaces. The other factors for pressure sores are moisture, surface friction and shear risk. Occurring moisture in microclimate between bed surface and body creates an uncomfortable condition for long term immobile patients and causes vulnerability of skin and tissues to pressure, friction and shear forces. Surface friction factor trigger pressure sores with skin deformation during transporting or changing patients positions. The other factor is shear forces which are generated by slipping up or down on bed surface. This situation caused to block blood flow with deforming or bending skin surface and tissue form. In addition to these factors, elderliness, lack of nutrition, diabetes and edema enable high pressure sore risk [3, 4].

Warp knitted spacer fabrics consist of two different fabric layers and one special layer which connects these separate layers with lapping yarns. These fabrics enable improved specialties such as low area densities, low bulk densities, wide range of thicknesses, high thermal comfort properties, compression and permeability properties; without using foam, rubber, latex and other coating or laminating techniques. The 3D structure of spacer fabric is knitted with three layers at the same time and this technique eliminates the cost of laminating and combining process.The outside layers of warp knitted spacer fabrics can be consisted of different materials to create different surface characteristics. The inter layer can link directly two fabrics for fixed structure or can create space between them.This space is the source of special properties of spacer fabrics. They have wide range of thickness from 2 to 65 mm. The thickness of the spacer fabric depends on the gap between the two needle bars, type of yarn and structure of the two outer fabrics. The lengthwise and widthwise stability can be adjusted by the threading and lapping of the guide bars. Furthermore the compression and resilience properties of the spacer fabric can be changed depending upon the yarn type, yarn count and pattern of lapping of the guide bars. Spacer fabrics are commonly used for as a supporting material for bra and swim suits, thermal insulating material for outerwear, bandages, compression bandages, bed sheets and wheel chair cushioning for medical applications, protective clothes for flame, heat and impact resistance, cushioning material for automotive components such as seats, carpets and interior parts [5, 6].

In this study, the effects of machine parameters on warp knitted spacer fabric properties such as thickness, tightness, mass per unit area, compression and pressure dissipation characteristics were examined in order to determine their influence on bed sheet caused pressure sore. Space distance between two needle bars, course per cm and fabric surface type are the parameters selected for this investigation. Experimental design is given on Table 1.

Table 1. Experimental design

Fabric Type	Yarn Thickness (dtex/mm/dtex)	Space Distance (mm)	Course per cm	Fabric Pattern
C1	600/0.27/1080	12.5	5.25	Two side open structure
C2	600/0.24/1080	13.0	5.25	Two side open structure
C3	600/0.24/1080	13.5	5.25	Two side open structure
C4	600/0.24/1080	13.0	5.00	Two side open structure
C5	600/0.20/600	14.0	5.75	Face side open/Back side close
C6	600/0.20/600	12.5	6.50	Two side close structure

The space distance is found as effective parameter for physical fabric characteristics, compressibility and pressure dissipation. The pressure dissipation results revealed that this unique characteristic is a complex phenomenon, which could not be explained by only compressibility or thickness; it should be considered all fabric properties in order to achieve sufficient pressure support.

Key Words: Warp knitting, spacer fabric, pressure sores, compressibility, pressure dissipation

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ANTIBACTERIAL WATERPROOF-BREATHABLE POLYURETHANE COATINGS ON FABRICS

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With the developing technology, functional products have started to use instead of classical products. Antibacterial, antistatic, nonflammability, stainproof and water repellency and many other properties have been become necessary in textile products with increasing consumer demand. In recent years, the use of waterproof breathable fabrics has become more widespread in products such as protective textiles, outwears and footwear.

Breathable membranes will be produced with or without microporous structure. While the porous are large enough to allow water vapor transport, these are too small to allow the passage of water molecules in microporous membrane structure on the other hand in nonporous hydrophilic membrane stucture, water vapor permeation occurs with solution diffusion especially amorphous regions in polymer chains. The most important feature of these hydrophilic membranes is the presence of hydroxyl, amide, ether or amide bond which can make hydrogen bonding with water vapor molecules. Commercially waterproof breathable membranes are available on the market with a variety of structural and commercial names such as polytetrafluoroethylene (Goretex®), polyurethane (Permax®), polyester (Perprene®), polyvinylchloride (Saran®).

N-halamine compounds, silver ions and quaternary ammonium salts and etc. are generally imparted to the polymeric materials to obtain antibacterial properties. The most important disadvantage of antibacterial agent is that they can't bond covalently the structure, so leach out of structure and lost their antibacterial activity. Quaternary ammonium salts may be incorporated into the structure during polymeric membrane synthesis to provide permanent antibacterial properties with strong covalent bonds. Quaternary ammonium salts are cation active agents and are usually targeted to the cytoplasmic membranes of bacteria and plasma membranes of fungi.

Polyester and cotton fabrics are known to pass water and water vapor. In this study, quaternary ammonium salt-added polyurethanes will be synthesized at different rates and coated on fabric surfaces. With polyurethane coating, antibacterial waterproof breathable products will be obtained. When the presence of coating on the fabric surface is detected by FTIR and SEM, thermal analysis by DSC and TGA will be detected. Vapor permeability will be determined at different temperatures and the effects of temperature on vapor permeability will be determined. Waterproof properties of fabrics will be tested at different pressure values and antibacterial activities will be determined.

MECHANICAL CHARACTERISTICS OF SURGICAL SUTURES

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Among the medical textiles, surgical sutures have protected its importance in the market since ancient era. As one of the significant textile material, surgical sutures have significant function to bring and hold tissues together separated by surgery or trauma. Sutures fail for various reasons such as breaking of suture materials, slipping of the knots or detaching from needle and therefore during suturing process, the mechanical characteristics of the sutures play an important role for a successful wound healing. In this study, breaking force and breaking elongation, detaching force from needle and knot breaking load properties of the sutures produced in different sizes and materials were determined and the effect of suture size and material on these mechanical characteristics was investigated statistically.

Key Words: Surgical suture, breaking load, detaching force from needle, knot breaking load

TEST AND ANALYSIS SYSTEM DESIGN FOR FLEXIBLE HINGES

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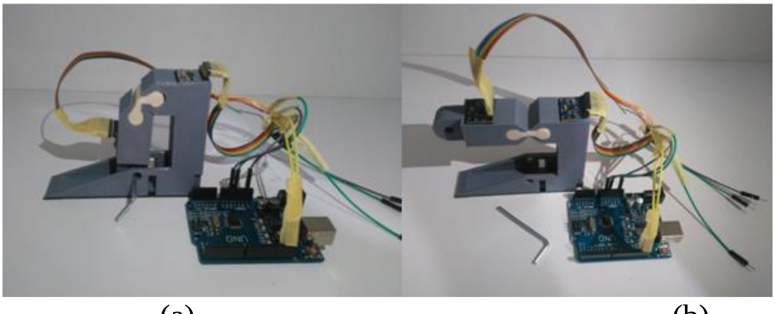
Flexible hinges are used in especially in the joint region of the prosthesis. The advantages of the flex hinges are no friction losses, no need to lubricate, no hysteresis and compactness, capacity to be utilized in small scale applications, ease of fabrication and low or no maintenance. In this study, it has been tried to develop a test and analyzing system which will help to design different type of flexible hinges and extract characteristics. It is aimed to create a cheap and easily repeatable measurement system. Therefore, the mechanical design of the system was designed to be produced in 3d printer which is shown in Figure 1 and also the electronic measurement system was shared with the connections.



(a) (b)

Figure 1. Test System (a) Hinge is in tension (b) Hinge is free

The characterization of the flexible hinge placed between the body and the limb is accomplished by storing the energy on the flexible structure and then measuring the force generated during the oscillation of this energy. Two accelerometers were used to measure force for detecting and removing of destructive effects from body. The measurements were made simultaneously and software was developed to analyze the resultant forces of the body and limb accelerations in time and frequency domain.

Measurement signals are formed by first combining the measured values obtained from the three axes. The isolated signal is obtained by subtracting the body signal from the limb signal. In the next step, the isolated signal is examined starting from a second before the first peak to damping the signal. Characteristics in the time domain consist of the value of highest peak and the duration of the time domain signal. Then, the power spectral density of the time domain signal is examined and the phase of the extraction of the frequency domain characteristics begins. In this phase, the peak values that occur at frequencies greater than 15Hz and the frequency values at which these peaks are located are taken as characteristics. An measurement of 3d printed flexible hinge and analysis process is shown in Figure 2. Thanks to this system, flexible hinges with different designs can be tested cheaply and their characteristics can be removed.

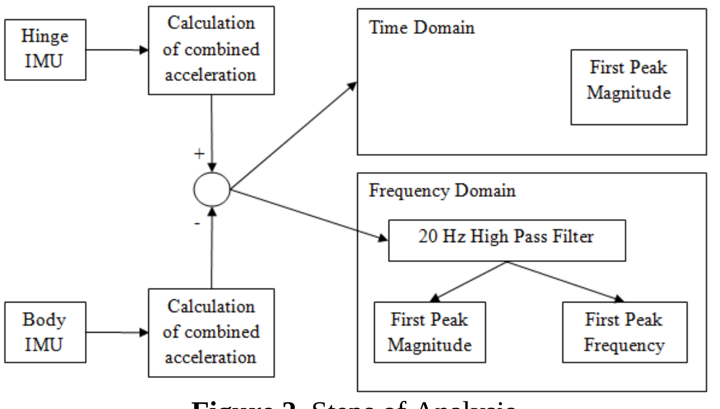


Figure 2. Steps of Analysis

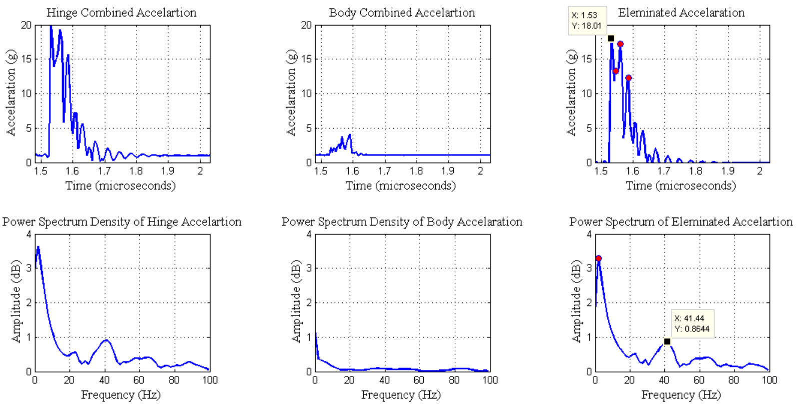


Figure 3. Experiment result's graphic

Key Words: Flexible hinges, prostheses

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SOLVING THE ENVIRONMENTAL POLLUTION FROM CIGARETTE LITTERS

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Cigarette litters are the most common form of solid waste in the world that we get used to see at streets, beaches, common sidewalks. Approximately 5.6 trillion cigarettes are smoked every year worldwide and as an estimated 4.5 trillion cigarette litters are thrown away every year [1]. Over 2 million cigarettes (%32 of litter) were collected during the 2009 cleanup in U.S.A. [2]. Besides it creates really bad semblance, also has a huge danger with draining to the rivers, seas and oceans. It causes a hazardous environmental problem and there is no accurate solution for litter at the present time.

Most cigarette filters are surrounded by two layers of paper and/or rayon wrapping, which contain chemicals, such as glues to hold the paper together, and alkali metal salts of organic acids (eg, sodium acetate) in order to maintain burning while the cigarette is being smoked [3]. Therefore, over 4000 chemicals may also be introduced to the environment via cigarette particulate matter (tar) and mainstream smoke [4]. The filter of a cigarette is composed of cellulose acetate fibers. These fibers, each approximately 20 mm in diameter, are treated with titanium dioxide and over 15.000 of them are packed tightly together, using triacetin (glycerol triacetate) as a binding agent, to create a single filter [5]. Cellulose acetate is not soluble in water. So filters thrown away causes litter in public areas and also waters, lands etc.

Filtration is the process of increasing fluid purification by separating particles having certain dimensions within air or liquid. Filtration textiles include a wide range of products which can be grouped under industrial, medical and geotextiles subgroups of technical textiles. The raw materials used for filter structures are divided into the following categories; • Fiber • Resins and adhesives (formaldehyde and latex resins, etc.) • Additives, finishing chemicals (adsorbent structures, flammable chemicals, water repellents, antimicrobial chemistry, etc.) [6].

Alternative solutions for cigarette litter pollution: 1. Bans: Governments can make laws about smoking areas and the waste of filter. In response to the issue of cigarette litter, some municipalities have banned smoking on beaches, including in Chicago, San Diego, and other areas. These bans are widely seen as a good first step to controlling litter waste, but because of the runoff from streets to waterways to ocean, they will not eliminate them from beaches [7]. 2. Supplying the return of litters: There can be a deposit for litters as bottles. Or government and tobacco industry can make a recycle policy as cans, glasses, papers. It would also increase the opportunity costs of smoking, thus perhaps having a salutary effect on reduced cigarette consumption. 3. Consumer Education: There are several organizations about health care, environmental health. With using these organizations, public can be raised awareness. Maybe consumers can decrease the waste or try to destroy litters. On the other hand, maybe tobacco industry tries to find a solution. 4. Biodegradable filters: Since 1990s, researchers studying on biodegradable filters. There are also patents about it [8]. But currently, there is no evidence that the industry has developed a marketable, degradable filter. However, one biotech company (Stanelco) has developed a food-starch-based filter and has appointed Rothschild International, to develop and test this device for possible widespread adoption [9]. Even with starch-based composition, these filters may take two months to biodegrade, and they would still release toxic filtrates into the environment when they do so [7]. Several options are available to reduce the environmental impact of cigarette litter waste, including developing biodegradable filters, increasing fines and penalties for littering litters, monetary deposits on filters, increasing availability of litter receptacles, and expanded public education [7]. We are hoping that biodegradable cigarette filter use would be the most effective solution to prevent this environmental pollution. Biodegradable and renewably derived polymers have distinguished due to the environmental concerns and sustainability issues associated with petroleum-based polymers. Since the subject of biodegradable polymers received wide attention in the early 1970s, biodegradable polymers have undergone extensive investigations in academia and industry and experienced several important stages of development. These biodegradable polymers mainly include aliphatic polyesters such as polycaprolactone(PCL), poly(butylene succinate) (PBS), poly(butylene succinate-co-adipate) (PBSA), and other aliphatic copolyesters and aliphaticearomatic copolyesters such as poly(butylenes adipate-co-terephthalate) (PBAT). Polylactic acid (PLA) and polyhydroxyalkanoates (PHAs) represent the two most important biodegradable polymers derived from renewable resources. They are thermoplastics and show mechanical properties and processability similar to that of some petroleum-based polymers. The advent of PLA and PHAs is a great leap forward in the development of biodegradable polymers [10]. Biodegradable polymers have applications in a variety of filament and nonwoven structures, such as monofilament, multifilament, staple fiber, bicomponent fiber, spun bonded nonwoven, needle punched nonwoven, electro spinning surface, knitted structure, woven structure and composite materials, etc. The versatility of the polymers to transformation into various shapes and morphology along with good mechanical properties and filtration performances has led to wide range of applications [11]. Since biodegradable polymers are compostable and derived from sustainable sources, these specialities highlight as a promising material to reduce cigarette litter disposal problem. Low toxicity and environmentally advantageous characteristics of biodegradable filters have made an ideal material for this purpose.

Key Words: Biodegradable polymers, renewable polymers, filtration, cigarette filter, cigarette litter pollution

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POSTER SESSION

NANOFIBERS FOR ANTIMICROBIAL WOUND DRESSING APPLICATIONS

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As long as chronic wounds remain a global healthcare problem, the development of alternative treatments and multifunctional dressings are desperately needed. For quick healing of wounds, several factors, which includes eliminating infection, limiting inflammation, wound cleansing, maintaining moist environment of wound, controlling wound exudates, debriding of necrotic tissues, promoting tissue growth, and oxygenating the wound, should be considered before selecting a dressing. In this regard, the role of nanofibers becomes much more significant. This review explores the recent strategies employed to produce nanofiber mats intended to promote wound healing process and improve antibacterial properties.

Key Words: Nanofiber wound-dressings, antimicrobial activity, chronic wounds, acute wounds, wound healing

POLYCAPROLACTONE AND ITS BIOMEDICAL APPLICATIONS

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During the resorbable-polymer-boom of the 1970s and 1980s, polycaprolactone (PCL) was used extensively in the biomaterials field and a number of drug-delivery devices. Its popularity was soon outdated by faster resorbable polymers with fewer disadvantages in terms of long-term degradation (up to 3–4 years) and intracellular resorption; and consequently PCL was almost forgotten for decades [1]. Recently, once again PCL has received a great attention in the biomedical field due to its good biodegradability, biocompatibility, flexibility, solubility, low melting point and exceptional blend compatibility characteristics [2].

The polycaprolactone (PCL) monomer is a hydrophobic, semicrystalline homopolymer of ε-caprolactone and has a glass transition temperature of -60 ° C and a melting point of 59 ° C to 64 ° C. The crystal structure and low melting temperature make it easy to shape. Another important feature of polycaprolactone is that it can be blended with many different natural and synthetic polymers to improve its physical, chemical and mechanical properties. Biodegradation of PCL occurs through hydrolysis of its ester linkages in physiological conditions such as in the animal or human body. However, because of deficiency of suitable enzymes in bodies the degradation rate is slower than other polymers [3].

PCL can be also turned into fibers by melt spinning, wet spinning and electrospinning processes. The major applications of the PCL fibers in biomedical field are sutures, drug delivery systems and tissue engineering applications. Particularly, PCL fiber mats obtained through electrospinning have excellent characteristics such as high porosity and surface area which promote adhesion, proliferation and differentiation of cultured cells, make these mats suitable for use as drug carriers or wound dressing materials [4].

This study explores the biomedical applications of the electrospun PCL fiber mats.

Key Words: Polycaprolactone, drug delivery systems, tissue engineering, wound dressings

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SOME PROPERTIES OF VASCULAR GRAFTS MADE FROM POLYESTER AND PBT YARNS

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Vascular grafts are widely used for the replacement of damaged segments of blood vessels and the treatment of cardiovascular diseases [1, 2]. There are several requirements for an acceptable and successful vascular graft. It must be strong enough to withstand hemodynamic stresses and maintain an open lumen to permit normal blood flow throughout the graft, it must be made from a biologically compatible material to ensure cell attachment and proliferation and it also must be conformable, suturable and easy to handle to be acceptable for surgical applications [3]. The common vascular grafts in the market are tubular structures formed by circular knitting or weaving techniques mostly from PET fibers or by extrusion of the PTFE (ePTFE) [2,4]. The PET fibers may be a monofilament, multifilament or staple yarn or combination of each, and knitted or woven fabrics may be with or without a velour construction. The tubular fabric grafts are also crimped longitudinally to eliminate the danger of kinking or collapse of the graft when flexed [4]. However, crimped walls can interrupt blood flow and cause thick tissue buildup due corrugate walls [3].

This study aims to examine the properties of woven vascular grafts made by polyester and poly(butylene terephthalate) (PBT) yarns. PBT is a texturized polyester filament yarn with a natural stretch and recovery properties. The purpose of utilizing PBT was to eliminate the need of crimping by improving the bending flexibility.

EXPERIMENTAL

Woven vascular grafts were produced from 55/28 dtex PBT and 150/48 tex polyester yarns on a narrow weaving machine. The fiber composition of grafts are given in Table 1.

Table 1. Fiber composition of grafts

	Number of PES and PBT warp threads			
	32 PES	24 PES-8 PBT	16 PES-16 PBT	24 PBT-8 PES
Weft	Single PES	Single PES	Single PES	Single PES
	2-ply PES	2-ply PES	2-ply PES	2-ply PES
	3-ply PES	3-ply PES	3-ply PES	3-ply PES
		Single PBT	Single PBT	Single PBT
		2-ply PBT	2-ply PBT	2-ply PBT
Weave type	Plain			

After weaving, vascular grafts were washed at 100 ^{0}C for 50 minutes to impart the elasticity to PBT fibers. The shrinkage rate was determined by measuring the dimensions of grafts before and after washing. Tensile properties of vascular grafts were tested on a ZWICK Z10 universal testing machine according to the EN ISO 13934-1 standard method.

RESULTS AND DISCUSSION

Results showed that the highest axial shrinkage was observed in the vascular graft with 24 PBT warps. As the number of PBT warps decreased the shrinkage rate decreased. PBT weft also enhanced the lengthwise shrinkage. PBT warps increased breaking elongation as well. PES yarns, on the other hand, improved breaking strength.

CONCLUSION

The preliminary results obtained in this study demonstrated that incorporation of PBT yarns in woven vascular grafts might contribute to further *improvement* of the bending flexibility of woven vascular grafts by providing longitudinal stretch. Further work will include coating of vascular grafts with a biocompatible polymer and a detailed investigation of mechanical properties of resulting grafts.

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LAYER-BY-LAYER DEPOSITION OF CA-ALGINATE ONTO COTTON FABRICS

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The improvement of properties and performance of textile materials by modification without altering comfort and handle properties is of great importance. One of the new methods used for this purpose is layer-by-layer deposition (L-b-L) method. The principle of the layer-by-layer deposition method is the coating of the surface of the material by positively and negatively charged polyelectrolytes up to desired number of bilayers. In this way, extremely thin films can be formed on the surface of the material.

In this contribution, the improvement of water absorption properties of cotton fabrics by using layer-by-layer deposition method was aimed. For this purpose, cationized cotton fabrics were treated with sodium alginate and calcium chloride solutions to produce alginate/calcium bilayers on the fibre surfaces. The formation of thin film layers on the cotton fibres by layer-by-layer deposition method was verified by SEM analysis. It was observed that water absorption increased significantly by the formation of Ca-alginate thin-films on the cotton fabrics through layer-by-layer deposition method. The number of bilayers and solution concentration were found to have insignificant effect on water absorption. pH of the solutions was found to be the most important parameter.

Key Words: Layer-by-layer deposition, cotton fabric, alginate, water absorption

COMPARISON OF DIFFERENT ABSORPSION MEASUREMENT METHODS FOR WOUND DRESSINGS

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Wound dressing materials have a great significance on the appropriate care of wounds. With the improvement in the medical care materials, numerous special wound dressing products has been replaced in the market. These materials could be chosen according to several factors such as wound characteristics and type, stage of healing, tissue type and bacterial recruitment. During application of wound dressing, it is expected to have various features in use including comfort, lightweight, fluid handling capacity, ease of application and removal, antibacterial activity, haemostatic properties, permeability and microclimate impact. Modern wound dressings are usually made from synthetic polymers and are classified as passive, interactive and bioactive products. Passive products, such as gauze and tulle dressings, are used to cover the wound to restore its function underneath, while interactive dressings are semi-occlusive or occlusive, and act as a barrier against penetration of bacteria. At this point, the liquid absorption and transfer properties of these medical materials affect their performance.

There are numerous methods to measure water absorption of textile materials. In order to compare the results of each one and to determine the most sensitive method for wound dressings, wound dressing materials commonly used in the market were tested in terms of absorption characteristics. Traditional gauze dressing and various interactive dressing materials were compared with each other for their water absorptivity properties. Besides using traditional methods such as drop test and vertical wicking test, moisture management tester was also used to determine liquid moisture transfer properties. Test results were compared and analyzed.

Key Words: Wound dressing, water absorbency, vertical wicking test, drop test, moisture management tester

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WEARABLE TEXTILES USED IN MONITORING OF THE PATIENTS

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Along with the evolving technologies, the built-in computer perception in the minds of the users has now been left to the smartphones, tablets and, ultimately, wearable technology, from desktop computers. Despite the increase in the population aging in European countries, the number of staff to provide care, the need for doctors to follow the patients' situation for a long time outside the hospital, the increase in self-care activities at home and the desire of the users to follow their own health conditions increase the need for these Technologies.

Sensor technologies and wearable technologies enable patients to be remotely transferred to the diagnosis, treatment and maintenance processes and to be monitored in the hospital. In this way, the daily life of the patient is not interrupted, and the physical values can be obtained in a more healthy way within the naturalness of daily life.

A study conducted in the UK in the past few years shows that while remote monitoring of patients' health status does not appear to reduce death rates by 45 percent and intensive care admissions by 20 percent, only 5 percent of today's medical devices have wireless connectivity. Other investigations reveal the doctors' demands for the concept of remote surveillance. This transformation leads to significant savings in health expenditures, allows patient data to be processed more accurately, and the diagnosis and treatment processes of patients are much easier and faster.

In this study, wearable technologies used especially in monitoring patients have been investigated.

Key Words: Wearable biosensors, monitoring, smart textiles for healthcare.

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BRAIDED MEDICAL TEXTILES

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Medical textiles or Medtech is one of the most important, continuously expanding and growing field in technical textiles. Medical textiles can be classified into five namely: knitted medical textiles, braided medical textiles, woven medical textiles, non-woven medical textiles, healthcare and hygiene product medical textiles. Braiding, which is one of the most cost-effective fabric manufacturing process, provide excellent strength for the structure in all directions and have exceptional ability to form complex shapes. Braided fabrics are manufactured by interlacing yarns or strips of fabric. Braided materials, with lightweight, high strength to weight ratio and good stiffness properties have come a long way in replacing the conventional materials like metal pipe, steel bars, shaft etc. for certain specific end user applications.

Some of the medical textiles that are manufactured using braiding technology includes, sutures, biodegradable as well as non-biodegradable, prostatic stents, braided composite bone plate, bone setting device, braided pillar implants, artificial ligament or tendon, artificial cartilage, braided dental floss, surgical braided cable, braided biomedical tubing and so on. Details of using braiding technology in Medtech are discussed in this review.

Key Words: Braiding technology, medical textiles, braided sutures, braided stents

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INVESTIGATION OF RECENT DEVELOPMENTS IN MEDICAL PROTECTIVE CLOTHING

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Interest in medical protective clothing has grown significantly in recent years due to greater awarness about worker safety and health. The growing concern of health professionals about potential infection from viruses has stimulated interest in developing medical protective clothing. There are a number of different types of medical protective clothing used today. These items include caps, gloves, gowns, suits and booties.

Many of studies reported on new developments and novel approaches for evaluating the performance of medical protective clothing. In this research, new performance test methods, materials, seam and stitch types for medical protective clothing were investigated.

Key Words: Medical, protective clothing, gloves, mask, gown, ultrasonic seam

INTRODUCTION

Medical protective clothing is considered as a clothing product that protect medical professionals from microbial pathogens. Medical protective clothing is not only protect medical professionals but also patient from possible contamination by non-sterile garments.

Masks, gloves, glasses or face shields, laboratory coats, gowns, shoe and boot covers are important medical protective clothing.

High efficiency particulate air (HEPA) masks are primarily preferred for medical use that provides maximum protection from microorganism. Gloves are utilized when working with body fluids and strelize equipment [1,2].

Growing number of surgeries and increasing of various chronic diseaes are also significantly improving the global market demand of medical protective clothing.

Performance Evaluation of Medical Protective Clothing

Biological test methods developed for determining clothing resistance to microbiological hazards. There are a number of different types of medical protective clothing used today. These items include caps, gloves, gowns, suits and booties.

There are a number of different types of test methods for determining whether clothing is liquid-resistant. AATCC has several water-resistant methods and (INDA), an association of the nonwovens fabrics industry, has the Mason Jar test.

The latest developments in biological clothing test methods are standards created by ASTM 's committee F-23 on protective clothing. ASTM Method F903-87 is used for determining resistance of protective clothing materials to penetration by liquids and ASTM F903-90 is used for determining resistance of protective clothing materials to penetration by synthetic blood penetration [3,4].

Materials for Medical Protective Clothing

Appropriate material selection and clothing design play an important role in the production of medical protective clothing. There are lots of different types medical protective clothing used today. Some of these are disposable and others are nondisposable. They are all constructed from materials that are woven, knitted and nonwoven. Fibers used in the medical textile industry may vary from natural fibers such as cotton, viscose, silk and synthetic fibers such as polyester, polyamide, polyethylene, polypropylene, elastomer and glass fiber. Packaging and sterilazation of medical clothing also have an important role in production [5, 6, 7, 8].

Seam and Stitch Types for Medical Protective Clothing

In terms of comfort and cost in the production of medical protective clothing, it is very important to select appropriate seam and stitch types [9].

Nonwoven seam sealing tapes are extensively used in seam sealings of medical protective clothings. Ultrasonic sewing machine used in medical garments and disposable items instead of lockstitch or overlock machines. Instead of needles, thread, glues or other adhesives, ultrasonic sewing machine uses a patented rotary system, coupled with high frequency vibration to bend 100 percent synthetic woven and nonwoven materials or blends containing up to 40 percent natural fibers.

RESULTS

Medical protective clothing, impose a barrier between the wearer and the working enviroment. Medical protective clothing design involves a process that takes the designer lots of steps. Standards are very important for evaluating the performance of medical protective clothing. The medical protective clothing should provide adequate protection as well as should be comfortable to wear.

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PERFORMANCE COMPARISON OF COMMERCIALLY AVAILABLE SURGICAL GOWNS

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INTRODUCTION

Surgical gowns are used in operating rooms to reduce the risk of disease acquisition from patient to operating staff and vice versa. The commercial surgical gowns can be categorized as reusable and disposable. The reusable category consists of products made up by using weaving technology and the disposable category i.e., single use type, is produced via nonwoven technique. The reusable products have some benefits in terms of environment, cost and wearer preference over the disposable ones. The reusable gowns provide minimizing the amount of clinical waste and ignore the need to dispose of potentially hazardous, contaminated materials. But, reusable surgical gowns have some disadvantages in usage. It is known that the quality and the performance of reusable gowns decrease after the high processing cycles and it is difficult to ensure the sterilization and ready for reusing after each surgical operation. Products made from microfibers must be repeatedly impregnated in order to maintain a uniform barrier performance. Also key is the reliable recording of the frequency of processing for each individual surgical item [1]. On the other hand, since the disposable surgical gowns are used only once, the product quality is consistent and there is no potential about damage to the barrier performance. Furthermore, there is no need for in-house processing [1]. Disposable surgical gowns are generally produced from nonwoven media either alone or in combination with materials to avoid liquid penetration. The most widely used disposable surgical gown fabrics are; hydroentangled spunlace, SMS (Spunbond/Meltblown/Spunbond) and wetlaid nonwovens. It is not possible to make an exact distinction for disposable and reusable surgical gowns about their superiority to each other. The selection should depend on the healthcare facility requirements, available products, cost and many other probable factors [2].

This research study is different from previous studies with respect to being an experimental study on the effects of fabric mass of commercially available disposable surgical gowns on permeability performance. In addition, a performance comparison between commercially available reusable and disposable surgical gowns is done by this experimental study.

MATERIALS AND METHODS

In this experimental study, it is aimed to investigate the effect of fabric mass on the performance properties of disposable surgical gown fabrics. For this aim, three commercially available disposable surgical gowns and one reusable gown were used (Table 1, Table 2). Disposable samples were made of polypropylene fibers and produced as spunbond-meltblown-meltblown-spunbond (SMMS) nonwoven configuration. Disposable samples consist of three different fabric masses; Low mass, medium mass and high mass.

	Sample code	Samples	Thickness, mm	Fabric mass, g/m^2
DISPOSABLE	**LM**	Low mass SMMS	0.25	33
	MM	Medium mass SMMS	0.31	42
	MM+PE	Medium mass SMMS with PE lamination	0.4	69
	HM	High mass SMMS	0.12	47

Table 1. Structural properties of disposable samples

	Sample code	Samples	Thickness, mm	Fabric mass, g/m^2	Fabric sett
REUSABLE	**PES**	Polyester Woven Fabric	0.08	60	50 warp/cm 36 weft/cm
	PES/CO	Polyester& Cotton (50:50) Woven Fabric	0.25	116	42 warp/cm 30 weft/cm
	PES/CO+L	Polyester& Cotton Fabric with woven PES layer	0.32	176	-

Table 2. Structural properties of reusable sample layers

RESULTS and DISCUSSION

Air permeability and water resistance test results are exhibited in Figure 1 and Figure 2, respectively.

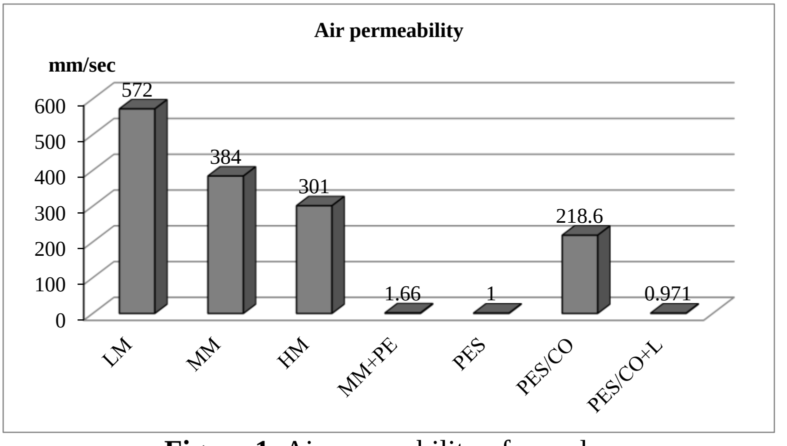

Figure 1. Air permeability of samples

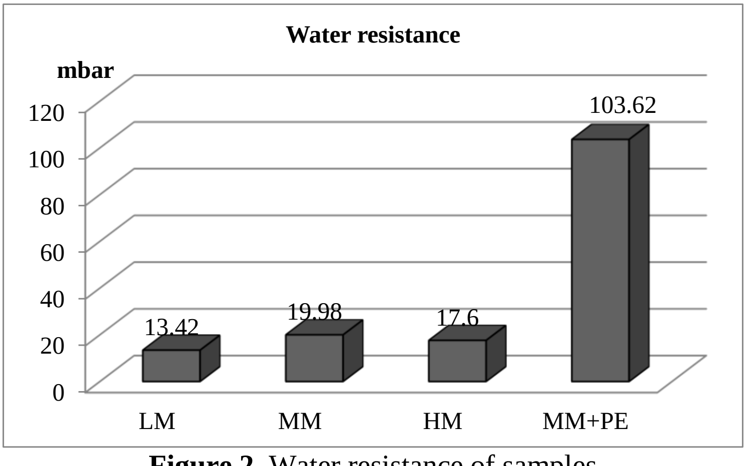

Figure 2. Water resistance of samples

CONCLUSION

Air permeability and water resistance tests were applied to compare the permeability performance. As a conclusion of the test results, it can be said that the disposable surgical gowns have both better air permeability and water resistance than reusable sample. Also, it is seen that air permeability performance of disposable fabrics are increase by lower mass values.

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PROTECTIVE CLOTHING IN VIEW OF OCCUPATIONAL HEALTH AND SAFETY

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Personal protective equipment is all equipment which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety. Classification of PPE according to occupational health and safety.

Table 1. Classification of PPE

Personal Protective Equipment	Textil-based personal protective equipment
Head protection	Fire protection
Hearing protection	Heat and cold protection
Eye and face protection	Chemical protection
Respiratory Protection	Mechanical impact protection
Abdomen and upper body protection	Biological protection
Hand and arm protection	Radiation protection
Food and leg protection	Electrical protection
Skin protection	Reduced visibility protection
Body protection	

Protective clothing covers or replaces personal clothing and is designed to provide protection against one or more hazards. The protective clothes are related to abdomen and upper body and all body protection.

This poster includes highlights for producers of protective clothings in view of occupational safety. Factors to consider in selecting protective clothing are below;

- ✓ Hazards - physical, chemical, biological etc.
- ✓ Exposure duration
- ✓ Regulations and standards
- ✓ Level of protection required

- ✓ Material properties
- ✓ Garment design.

Table 2. Some pictograms for protective clothing

Pictogram	Protective target
	Protection against ionizing radiation ISO 7000-2809
	Protection against moving arts ISO 7000-2411
	Protection against cuts and stabs ISO 7000-2483
	Protection against micro-organism hazards ISO 7000-2491

Key Words: Occupational safety, personal protective equipment, protective clothing, protective textiles

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TS EN ISO 13688.

DIABETIC FOOT AND DIABETIC SOCK PROPERTIES

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Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar by acting like a key to let glucose from the food we eat pass from the blood stream into the cells in the body to produce energy (World Health Organization, 2016; International Diabetes Federation, 2017). International Diabetes Federation (IDF) (2017) brings out that more than 415 million people are living with diabetes worldwide and this number is expected to be 642 million by 2040. This significant rise leads World Health Organisation to characterise diabetes as "epidemic" (Republic of Turkey Ministry of Health, 2014).

Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and results in serious damage to many of the body's systems, especially the nerves and blood vessels (World Health Organization, 2016). One of the most commonly affected body parts is the foot. Diabetic foot as defined by the World Health Organization is, "The foot of a diabetic patient that has the potential risk of pathologic consequences, including infection, ulceration, and/or destruction of deep tissues associated with neurologic abnormalities, various degrees of peripheral vascular disease, and/or metabolic complications of diabetes in the lower limb" (Chand et al, 2012). Foot complication of diabetes is reported to cause a foot loss in every 30 seconds worldwide (Saltoğlu et al., 2015).

There are 3 main factors of diabetic foot ulcer formation. The most important one is nerve damage which is called as "neuropathy". Decrease in amount of blood flow due to arterial stiffness and infection caused by insufficient hygiene are the other factors (Çetinkalp and Yılmaz, 2011). Most injuries or ulcers in patients with diabetes occur at site of high plantar pressure (Cavanagh et al., 2000). Due to neuropathy, patients are unable to sense pressure, pain or micro-trauma in or on the foot (Rahman et al., 2006). Therefore friction or repeated micro-traumas leading ulceration may remain unnoticed (Bucki et al., 2011) resulting in a delayed medical help search (Saltoğlu et al., 2015). Moreover, dry skin (Pham et al., 2001) and fungal infection are other common foot problem of diabetics (Borkow et al., 2009).

Diabetic foot is also an economic problem besides being a medical issue. A new diabetic foot ulcer is estimated to cost $45.000 over a 2 year treatment period (Futrega et al., 2014). Foot ulcers frequently require prolonged treatments and are the source of serious infections, hospitalizations and amputation of feet and legs (Morey-Vargas and Smith, 2015). Healed ulcers often recur and despite treatment ulcers become chronic wounds (Jeffcoate and Harding, 2003).

As sock being the first phase of protecting the diabetic foot, choosing the right sock is crucial. Patients must wear socks even at home, as barefoot walking increases the risk of ulcer formation (Çetinkalp and Yılmaz, 2011). Diabetic sock should be much more functional than standard sock since diabetics have special needs. First of all, the sock should transport moisture efficiently because of the fact that moisture has negative effect on the skin such as decreased resistance against skin abrasion, changes in pH value and increasing the risk of infection (Bartels, 2011; Akaydın and Can, 2010). Fabric-skin friction and the fabric surface roughness are two important components in evaluation of the sensorial comfort (Troynikov et al., 2011). Of particular interest for sock fabrics, moisture content is an important factor affecting the friction between the sock and the skin (Van Amber et al., 2015) since friction and roughness is influenced by the perceived moisture (Li, 2001). Furthermore, patients should avoid socks with tight elastic bands as they may prevent blood flow (Çetinkalp and Yılmaz, 2011).

Although the diabetic foot is a repetitive condition which requires long treatment periods and high cost, it is also the only complication of diabetes which is preventable with education (Saltoğlu et al., 2015). Thus, educating patients and their relatives about foot care such as hygiene, choosing right socks and shoes will help avoiding diabetic foot complication. Moreover, as a conducted study by Feldman and Davis

(2001) revealed that patients are not getting uniform suggestions about sockwear from healthcare professionals since the doctors and nurses do not have/do not have the obligation to have information about fibers. Therefore for the sake of patients, both the textile and healthcare professionals should work together in order to develop functional diabetic socks that meet the special needs of diabetic patients.

Key Words: Diabetes, diabetic foot, diabetic sock

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MECHANICAL PROPERTIES AND WATER ABSORPTIVE CAPACITIES OF STARCHED REINFORCED HYDROGELS

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Hydrogels are three-dimensional networked polymers with reversible water absorption capacity reaching to 1000 g/g. While the absorption capacities of hydrogels are provided by hydrophilic functional groups linked to the polymer skeleton, their resistance to dissolution is provided by physical and/or chemical crosslinked nature of polymer chains. These materials are preferred in various areas including controlled drug release, agro-industry, biosensor and tissue engineering. Development of biocompatible and biodegradable hydrogels is needed for a sustainable production, as most hydrogels are produced from acrylic-based synthetic monomers. Therefore, in this study, the use of starch as a biocompatible, biodegradable, low-cost and recyclable reinforcement to an acrylamide-based hydrogel was investigated[2]. In this regard, the 2-acrylamido-2-methylpropane sulfonic acid monomer was grafted and crosslinked onto starch surfaces using redox polymerization. The developed hydrogels were characterized by FT-IR spectroscopy. The resulting hydrogels were granulated and swelling degrees were determined with respect to increased starch amount. Effect of starch reinforcement on mechanical properties were analyzed with crack formation observation during drying under light microscope. The mechanical properties were also analyzed with a compression test. It was found that water swelling degree decreased with starch reinforcement. Moreover, delayed the crack formation and increased modulus was observed for starch containing hydrogels.

Key Words: Hydrogel, starch, acrylamide, water absorption, mechanical properties

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ALGINATE GELS AS WOUND DRESSING

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Wound dressings form an important part of the medical and pharmaceutical wound care market worldwide. In the past, traditional dressings such as bandages, cotton wool, lint and gauzes all with varying degrees of absorbency were used for the care of wounds. Their primary function was to keep the wound dry by allowing evaporation of wound exudates and preventing entry of harmful bacteria into the wound. In modern aspect, successful wound healing depends on maintaining a moist environment around the wound. Since, a balanced moist environment facilitates cellular growth and collagen proliferation within acellular matrix. Therefore the modern dressings are based on the concept of creating optimum conditions to allow epithelial cells to move unimpeded for the treatment of wounds. The ideal dressing should also provide effective oxygen circulation to aid regenerating cells for rapid healing with minimal inconvenience to the patient.

The variety of wound types has resulted in a wide range of wound dressings. In many wound clinics, dressings made of alginate recently have become very popular, as they have various advantages in comparison with the traditional cotton and gauze dressings Alginate are natural polysaccharides with good biocompatibilities and biodegradabilities, which have been widely applied in wound dress. Due to their excellent gel-forming properties, alginate also show promise in biomedically-relevant hydrogel systems. Favourably, all alginate dressings form gels by absorbing wound exudate, which prevents the wound surface from drying out, providing a favourable moist wound environment. In addition to the excellent moisture balance by exudate management, alginate dressings are able to reduce wound pain and odour, have haemostatic properties, and a good permeability for oxygen, other gases and fluids. The aim of this manuscript is to provide a review of wound dressings alginates gel their physical characteristics and to describe their best use in relation to the condition of the wound. It also reviews alginat gels for wound healing dressings, their key advantages and shortcomings.

Key Words: Alginate, wound dress, wound healing, alginate gel

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TEXTILE BASED MATERIALS FOR WOUND HEALING APPLICATIONS

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Skin, acts as a shield guarding the body against sunlight, harmful materials, and extremes of temperature, exudes antibacterial substances that prevent infection and manufactures vitamin D for converting calcium into healthy bones, keeps the brain in touch with the outside world, allows humans' free movement. As the largest organ of the body in touch with the outside world, it is vulnerable to wounds, which heal through a complex process including different phases as homeostasis, inflammation, granulation tissue formation, and remodelling. Wound dressings forming an essential part of any wound management, are applied to wounds in order to promote healing and/or prevent further harm [1-3]. Ideal wound dressings are expected to be non-toxic, non-allergic, sterilisable, comfortable and easily removable, absorb exudates and toxic components from the wounds surface, provide or maintain moist environment, buffer pain and trauma, allow gas exchange between wounded tissue and environment, provide thermal insulation and maintain appropriate tissue temperature to improve the blood flow to the wound bed and enhances epidermal migration, protect the wound from bacterial penetration [4-6].

Gauze wound dressings made from woven or nonwoven textile structures were used as wound dressings in ancient times and they still continue to be the most readily available wound dressings in use today [7]. Emerging materials and production techniques led to the development of new dressings, which promise to play an important role in healing of all types of wounds. Modern wound dressings, which are mostly manufactured from synthetic polymers,include passive, interactive, bioactive, medicated, and composite wound dressings. Passive products (gauze, etc.) are non-occlusive and their only function is to cover the wound while interactive dressings (films, foam, hydrogel and hydrocolloids, etc.) are semi-occlusive or occlusive, and act as a barrier against penetration of bacteria.Bioactive wound dressings are derived generally from natural tissues or artificial sources such as collagen, hyaluronic acid, chitosan, alginate and elastin, which are known for their biocompatibility, biodegradability and non-toxic nature [8,9]. For example, chitosan/ polyvinylalcohol nanofiber hydrogels and cellulose acetate/ polycaprolactone core-sheath nanostructures [10], gelatin [11], silk fibroin/ gelatin [11] are utilized as alternatives in wound dressing. Medicated dressings contain drugs, antimicrobial agents, growth factors, and enzymes andplay an important role in the healing process by removal of necrotic tissues.Composite dressings have multiple layers. Outer most layer protects the wound from infection, middle layer maintains moisture environment and assists autolytic debridement, bottom layer prevents from sticking to young granulating tissues.

Textile structures are the most widely used materials as wound dressings.They can be as simple as a piece of plain fabric or a part of a complex composite structure [4]. Textile structures used for modern wound dressings can be in sliver, yarn, nanofibrous membrane, woven, non-woven, knitted, crochet, braided, embroidered fabric and composite forms. Textile based composite structures are used as wound dressings due to their properties such as large porosity, surface area, high air and moisture permeability, high strength and flexibility [8].Wound dressing from electrospun nanofibrous membranes can provide many advantages compared with conventional ones such huge surface area and microporous structure which help to repair damaged tissue, porosity, and lightweight [8,12]. Besides, the electrospun membrane also plays an important role for cell attachment and proliferation in wound healing [12].

In this paper, after a general overview of the wounds and their healing, a detailed review about textile wound dressings and the recent advances about the subject are presented.

Key Words: Wound dressing, textile, gauze

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RECENT DEVELOPMENTS IN ELECTRONIC TEXTILES TARGETING HEALTH SECTOR

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The term electronic textiles (e-textiles) are used to denote the class of fabric structures that integrate electronic elements with textiles and can sense changes in its environment and respond to it. This new class of wearable electronic systems is being designed to meet new and innovative applications in the military, public safety, healthcare, space exploration, sports, and consumer fitness fields. There are examples for applications of wearable e-textile devices; in future it is expected to be used more spreadly in worldwide. The value of smart wearable is around $600 million in 2013 and it is accelerating currently. It is expected to reach $30 billion in 2020 [3]. Pressure of a growing world population and attempt for greater longevity creating an urgent need for specific development in different field of medical application such as managing nursing care, monitoring and diagnosis, delivery of drugs, surgical and therapeutic treatments, and patient recovery. E-textiles applications are helpful for approaching this goal [10].

Wireless connectivity together with the widely available internet infrastructure leads the devices to be able to provide real-time information and facilitate timely remote, particularly in rural or underserved areas, where expert treatment may be unavailable. By this way, intervention to acute events such as stroke, epilepsy and heart attack becomes easier. In addition, for healthy population, it can provide detailed information regarding their health and fitness. Such that they can closely track their wellbeing, which will not only promote active and healthy lifestyle, but also allow detection of any health risk and facilitate the implementation of preventive measures at an earlier stage. Although significant progresses in developing these systems for healthcare applications have been made in the past decades, most of them are still in their prototype stages. The existing wearable devices are mainly for the continuous monitoring of a person's physiological or physical status. For future development, wearable devices will spread also intervention in disease [8]. Some applications currently used and expected to become widespread in next coming days.

The goal of this paper is to focus on recent advances in the field of Electronic Health Textiles. Previous studies and currently used applications in this field were investigated and presented as an overview.

Key Words: Electronic textiles, health, wearable, recent developments.

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HOT MELT EXTRUSION AND IT'S APPLICATIONS IN MEDICAL TEXTILE

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INTRODUCTION

Hot melt extrusion has been in use with polymers for for a long time in different areas. When pharmaceutical formulations started to need innovations, polymers entered to the formulations. At first, polymers were used for stabilizer, solubiliser and mechanical support. Over the time, polymers have provided specific features such as temperature and pH responsivity[1]. Later on, the techniques which are working with polymers became common method in different fields such as food, textile and pharmaceutical industry. Hot melt extrusion is one of these techniques.

Extrusion is a process of pumping the raw material at elevated controlled temperature and pressure through a heated barrel into a product of uniform shape and density. The extruder comprises a feeding unit, one or two rotating screws in a cylindrical barrel and a die[2].

Hot-melt extrusion technique was first invented for the manufacturing of lead pipes at the end of the eighteenth century[3]. In later times, it has been used in the plastic, rubber, and food manufacturing industry. On the other hand, it is quite new and promising in pharmacy. For textile, it is using for coating, synthesis of fibrils and customized textiles such as antimicrobial, adhesive textiles and sportswear.

APPLICATIONS IN MEDICAL TEXTILES

Polystyrene matrixes containing cellulose nanofibril (CNF) with fiber content of 0.5, 1, 5, and 10 w/w% were successfully hydrophobized by silylation and extruded into single filaments using extrusion processing. This research aimed to develop a strategy for nanocellulose biocomposites as a reductionist strategy to traditional textile reinforcement. This was achieved by creating filamentary textile composite through hot melt extrusion[4].

In a study, thermoplastic nanocomposite fibers based on hot melt copolyamide and multi-walled carbon nanotubes (MWCTs) were fabricated with a two-step approach. In the first step, a masterbatch containing 20 w/w% MWCTs was diluted by pure hot melts to produce nanocomposite pellets with 2, 4, and 6 w/w% MWCTs. In the second step, nanocomposite fibers were extruded and drawn from the fabricated pellets[5].

In a study, the cellulose aerogels were synthesized from microcrystalline cellulose in a hydrated calciumthiocyanate salt melt, which upon cooling forms a gel at around 80ºC. The homogeneous viscous cellulose solution was transferred to the twin-screw extrusion apparatus for fiber production. Twin screw extrusion experiments were performed systematically yielding thin and wet cellulose filaments. Washing and coagulation of the wet gels in ethanol was followed by supercritical drying with CO2 yielding cellulose aerogel filaments[6].

The results of a study clearly indicate that paracetamol molecules form nanoaggregates is placed in the interstitial channels between nanotubes by hot melt extrusion. Nanoaggregates after heating are destroyed and drug molecules are distributed among nanotubes. Paracetamol molecules can be successfully applied for the preparation of a new drug delivery system[7].

In the light of these developments, it was came out that hot melt extrusion technique will be a promising method for medical textiles in the future.

Key Words: Hot melt extrusion, extruder

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EXPERIMENTAL EVALUATION OF RELEASE OF HYPERICUM PERFORATUM FROM SILK FIBROIN DISCS

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A wide variety of plants have been used for therapeutic purposes for centuries. Lots of applications were tried such as eating edible ones, drinking oils or extracts, putting on liquid or powder plant extracts on wounds. According to the technological developments, utilization of plants has been increased. Much effort has been made to control the antimicrobial, antioxidant, and antiviral properties and healing effects of plants. *Olea europaea*, *Liquidambar orientalis*, *Thymus vulgaris*, *Ziziphus jujuba*, *Juniperus communis*, *Pistacia terebinthus*, *Pistacia lentiscus*, *Hypericum empetrifolium*, *Ginkgo biloba*, *Jasminum auriculatum*, and *Centella asiatica* are some of these plants [1]. Photochemical characteristics and antioxidant activity of *Hypericum perforatum* were determined by some researchers [2, 3]. Olive oil which is rich in antioxidant compounds is also commonly studied [4, 5]. Therefore, *Hypericum perforatum* and virgin olive oil were chosen as antioxidant and healing agents in this study.

Silk fibroin (SF) that is a natural biodegradable polymer obtained from *Bombyx Mori* was chosen as the polymer for the formation of discs. Freeze drying method was used to get the discs and the blend of active agents was obtained by a traditional method (keeping *Hypericum perforatum* plant in olive oil). Then the blend was loaded on freeze dried SF discs at two different ratios (1 and 5 mL/mg). Since healing of skin wounds is purposed, release medium was prepared by using isotonic solution (0.9 % w/v NaCl/water). Blend soaked discs were placed in 6-well plates. Each well has been filled with 3 mL isotonic solution. During release test an incubator at 37 °C was used. Determined quantity of release medium has been extracted and the same quantity of fresh medium has been added to each well at determined time intervals. Experiments were made triplicate.

Release media taken from samples were tested with UV-visible spectrometer. Absorbance values of the samples were recorded at 294 nm and 291 nm that are significant in terms of compounds of *Hypericum perforatum* and olive oil. Fourier Transform Infrared Spectroscopy (FTIR) analyses were made both released and unreleased samples. Figure 1 and 2 denote the results of UV-vis and FTIR analyses, respectively.

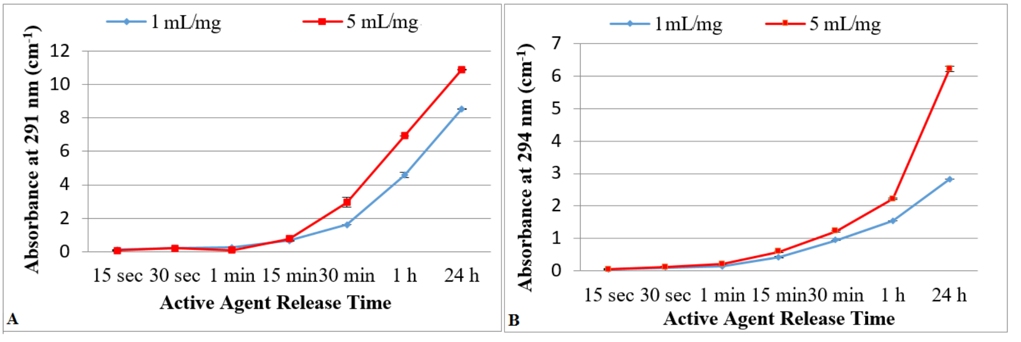

Figure 1. Release at (a) 291 and (b) 294 nm

1 and 5 mL/mL blend/isotonic solution diluted at a ratio of 1/100 were prepared and these samples were also tested to calculate the total released quantity from SF discs. According to the results, 9.50 % of the active agents (detected at 294 nm) released from 1 mL/mg blend loaded SF discs, where 7.89 % of the agents released from 5 mL/mg blend loaded SF discs. The release percents of agents detected at 291 nm were 2.75 % and 2.69 % for 1 and 5 mL/mg blend loaded SF discs, respectively. Although a short contact time with a skin wound was considered at the beginning, release tests denote that longer contact times or increased loading ratios should be useful. FTIR analyses made with samples confirmed the UV-vis test results. The small amounts of agents were released to media from SF discs. And also characteristics peaks related to phenolic compounds were observed on both released samples (Fig.2).

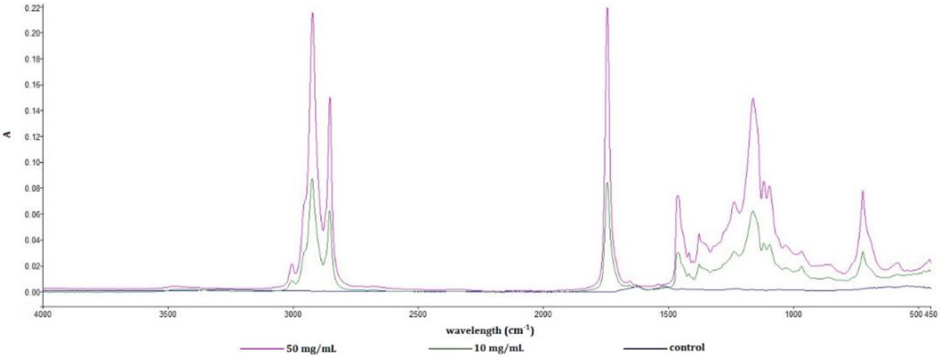

Figure 2. The FTIR spectra of released samples

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NANOCELLULOSE: A PROMISING CANDIDATE FOR SUSTAINABLE PRODUCTION

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Cellulose is the most abundant biopolymer in the landscape and the major constituent of plant biomass can be found in many different organisms. It is a virtually inexhaustible raw material and a key source for biomass production and bio-refineries to produce sustainable materials for industrial applications. Over the centuries, this abundant biopolymer had been used for making textiles clothing and papers while many researchers have also been trying to utilize its structural features to make new engineered materials[1].

Recently, novel and interesting cellulosic materials were developed which were obtained by disintegrating cellulosic or lignocellulosic fibres using mechanical, chemical and enzymatic approaches or combinations thereof. In this context, there appears to be an increasing interest and demand in nanoscaled cellulosic materials. [2-4]

The development of nanocellulose has attracted significant interest in the last few decades due to their unique and potentially useful features. These novel nanocelluloses boost up the strongly expanding field of sustainable materials and nanocomposites[5]

Nanocellulose can be obtained by disintegration of plant cellulose pulp or by the action of specific types of bacteria. It can be found in a number of forms that have been given a variety of names. These names are given such as homogenized cellulose pulps commonly described as microfibrillated cellulose (MFC) or nanofibrillated cellulose (NFC); acid hydrolyzed cellulose whiskers, known as nanocrystalline cellulose (NCC) or cellulose nanocrystal (CNC); and bacterially produced cellulose or bacterial cellulose (BC). [6]

The special and useful features of nanocellulose are its plenty, high strength and stiffness, low weight and biodegradability which make them promising candidates for mainly bio-nanocomposite production.[5]

Nanocellulose can be used to make transparent films, fibers, hydrogels, or aerogels that exhibit extraordinary mechanical, thermal, and optical properties. The application potential of these materials is mainly dependent on the scale of production and its cost[1,7].

Also, nanocellulose is regarded as an ideal platform to house a range of guest nanomaterials due to its high specific surface area, highly porous structure, and its mechanical strength. By this way, nanocellulose-based nanocomposites combine the advantages of both the guest nanomaterial and the nanocellulose substrate and often exhibit synergetic properties. Thes etypes of materials have been already seen in the medical field, such as novel wound dressings and sutures. Moreover, it reduces pain and accelerates granulation, ensuring proper wound healing[1,8,9].

The unique properties, resulting from the ultrafine structure, nanocellulose has found a multitude of applications in paper, textile, and food industries, and as a biomaterial in medicine and cosmetics. Since there is an important demand for sustainability, the use of nanocellulose in several areas and industries is expected to increase significantly. In this study, the structure of nanocelluse, its advantages, commercial situation, present usage areas and potential future applications including medical textiles will be presented.

Key Words: Biopolymer, nanocellulose, textile, textile application

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A REVIEW ON YARNS USED IN MEDICAL TEXTILES

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Medical Textiles are one of the most important technical textiles in view of their area of utilization. They have been defined by Textile Institute as "a general term which describes a textile structure which has been designed and produced for use in any of a variety of medical applications, including implantable applications" (1). In this case it is reasonable that sales of medical textiles worth 7 billion $ just in EU and have 10% of technical textiles market share (3). Medical textiles include non-implantable materials (wound dressings, bandages, plasters, etc.), implantable materials (sutures, vascular grafts, artificial ligaments, artificial joints, etc.), extracorporeal devices (artificial kidney, liver, and lung), healthcare/hygiene products (bedding, clothing, surgical gowns, cloths, wipes, etc.) (3).

Besides nonwoven surfaces, yarns need to be produced in order to produce fabrics. For technical textiles, this situation remains same. In this case, yarns used to produce should have extra features for being counted as input for technical textiles. These yarns are generally called as "Technical Yarns" and their properties come from raw materials used in them or parameters used in their production. Technical Yarns must meet the specific functional requirements of the intended end use (4). An example for these features is biodegradability. Natural fibers should be selected as raw material for technical yarns if biodegradability has importance for the technical textile product. Technical yarns used for medical textiles should not be toxic, allergenic or canserogenic (4).

In this paper, a number of articles about medical textiles will be reviewed in order to examine what kind of technical yarns used in productions. Yarns will be categorized according to raw materials (Natural/synthetic), production methods (spun yarn, filament yarn, etc.) and end-use (like implantable/non-implantable, hygienic products etc.) properties.

Key Words: Medical textiles, technical yarns, medical yarns.

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FIBROUS SCAFFOLDS FOR PERIPHERAL NERVE REGENERATION

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The majority of people are suffering from peripheral nerve injury which mostly results in the poor functional recovery of patients' motor and sensory abilities [1]. Since peripheral nerves are fragile, they can be damaged easily [2]. Although peripheral nerves have a higher capability of regeneration compared to central nerves, this ability is limited by the degree of injury [1]. The most common approach in peripheral nerve regeneration is the in vivo implantation of artificial scaffolds that will guide naturally regenerating axons [2]. Therefore, electrospinning technology is one of the pioneer options for building fibrous structures that meet the requirements of nerve guidance conduit [3]. The ideal scaffold for peripheral nerves should have similar physical and biochemical characteristics with the target tissue thus they should have biocompatible material composition which encourages cell adhesion and proliferation; similar spatial structure that the neural tube can create a suitable microenvironment for the guidance of Schwann cell migration; oriented fibrous arrangement which guides axons along the Schwann cell to nerves in the distal stump; and suitable fabrication and storage stages for clinical usage [1]. Therefore, a highly aligned fibrous construct mimicking the endoneurium layer surrounding inner axons of a nerve fascicle is a suitable candidate for a nerve guide [3]. Nerve guides can be fabricated from nonbiodegradable materials, biodegradable synthetic polymers and natural polymers. Moreover, natural and synthetic polymers' blends can be used for nerve regeneration guides to combine the biocompatibility of the natural component with the advantageous processing properties and mechanical performance of the synthetic materials [4]. In the context of this review, fibrous scaffolds fabricated for peripheral nerve conduits are discussed in details based on the constructional requirements and material preferences. It is aimed that with the scrutinised literature survey, this review can be a guide for

researchers about the future prospects of the fibrous scaffolds for peripheral nerve regeneration.

Key Words: Peripheral nerve regeneration, tissue engineering, fibrous scaffold

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RESPIRATORY PROTECTIVE EQUIPMENTS AND THEIR IMPORTANCE IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY

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Abstract
In recent years, along with the increased demand on occupational health and safety, improvements have been made about this issue in many type of industries [1]. Some risks that cause to work accidents are fire, noise, occupational diseases, chemical risks and risks arising from moving parts of machines. There are many risks arised from dust and this threated workers health [2]. With this reason serious precautions should be taken against to cotton dust, otherwise one of the occupational diseases called by Byssinosis incidence rate ratio increase in the textile mills. So personal protective equipment (PPE) should be used by workers, health controls should be made and working ambient should be ventilated effectively at regular periods. There are some types of respiratory protective equipments (RPE). By the way, in this work type of respiratory protective equipments, their properties and developments are investigated.

Key Words: Personal protective equipment, respiratory protective equipment, dust mask, occupational health and safety

INTRODUCTION

Choice of respiratory protective equipment depends on amount of oxygen in the ambient, harmful substances, chemicals and the size of dust particles [3]. Respiratory protective equipments are used by workers who come across hazards. RPE should be selected according to working ambient, also must be fit workers face correctly and they should feel comfortable. For this occasion, they have different type of shapes; half masks, full face mask respirators and fan assisted respirators [4, 5, 6].

(a) (b)

Figure 1. (a) Particulate respirator mask, (b) Full face mask [5,7]

Type of Respiratory Protective Equipments and Current Developments

There are two types of breathing apparatus as device type and filtering devices. Fibrous air filters produced from nonwovens are commonly used for dust protection because of their high filtration efficiency to collect dust particles and low air resistance due to low pressure drop across the filter [5, 6, 8]. Generally there are two types of fibrous filters used in RPE, mechanical and electret filters. In mechanical filters, aerosols are removed by inertial impaction, interception, and diffusion processes (Figure 2). On the other hand, electret filters increase the effectiveness of the mechanical filters thanks to their electrically charged polymer fibers. With this type of fibers, it is possible to filter the submicron aerosol particles. While charged airborne particles are attracted via coulombic attraction, uncharged particles are attracted by polarization forces [9]. Today modern type of masks are produced by electret filter media. It is possible to charge electret filters in three ways, triboelectric charging, corona charging, or charging by induction [12].

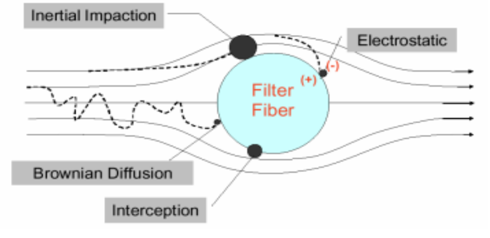

Figure 2. Particle capture mechanism in air filtration[10]

Motyl and Lowkis (2006) studied about humidity effect on polypropylene electret nonwovens charged by corona technology. According to their results, the samples were affected by the high amount of humidity [8]. Golanski et al. (2009) evaluated the different personal protection devices (respirators, filters) against graphite nanoparticles. They designed two test benches through diffusion method; in the results they figured out that penetration decreases when particle diameter decreases [13]. Mostafi et al. (2010) studied about the nanoparticles filtration performance of mechanical filters and respirators. They discussed about the factors of filtration efficiency, filtration mechanisms, testing standards [14]. Huang et al. (2013) made research about the factors affecting filtration characteristics, and they used some parameters to determine the theoretical model of filtration. They observed that aerosol penetration of electret filter media effectiveness increased with increasing face velocity and increasing fiber diameter, and decreased when the parameters such as packing density, filter thickness or fiber charge density increased [15]. Thakur et al. (2016) worked on filtration behaviour of electret filter media prepared from polymeric nonwoven using corona charging process. They determined some parameters that affected filtration effectiveness such as fibre diameter, basis weight, point voltage and grid voltage. They found out that the fibre diameter was the most important parameter in the stated parameters [16].

CONCLUSION

Occupational health and safety is an important issue for all over the world. Dust is the one of the hazard factors threated workers health. Recently there are various researches about dust masks produced from electret fibrous filters because of their increasing demand, filtration effectiveness and low cost.

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