The delicacy on the alpaca animal is estimated by the age of the animal. Classification of alpaca fiber according to fineness values was explained in this article, also. The fibers over 30 microns carry a characteristic that is defined as the pricking factor and makes them feel uncomfortable when touched(7). It is preferred that this value is as small as 5%. For fibers over 30 microns in fiber distribution, the modulation rate is high, but not always precise (9). Crimp can be described as having a high or low frequency (crimps per inch) or as having high or low amplitude, which is best described as the height of each wave of crimp. The style of crimp tends to be less important than the uniformity of the crimp throughout the fleece. The curvature is related to the curl (6). The average fiber curvature is determined by measuring 2 millimeters and the curl per mm is expressed in parts (degrees / mm). As the degree per inch increases, the curvature decreases. For wool fibers: low fiber curvature when the value is less than 50 degrees / mm, medium fiber curvature between 60 ° and 90 °, and high fiber curvature when the value is greater than 100 ° (10) The fiber curvature is one of the most important factors affecting the spining performance and the subjective / objective properties of the yarn and fabric (3). The cuticle is the shell cells located on the outer surface of the fiber and is the element carrying the fiber's charge. The fiber determines its unique properties such as attitude, brightness and softness. (10) Alpaca fibers can be classified according to their fineness, color, length and medulla content. Wang et al. (2003) used Australia and Peru standards to form a standard table (4).The classification of alpaca fiber was given in this study.

Key Words: Alpaca fiber, alpaca fiber properties,alpaca fiber evaluation methods

REFERENCES

[1] Charlotte Q. Alpaca: An Ancient Luxury. Interweave KnitsFall 2000; 74–76

[2] Czaplicki Z. Properties and structure of Polish alpaca wool. Fibres Text East Eur 2012; 20(1, 90): 8–12.

[3] Holt , C., (2006), A Survey of The Relationships of Crimp Frequency, Micron, Character & Fibre Curvature , A Report to the Australian Alpaca Association www.cameronholt.com

[4] Wang , X., Wang L. and Liu X., (2003), The Quality Processing Performance of Alpaca Fibers, A report for the Rural Industries Research and Development Corporation , Australia.
[5] Wang, L., Wang X., Liu X., (2005), Wool and Alpaca Fibre Blends, Wool Research Conference, Leeds.
[6] McColl, A.,2007 , Understanding Micron Reports Integrity of Sampling and Use of Micron Results, http://www.ymccoll.com/micron_reports.html
[7] 7.Pearce, R., 2007, Processing of Alpaca: Systems, Fibre Parameters and the Future. www.alpaca.asn.au
[8] Safley, M., A Brief Primer on Alpaca Fiber http://www.alpacafarmer.com/alpaca_fiber.htm
[9] www.llamapadia com
[10] http://www.alpacas.com/AlpacaLibrary/FiberTesting.aspx

USE OF TEXTILE SURFACES AS IMMOBILIZED ENZYME SUPPORT

Ebru Bozacı, Esen Özdoğan
Ege University, Faculty of Engineering, Department of Textile Engineering, 35100, İzmir, Turkey
ebru.bozaci@ege.edu.tr

Enzymatic applications are of growing importance especially in textile, food, pharmaceutical and biomedical industries. For a successful industrial application of enzymes, they must be stable and fully functional under challenging process conditions like temperature and pH-value.

Also the recovery yield and reusability of free enzymes in industrial continuous production systems is low. Therefore the use of enzymes by immobilizing has become more important in recent years. The methods of immobilization include adsorption, ionic, and covalent binding, entrapment, and encapsulation. Both organic (polysaccharides, polyacrylic and polyvinylic materials etc.) and inorganic supports (silica- or other metal-oxide-based ect.) can be used for the immobilization of enzymes. Textiles have been widely used as immobilization supports for enzymes. This paper briefly reviews the most recent researches concerning the immobilization of enzymes onto textile supports.

Key Words: Enzyme, immobilized enzyme, support, textile

REFERENCES

[1] Ibrahim N. A. Et Al., Journal Of Applied Polymer Science, (2007) 104, 1754–1761.
[2] Liese A. And Hilterhaus L., Chem. Soc. Rev. (2013) 42, 6236-6249.
[3] Soares J. C. Et Al., Biocatalysis And Biotransformation, (2011) 29(6), 223–237.
[4] Li F-Y Et Al., Enzyme And Microbial Technology (2007) 40, 1692–1697.
[5] Zucca P. And Sanjust E., Molecules (2014) 19(9), 14139-14194.
[6] Tzanov T. Et Al, Journal Of Biotechnology (2002) 93, 87–94.
[7] Jegannathan K.R. Et Al., Critical Reviews İn Biotechnology, (2008) 28, 253–264.

[8] Sulaiman S. Et Al. Applied Biochemistry And Biotechnology (2015), 17 (4), 1817–1842.
[9] Seventekin Et Al., Tekstil Dünyası, (2009), 7, 72-81.

GAS RELIEF ROMPER DESIGN FOR BABIES

Derya Buluç
Mimar Sinan Güzel Sanatlar University
derya.buluc@msgsu.edu.tr

The most common illness of childhood period is gas pains (colic). Gas pain is a behavioral disturbance which cannot be attributed to a specific gesture seen between 2 weeks and 4 months, accompanied by pulling the legs to the ground, fist clenching, gas extraction and difficulty to stop despite all the struggles, is a syndrome. Various treatment modalities have been explored and tried to remove or relieve gas pneumonia. These treatment modalities include; drug therapy, behavioral therapy and natural treatment methods. In the scope of this study, the products existing in the market were examined and a romper was designed for babies with gas relief pads.

INTRODUCTION

The most frequent illness of the dairy childhood is gas stigma (colic), behavioral disturbance which cannot be attributed to a specific gesture seen between 2 weeks and 4 months, accompanied by pulling the legs to the ground, fist clenching, gas extraction and difficulty to stop despite all the struggles, is a syndrome. Gas pain is a very annoying situation for babies and mothers. Various treatment modalities have been explored and tried to remove or relieve gas pneumonia. These treatment modalities include; drug therapy, behavioral therapy and natural treatment methods [1].

As a gas reliever, the market has a wide variety of models and materials; waistband, booties, pillow [2]. In the scope of this study, the products existing in the market were examined and a bag was designed for infants with gas relief pads. It is thought that the gas pain of the babies will decrease with this designed product.

METHOD AND PRODUCT DEVELOPMENT

A garment made of a rompers was designed in consideration of the reduction of gas pain seen in babies. This romper is different from other baby rompers on the market and is a pedal pad placed on the abdomen. The stuffing material of the waistband, booties and pedal pads, which are thought to be good for gas relief in the market, is made from cherry core. Because the cherry kernel is thought to disturb the baby, lavender seed is preferred because of the relaxing effect of light and fragrance in the design of this product. After design process the patterns of the product were prepared. Then rompers sewed by industrial sewing machines. The design was tested on three babies and the suitability of patterns and stitches was examined through observation.

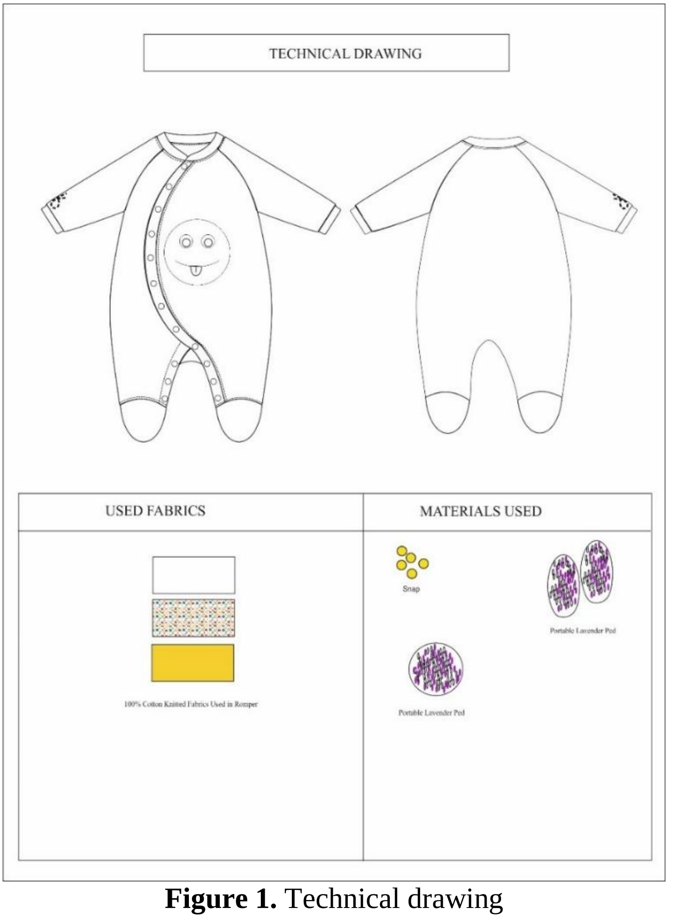


Figure 1. Technical drawing

CONCLUSIONS AND RECOMMENDATIONS

As a result of the study, a functional garment design for babies with gas pain was performed. The pad designed as gas pain reliever is designed as mobile. In the absence of gas pain, it can be removed from the romper and used as a normal romper. In addition, the design of the product was made on three babies with gas problems. During these experiments, only observations were made at this time and it was observed that the design was useful.

Key Words: Gas crisis, baby rompers, baby accessories, gas relief pads

REFERENCES

[1] Yılmaz,G. (2013). " The Effects of The Two Different Methods on Colic and Crying Duration" Ataturk University, Institute of Health Sciences, PhD Thesis, Erzurum.

[2] Buluç, D. (2015). "Innovatıve Cloth Suggestıons Supportıng Psychomotor Development Of 6-9 Month-Old Babies" Haliç University Institute of Social Sciences Textile and Fashion Design Proficiency in Art Thesis, İstanbul.

ANALYSING THEORETICALLY THE AIR FLOW THROUGH CAR SEAT FOAM MATERIAL

Funda Buyuk Mazari, Adnan Mazari, Antonin Havelka, Karel Adamek, Engin Akçagün
Department of Clothing, Technical University of Liberec, Czech Republic
fundabuyuk@hotmail.com

Textile material stand out as a unique class of porous media, which contain relatively high volume of air and very complex structure due to the random arrangement of fibres or pores. Air permeability is one of the most important properties of textile materials in many applications. The air permeability of different geometry of the perforated foams are tested for different pressure. The initial experimental results is used to develop a theoretical model to simulate the air permeability of perforated foams. The percentage difference of the experimental and the theoretical results shows less than 5%. This model can be used for predicting the air permeability of PU foam under different load and different geometry of perforation. For this research work the software FLUENT is used to predict the air flow through porous medium using DARCY, Weissbach's and Moody's law. The results shows less than 5% error with respect to the experimental results.

Key Words: Air flow, theoretical model, car seat, comfort

SYNTHESIS OF POLYMERS AND THE RESEARCH OF THEIR ANTIPILLING EFFECTS ON DIFFERENT FABRICS

Burcu Büyükkoru, Ali Kara
Uludağ University, Bursa, Turkey
burcubuyukkoru@hotmail.com

Fabrics with pilling problem have not been desired in textile industries. However, this problem has not been still solved and researchers have conducted studies concerning this topic. Although pilling has been a great concern for many years, the importance of this area has further increased after synthetic fabrics such as polyester started to be used more often.

Pilling is a fabric defect which is observed as small fibre balls or groups consisting of intervened fibres that have been attached to the fabric surface by one or more fibres. Several methods have been developed in order to decrease pilling tendency of fabrics [1,2]. Application of textile chemicals by padding or coating is one of them. For this purpose, in general enzymes are preferred. Our perspective is to use polymers as an antipilling textile chemical instead of enzymes. By this way, we could get rid of the problems caused by enzymes which are not effective for polyviscon fabrics. With all these reasons, antipilling polymers could be a solution.

Polymer is a macromolecule built up by the repetition of small chemical units. It is also similar to the enzyme structure. Furthermore, polymers have more proper structure. In terms of economic reasons, polymers are more preferrable since they are much more cheaper than enzymes.

In this project, we synthesized polymers and researched their antipilling effects on different fabrics by padding application. After antipilling polymer was applied to the fabrics, yellowing, hydrophilicity and softness of the fabrics were also investigated. Also, the stability of the product was observed.

ACKNOWLEGEMENT
I sincerely thank Dr. Ö. Nafi Yavuz who is the factory manager of the Rudolf Duraner for providing me the oppurtunity to work on this project. Martindale abrasion pilling tester and all fabrics can be used for the supply of Rudolf-Duraner. I am also grateful to this company.

Key Words: Antipilling, polymer, hydrophilic softener, pilling tendency, fulard

REFERENCES

[1] Hussain, T., Ahmed, S., Qayum, A. 2008. Effect of different softeners and sanforising treatment on pilling performance of polyester/viscose blended fabrics. *Society of Dyers and Colourists, Color. Technol*., 124: 375–378.
[2] Furferi, R., Carfagni, M., Governi, L., Volpe, Y., Bogani, P. 2014. Towards Automated and Objective Assessment of Fabric Pilling. *Int J Adv Robot Syst,* 11:171 | doi: 10.5772/59026.

PHYSICOCHEMICAL STUDIES OF POLYMER AFFINITIES ON VISCOSE FABRICS

Burcu Büyükkoru[1,2], Ali Kara[1]

[1]*Uludağ University, Bursa, Turkey*

[2] *Rudolf-Duraner*

burcubuyukkoru@hotmail.com

Textile auxiliary products confer different characteristics to fabrics. Adjusting the water absorption capacity, giving special handle, improving anticrease properties, abrasion resistance, tear strength, sewebality are the most common features which are desired to be obtained by textile chemicals. Nowadays, decreasing pilling tendency is one of the most important topics. Fabrics that have a pilling show serious quality problems and have not been desired in textile industries.

Pilling is a fabric defect which is observed as small fibre balls or groups consisting of intervened fibres that have been attached to the fabric surface by one or more fibres. The stages of the mechanism of pilling formation are fuzz generation, entanglement of fuzz into pills and pill wear off. To reduce the forming of pills some useful methods were reported. These methods are application of chemical finishing, solgel technology, APP treatment, using enzymes and NaOH treatment. Most of these methods can work on some special fabrics, but they are not totally effective for all fabrics. Although these methods can be useful for cotton, wool or polyester fabrics, it is hard to say that these methods can also work for viscose fabrics. For this reason, application of antipilling polimers is another way which has to be taken into consideration.

In our project, we decrase pilling tendency of the viscose fabrics thanks to polymer we synthesized. Besides, the handle of the fabrics should be soft and slipperly. It is also preferred that the fabrics are hydrophilic after poymer application. To conclude, we synthesized polymer, after that we applied our antipilling polymer to viscose fabrics and researched physicochemical studies of polymer affinities on these fabrics.

ACKNOWLEGEMENT

I sincerely thank Dr. Ö. Nafi Yavuz who is the factory manager of the Rudolf Duraner for providing me the oppurtunity to work on this project. Martindale abrasion pilling tester and all fabrics can be used for the supply of Rudolf-Duraner. I am also grateful to this company.

Key Words: Viscose fabrics, pilling, polymers

REFERENCES

[1] Hussain, T., Ahmed, S., Qayum, A. 2008. Effect of different softeners and sanforising treatment on pilling performance of polyester/viscose blended fabrics. Society of Dyers and Colourists, Color. Technol., 124: 375–378.

[2] Bui, H. M., Enhrhardt, A., Bechtold, T. 2008. Pilling in Man-Made Cellulosic Fabrics, Part 1: Assesment of Pilling Formation Methods. Journal of Applied Polymer Science, 110: 531-538.

STUDY OF COTTON FIBRES DEVELOPED FOR IMPROVED PROPERTIES

Özgür Ceylan[1], Karen De Clerck[2]
[1] Anadolu University, Faculty of Architecture and Design, Department of Fashion Design, Eskişehir, Turkey
[2] Ghent University, Faculty of Engineering and Architecture, Department of Materials, Textiles and Chemical Engineering, Ghent, Belgium
ozgurceylan@anadolu.edu.tr

INTRODUCTION

Today's cotton fibres have developed over the last centuries, with the fibres being longer and stronger than a few centuries ago. Many of these improvements can be attributed to continues research and advanced breeding projects. Although quite some work has been done to optimize mechanical properties, a possible improvement of the intrinsic chemical properties is lagging behind. Profound studies on the novel fibre properties are essential to allow the development of bioengineered cotton fibres that are well-tuned and designed for demanding end applications. The target properties that are focused on in this work are namely reactivity/dyeability and thermal properties.

MATERIALS AND METHODS

Different types of cotton fibres were delivered by Utexbel (Ronse, Belgium) and by Bayer CropScience N.V. (Ghent, Belgium). The dyes and chemicals used were obtained from Sigma-Aldrich and Dystar.

All dyeing experiments were performed in a Mathis Labomat BFA-8 lab dyeing machine, using sealed stainless steel dye pots. A Perkin Elmer Lambda 900 double beam spectrophotometer was used to obtain UV-Vis spectra. The % nitrogen of fibres was determined in duplicate by the Kjehdahl method.

Thermogravimetric analysis experiments were carried out in a Q 5000-instrument from TA-instruments.

RESULTS AND DISCUSSIONS

A novel test method based on the absorption of Acid Orange 7 dye is established for the screening of bioengineered cotton fibres. The proposed method is intended to screen fibres containing chitin and therefore validated with cotton fibres containing increasing levels of a cationic agent and was validated using a well-established technique for nitrogen analysis.

A very high correlation value (R2=0,94) is obtained between Acid Orange 7 and Kjehdahl methods. This result demonstrates that Acid Orange 7 provides reliable accuracy and reproducibility to measure even the small differences in fibre reactivity.

Testing thermal properties of materials presents specific technical and scientific challenges. These tests are commonly applied on finished fabrics rather than loose fibres. A potential solution to this problem is to use small-scale thermal testing techniques to screen novel fibre lines prior to scale-up for a larger size production. Thus, the thermal decomposition of cotton fibres with various maturities and, in relation to this, the effect of water immersion on the thermal behaviour of cotton fibres is thoroughly investigated using Thermogravimetric Analysis.

A clear difference is noted between the degradation profile of the water immersed and untreated fibres with low maturity ratios. These differences were ascribed to the water-soluble fraction content.

CONCLUSIONS

A spectrophotometric method based on the absorption of CI Acid Orange 7 dye was studied and validated for the detection of differences in dyeability/reactivity between bioengineered fibres. Also, to obtain a better insight into the effect of the fibre structure and composition on the thermal degradation, a thermogravimetric study on cotton fibres is performed. The water-soluble content was found to be important factors influencing the thermal behaviour of raw cotton fibres.

Key Words: Cotton, bioengineering, test methods

FUNCTIONALIZING TEXTILE FIBERS USING BY MONOMER REACTOR WITH PLASMA METHOD

Ayşe Gizem Demir, Tülay Gülümser
Ege University, Faculty of Engineering, Department of Textile Engineering, İzmir, Turkey
aysegizemdemir@gmail.com

In textile materials, physical, chemical or physicochemical changes can be made in order to functionalize the material. Some of the disadvantages of physical and chemical methods on the material made the studies focus on physicochemical modifications. Plasma technology performs surface modification on textured surfaces using physicochemical methods. Today, environmentally friendly techniques for textile material production are as important as the quality of the products. With the help of the plasma method, environmentally sensitive and clean production is possible in gas phase with various savings. With the monomer reactor, which can be added to the plasma device, various chemicals can be bonded to the groups can be formed in the material with surface modification, without dissolving in water. In this study, information was given about the studies carried out in order to gain various functional properties with plasma modification to textile materials.

Key Words: Plasma technology, surface modification, monomer reactor, functional textiles

REFERENCES

[1] KANG, J., SARMADİ, M., Textile Plasma Treatment Review- Natural Polymer Based Textiles, AATCC Review, 2004, 28-32s.
[2] KARAHAN, A., Atmosferik Plazma Kullanılarak Doğal Liflerinin Yüzeysel Özelliklerinin Değiştirilmesi Üzerine Bir Araştırma, Yüksek Lisans Tezi, Ege Üniversitesi Fen Bilimleri Enstitüsü, İzmir, 2007, 257s.
[3] SEVENTEKİN, N., ÖZDOĞAN,E., Atmosferik Plazma Tekniğinin Sentetik Tekstil Materyallerine Uygulanabilirliğinin Araştırılması, 2008, 104s.
[4] SPARAVIGNA A., Plasma Treatment Advantages For Textiles, Date Of Access: 08.05.2017 Available On Https://Arxiv.Org/Ftp/Arxiv/Papers/0801/0801.3727.Pdf.

[5] Edited By SHISHOO R., Plasma Technologies For Textiles, Woodhead Publishing In Textiles, The Textile Instute, England, 2007.
[6] Edited By RAUSCHER H., PERUCCA M., BUYLE G., Plasma Technology For Hyperfunctional Surfaces, Food, Biomedical And Textile Applications, WILEY-VCH, 2010.
[7] CHEN G.L., CHEN W.X., YU J.S., HU W., Partial Hydrophilic Modification Of Biaxially Oriented Polypropylenefilm By An Atmospheric Pressure Plasma Jet With The Allylamine Monomer, Elsevier Science, 2016.
[8] HOCHART F. Et Al., Graft- Polymerization Of A Hydrophobic Monomer Onto PAN Textile By Low-Pressure Plasma Treatments, Elsevier Science, Surface And Coatings Technology, 2002, 165, 201–210.
[9] DAVIS R. Et Al., Use Of Atmospheric Pressure Plasma To Confer Durable Water Repellent Functionality And Antimicrobial Functionality On Cotton/ Polyester Blend, Elsevier B.V., Surface & Coatings Technology, 2011, 205, 4791–4797.
[10] HUANG C., LIN H.H., LI C., Atmospheric Pressure Polymerization Of Super-Hydrophobic Nano-Films Using Hexamethyldisilazane Monomer, Springer, Plasma Chem Plasma Process, 2015, 35:1015-1028.
[11] DALKILIÇ H., Medikal Ürünlerin Modifikasyonunda Plazma Kullanımı, Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi Fen Bilimleri Enstitüsü, İzmir, 92s.
[12] ZANINI S. Et Al., Surface Properties Of HDMSO Plasma Treated Polyethylene Terephthalate, Surface & Coatings Technology, 2005, 200, 953-957.
[13] JI Y-Y. Et Al., Formation Of Super-Hydrophobic And Water-Repellency Surface With Hexamethyldisiloxane (HMDSO) Coating On Polyethyleneteraphtalate Fiber By Atmosperic Pressure Plasma Polymerization, Surface & Coatings Technology, 2008, 202, 5663-5667.
[14] SAMANTA K.K Et Al., Study Of Hydrophobic Finishing Of Cellulosic Substrate Using He/1,3-Butadiene Plasma At Atmospheric Pressure, Surface & Coatings Technology, 2012, 213, 65-76.

ANALYSING THE CONSUMER BEHAVIOUR AND THE INFLUENCE OF BRAND LOYALTY IN PURCHASING SPORTSWEAR PRODUCTS

Nazan Erdumlu, Canan Sarıçam, Muhammed Tüfekyapan, Metin Çetinkaya, Ahmet Cem Dönmez

İstanbul Technical University, Faculty of Textile Technologies and Design, İstanbul, Turkey

okurn@itu.edu.tr

Brand loyalty is an important term that defines the relationship between customer and brand and expresses the extent to which customers feel that they are in synchronization with the brand [1]. Aaker defines [2] brand loyalty as a situation which reflects how likely a customer will be to switch to another brand, especially when that brand makes a change, either in price or in product features. Defined as above, brand loyalty was analysed as one of the major component of brand equity by several researchers [3-6].

It is important for the retailers to have a large loyal consumer base. The loyalty enables the consumers to develop habits such as making purchases from the same brand or same retailer and as consumers become more loyal, they do not prefer to assess the other alternatives such as lower price, attractive promotions and they are less likely to switch to other rivals. On the other hand, some product categories are more convenient for the consumers to develop loyalty. For instance being highly functional and technology intensive products, sportswear is one category of apparel products for which the consumers usually make their decision considering the brands.

However, studies exploring the brand loyalty of consumers to apparel products particularly sportswear products are quite limited. Competing in a harsh environment, the sportswear brands and retailers should find out level of loyalty of their consumers and the approaches of consumers towards sportswear products. In this study, it was aimed to analyse the consumer loyalty to the leading sportswear retailers in Turkey. To reach this aim, a survey was prepared including questions about socio demographic characteristics, sportswear purchasing habits of the consumer and questions measuring consumers' brand loyalty which were adopted from the previous studies [4-6]. The survey was conducted among 190 participants aged between 18-40 and the results were analysed statistically.

The results revealed that 54.7% of the participants are male while 45.3% of the participants are female. Most of the participants (65.8%) are between the ages of 18-23 and 64.7% of them are attending undergraduate. Regarding the purchasing habits of the participants, it can be stated that 56.3% of the participants spent 0-10% of their monthly income for sportswear, which was followed by 28.4% of the participants that spent 10-20% of that amount. Moreover, the shopping frequency was expressed to be once-twice in a year by 62.6% and once-twice in three-month time by 23.2% of the participants. Being inquired with 9 questions and 7-point Likert scale, regarding the brand loyalty, more than half of the participants identified themselves as loyal customers in terms of sportswear products. The loyal consumers stated that they will continue to buy from these brands in the future and recommend to others. Expressing the reason for loyalty, the majority of the participant related their loyalty to the outstanding product properties of this brand. Finally, the participants are less likely to switch to the other brands even if the other brands offer attractive promotions.

In conclusion, it was found out that the sportswear consumers in Turkey are medium to high level loyal to the sportswear brands, which means that the retailers should concentrate on the activities, which increase the loyalty of consumers. However, these activities should be particularly underline the outstanding features of the products rather than the other components of marketing mix, which are promotion, price and place.

Key Words: sportswear, brand loyalty, Aaker, consumer behaviour

REFERENCES

[1] Keller Kl 2003 Strategic Brand Management: Building, Measuring and Managing Brand Equity, (New Jersey :Prentıce-Hall, Englewood Clıffs).

[2] Aaker Da 1991 Managıng Brand Equıty (New York: The Free Press).

[3] Atılgan E, Aksoy S, Akıncı S, 2005, Determınants Of The Brand Equıty A Verıfıcatıon Approach In The Beverage Industry In Turkey, Marketıng Intellıgence & Plannıng 23 237
[4] Kım Wg, Kım Hb, 2004, Investıgatıng The Relatıonshıp Between Brand Equıty And Fırms' Performance, Cornell Hotel And Restaurant Admınıstratıon Quarterly 45 115
[5] Tong X, Hawley Jm, 2009, Measurıng Customer-Based Brand Equıty: Empırıcal Evıdence From The Sportswear Market In Chına", Journal Of Product & Brand Management, 18 262
[6] Yoo B, Donthu N, 2001, Developıng And Valıdatıng A Multıdımensıonal Consumer-Based Brand Equıty Scale, Journal Of Busıness Research 52 1

ANALYSIS OF THE COMPONENTS AFFECTING PRODUCT COST IN APPAREL SECTOR

Emine Rümeysa Eren[1], Oktay Pamuk[2]
[1] Beykent University,
[2] Ege University, Faculty of Engineering, Department of Textile Engineering, 35100, İzmir, Turkey
rumeysaeren@hotmail.com

Businesses should determine the need for materials to respond to customer orders and requests, to plan production conditions, and to calculate the product price. Determination of material need and cost is important for preliminary cost calculation, pre-production inventory control, supply of quantity needed and progress of production.

The components that make up the cost of the product should be identified to calculate the cost of a product and analyze costs. In ready-to-wear businesses, the first place is fabric cost that the biggest share is the main raw material in total cost and direct labor cost is in the second place. From past to present, the cost of raw materials and auxiliary materials maintains a significant share in cost distribution. Financing, depreciation, management, marketing and overhead costs constitute other cost components. In order for the cost calculations to be done correctly and accurately, it is necessary to know and calculate other expenditure types besides material and labor costs.

Costs incurred in manufacturing enterprises can be classified into two groups as production cost and term cost. Measurable value that is spent on all components of a business to generate a product and the cost that can be installed on the product creates the cost of production. Production cost is affected by many factors such as price, productivity, capacity, production technology, quality of products and services, management structure, flexibility of production system, order quantity, social development and economic situation in the country, size of enterprise and place of establishment. Optimally combining these factors as much as possible will have positive effects that reduce costs. Production cost includes material, labor and general production costs. In terms of cost, factors to be considered when choosing raw materials and auxiliary materials used as production inputs; suitability to the target market, suitability for the purpose of use, suitability for the quality of the product and the unit cost of the planned material. The monetary value of operating expenses consisting of goods and services consumed and consumed during a certain accounting period in order for the enterprises to maintain their normal operation and existence is called period cost. Research and development, marketing, financing and general administrative expenses constitute the period cost. With the development of production technique methods, the changing and widespread management approach, the share of period costs increased in total cost and the share of production costs started to decrease.

Savaş (2003) analyzed the factors affecting the success of the target cost management system and classified them into factors related to the competitive environment, customer profile, sector profile, product and company profile and investigated the situation of the Turkish garment sector in terms of these factors. Vuruşkan and Bulgun (2006) examined the cost components of the unit product in ready-to-wear and ready-to-wear sector and expressed the percentage values of the total product cost of the components with graphical representations. Kothari and Joshi (2012) have examined the cost components in the confection and have emphasized the importance of cost management in terms of companies that sell products directly to the final consumer. In order to determine the sustainability of the Turkish textile and apparel sector's competitive advantage, Gacener Atış (2014) analyzed the present situation and the level of competition in the most important markets of Turkey, the European Union, the United States and the Middle East-North Africa, according to competitive sectors. Choudhary (2015), apparel cost analysis; manufacturing, fabrics, cutting, labor, overhead, sales commission, a manufacturer's profit and transportation costs. Clothing classified production cost as preliminary cost and final cost.

On this reserach, the components forming the product cost and the factors affecting these components were investigated and analyzed with sample applications considering the frequent and continuous costing requirements in a rapidly increasing competition of garment manufacturers.

Key Words: Ready-wear cost, product cost, production cost, cost components

REFERENCES

[1] Acar, V. ve Aktaş, R., 2010, Üretim İşlevi ve Maliyet Muhasebesi Etkileşiminde Maliyet Muhasebesi Eğitiminden Beklentiler: Uygulama Eğitimi Model Önerisi, Atılım Üniversitesi İşletme Fakültesi ve Dumlupınar Üniversitesi İktisadi ve İdari Bilimler Fakültesi İşletme Bölümü, Alanya XXIX.Muhasebe Eğitimi Sempozyumunda Bildirisi, 94s.

[2] Bilim Sanayi ve Teknoloji Bakanlığı (BSTB), 2013, Türkiye Tekstil, Hazır giyim ve Deri Ürünleri Sektörleri Strateji Belgesi ve Eylem Planı 2015-2018, T.C. Bilim Sanayi ve Teknoloji Bakanlığı Sanayi Genel Müdürlüğü, 75s.

[3] Choudhary, A. S., 2015, Cost Analysis in Garment Industry. International Journal of Recent Advances in Multidisciplinary Research, 2(09), pp.0702-0704

[4] Dayanıklı, F., 2009, Dokuma Konfeksiyon İşletmelerinde Üretim Parametrelerinin Hesaplanması Üzerine Bir Bilgisayar Programının Geliştirilmesi, Dokuz Eylül Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi Tekstil Mühendisliği Bölümü, Tekstil Teknolojisi Anabilim Dalı, İzmir.

[5] Gacener Atış, A., 2014, Türkiye'nin Tekstil ve Konfeksiyon Sektörünün Karşılaştırmalı Rekabet Analizi, Ege Academic Review, 14(2), 315-334s.

[6] İstanbul Ticaret Odası (İTO), 2007, Hazır Giyim Sektörü ve Çin Mallarıyla Rekabet Gücü, 15, İstanbul, 35-36s.

[7] Kasapoğlu, Ö., 2007, Organik Pamuk ve Organik Pamuk İplikçiliğinde Maliyet Hesapları, İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü Tekstil Mühendisliği Yüksek Lisans Tezi, İstanbul.

[8] Kothari, V. R., and Joshi, S., 2012, Fashion Merchandising: Garment Costing.

[9] Milli Eğitim Bakanlığı (MEB), 2012, Giyim üretim teknolojisi üretim organizasyonu-II, T.C. Millî Eğitim Bakanlığı, Ankara.

[10] Savaş, O., 2003, Hedef Maliyet Yönetim Sisteminin Başarısını Etkileyen Faktörler Üzerine Türk Hazır Giyim Sektöründe Bir Araştırma, Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, Sayı: 20, 183-201s.

[11] Temel Eğitim ve Staj Merkezi-1 (TESMER-1), 2016, "Maliyet Muhasebesi", Türkiye Serbest Muhasebeci Mali Müşavirler ve Yeminli Mali Müşavirler Temel Eğitim ve Staj Merkezi.

[12] http://home.anadolu.edu.tr/~vekergil/resim/Dersler/Tesmer/Tesmer%20IV-1.ppt (Erişim tarihi: 28 Mart 2016)

[13] Vuruşkan, A., ve Bulgun, E. Y., 2006, Hazır Giyim ve Konfeksiyon Sektöründe Ön Maliyet Tahminlime: Ege Bölgesindeki Konfeksiyon Firmalarına Yönelik Bir Araştırma, Cilt: 13, 64s.

SURFACE MODIFICATION OF TEXTILE MATERIALS VIA OZONE TREATMENT FOR COMPOSITES

<u>Hüseyin Aksel Eren</u>[1], Semiha Eren[1], Zaide Saka[1], Ozan Avinç[2]
[1] Uludağ University, Bursa, Turkey
[2] Pamukkale University, Denizli, Turkey
aksel@uludag.edu.tr

A composite material is a microscopic combination of two or more distinct materials, having a recognizable interface between them. Most composites consist of a bulk material (matrix), and a reinforcement material added primarily to increase the strength and the stiffness of the matrix. Fiber-reinforced composites are used in many different areas. In a composite material, the textile fibers are surrounded by a thin layer of matrix material that holds the fibers in the desired orientation. The strength of the adhesion between the fiber and the matrix strongly depends on the surface properties of the fiber. However, in some cases fiber surface characteristics are not very suitable for good adhesion or high rates of particle collection. Many approaches have been investigated to improve the textile fiber matrix interfacial properties. The mechanical properties of a fiber-reinforced composite depend mainly on the degree of adhesion between the fiber and the matrix. When a material interacts with another or with the surrounding environment, it is the nature of the surface field of forces that determines the kind of interaction. Several theories have been introduced to provide an explanation for adhesion phenomena. However, no single theory explains the adhesion in a general, comprehensive way. Presently four main mechanisms survive, involving physical or chemical forces. These are: mechanical interlocking, interdiffusion, electrostatic interaction and chemical interactions. In order to improve the textile fiber–matrix adhesion, many surface treatments have been developed including ray radiation, electrochemically oxidation, plasma treatment, ozone (O_3), etc. Surface modification of polymers via ozone treatment is a convenient and efficient method for introducing specific functionalities, such as hydrophilicity or hydrophobicity, into existing polymers. Obtained results indicate that ozone treatment is the most efficient methods for improving surface layer adhesive properties. Surface functional groups and the surface energy of fibers are considered to be critical properties in predicting the adhesion between fiber and matrix. In this paper, detailed information about the surface modification of textile materials with ozone treatment for composites will be given and explored.

Key Words: Surface modification, ozone method, ozonation, composite, interfacial adhesion

REFERENCES

[1] Q. Wei (2009), 'Surface Modification Of Textiles'

[2] Garbassi F, Morra M And Occhiello E (1994) ' Polymer Surfaces From Physics To Technology'

[3] Jennings C W (1972), ' Surface Roughness And Bond Strength Of Adhesives'

[4] S. Weidner, G. Kuhn, R. Decker, D. Roessner, And J.Friedrich, J Polym. Sci. Part A: Polym. Chem., (1998).

[5] M.J. Walzak, S. Flynn, R. Foerch, J.M. Hill, E. Karbashewski, A. Lin, And M. Strobel, J Adhes. Sci. Technol, 1229 (1995).

[6] H.-Y. Nie, M.J. Walzak, B. Berno, And N.S. Mcintyre, Appl. Surf. Sci., 144/145, 627 (1999).

[7] C.U. Pittman Jr., W. Jiang, Z.R. Yue, S. Gardner, L. Wang, H. Toghiani, C.A. Leon Y Leon, Surface Properties Of Electrochemically Oxidized Carbon Fibers, Carbon 37 (1999) 1797–1807.

[8] S. Golczak, A. Kanciurzewska, J.J. Langer, M. Fahlman, Degradation Of Microporous Polyaniline Film By Uveozone Treatment, Polym. Degrad. Stab. 94(2009) 350.

[9] M. Kłonica, J. Kuczmaszewski, M.P. Kwiatkowski, J. Ozonek, Polyamide 6 Surface Layer Following Ozone Treatment, Int. J. Adhes. Adhes. 64 (2016) 179.

[10] T. Oku, A. Kurumada, K. Kawamata, M. Inagaki, Effects Of Argon Ion Irradiation On The Microstructures And Physical Properties Of Carbon Fibers, J. Nucl. Mater. 303 (2002) 242–245.

[11] Zheng Jin , Zhiqian Zhang, Linghui Meng ' Effects Of Ozone Method Treating Carbon Fibers On Mechanical Properties Of Carbon/Carbon Composites' August 2005

[12] J. Jang And H. Yang: J. Mater. Sci., 2000

[13] P. C. Varelidis, R. L. Mccullough And C. D. Papaspyrides: Compos. Sci. Technol., 1999
[14] J. Li And X. H. 'Sheng Surface Oxidation Of Carbon Fibre On Tribological Properties Of Peek Composites'

FAR INFRARED RAY (FIR) TECHNOLOGY AND FIR REFLECTING YARNS AND FABRICS

Mustafa Ertekin, Gözde Ertekin, Arzu Marmaralı
Ege University, Faculty of Engineering, Department of Textile Engineering, 35100, Bornova-İzmir, Turkey
mustafa.ertekin@ege.edu.tr

Far infrared ray (FIR) is a region in the infrared spectrum of electromagnetic radiation and is defined with a wavelength of 5.6 to 1000 μm. Far infrared waves are the safest and the most beneficial of the sun's waves. FIR has several beneficial effects such as increasing blood circulation, improving the body's metabolism, pain relief, reducing inflammation and regeneration of cells. In this study, a comprehensive review is given about far infrared rays, therapeutic effects, FIR reflecting yarns and fabrics, their application areas and biomedical laboratory studies using FIR reflecting yarns and fabrics.

Key Words: Far infrared rays (FIR), therapeutic effects, FIR reflecting yarns and fabrics

ACKNOWLEDGEMENT
This work was financially supported by Ege University Scientific Research Project Office [grant number 16-TKUAM-004].

PRODUCTION AND CHARACTERIZATION OF COMPOSITE POLYPROPYLENE YARNS FOR NO_2 GAS ADSORPTION APPLICATION

Duygu Gazioğlu Rüzgar, Şule Altun
Bursa Technical University, Bursa, Turkey
duygu.gazioglu@btu.edu.tr

Nowadays, most people spend significant part of their time indoors. Increased uses of industrial chemicals and enhanced air-tightness in building construction have caused serious indoor air pollution problems. Therefore, indoor air quality has strong impacts on human health and life quality.

In this study, composite PP yarns were produced to improve the indoor air quality. For this purpose, as additive commercially available activated carbon, zeolite and as master batch carrier polymer polypropylene had been used. The additives were added during the fiber extrusion process. The produced yarns were tested with gaseous indoor air pollutant (NO_2) for different time periods and gas adsorption values were measured.

Composite yarn tenacity tests were done according to the TS EN ISO 5079 standard. SEM characterizations and gas adsorption studies were done too.

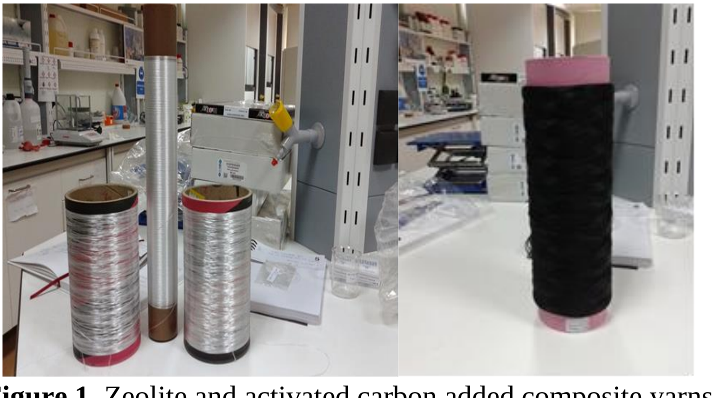


Figure 1. Zeolite and activated carbon added composite yarns

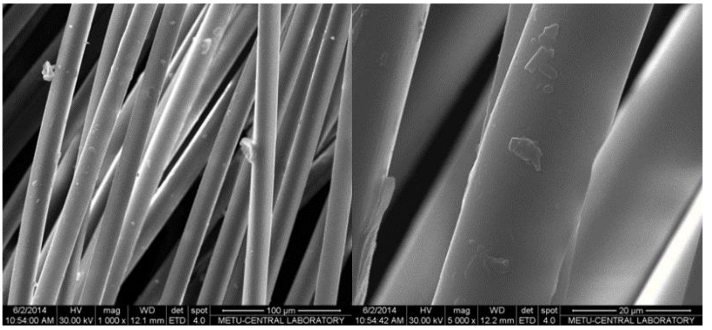


Figure 2. SEM images of zeolite added composite yarns

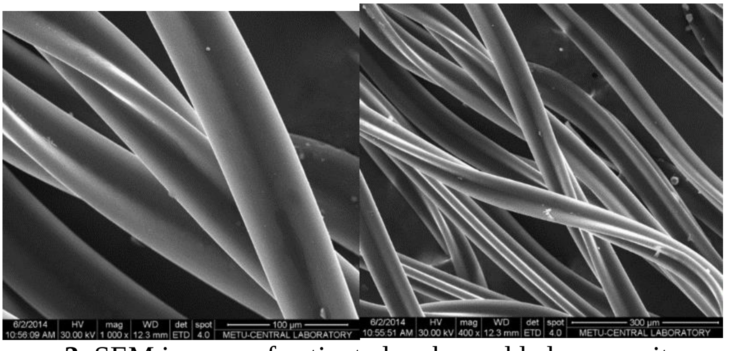


Figure 3. SEM images of activated carbon added composite yarns

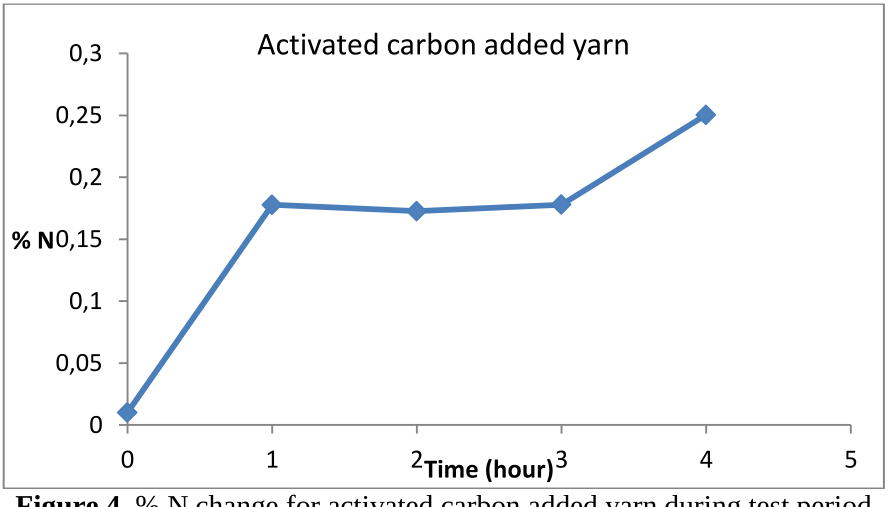


Figure 4. % N change for activated carbon added yarn during test period

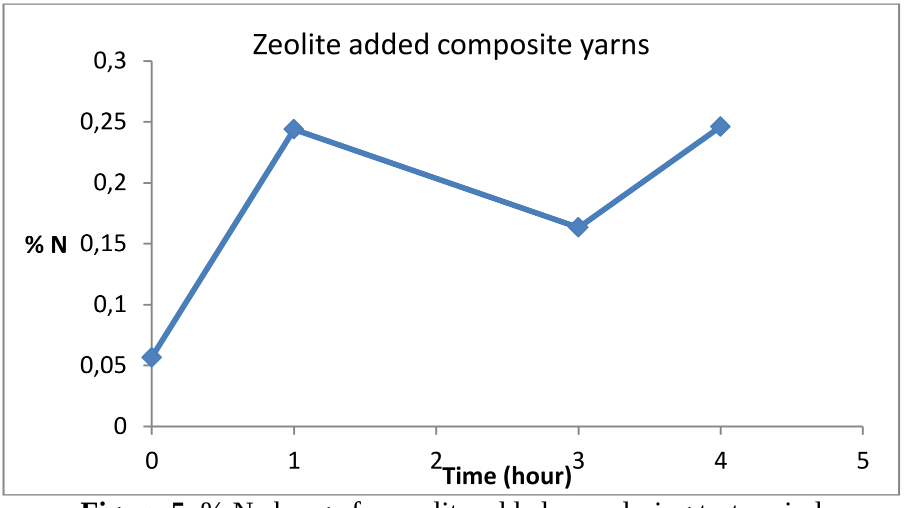


Figure 5. % N change for zeolite added yarn during test period

Key Words: Composite yarn, gas adsorption, indoor air quality

REFERENCES

[1] Albreight, R. L. 1986. “Porous Polymers As An Anchor For Catalysis”, Reactive Polymers, 4(2),155-174
[2] Alyüz, B., Veli, S. 2006. “İç Ortam Havasında Bulunan Uçucu Organik Bileşikler Ve Sağlık Üzerine Etkileri”, Trakya Univ J Sci, 7(2), 109-116.
[3] Chen, B., Hong, C., Kan, H. 2004. “Exposures And Health Outcomes From Outdoor Air Pollutants İn China, Toxicology, 198, 291–300.

ENVIROMENTAL EFFECTS OF TEXTILE WASHING HABITS IN TURKEY AND EUROPE

Fatma Gündüz Balpetek[1], Tülay Gülümser[2]
[1] Ege University Textile and Apparel Research-Application Center, Izmir, Turkey
[2] Ege University Faculty of Engineering, Department of Textile Engineering, Izmir, Turkey
fatma.gunduz@mail.ege.edu.tr

Maintenance procedures of textile products are laundry, dry cleaning and ironing. According to the A.I.S.E (International Association for Soaps, Detergents and Maintenance Products) report in 2014, 35.60 billion laundry washes are performed each year in Europe. This is equivalent to 2.97 billion washes a month, 684 million washes a week, and 98 million washes a day. 1,100 washing cycles are started every second in Europe [1]. Total market value of the overall detergents and maintenance products industry (for both household and professional cleaning and hygiene products) for 2014 is estimated to be 35 billion € and for laundry care it is estimated to be 13,620 million € [2]. When these results are taken into account, the consumer usage habits in washing processes of textile products are gaining importance. In this study, the average values of parameters such as washing temperature, washing load, water consumption and energy consumption of washing processes were given for textile cleaning / care in Turkey and some of the environmental effects of washing habits in Turkey were evaluated.

1. INTRODUCTION

Washing processes for domestic use of textile products are mostly done by washing machines in Europe. Energy and water used in the washing process are affected by the type of the machine such as horizontal axis or drum, vertical axis or impeller. In general, drum type machines use less water, but more energy. The energy consumption is much lower for the impeller type of machines, because in most vertical machines the washing water is not heated internally and therefore, the laundry process is performed at low temperature. Temperature of washing is the most important factor for energy consumption of a washing machine. Also, washing program and washing load are affected by energy consumption.

For example, cotton program can be use higher temperature whereas synthetic program or wool program requires low temperatures [3].

Stamminger et al. (2005) published an average water consumption of 59 L per wash cycle with a load size of 5 kg for washing machines built in 2000. The German Öko-Institut reports 61 L for washing machines in stock in 2006 (Rüdenauer et al. 2006). According to Pakula and Stamminger (2010), an average consumption per wash cycle is estimated 60 L for all European countries [4].

Filling grade should be select lower for delicate and wool textiles. For example, maximum load for delicate program is 2 kg/cycle and for cotton program 4,5-6 kg/cycle. As a result of decreasing of filling grade, number of washing cycle, energy and water consumption increase.

Water and energy consumption of domestic laundering for average load of 3,7 kg/cycle is given in Table1.[3]

Table 1. Yearly energy and water consumption for automatic laundry washing per household in Turkey [3]

Country	Turkey
Number of household year (×1,000)	17,698
Average wash temperature (°C)	42,5
Energy consumption/wash cycle (kWh)	0,63
Number of wash cycles/year	135
Energy consumption/household/year (kWh)	85,6
Water consumption/household/year (m^3)[a]	6,8

[a]Based on 50 L water consumption per wash cycle

Hardness of water interfere the cleaning action of soaps and detergents. Due to surfactant molecules that react with water, larger amounts of detergents are needed to counteract the hardness minerals, and cleaning performance results are not as good as when there is no hardness. Also, hard water may lead to precipitation of $CaCO_3$ on surfaces in contact with water, particularly in devices operated at elevated temperatures such as washing machines [5]. Therefore, setting of temperature in machine become difficult and energy consumption may increase.

The consumer habits data was obtained from the Turkish Consumer Habits & Attitudes (HA) report and Technical Observation Survey of the year 2006, provided by Unilever Turkey [6].

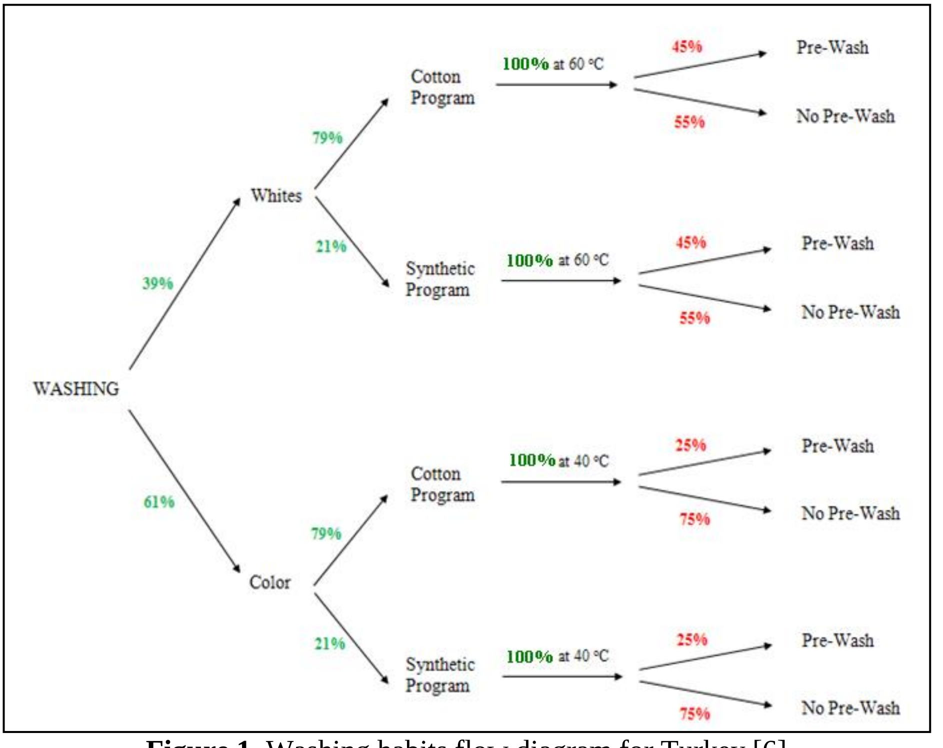


Figure 1. Washing habits flow diagram for Turkey [6]

CONCLUSION

Consumers' washing habits are changing by the time. A large portion of clothing is washed purely habitually rather than evaluation of soiling level first. The cleaning performance is changed depending on the filling grade, washing program, duration, temperature, water hardness, type of detergent as well as level of soiling on textiles. Understanding of environmental effects of domestic washing requires an understanding of consumer's attitudes, habits and prejudices as well as information on how relevant variables such as washing temperature, filling grades, detergent use and drying methods [7]. In this study, the average values of parameters such as washing temperature, washing load, water consumption and energy consumption of washing processes were given for textile cleaning / care in Turkey and some of the environmental effects of washing habits in Turkey were disclosed. When these results are taken into account, the consumers' usage habits in washing processes of textile products are gaining importance.

Key Words: Water consumption, energy consumption, washing habits

REFERENCES

[1] https://www.aise.eu/documents/document/20140211164810-final_aise_habits_survey_2014update.pdf

[2] https://www.sustainable-cleaning.com/content_attachments/documents/AISE_ARSR2015_lowdef.pdf

[3] Gooijer, H., Stamminger, R., Water and Energy Consumption in Laundering Wordwide-A Review, Tenside Surfactant Detergent, Vol.53, Page:402-409, 2016.

[4] Pakula, C. , Stamminger, R., Electricity and water consumption for laundry washing by washing machine worldwide, Energy Efficiency (2010) 3:365–382, DOI 10.1007/s12053-009-9072-8

[5] Abeliotis, K., Candan, C., Amberg, C., Ferri, A., Osset, M., Owens, J. and Stamminger, R., 2015, Impact of water hardness on consumers' perception of laundry washing result in five European countries, International Journal of Consumer Studies, 39 (2015), 60–66.

[6] Cılız, N., Mammadov, A., Turhan N., Life Cycle Assessment of Powder and Liquid Laundry Detergents, Boğaziçi University, Sustainable Development and Cleaner Production Center, 01.11.2010.

[7] Laitala, K., Boks, C., Grimstad Klepp I., Potential for environmental improvements in laundering, International Journal of Consumer Studies, Vol. 35, Page: 254–264, 2011, DOI: 10.1111/j.1470-6431.2010.00968.x

AN INVESTIGATION ON ABRASIVENESS OF DIFFERENT SEWING THREADS

Mehdi Hatamlou[1], Gamze Süpüren Mengüç[2], Gonca Özçelik Kayseri[2], Arif Taner Özgüney[1] , Nilgün Özdil[1]

[1] Ege University Faculty of Engineering, Department of Textile Engineering, Izmir, Turkey

[2] Ege University, Emel Akin Vocational Training School, Bornova, İzmir, Turkey

mhatamloo@gmail.com

Sewing threads designed to work at the high operating speeds of the sewing machines cause abrasion as a result of friction among different parts of the machine. Abrasion which is generated during the usage of sewing threads that have different surface properties depends on various working parameters such as speed and yarn tension. There are numerous studies concerning sewing threads in the literature. In most of these studies, the relationship between sewing thread properties and various mechanical properties of sewn fabrics were investigated. Seam strength and seam slippage resistance are the most studied fabric mechanical properties among them. In addition to this, the multiple effects of sewing thread and sewing type on seam strength is another investigated parameter. However, the abrasiveness due to the structural characteristics of the sewing thread has not been investigated yet. In this study, it is aimed to measure the abrasiveness of sewing threads in machine elements, which is occurred due to the friction of thread and machine parts under a certain usage tension. For this purpose, an objective abrasion measurement system, CTT (Constant Tension Transport) device was used to measure yarn abrasiveness. The relationship between test results and other yarn properties were analyzed.

Key Words: Sewing threads, CTT (Constant Tension Transport), yarn abrasiveness

REFERENCES

[1] Behera, B.K., Chand, S., Singh, T.G., Rathee P.,1997, "Sewability of Denim", International Journal of Clothing Science and Technology, 128-140

[2] Korkmaz Y., Çetiner S., dikiş mukavemetine etki eden denim kumaş ve dikiş ipliği parametrelerinin araştırılması, the journal of textil and engineer, Sayı:65, Sayfa: 24-28, 2013

[3] Mori, M., Niwa, M.,1994, "Investigation of the Performance of Sewing Thread" , International Journal of Clothing Science and Technology, 20- 27.

[4] Matukonis, A., Kauzoniene, S., Gajauskaite, J. Fric-tional Interaction Between Textile Yarns.- Materials Science, 1999, No4, p. 50-52.

[5] Wegener, W., Shuler, B. Determination of the friction coefficient.- Textilindustrie, 1964, No6, p.458-463

[6] Gardner, F.F., B. Burtonwood, D.L. MUNDEN, 1978. "The Effect of Angle of Angle of Bias and Other Related Parameters on Seam Strength of Woven Fabrics", clothing Research Journal, No.6, 130-140.

OZONE BLEACHING OF COTTON IN WATER

Ersin Dobur[1], Ayşegül Körlü[2], Kerim Duran[2]
[1] Ege University, Graduate School of Natural and Applied Science, İzmir, Turkey
[2] Ege University, Faculty of Engineering, Textile Engineering, İzmir, Turkey
aysegul.ekmekci@ege.edu.tr

Ozone was first acknowledged in 1840 by the German chemist C. F. Schönbein (1799–1868). Ozone is thermodynamically unstable and spontaneously reverts back into oxygen. Ozone is a strong oxidizing agent, capable of participating in many chemical reactions with inorganic and organic substances. Ozone was first proposed as a bleaching agent for wood in 1871. It is currently being used by a growing number of mills to produce fully bleached hardwood and softwood pulps that have mechanical properties compatible with most paper making applications.[1]

Ozone, a highly unstable compound in water, liberates radicals according to the pH of the medium, and can also be used for bleaching of cellulose much faster than hydrogen peroxide and hypochlorite, much like its use in bleaching of wood pulp. But this process induces some damage to cellulose.

Nowadays, ozone gase is a very popular agent in scientific researches about bleaching of textile materials. [1-5] Gase form of ozone is not so practical in finishing mill. Because a lot of finishing machines and systems are suitable for liquid.

The study is about bleaching of cotton with ozone in water. 0,8 ppm ozone discharged into water and then cotton fabrics were bleached witn ozone in water for 15-45-90 minutes. Bleaching temperatures were 25-55 and 70°C at pH 4. Whiteness, yellowing index were evaluated according to ASTM WI E313 [D65/10°] and ASTM YI E313. Damage of the fabrics were determined breaking strength, harrison's silver test and Fehling's solution.

During the bleaching processes some technical problems were available because of bleaching machine design and unstability of ozone gase.

Although unstability of ozone gase, the results show that ozone in water can be used as bleaching agent for cotton. The highest whiteness degree obtained at low temperature for 45 minutes. All the bleached fabrics were in usable form. Because chemical damage was not high.

ACKNOWLEDGEMENT
The authors are gratefully acknowledge the support of Ege University Scientific Research Project Department through the number 12-MÜH-52.

Key Words: Bleaching, ozon, cotton, pretreatment

REFERENCES

[1] Perincek S. D., Duran K., Körlü A. E., Bahtiyari İ. M., Ozone: Science and Engineering, 29 (2007) 325–333

[2] D Sargunamani., N Selvakumar., Polymer Degradation and Stability 91 (2006) 2644-2653

[3] Eren H. A., Öztürk D., Textile Research Journal, 81(2010) 512–519

[4] Perincek S.D., Duran K., Körlü A. E., Ozone: Science & Engineering, , 35 (2013) 316–327

[5] Perincek S. D., Duran K., Körlü A. E., Ozone: Science & Engineering, , 37(2015), 195-202

A NEW APPROACH TO THE USE OF INNOVATIVE MATERIALS IN TEXTILE AND FASHION DESIGN: SANDWICH STRUCTURES

Derya Meriç, Nesrin Önlü
Dokuz Eylül University, Faculty of Fine Arts, Department of Textile and Fashion Design, İzmir, Turkey
deu.deryameric@gmail.com

The processes of function-based high-tech textiles starting with scientific studies in various medical, military and sports fields have inspired everyday use scenarios with the influence of today's world in relation to technology. Nowadays, these innovative textile solutions, which have been developed as research results, have become one of the important factors that guide the textile industry. Such that; in addition to experimental studies on the development of technology, products designed in recent years can be observed as technologies that can adapt to everyday life. When analyzing the samples and development processes of these products based on high technology basis in terms of materials and production methods, it is seen that developments parallel to the processes mentioned earlier have been experienced. In addition, these materials are a new and exciting material group with the potential for future use in today's applications. For this reason, in order to benefit from new product design possibilities in textile and clothing design, innovative material properties and usage areas need to be investigated and examined in depth.

Sandwich structures, which are used in various fields and which are developing methods, allow the multithreading of various materials and production techniques and have effects that can be different in terms of function and aesthetics in textile design field. It is possible to say that these structures have a great potential when they are examined within the scope of high-tech textiles today. The use of these structures in the field of innovative product design has begun to reveal remarkable and innovative working examples. It is possible to find examples of these function-based structures, as the examples given in military and medical fields, as well as in sports activities and daily use. Waterproof structures used in outdoor shoes or textile materials used in bedding could be good examples for these structures.

In this study, the definition and technical features of sandwich textiles are discussed and comparative analyzes of various sandwich textile structures composed of weaving, knitted and nonwoven surfaces are investigated and the possibilities of usage in today's textile and fashion design are investigated and possible usage scenarios with future values are discussed.

Key Words: Sandwich structures, spacer fabrics, innovative textile design, hig-tech textiles, function-based textile design

REFERENCES

[1] O'mahony, M. Advanced Textiles For Health And Well-Being. Thames & Hudson, 2011.

[2] Ertekin, G.; Marmaralı, A. Sandviç Kumaşlar. Tekstil Teknolojileri Elektronik Dergisi, 2010, 4.1: 84-98.

[3] Blaga, M., Et Al. Investıgatıon Of The Physıcal And Thermal Comfort Characterıstıcs Of Knıtted Fabrıcs Used For Shoe Lınıngs. Journal Of Textile & Apparel/Tekstil Ve Konfeksiyon, 2015, 25.2.

[4] Terlıksız, S. Sandviç Kumaşların Termal Konfor Özellikleri. 2013 Master Degree Thesis. Fen Bilimleri Enstitüsü.

[5] Bruer, S. M., Powell, N., Smıth, G. (2005). Three-Dimensionally Knit Spacer Fabrics: A Review Of Production Techniques And Applications, Journal Of Textile And Apparel, Technology And Management, 4, 1-31.

[6] Http://Www.Outdoorsports.Com/Posts/Gore-Tex.Aspx Date Accessed: 21.07.2017

[7] Dent, Andrew; Sherr, Leslie H. Material İnnovation: Product Design. Thames & Hudson, 2014.

[8] Http://Www.Knittingindustry.Com/Warp-Knitted-Spacer-Fabrics-Open-New-Design-Horizons/ Date Accessed: 21.07.2017

STATIC ELECTRICITY BEHAVIOR OF VARIOUS TEXTILE PRODUCTS USED IN GROUND FLOORS

Zeynel Deniz Mizmizlioğlu[1], Gamze Süpüren Mengüç[2], Faruk Bozdoğan[1], Emrah Temel[1]

[1] Ege University / Department of Textile Engineering / Ege University Campus, Bornova/Izmir

[2] Ege University / Emel Akın Vocational Training School / Ege University Campus, Bornova/Izmir

denizmizmiz@gmail.com

Synthetic carpets cause electrostatic charging and have negative effects both on health and on electronic devices which are widely used. Especially, as the electronic devices are statically charged, they cannot perform functionally. For this reason, static electricity problem plays an important role for the flooring materials which are used. In this study, the electrostatic properties of floor materials produced from different materials and different production techniques were measured according to TS EN 1149-1 and TS EN 1149-2 standards. In these methods, electrical resistance values both on surface and vertical directions are measured and the result is used as an indication for electrostatic charging propensity of the material. After the measurements, test results were analyzed by using statistical methods.

Key Words: Electrostatic properties, static electrification, electrical resistance, surface resistance, vertical resistance.

THE USE OF HAPTIC TECHNOLOGY IN TEXTILE

Okşan Oral, Esra Dirgar
Ege University Bergama Technical and Business College, İzmir, Turkey
oksan.kansoy@ege.edu.tr

The Textiles and Fashion Industries have become increasingly aware of the need to enhance the sensory experience for the potential customer when observing highly tactile images, using the internet or other technological means. By purchasing clothes over the Internet, you can save time and money, but you can never be sure how the fabric feels until the clothes come home. With haptic technology, user could study and feel the texture and quality of material during the sale of cloth through internet. Haptics is the science of applying touch (tactile) sensation and control to interaction with computer applications. The word derives from the Greek haptein meaning "to fasten." Haptics offers an additional dimension to a virtual reality or 3-D environment and is essential to the immersiveness of those environments. In recent years, wearability has become popular as the novel paradigm for human robot interaction, paving the path towards new opportunities to convey haptic stimuli to users in a more naturalistic and effective manner. Wearable haptic systems can indeed be comfortably worn by humans, carried around and integrated into their everyday life, with ideal applications related (but not limited) to assistive technologies, virtual reality, affective touch and telemanipulation of remote robotic systems. In this study haptic systems and applications that can be used in textile field have been investigated.

Key Words: Wearable haptic systems, haptic in textile, haptic fabrics, virtual reality

REFERENCES

[1] Allerkamp, D., Glöckner, D., Wolter, F. E., 2008, Haptic Two-Finger Contact With Textiles Guido Böttcher, Vis Computer, 24: 911–922

[2] Bianchi, M., Battaglia, E., Poggiani2, M., Ciotti, S., And Bicchi, A., 2016, A Wearable Fabric-Based Display For Haptic Multi-Cue Delivery, Haptıcs Symposıum, Usa.

[3] Bianchi, M., A, Fabric-Based Approach For Wearable Haptics, Electronics 2016, 5, 44
[4] Grunwald , M., Human Haptic Perception Basics And Applications, , Isbn 978-3-7643-7611-6, Germany, 654 P.
[5] Haptex - Haptic Sensing Of Virtual Textiles, Project - Ist-6549 (01.12.2004 – 30.11.2007) Coordinator Mıralab - University Of Geneva Prof. Dr. Nadia Magnenat-Thalmann
[6] Kurita, Y., 2014, Wearable Haptics, Wearable Sensors, Fundamentals, Implementation And Applications, Academic Press, P. 45–63
[7] Meinander, H., 2008, Haptic Sensing İn Intelligent Textile Development, Advances İn Science And Technology, Vol. 60, Pp. 123-127, 2008
[8] Sreelakshmi, M., , Subash, T.D., 2017, Haptic Technology: A Comprehensive Review On İts Applications And Future Prospects, Materials Today: Proceedings , Volume 4, Issue 2, Part B, 2017, P. 4182–4187
[9] Yanga, T., Xiec,D., Lib,Z., Zhua, H., 2017, Recent Advances İn Wearable Tactile Sensors: Materials, Sensing Mechanisms, And Device Performance, Materials Science And Engineering.

DEVELOPMENT OF DIFFERENT STRUCTURES WITH PARA-ARAMIDE YARN AT THE KNITTED FABRICS, WHICH ARE USED AT SPORTS TECHNICAL TEXTILES

Ozan Parer, Hediye İpek Gülbaş
Gamateks Tekstil Sanayi ve Ticaret A.Ş., Denizli, Turkey
ozanp@gamateks.com.tr

ABSTRACT
In this study, it's aimed to achieve a strong and a safe surface by using the advantages of strength characteristics of para-aramide fiber, and also including wear comfort potentials of knitted structures at the wearable Sports technical textiles, which are used at the fields like mountaineering and motorcycling, and requires protection from external impacts like abrassion. The knitted structures, textile comfort providing fiber types, which would be combined with para-aramide fiber and the placement of para-aramide fiber in those structures were determined. Abrassion tests were performed at developed fabrics and the results of the developments were evaluated.

Key Words: Para aramide, circular knitting, textile comfort

1. INTRODUCTION

Para-aramide is a five times stronger fiber, when compared with the same-weight steel, which is used at the fields like industrial protective clothings, fiber optic, ropes and cables, tires and straps, personal electronics, sports clothings and accessories and automotive hoses, to provide more strength and safety at clothings, accessories and equipments.

Current protective trousers used at the sports like motorcycling are stitched with 100% para-aramide woven linings. But they don't provide any wear comfort becuase of the rigidity of para-aramide yarns. It becomes worse, when it's combined with the tough structure of woven. Para-aramide wovens also have a worse abrassion resistance compared to the knitted ones. The comparison can be seen from Figure 1. [1].

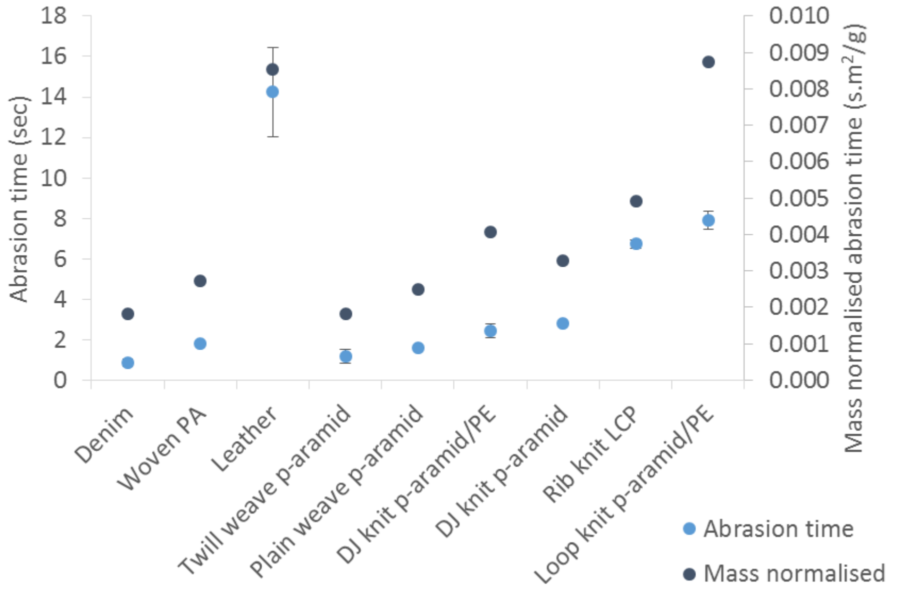


Figure 1. Abrasion resistance results of each fabric structure [1]

In this study, it's aimed to create a good wear comfort, when providing the same or better protection factor compared to woven para-aramide fabrics. So knitted structures, which are more flexible were chosen from practical experiences and the placement of para-aramide yarns inside these structures were determined.

2. EXPERIMENTAL

Loop knit and three thread loopback knitted structures were chosen to achieve a better wear comfort for technical fabrics used in outdoor sports. Full constructions can be seen from Table 1. All samples are washed at cold conditions and relax-dried.

Table 1. Material components

Samples	Knit type	Machine diameter	Gauge	Yarn 1/Placement	Yarn 2/Placement	Yarn 3/Placement	Final Weigh (gsm)
1-3	Loop knit	30	20	30s para-aramide (base)	30s para-aramide (pile)	-	320
4-6	Three thread loopback (diagonal)	30	20	20s ring combed Co (dyed)/front yarn	30s para-aramide/mid yarn	10s ring carded Co (greige)/back yarn	320

3. RESULTS

Abrassion performances of the developments were tested according to Martindale Abrasion (two thread break) BS EN ISO 12947:1999 standard, under 9 kPa. Results can be seen at Table 2.

Table 2. Abrasion test results

Samples	Break Cycle
1	56000
2	57000
3	58000
4	65000
5	65000
6	77000

4. CONCLUSIONS

The fabric, which has a three-thread loopback knit, had a better abrassion resistance, when compared with surface area-increased 100% para-aramide Loop knit fabric. Knitted Loop knit fabric's high protection performance was known from literature studies [1] and this study proved the performance of three-thread loopback structure. On the other hand, preferring more comfortable cellulosic fibers at the correct connection points of three-thread loopback construction won't effect the protection level negatively, when providing wear comfort. Having a dyed yarn at the front and diagonal fashionable knit structure also eleminates stitching an extra protective lining surface inside sports trousers, used at outdoor sports.

REFERENCE

[1] URREN, C. J., PHILLIPS, P. and WANG, X. Performance Comparison of Abrasion Resistant Textile Motorcycle Clothing. The 89th Textile Institute World Conference: Conference Proceedings, Edited by Wuhan Textile University, 2014, pp 235-239.

LIFE CYCLE ASSESSMENT OF A COTTON T-SHIRT

Ali Rüzgar, Elif Gamze Taşkın, Seda Güney, Nilay Cambaz
BUTEKOM Bursa Teknoloji Koordinasyon ve Ar-Ge Merkezi, Bursa, Turkey
ruzgara@uib.org.tr

In this study, the environmental effects of cotton t-shirt weighing 175 grams were examined by Life Cycle Assessment (LCA) method in "cradle to grave" boundary. As a result of the analysis made, the carbon footprint of one cotton T-shirt weighing 175 grams was found to be 8.46 kg CO_2-eq. 37.4% of this CO_2-eq greenhouse gas emissions are generated from usage phase. When the usage phase, where the most greenhouse gas emission is released, is examined in detail, it has been determined that the carbon emission is the highest in electricity consumption, followed by detergent and water consumption respectively.

A VIEW OF WOOL FIBERS IN TERMS OF ORGANIC TEXTILE PRODUCTION

Pelin Seçim Karakaya, Tülay Gülümser
Ege University, Textile Engineering Department, Izmir- Turkey
pelinsecim@gmail.com

The textile industry is one of the industries that consume energy, water and chemicals in many stages of production, from raw material to final product in great amounts. Especially in textile finishing enterprises, the use of various dyestuffs and chemicals cause environmental pollution (6). The demand for organic products in the textile sector is increasing day by day with the increasing awareness of the environment concerns spreading rapidly in the world. Organic production aims to reduce environmental pollution and manufacture according to internationally accepted standards by taking the health conditions of the workers in the textile and ready-wear sectors seriously as well as consumer health. There are different standards such as GOTS (Global Organic Textile Standard), OCS (Organic Content Standard), Ecocert Standard (Ecological & Recycled Textiles), which aim to limit the environmental effects of textile products, which are used in this area and aim to provide social and environmental responsibility. The Global Organic Textile Standard (GOTS), which has been mostly used in organic textile production in recent years, is the world-wide leading standard that sets textile processing requirements for organic fibers, including ecological and social criteria, documenting the entire textile supply chain with independent certification.

The organic products produced in our country in recent years are increasingly diversified. Although the first thing that comes to mind is cotton in manner of organic textiles, there is a growing demand for organic wool products in recent times. In the production of organic wool, all steps of the process are regularly checked and certified until the product is ready to grow. This study emphasizes the importance of organic wool in terms of human health and environment and at the same time searches the requirements of organic wool production conditions.

Key Words: Organic wool, standard, GOTS, human health

PHYSICAL PROPERTIES OF REGIONAL HAND-WOVEN FABRICS

<u>Nefise Gönül Şengöz</u>[1], **Gülşen Bağcı**[2]
[1] *Uşak UniversityEngineering Faculty Textile Engineering Department Uşak, Turkey*
[2] *Uşak University Vocational High School of Technical Sciences Clothing and Manufacturing Technology Department Uşak, Turkey*
nefisegonul.sengoz@usak.edu.tr

The art of hand-weaving is expiring nowadays. In order to keep hand-weaving alive, a research on which characteristics have to be considered in ready-wear production of hand-woven fabrics is done. The physical properties of hand-woven fabrics in Buldan, Kastamonu, Tokat, Denizli, and Uşak which are located in Middle and West Anatolia are studied and with this information, some styles of garments are designed and their suitability to ready-wear production is practiced. It was concluded which fabric construction and physical properties hand-woven fabrics should possess.

Key Words : Hand-woven, Anatolia, ready wear production, apparel, fabric properties, fabric construction

STUDY THERMAL PROPERTIES OF CHICKEN FEATHER FIBER AS FILLING MATERIAL

Onur Tekoğlu, Nazım Paşayev
Erciyes University Faculty of Engineering / Departman of Textile Engineering
onurtekoglu@hotmail.com

Among the natural materials, the bottom feathers of water birds are known as the most favorable materials in this respect. These materials, which have high heat protection, felting, lightness, softness and long serviceability, are highly expensive materials. In contrast, artificial fibers, especially developed in recent times, exhibit superior properties to natural fibers from some angles, but heat insulation, softness and long service life still fall behind natural fibers. This makes the water bird feathers, especially the goose and puffer cuddle feathers, more expensive. In recent years, synthetic materials have been developed that can be compared to these feathers according to their thermal insulation properties, but they are also expensive enough.

According to this, it has always been noted that chicken fur can be used as filling material in winter clothes. as a material that can be reached easily, in abundant quantities and much cheaper than the feathers of water birds. On the other hand, about 22 million tons of chicken feather is obtained as a by-product and a large part of it is disposed. Only about 40 thousand tons of chicken feathers per year are produced in Turkey, and this material, which is a chemically resistant material, is either buried or burned. In the world, on average, 4 million tons of chicken feather remains in waste.

Chicken feather natural heat insulation materials. However, it is not possible to utilize hen feathers like goose and duck feathers. Because, in chickens, there are no down feathers which is different from goose and ducks. On the other hand, the roughness, weight, fragility, low elasticity of the chicken fur and excessive migration of the fur in the material are also problems.
In order to overcome these problems, we proposed to remove the "barbs" part of the chicken fur from the "rachis" part by mechanical cutting and to use this fiber as filling material in the winter clothes.

Research has shown that the fibers taken from chicken feathers have porous internal structure, which gives them high insulating properties. The presented study is about examining the thermal insulation parameters of chicken hair fibers obtained from chicken feathers.

EXPERIMENT

Material

In experimental studies, chicken feather from the farm was used as material. These feathers were washed and disinfected. After being dried in the dryer, fiber was produced from these feathers (Fig. 1).

Method

Test specimens were prepared using chicken hair fibers as filler material. The filling material was homogeneously laid between the two fabric pieces and the edges were covered with a straight stitch and overlock was pulled (Fig. 2). Filler materials weighing 8, 16, 24, 32 and 40 gr were placed in the samples and the measurements were made to be 25x25cm. The samples were locked in the sachets and the thickness and weight of each sample were written on the sachet. The thermal properties and air permeability values of the prepared samples were measured. Prior to the measurements, the samples were kept in the test cabinet under normal conditions for 24 hours, after which measurements were placed in the bags again.

Figure 1

Figure 2

Figure 3

DISCUSSION AND RESULTS

The structural parameters of the produced samples were determined and the connection between these parameters and the amount of fill material in the samples was established. It has been found that there is a positive linear relationship between the amount of filler material in the samples and the heat transfer coefficient of the sample. Curves expressing the change in the thermal resistance and air permeability values of the test samples with respect to the amount of the sample in the sample are obtained. According to these curves, it is possible to determine the amount of fiber and other structural parameters required to produce the structure with the desired thermal resistance. Fig. 3 shows the construction of the chest pile fibers filled into the jacket.

ACKNOWLEDGEMENT/ FOUNDING
The present study is supported by the project of FDK-2016-6385 by Erciyes University BAP Unit.

Key Words: Chicken feather, chicken feather fibers, winter garment filling materials, heat protection properties of the fibers

DECOLORIZATION OF REACTIVE YELLOW 15 TEXTILE DYE WITH BOLETUS EDULIS LACCASE IMMOBILIZED ONTO MODIFIED RICE HUSKS

Didem Tuncay[1], Hülya Yağar[2]
[1] Trakya University, Edirne Vocational College of Technical Sciences-Edirne
[2] Trakya University, Faculty of Science, Department of Chemistry-Edirne
dleventer@gmail.com

Reactive Yellow-15 is one of the most important azo dyes used in the textile industry. Azo dyes are aromatic compounds with one or more -N=N- chromophore groups. These dyes which are extremely resistant to degradation are highly toxic for natural ecosystems. Several methods have already been developed for treat textile effluents including physicochemical methods such as filtration, carbon activated, coagulation and chemical flocculation. Although these methods are effective, they are expensive and involve formation of concentrated sludge that creates a secondary disposal problem. The most recent researches in this area have focused on the enzymatic process for the treatment of wastewater and soil. The potential advantages of the enzymatic treatment, as compared with conventional treatments, include from application to recalcitrant materials, operation at high and low contaminant concentration over a wide pH, temperature and salinity range, the easy control process among others and less sludge formation [1, 2].

Laccases (EC 1.10.3.2), have natural ability to act on a wide range of substrates make them highly useful as a biocatalysts for various biotechnological applications such as textile dye decolorization, paper pulp biobleaching and bioremediation. They have an ability which can be transform chromatic groups of dyes to less harmful products [3].

In this study, Reactive Yellow-15 was decolorized by using immobilized laccase on modified rice husks. Laccase was isolated from *Boletus edulis* mushroom and was purified 11.7 fold compared to crude extract after precipitation with a three-phase partitioning method [4-7]. The specific activities of free and immobilized enzymes were determined as 240 and 49.9 U/mg protein, respectively. Immobilization yield was calculated to be 95%. Immobilized laccase was efficiently decolorized the Reactive Yellow-15 dye solutions prepared in the concentration range of 100-400 mg/mL. Dye decolorization was determined spectrophotometrically by monitoring the decrease in the absorbance peak at 416 nm, which is the maximum wavelength for Reactive Yellow-15 [5, 8]. The decolorization activity of immobilized enzyme was observed to be higher in the acidic conditions (pH 4.0) and it was determined to be about 89.5% at the end of 1 h. In the reusability assay, it retained approximately 50% of its initial activity at the end of 10 cycles. The biodegradation of Reactive Yellow-15 was monitored with UV-VIS spectrophotometer.

Decolorization of Reactive Yellow-15 in the presence of metal ions and auxiliary chemicals contained in textile waste waters was also monitored. After 1 hour incubation, the decolorization activity (%) of immobilized laccase decreased to 77.7% in the presence of 10 mM Fe^{2+}, whereas it was increased up to 92 and 93.9% by 10 mM Cu^{2+} and 10 mM Mn^{2+}, respectively. In addition, it was observed that solutions of polyvinyl alcohol (100 and 1000 mg/L), ethylenediaminetetraacetic acid (10 mM), hydrogen peroxide (10 mM) and Tween 80 (1 and 10 mM) added to the reaction medium at different concentrations reduced the decolorization percentage, slightly.

Key Words: Laccase; Boletus Edulis; immobilization; rice husk; reactive yellow-15; decolorization; biodegradation.

REFERENCES

[1] R. L. Singh, P. K. Singh, R. P. Singh, Enzymatic decolorization and degradation of azo dyes: A review, International Biodeterioration & Biodegradation 104, 21-31, (2015).
[2] O.J., Hao, H., Kim, P.C., Chiang, Decolorization of wastewater, Crit. Rev. Environ. Sci. Technol. 30, 449, (2000).
[3] S. R. Couto, J. L. T. Herrera, Industrial and biotechnological applications of laccases: A review, Biotechnology Advances 24, 500–513, (2006).
[4] G. Q. Zhang, Y. F. Wang, X. Q. Zhang, T. B. Ng, H. X. Wang, Purification and characterization of a novel laccase from an edible mushroom Clitocybe maxima, Process Biochemistry 45, 627-633, (2010).
[5] V. V. Kumar, V. Sathyaselvabala, M. P. Premkumar, T. Vidyadevi, S. Sivanesan, Biochemical characterization of three phase partitioned laccase and its application in decolorization and degradation of synthetic dyes, Journal of molecular catalysis B: Enzymatic 74, 63-72, (2012).

[6] T. Brànyik, A. A. Vicente, J. M. Machado Cruz, J. A. Teixeira, Spent grains-a new support for browing yeast immobilization, Biotechnol. Lett. 23, 1073-1078, (2001).
[7] A. M. Da Silva, A. P. M. Tavares, C. M. R. Rocha, R. O. Cristovao, J. A. Teixeira, E. A. Macedo, Immobilization of commercial laccase on spent grain, Process Biochemistry 47(7), 1095-1101, (2012).
[8] R. O. Cristóvãoa, A. P. M. Tavaresa, A. I. Brígidab, J. M. Loureiroa, R. A. R. Boaventuraa, E. A. Macedoa, M. A. Z. Coelhob, Immobilization of commercial laccase onto green coconut fiber by adsorption and its application for reactive textile dyes degradation, Journal of Molecular Catalysis B: Enzymatic 72, 6–12, (2011).

Figures

Fig.1 Decolorization of Reactive Yellow-15 by immobilized laccase onto the modified rice husks

Fig.2 (a) UV-VIS absorbance spectrum of the Reactive Yellow-15 dye solution,

(b) UV-VIS absorbance spectrum of Reactive Yellow-15 dye solution after the incubation with DRHIL for 60 min

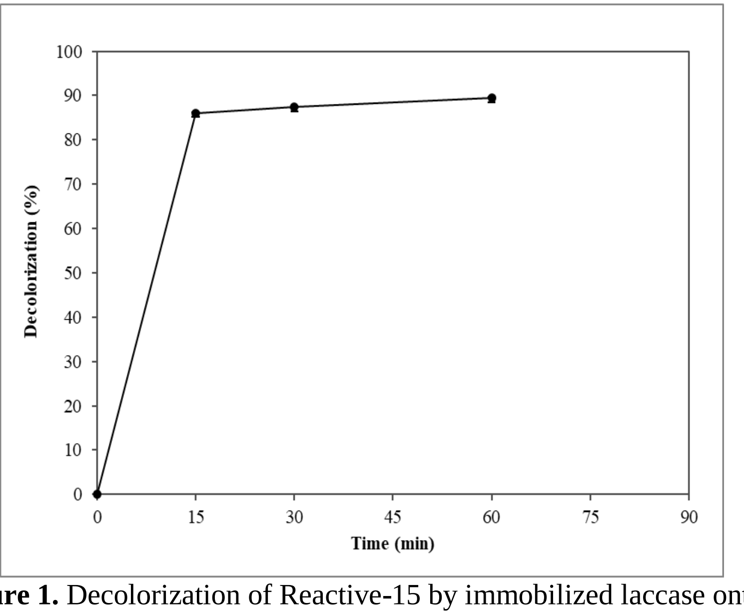
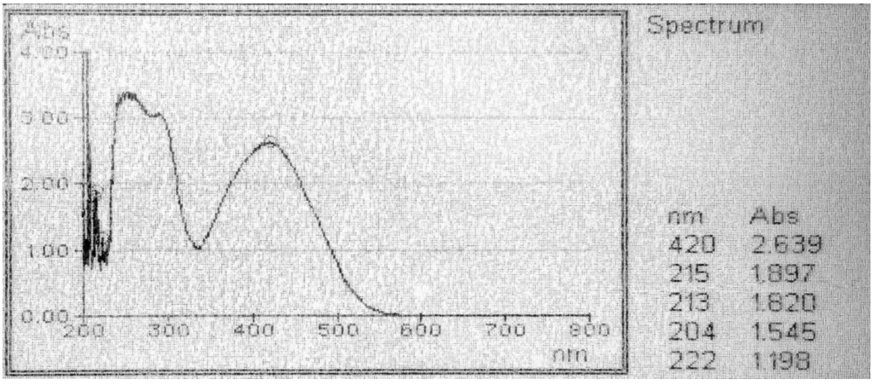
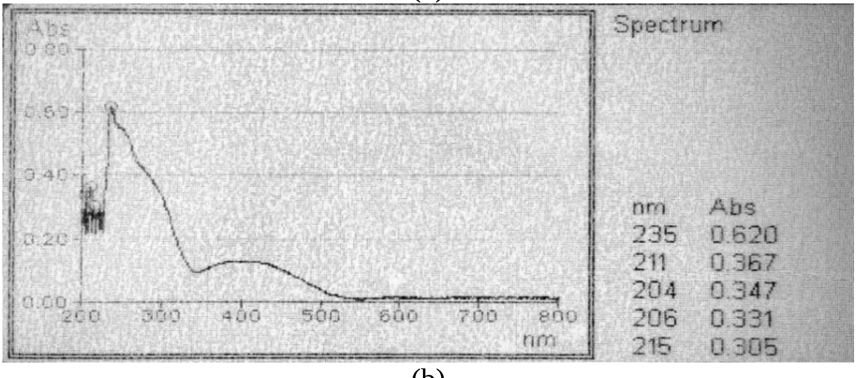


Figure 1. Decolorization of Reactive-15 by immobilized laccase onto the modified rice husks



(a)



(b)

Figure 2.(a) UV-VIS absorbance spectrum of the Reactive Yellow-15 dye solution, (b) UV-VIS absorbance spectrum of Reactive Yellow-15 dye solution after the incubation with DRHIL for 60 min

PRODUCTION OF ESPUN NANOFIBER YARNS BY USING WATER BATH AS COLLECTOR

Gamze D.Tetik, Ayşe Pınar Turgut Yiğen, Baran Uğur
Uşak University, Faculty of Engineering, Department of Materials Science and Nanotechnology Engineering, Uşak, Turkey
apinarturgut@gmail.com

Electrospinning is a fascinating technique that allows production of nonwoven mats, functional composite fibers, and nanofiber yarns. These mats, fibers or yarns are used in many applications such as electronics, filtration, cosmetics, biomaterials, protective clothes, etc. Production of nanofibers by electrospinning is a consequence of the interactions on polymer solution/ melt such as electrostatic forces, viscoelastic forces, and surface tension. A high voltage power supply provides the electrostatic forces acting on solution/ melt and polymer molecular chains are responsible for viscoelastic forces and surface tension. When the electrostatic forces overcome the others, the spinning balance is achieved and a jet moves towards a grounded metal plate in traditional electrospinning equipment. Traditional electrospinning equipment lead fabrication of randomly aligned nanofiber mats. But some modifications made on the equipment have been made to produce nanofiber yarns. In this study, a water bath was used as a collector for formation of continuous nanofiber yarns. Some researchers have been studied on production of these yarns using a water bath. Khil et al., Smit et al. and Pan et al. are the some of them [1-3]. Khil et al. named the equipment as electro-wet spinning because they used a coagulation agent to obtain solid polycaprolactone nanofibers [1]. Smit et al. have fed the solution through a glass pipette on a water bath. polyvinyl acetate, polyvinylidene fluoride and polyacrylonitrile were the polymers that they get cylindrical nanofiber yarns [2]. Pan et al. tried obtaining Polyamide 6/66 copolymer nanofiber yarns and made a post drawing process for the improvement of orientation in yarn and the crystal structure and thereby the improvement of mechanical properties [3].

In this study Polyamide 6 (PA6) was chosen as polymer for producing nanofibers and formic acid (FA) was chosen as solvent since PA6/FA polymer solution was an easily electrospinnable one. Also PA6 is insoluble in water. Both PA6 and FA were purchased from Sigma-Aldrich. Homogenous electrospinning solution was obtained after overnight stirring on a magnetic stirrer. The concentration of the solvent was 20% w/v. A Gamma High Voltage Power Supply and a New Era Syringe Pump Systems – NE 300 syringe pump were used during electrospinning. Voltages of 20-22 kV and a feed rate of 5 µL/min were adjusted. A glass bath (40x40x10 cm^3) was purchased and filled with approx. 4 liters of distilled water. A rotating cylinder driven by a servo motor was used for the collection of nanofiber yarns. Grounding was performed by attaching a crocodile clips to the metal plate placed on the bottom of the water bath. In order to provide efficient nanofiber yarn formation on the surface of the water, feeding was made under a horizontal angle of 45 degrees. The schematic representation of the equipment is given in Figure 1.

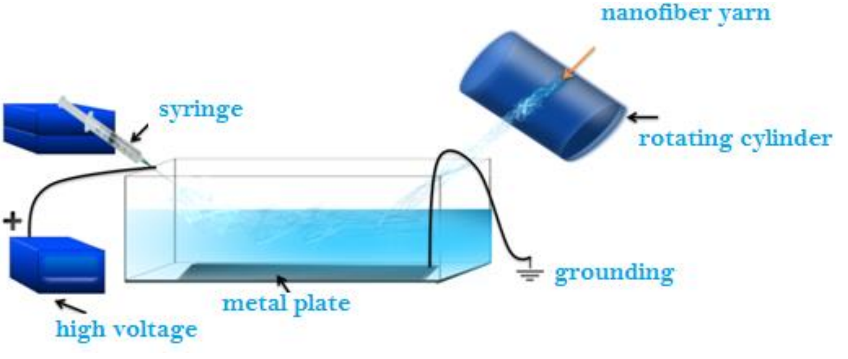
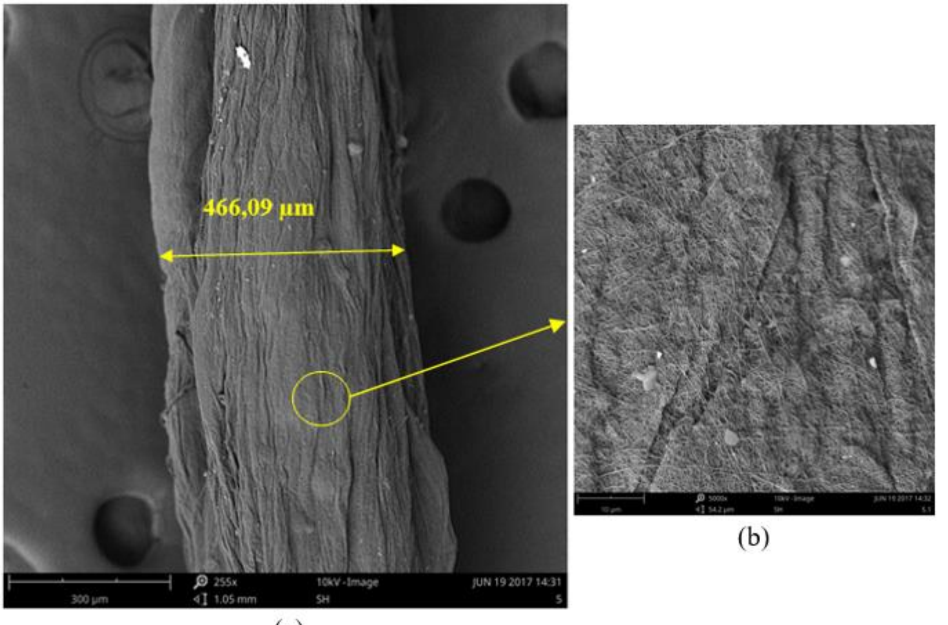


Figure 1. Schematic representation of electrospinning equipment of nanofiber yarns

The distance between needle tip and water surface was set to 20 cm. After the first 15 minute’s electrospinning at a voltage of 20-22 kV, the fiber mat collected on water surface was taken by the help of a glass rod and hanged on the rotating cylinder in the form of yarn. The surface velocity of the cylinder was set to 1 rpm. This low velocity ensured the continuous yarn formation during spinning.

For morphological characterization of nanofibers, scanning electron microscope (SEM) images were taken with a Phenom ProX scanning electron microscope after gold sputtering by Cressington Sputter Coater.

The SEM images are given in Figure 2 (a) and (b). The diameter of the yarn was measured as 466 µm by Image J Visualization Software. Randomly aligned nanofibers in the structure of the yarn can be seen from Figure 2 (b).



(a) (b)

Figure 2. SEM images of espun yarn (a) 255X (b) 5000X

Although electrospinning is a simple method to produce nanofibers, determination of the optimum process parameters is not so easy. Changing the collector and choosing a different one from a metal plate requires some fragile adjustments. After the observation of a stable emerging jet from the tip of the needle by naked eye, SEM images were taken with the samples. Electrospinning of PA6 nanofiber yarns was performed at an approx. 100000 V/m electric field strength.

Here we present the first studies about production of PA6 nanofiber yarns. Our studies will continue on mechanical characterization of these yarns.

ACKNOWLEDGEMENT
This work was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under Grant No. 1919B011604005.

Key Words: Electrospinning, nanofiber, polyamide 6, nanofiber yarn, water bath collector

REFERENCES

[1] Pan, Z. J., Liu, H. B., Wan, Q. H. (2008). Journal of Fiber Bioengineering and Informatics, 1(1), 47-54.
[2] Khil, M. S., Bhattarai, S. R., Kim, H. Y., Kim, S. Z., Lee, K. H. (2004) Journal of Biomedical Materials Research, Vol 72 (1): 117-124.
[3] Smit E., Bűttner U. and Sanderson R.D. (2005), Polymer, 46: 2419–2423.

EVALUATION OF FLAME RETARDANT PERFORMANCE OF COTTON FABRICS USING LOI, TGA AND MICRO-SCALE COMBUSTION CALORIMETRY

Mustafa Erdem Üreyen[1], Fadime Karaer[2], Ümit Yılmaz Yıldız[2], Elif Kaynak[2], Ali Savaş Koparal[2]

[1]Anadolu University Civil Aviation Research Center, Eskişehir, Turkey

[2] Anadolu University, Eskişehir, Turkey

meureyen@anadolu.edu.tr

INTRODUCTION

LOI and TGA are very common test methods to evaluate the flammability of textile fabrics. Nevertheless these methods are not able to predict the real fire performance of the samples in most cases [1]. The heat release rate value, which is the most significant predictor of fire hazards, can not be determined easily in textile materials. The cone calorimeter, widely used test device for determining the heat release rate, is not suitable for the textiles. Micro-scale combustion calorimetry is a pyrolysis combustion flow calorimetry with dynamic capability to measure heat release rate of a few milligrams samples. The MCC device allows for the specimen pyrolysis and evolved fuel gases combustion to be sequential processes, with char formation occurring during the pyrolysis. MCC can be a useful tool to evaluate FR treatments of textile fabrics. Grey cotton polypropylene needle punched nonwoven fabrics treated with P-N based FR agents were evaluated by MCC [2]. Yang et.al [3] applied MCC for evaluating the flammability of cotton woven fabrics and nylon 6.6 woven fabrics treated with a flame retardant agents. They successfully compared the LOI and DSC test results with the MCC test results. Several other researchers have been used to MCC to evaluate the fire performances of textile materials [4-7]. As a result, it was found that MCC is a useful tool to evaluate flame retardant treatments of cotton and cotton-synthetic blend fabrics.

In this work, flame retardancy of 100% cotton fabrics treated with flame retardant agent was evaluated by limiting oxygen index, TGA and micro-scale combustion calorimetry. The effect of sample weight and amount of finishing agent on the test results of MCC was investigated. MCC results were also compared by LOI and TGA test results.

MATERIALS AND METHODS

The cotton woven fabric with a density of 200 g/m^2 was selected. In order to remove the impurities and reactive groups remaining on the fabric samples, it was washed with a soda ash. The washing was performed using a wascator (Electrolux, FOM71 CLS) according to ISO 6330-2002 following 5A program. The fabric samples were then dried flat at room temperature. Mixture of special phosphorus and sulphur compounds, halogen free flame retardant finishing agent was provided by CHT/Germany under commercial name of Apyrol BKW.

Finishing applications in two different concentrations (100 g/l and 150 g/l) of flame retardant agent were performed by using a laboratory vertical padder (ATAC, F350). Following the padding, fabric samples were dried at 120 °C for 2.5 min and cured at 160 °C for 3 min in a laboratory stenter (Rapid, minidryer QCA 1708). The solution pH was adjusted by phosphoric acid. The wet pick-ups of the treated fabric samples were approximetly 90±2%. In order to eliminate the deteriorating effects of phosphoric acid, the fabric samples were washed in wascator after the finishing treatment with soda ash (20 g/L).

All fabric samples were conditioned in a climatic chamber at 23 ± 1 °C, 50% relative humidity for 24 h before the tests.The Limiting Oxygen Index (LOI) of the fabric samples was measured according to ASTM D2863-08 test method. The micro-scale combustion (MCC) measurement was performed using an MCC test device produced by Fire Testing Technology according to ASTM D7309-2007 (Method A). Samples 2-6 mg was heated to 750 °C using a linear heating rate of 1 K/s. All the measurements were repeated three times and average results were presented. Peak heat release rate (pHRR), temperature at pHRR, heat release capacity (HRC), total heat release (THR) were determined. The thermal stability of the fabrics was evaluated by thermogravimetric analyses (TGA) in nitrogen from 30 to 800 °C with a heating rate of 10 °C/min by using TA Instruments SDT Q600.

RESULTS

pHRR value of the samples are shown in Figure 1. It was found that pHRR value of the untreated cotton (235.5 W/g) is decreased significantly after FR treatment to 71.82 W/g and 61.79 W/g. The depolymerisation of the untreated cotton started at approximetly 300 °C and the HRR reach maximum value at 367 °C. FR treatment of cotton is significantly reduced the decomposition temperature and peak heat release rate. TGA test results confirmed the MCC results. TGA test results are also showed that the char residue of the samples are increased after FR treatment. LOI values of untreated cotton (19.0) is increased to 26.9 and 28.1 respectively.

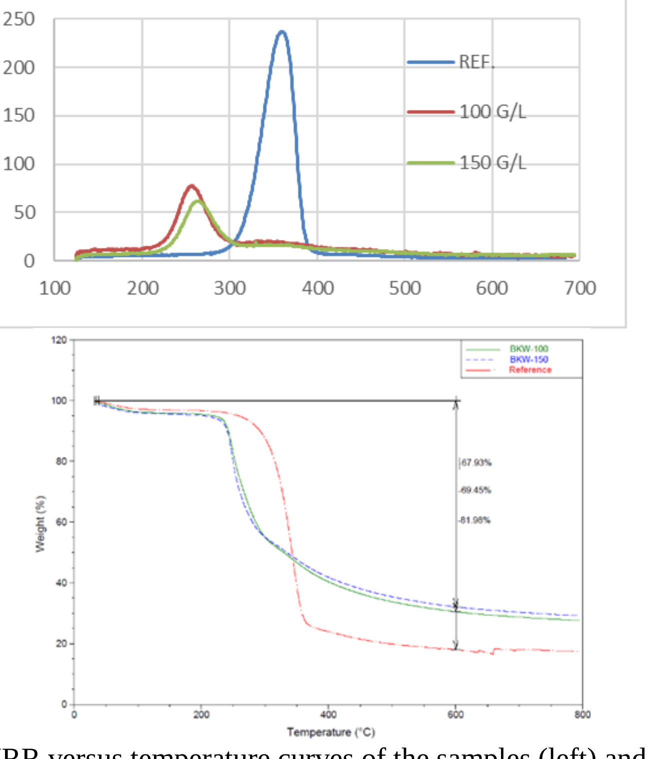


Figure 1. HRR versus temperature curves of the samples (left) and TGA test results of the samples (right)

Results showed that MCC test can be used as an effective technique for the evaluation of flame retardancy of cotton fabrics.

REFERENCES

[1] Weil E.D., Hirschler M.M., Patel N.G., Said M.M. and Shakir S., Oxygen index: correlations to other fire tests, Fire and Materials, 16, 159–167 (1992).

[2] Dharnidhar V. Parikh D.V., Nam S., and He Q., Evaluation of three flame retardant (FR) grey cotton blend nonwoven fabrics using micro-scale combustion calorimeter, *Journal of Fire Sciences*, 30(3), 187–200 (2012).

[3] Yang C, He Q, Lyon R, et al., Investigation of the flammability of different textile fabrics using micro-scale combustion calorimetry, *Polym Degrad and Stab*, 95(2), 108–115 (2010).

[4] Zhang, W., *et al.*, Thermal Properties of Wool Fabric Treated by Phosphorus-Doped Silica Sols Through Sol-Gel Method, *Thermal Science*, 18(5), 1603-1605 (2014).

[5] Lyon R.E., Walters R.N., Stoliarov S.I., A thermal analysis method for measuring polymer flammability, *Journal of ASTM International*, 3(4), 1–18, (2006).

[6] Cogen J.M., Lin T.S., Lyon R.E., Correlations between pyrolysis combustion flow calorimetry and conventional flammability tests with halogen-free flame retardant polyolefin compounds, *Fire and Materials*, 33, 33–50 (2009).

[7] Yang C.Q. and He Q., Applications of micro-scale combustion calorimetry to the studies of cotton and nylon fabrics treated with organophosphorus flame retardants, *Journal of Analytical and Applied Pyrolysis*, 91, 125–133 (2011).

PERMEABILITY PROPERTIES OF R-PET FIBERS IN NON-WOVEN FABRICS USED IN THE CONSTRUCTION SECTOR

Sevcan Üstün Çetin[1], **Ayşe Ebru Tayyar**[2]

[1] *Uşak University, Vocational High School of Technical Sciences, Uşak, Turkey*

[2] *Uşak University, Faculty of Engineering, Department of Textile Engineering, Uşak, Turkey*

sevcan.ustun@usak.edu.tr

In the last century, the difficulties in obtaining raw materials have led to increase in the idea of recovery and secondary use. With the development of non-woven surface in the textile production have gained speed in many field of multi-disciplinary studies. Non-woven surfaces from recycled textile products have a wide market share such as, the fields of construction industry (sound and heat insulation webs, filter products, ground isolation), automotive-agriculture-paper sector. [1]

The investigation of non-woven fabrics with v-PET (virgin) and r-PET (recycled) fibers in construction area has been carried out. Before fabric production, the length, fineness, and cross-sectional appearance of the fibers are examined and did not spot many differences. It is observed that the number of crimp of v-PET fibers, texturized, is twice than the number of crimp r-PET which it is not texturized and tensile strength of the r-PET fibers are approximately two times higher than those of v-PET. Structural properties of r-PET and v-PET fibers are presented in Table 1.

Table 1. Structural properties of of r-PET and v-PET fibers.

Fiber Type	Crimp (1 / cm)	Fiber Strength (cN/dtex)	CV Strength (%)	Breaking Extension (%)	CV Breaking Extension (%)	Fiber Fineness (dtex)	Fiber length (mm)
v-PET	4,2	3,39	17,9	31,07	19,1	3	60
r-PET	2,2	5,06	14,4	44,75	25,22	3	60

Five different blends of the aforementioned fibers have formed as follows: 100 % PET; 70% PET and 30 % r-PET; 50% PET and 50 % r-PET; 30 % PET and 70 % r-PET; and 100 % r-PET. Since blends consist of synthetic fibers, they are laid to rest for 24 hours after anti static materials are applied to prevent electrification. Then non-woven fabrics using these blends have been produced in three different layers such as, 6, 10, and 14 layers. Non-woven fabrics with 5 different blends were produced needle punching methods. During production; fiber feeding direction, production speed, needle orientation and type are kept stable. Preliminary needling is carried out with 10 mm needling depth using 4000 needles at 150 rpm and the main needling is carried out with 3 mm needling depth using 40000 needles at 450 rpm. The speed of production is kept constant at 42 m/h. 15 different fabrics are examined by means of thickness, weight, air permeability, relative water vapor transmission and thermal properties such as thermal conductivity, thermal absorbency and thermal resistance . The mean values of results are demonstrated in Table 2. In literature, there are many studies about examining the conductivity properties of nonwoven fabrics [2-3]. The properties of fabrics with different blending ratio but same weight and fabrics with different weight but same blending ratios have been examined.

RESULTS

The increase in the number of layers has negative effect on the air permeability of all fabrics. It was observed that the air permeability values of 100% r-PET and v-PET fabrics were lower than that blended fabrics and almost same with each other. The air permeability values of the blended fabrics were parallel to each other.

Table 2. Sample test results

	FABRICS	Weight (g/m^2)	Thickness (mm)	Air permeability (mm/sn)	Relative Water Vapor Transmission (%)	Thermal Conductivity (W/m K)	Thermal absorbency ($Ws^{½}/m^2 K$)	Thermal Resistance ($m^2 K/W$)
6 LAYER	100% r-PET	165,075	0,250	2973,0	24,83	0,0318	31,9567	0,1268
	70% r-PET 30% v-PET	112,425	0,218	3716,0	25,87	0,0317	36,1633	0,1044
	50%r-PET 50% v-PET	117,625	0,253	3655,0	27,37	0,0312	35,8000	0,1068
	30% r-RET	116,275	0,223	3602,0	25,37	0,0315	38,1433	0,1034

	70% v-PET							
	100%v- PET	136,400	0,353	2941,0	24,83	0,0312	31,9567	0,1268
10 LAYER	100% r-PET	308,825	1,353	1454,0	20,60	0,0361	51,8300	0,1117
	70% r-PET 30% v-PET	244,850	0,738	1843,0	25,47	0,0322	50,9633	0,1090
	50%r-PET 50% v-PET	243,900	0,955	1764,0	25,87	0,0319	55,3267	0,1143
	30% r-RET 70% v-PET	246,550	0,945	1646,0	24,00	0,0349	56,5000	0,1038
	100%v- PET	306,900	1,648	1261,0	23,80	0,0321	50,3067	0,1342
14 LAYER	100% r-PET	540,100	2,848	806,7	19,50	0,0332	68,4033	0,1624
	70% r-PET 30% v-PET	395,650	1,385	945,8	24,40	0,0351	68,3467	0,1151
	50%r-PET 50% v-PET	400,625	1,940	1075,6	22,43	0,0316	62,6000	0,1481
	30% r-RET 70% v-PET	477,800	2,123	864,7	20,20	0,0332	59,0433	0,1702
	100%v- PET	635,73	2,820	751,2	18,93	0,0324	58,9333	0,1845

Among the production groups, increasing the weight caused lower relative water vapor transmission values. It has been found that the production weight did not an effect on the thermal conductivity value among the production groups. It was also found that the different blending ratios were not a significant influence on the thermal absorbency.

Key Words: Recycled PET, non-woven fabrics, permeability properties

REFERENCES

[1] Altun Ş. , Ulcay Y. , I. Tekstil üretimi sırasında ortaya çıkan atıklar ve nitelikleri, Tekstil Mühendisliği Bölümü, Uludağ Üniversitesi.

[2] Tao X., Koncar V. ve Dufour C., Structural and electrical properties of PET nonwoven fabrics coated with pyrrole/aniline copolymers, The Journal of Textiles and Engineers, 72-2015.

[3] Mohammadı M., Banks-Lee P.,Ghadımı P., Determining effective thermal conductivity of multilayered nonwoven fabrics, Textile Research Journal 73(9),2003.

SYNTHESIZE AND ELECTROCHEMICAL IMPEDANCE BEHAVIOUR OF NATURAL ARTICHOKE FIBER/PEDOT CONDUCTIVE COMPOSITES

Pelin Yazıcı[1], Baidaa Aikhateab[1], Belkıs Ustamehmetoğlu[1], Esma Sezer[1], Dilara Koçak[2], Müjgan Naycı Duman[2]

[1] İstanbul Technical University, Department of Chemical Engineering, İstanbul, Turkey

[2] Marmara University, Department of Textile Engineering, İstanbul, Turkey

pelinyazici@hotmail.com

Conducting polymer coated fibers have been taken great interest in recent years because of the possibility of obtaining a new hybrid material for different applications and they commonly prepared using in situ oxidative polymerization for various applications.

In this study it was aim to obtain poly (3,4-ethylenedioxythiophene (PEDOT) coated artichoke fibre (AF) and to investigate the charge storage behaviour by electrochemical impedance spectroscopy (EIS) for supercapacitor applications. For this purpose first the polymerization of EDOT on AF is performed through in situ chemical polymerization to convert the insulating form of AF into conductive form. EDOT concentration, polymerization method and time, EDOT/oxidant molar ratio were investigated and the optimum conditions were determined. Then the PEDOT coated fiber (AF/PEDOT(C)) used as a working electrode and it was further coated with PEDOT again by electrochemical polymerization. The resulting composite called as AF/PEDOT(CE) and then capacitive behaviour has been measured by electrochemical impedance spectroscopy(EIS). The AF/PEDOT(CE) electrode shows specific capacitance of 1.0 F g^{-1}, which correspond to the cell area-normalized capacitance of 7.7 mF cm^{-2} and this result suggests that it is good candidate for supercapacitor applications.

INTRODUCTION

In recent years also many types of natural fibres including silk, cotton, wool, coir, luffa, flax, hemp, jute, sisal, artichoke and banana have become valuable alternative elements to reinforce materials for various composites. Nowadays, they have been employed in combination with conductive polymers to be used in conductive textile industry because of their advantages that they are low cost, flexible and eco-friendly materials and they can be used in several technological area as biosensors, wearable textile [Skotheim et al. 2007]. The use of vegetal fibers as templates in the development of conducting composites is important since they are obtained from a renewable source, biodegradable, recyclable and easily available as a waste and the presence of the hydroxyl groups in their structure can induce chemical bonding with the functional groups of conducting polymers [Claudia et al. 2013]. The need to develop wearable and flexible electronics in various fields has promoted the development of highly flexible energy storage devices with high performance. PEDOT is considered a promising material for supercapacitor electrodes due to its high conductivity, good chemical and electrochemical stability. In this work, we successfully prepared large-area and flexible AF/PEDOT composite via a simple chemical and electrochemical polymerization method for supercapacitor applications.

RESULTS AND CONCLUSIONS

Since the AF fiber is an insulator, the electrochemical method can not be used for coating of PEDOT before obtaining some conductivity on the fiber. During polymerization dodecybenzenesuplhonic acid (DBSA) was used as a surfactant, acetonitrile (ACN) as a solvent and $FeCl_3$ (iron (III) chloride) as oxidising agent (Table 1). AF was coated with PEDOT by immersing fibers in solutions I and II for 30 min each, and then in solution III for 1 h. Lastly it put in solution IV for 10 min and then again in solution III for 10 min. The sequence of immersing in III and IV is repeated for 6 times. A stable continuous stirring at 200 rpm and room temperature conditions were maintained during the whole mentioned steps. Finaly AF/PEDOT(C) conductive composite was obtained.

Table 1. Optimal conditions for chemical polymerization of EDOT on the AF surface

Solution	I	II	III	IV
Content	0.02M DBSA 15 ml water	0.02M DBSA 15 ml ACN	0.01 M EDOT 15 ml ACN	0.6 M $FeCl_3$ 0.02 M DBSA 15 ml ACN

Then the AF/PEDOT(C) used as a working electrode and coated with PEDOT in ACN/propylene carbonate(PC)(9.5/0.5 v/v) that contains 0.01 M EDOT and 0.1M $LiClO_4$ as electrolyte by applying 10 cycles in the range of -0.7-1.85 V (vs Ag/AgCl) at the scan rate of 100 mVs^{-1}. The EIS measurements of resulting AF/PEDOT(CE) composites were performed in ACN/PC that contain 0.1M $LiClO_4$ in the range of 1MHz-1Hz and the resulting Nyquist graph was given in Figure 1. From these measurements, specific capacitance value was obtained as 1.0 F g^{-1}, which corresponds to the cell area-normalized capacitance of 7.7 mF cm^{-2}. The results suggested that AF/PEDOT(CE) composite is promising candidate for charge storage applications.

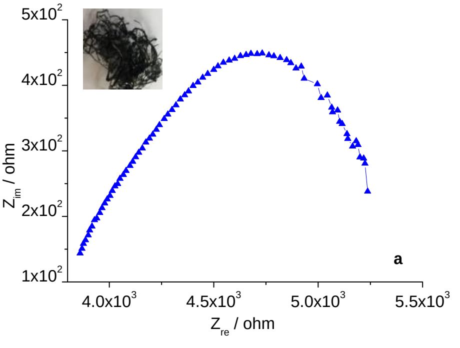


Figure1. Nyguist diagram of AF/PEDOT(CE) composite in ACN/PC / 0.1M $LiClO_4$(**inset:** AF/PEDOT(C)).

REFERENCES

[1] Skotheim T.A.,Reynolds J.R. CRC Press, Taylor & Francis Group, Handbook of Conducting Polymers, Conjugated Polymers, Third Edition, 2007

[2] Claudia Merlini, Sılvia D.A.S. Ramoa, Guilherme M.O. Barra, Conducting Polypyrrole-Coated Banana Fiber Composites: Preparation and Characterization, Polymer Composites, 2013, 34, p. 537–543.

SYNTHESIZE OF NATURAL ARTICHOKE FIBER/PCZ CONDUCTIVE COMPOSITES

Pelin Yazıcı[1], **Belkıs Ustamehmetoğlu**[1], **Esma Sezer**[1], **Dilara Koçak**[2], **Müjgan Naycı Duman**[2]
[1] *İstanbul Technical University, Department of Chemical Engineering, İstanbul, Turkey*
[2] *Marmara University, Department of Textile Engineering, İstanbul, Turkey*
pelinyazici@hotmail.com

The availability and the ease of manufacturing of natural fibers have tempted researchers to study their feasibility and to convert the waste of them to valuable material for different applications. The coated fibers with conducting polymers has been taken great interest in recent years because of the possibility of obtaining a new hybrid material that displays specialized functional properties, including high surface- to-mass ratio, flexibility, good mechanical properties, and electrical conductivity. This work aimed to obtain the polycarbazole (PCz) coated natural artichoke fibers (AF) as reinforcement conductive polymer and the extent to which they satisfy the required specifications which is a conductive polymer and obtained from their wastes based conductive composites. Carbazole(Cz) concentration, polymerization method and time, Cz/oxidant molar ratios were investigated and the optimum condition was obtained. The electrical conductivity properties of the composites were performed by using 4 - point probe measuring system and AF/PCz conductive composites were obtained with an electrical conductivity as $1.4x10^{-6}$ S/cm.

INTRODUCTION

All over the world 40 million tons of natural cellulose can be produced from the agricultural wastes, in comparison with the 70 million tons fibers that have been already produced per year in total. Nowadays, natural fibres have been employed in combination with conductive polymers to be used in conductive textile industry because of their advantages that they are renewable resources, low costs, and flexible materials (Emad, 2016).

Conductive polymers are already used in fuel cells, computer displays, electroluminesance, microelectronics, biosensors, microsurgical tools, and are now finding applications in the field of conducting textile. These polymers can be synthesised alone or combined into composites to improve their applicable properties as flexibility and mechanic properties (Nalwa, 1997). The most studied conductive polymers are polyaniline which is soluble in common organic solvents, poly(3,4-ethylenedioxythiophene (PEDOT) which has relatively more conductive properties and polycarbazole (PCz) which has good capacitive properties (Terje, 2007). Natural fibres based conductive composites can be used also in several technological area as biosensors, wearable textile because of electrical properties comes from conductive polymers and flexibility, relatively good mechanical properties comes from natural fibre (Claudia, 2013).

The study reports the conductivity properties of natural AF obtained from their wastes based conductive composite including PCz as conductive polymer.

RESULTS AND CONCLUSIONS

Chemical polymerization is the most feasible route for the large scale production of the conductive polymers. During the polymerization of the Cz on the AF surface, dodecybenzenesuplhonic acid (DBSA) was used as a surfactant, FeCI3 as an oxidant. The optimum conditions were determined and summarized in Table 1.

Table 1. Optimal conditions of Cz polymerization on the AF surface in acetonitrile (ACN)

Solution	**I**	**II**	**III**	*IV*
Content	0.02M DBSA 15 ml water	0.02M DBSA 15 ml ACN	0.01 M Cz 15 ml ACN	0.6 M $FeCI_3$ 0.02 M DBSA 15 ml ACN

Firstly, AF(Figure 1a) was waited in the aqueous solution I and then in the ACN solution II separately, both for 30 min then were waited in the ACN solution III, for an hour in order to ensure that the monomer is completely adsorbed on the fiber surface. In the next step, lifting the artichoke fibers in solution Cz IV, for 10 min. Instead of polymerization of the monomers in solution, to give opportunity of a slower polymerization on the surface, the fibers were waited in solution III and solution IV with 10 minute intervals. After 8 repeats, the dark green colored fibers (Figure 1b) were washed with ACN and the monomers and the oxidizer were taken away from the fibers, and it was dried for 16 hours, and then It was weighted and yield was calculated.The conductivity properties of composite have been measured by using Keithley 4 probe device. The conductivity of AF/PCz composite decreased as expected and composited that have the conductivities in the range of 10-5 - 10-7 S/cm were obtained. These results will be useful both in the development of conducting polymer composites for several technological applications such as reinforcing agent and conductive filler and to convert the natural artichoke waste to valuable product.

Figure 1. Uncoated **(a)** and PCz coated AF**(b).**

Key Words: Natural fiber, artichoke fiber, conductive composite, polycarbazole

REFERENCES

[1] Nalwa H.S. (Ed.), Handbook of organic conductive molecules and polymer, John Wiley, New York, 1997.

[2] Terje A., Skotheim and John R. Reynolds, CRC Press, Taylor & Francis Group, Handbook of Conducting Polymers, Conjugated Polymers, Third Edition, 2007.

[3] Emad Omrani, Pradeep L. Menezes, Pradeep K. Rohatgi, State of the art on tribological behavior of polymer matrix composites reinforced with natural fibers in the green materials world, Engineering Science and Technology, an International Journal, 2016, 19, p. 717–736.

[4] Claudia Merlini, Silvia D.A.S. Ramoa, Guilherme M.O. Barra, Conducting Polypyrrole-Coated Banana Fiber Composites: Preparation and Characterization, Polymer Composites, 2013, 34, p. 537–543.

USING CELLULASE ENZYMES TO IMPROVE ANTI-PILLING PROPERTIES OF THE TOWELS

Fatma Filiz Yıldırım, **Mustafa Çörekçioğlu, Abdullah Can Deniz, Şaban Yumru, Halil Akkaya**
Ozanteks Tekstil San. ve Tic. A.Ş. Ar-Ge Merkezi, Denizli, Turkey
filiz@ozanteks.com.tr

Pilling is a problem that is often encountered in fabrics using staple yarns in textile. This problem usually varies according to the state of the fiber, yarn, fabric and applied finishing methods. In order to overcome this problem, the properties of the fiber, yarn and fabric can be considered due to reduce the pilling tendency. However, when the softness and hydrophilicity properties become important in the fabric, such as towels, pilling becomes inevitable. Using ezymes, is one of the most environmentally-friendly methods, may be preffered in order to reduce the environmental load. In this study, pilling problems, causes of pilling, anti-pilling methods and the reasons of this phenomenon encountered in the towels are invesitgated.

1. INTRODUCTION

Pilling problem, which adversely affects the textile consumer and producer, is one of the most important problems that affect the quality of products. This problem, especially encountered in knitting fabrics, is distinguished itself by messy fibers and hairy structures on the surface of the fabric [1]. In this study, the anti-pilling finishing process can be used not only in knitted fabrics but also in towels is explained.

2. PILLING AND THE MAIN REASONS

Pilling is a phenomen that occurs especially in fabrics made from staple yarns. Pilings are mixed fibers occurring on the fabric surface during wearing and washing. Pilled fabrics exhibit undesirable appearance and handle (Figure 1) [2].

The pilling on the fabric give rise to quality losses and this may important for textile industry and country economy [4]. According to many researches, fiber, yarn and fabric properties were found effective on the fabric pilling. The properties of the fabric tendency to form pilling are fiber type, fiber length and cross section shape, fiber strength, fiber crimp, yarn producing method, yarn count, yarn twist, yarn hairiness, yarn ply, fabric density, fabric weight and fabric structure [4, 5, 6]. Additionally, applied finishing process may cause increases and decreases on the tendency to form pilling.

2.1 Fiber, Yarn, Fabric Properties and Finishing Processes Causing Pilling

Generally, due to incompatibility between the fibers the fabrics made from blended yarns have more tendencies to form pilling than that of the single fiber produced yarns. There is also a tendency pilling in fabrics made from short and fine fibers. Moreover, the fibers having rounded cross section can easily come out to the surface of the fabric and increase the pilling tendency due to their smooth surfaces. Due to the fact that the natural fibers have low strength, the pilling can be easily comprised of and easily remove [4]. The compact yarns exhibit the lowest pilling tendency [4, 7]. The lower hairiness amount procures the lower pilling tendency. The stranded and hooped fibers cause the yarn hairiness. In other words, it is expected to decrease the pilling as the number of fibers running out of the yarn decreases (Figure 2). Besides, it is stated that even a 46% reduction in the yarn hairiness provides a half-degree improvement on the knitted fabric pilling properties [4]. However, it is known that increment in the yarn hairiness leads to fly increase, warp shrink and break during weaving and knitting processes [7]. Furthermore, the increase of the yarn twist leads to decrease the pilling tendency because the move area of the fibers is reduced. The pilling tendency is also reduced in the multi-layer yarns [4]. When comparing the open-end and ring yarns, it is found that the hairiness values of the open-end yarns are lower than those of ring yarns (Figure 2) [4, 7].

As knitted fabrics are loser than weaving fabrics, the knitted fabrics tend to be more pliable. Ribena and Jersey fabrics are tend to be more pliable than interlock fabrics. The pilling tendency reduces when the yarn count and fabric weight are increased. In addition to all these features, the finishing processes also increase the pilling tendency, as well [4]. The fibers can come out of the fabric surface during the wet processing or, pills are formed by friction encountered while the clothes are wearing [10]. In other words, wet processing can be increased the pilling. Additionally, using softeners and lubricants tend to be increased the pilling. It is known that, frequent washing can accelerate the pilling, as well [2, 4].

3. ANTI-PILLING TEST METHODS

There are some standards and test methods for testing and evaluating the fabric pilling. Most commonly used test methods are; Random tumble pilling test (ASTM 3512), ICI pilling Box (ISO 12945-1), Martindale pilling test method. Moreover, the evaluation scale is given in figure 3.

4. ANTI-PILLING TREATMENT

The pilling problem can be reduced by correcting the fiber, yarn and fabric properties. Besides, anti-pilling finishing can be used for pilling removal. There are various chemical anti-pilling finishing approaches to achieve the anti-pilling. Acrylic copolymer and nano-polyurethane are used as polymers [2, 5, 15]. Apart from these, eco-friendly and durable enzyme finishing can be used [2]. Enzymes catalyze the low-rate reactions and they are affected by heat, pH, mechanical forces, UV, X-Ray and radiation, organic solvents, heavy metal salts, and some detergents [16]. Cellulase enzymes are used to reduce pills in cellulosic fabrics and this process is known as bio-polishing or bio-washing. This process removes the fiber end on the fabric surface, reduces the pilling tendency, and improves the fabric handle and provides durable effects [16]. Cellulose enzyme provides the catalytic hydrolysis on the adjacent repeating unit between the (1-4)ß linkage of the cellulose [17]. Commercially available cellulase enzymes are; acidic cellulase enzymes (pH 4,5-5,5), neutral cellulase enzymes (pH 6,6-7) and basic cellulase enzymes (ph 9-10) [18]. The bio-polishing process provides concretely improvement in softness and drape of both knitted and weaved fabrics and the cellulose enzymes do not reduce the fabrics hydrophilicity. However, due to the fact that this process depends on the mechanism of the fibers hydrolyses, strength loss is expected. Strength losses can differentiate according to the raw material of product and type of enzyme preferred [16]. The amount of the strength losses on the cotton fabrics does not exceed 11% [19]. The deactivation of the enzymes on the fabrics is an important subject because, if the enzymes cannot be removed completely, the hydrolysis process continues and this can damage the fabrics [2].

5. PILLING, CAUSES AND THE ANTI-PILLING TREATMENTS OF TOWEL FABRICS

It is expected that the towels are soft and water-absorbent. Recently, in order to make towel fabrics even softer and more absorbent, different twist types have been developed and applied. The low twisting structure of the yarns allows the air and water to enter the yarn easily and also provides quick drying [20, 21]. However, these low twisting structures of the yarns reduce the splicing fibers together and may cause hairiness and tufting. Furthermore, it is expected that this kind of yarns cause strength losses [20]. Many towels made up of 100% cotton yarns and these yarns cause a huge amount of lint. The yarn twist affects the lint amount and properties of the towels [21]. As a result of the softness and hydrophilicity desired in towels, it is preferred to use short staple yarns in order to have low weight, low-density and softer fabrics. These demands increase the pilling tendency and it seems to be that finishing process is more suitable for the terry towels to reduce the tendency of pilling properties. Therefore, anti-pilling process may be applied before, during and after dyeing process. Anti-pilling treatment can be applied by eco-friendly enzymes. When taken into account that the enzymes can cause fiber damage, it is also important that the process is carried out at optimum concentrations. In the literature, there is no study have been found about this issue and further studies should be done.

6. CONCLUSION

Pilling problem, which is often encountered in fabrics using staple yarns in textile, is one of the most important problems that affect the quality of products. In order to overcome this problem, it is important to select the right fiber, yarn and fabric properties to reduce the pilling tendency.

However, when the softness and hydrophilicity properties of the fabrics are important, pilling becomes unavoidable. To avoid the pilling problem in towels, it can be preffered to use eco-friendly enzymes. Doing more studies on this subject is important for the availability of enzymes in terry towels.

Key words: Pilling, enzymes, towels, bio-polishing, anti-pilling

REFERENCES

[1] Dayık, M., & Yılmaz, F. Pamuklu Kumaşta Boncuk Oluşumunun Bulanık Mantık Metoduyla Tespiti. Tekstil Teknolojileri Elektronik Dergisi, (2012). 6(2), 19-27

[2] W D Schindler,P J Hause, Chemical Finishing Of Textiles, Anti-Pilling Finishes, Woodhead Publishing Limited, 2004

[3] Http://Www.Etchandbolts.Com/Blog/Tips-For-Maintaining-Upholstered-Furniture/, [Cited: 01.05.2017]

[4] Özçelik G., Kumaş Boncuklanma Özelliğinin Objektif Olarak Değerlendirilmesi Ve Tahminlenmesi Üzerine Bir Araştırma, Doktora Tezi, Ege Üniversitesi, İzmir, (2009)

[5] Kayseri, G. Ö., & Kirtay, E., Part 1. Predicting The Pilling Tendency Of The Cotton Interlock Knitted Fabrics By Regression Analysis. Journal Of Engineered Fabrics & Fibers (Jeff), (2015), 10(3).

[6] Beltran, R., Wang, L., & Wang, X. Predicting The Pilling Propensity Of Fabrics Through Artificial Neural Network Modeling. Textile Research Journal, (2005), 75(7), 557-561.

[7] Çelik, P., & Kadoğlu, H. Kısa Ştapelli Đpliklerde Hammaddenin Ve Eğirme Metodunun Iplik Tüylülüğüne Etkisi. Tekstil Teknolojileri Elektronik Dergisi, (2009), 3(2), 20-28.

[8] Http://Www.Levinerwood.Com/2014/04/28/The-Wrinkle-İn-The-No-İron-Shirt-Story/ [Cited: 01.05.2017]

[9] Https://Www.Uster.Com/Fileadmin/Stats_Data_2013v1/Pdf/Uyagulama%20raporu_Tekstil%20end%C3%Bcstrisi%20i%C3%A7in%20ortak%20bir%20kalite%20dili.Pdf [Cited: 01.05.2017]

[10] Şekerci Kırca, G., Pamuk, Rejenere Selüloz Ve Karışımlarından Oluşan Örme Mamullerin Enzimatik Modifikasyonu Ve Optimizasyonu, Doctoral Dissertation, (2012), Deü Fen Bilimleri Enstitüsü.

[11] Http://Www.Manufacturingsolutionscenter.Org/Pilling-Resistance-Testing.Html [Cited: 01.05.2017]

[12] Https://Www.Tradeindia.Com/Fp2309996/Icı-Pilling-Box.Html [Cited: 01.05.2017]

[13] Http://Www.Textileinstruments.Net/Pod_Pro.Asp?İd=276 [Cited: 01.05.2017]
[14] Https://Www.Researchgate.Net/Figure/258195998_Fig1_Figure-1-Example-Of-Fabric-Pilling-Samples-From-Grade-1-To-Grade-5 [Cited: 01.05.2017]
[15] Karaboyacı, M., Nano Poliüretanın El Örgü İpliklerinde Anti-Pilling Ajanı Olarak Kullanılabilirliği., (2010), Tekstil Ve Mühendis, 17(77).
[16] Pınar, E. K. E. R., & Oğulata, R. T. Farklı Hammaddeler İçeren Lycralı Dokuma Kumaşlarda Biyo-Parlatma Ve Biyo-Parlatmanın Kumaş Performansına Etkileri.
[17] Hauser, P., & Schindler, W. Finishing With Enzymes: Bio-Finishes For Cellulose, Chap. 17. Chemical Finishing Of Textiles, (2004), 181-186.
[18] Araujo, R., Casal, M., & Cavaco-Paulo, A. Application Of Enzymes For Textile Fibres Processing. Biocatalysis And Biotransformation, (2008), 26(5), 332-349.
[19] Mavruz, S., & Oğulata, R. T. (2007). Tekstil Terbiyesinde Biyoparlatma Uygulamaları Ve Pamuklu Örme Kumaşların Bazı Fiziksel Ve Kimyasal Özelliklerine Etkisi. 2007 (Cilt: 14), 66.
[20] Uyanık S. , Ünal Zervent B. Ve Çelik N., Faklı Büküm Tiplerine Sahip Hav İpliklerinin Havlu Performans Özelliklerine Etkisi, Cukurova Universitesi Muhendislik Mimarlık Fakultesi Dergisi, (2013), 28(1), 101-110ss
[21] Mandawewala, R. (2003). U.S. Patent Application No. 10/412,790.

COMPARISON OF WASHING RESISTANCE OF METALLIZED FILMS USED IN SILVERY YARN PRODUCTION

Elif Yılmaz, Sevda Altaş
Ege University, Emel Akin Vocational Training School, Bornova, İzmir, Turkey
elifdanis@gmail.com

Silvery yarns which are produced as embroidery yarn, knitting yarn, weaving yarn and carpet yarn are preferred because of their glossy appearance in textile products such as knitted and woven apparel fabrics, upholstery, velvet, ribbon and lace for decorative purposes. Silvery yarns which are obtained by coating one or two sides of polyester films in different thicknesses with aluminum and with epoxy or dye for protection purposes, and by slicing the coated polyester films in different sizes are evaluated under the title of metallic yarns. These yarns could be used as it is produced and also by twisting with different filaments such as polyester and polyamide [1-3]. The processing of polyester films which are the raw material of the silvery yarns are carried out with two different methods. These methods are lamination and metallizing. In the lamination process, aluminum is placed between two polyester layers and in metallizing, aluminum is evaporated by heating and then sprayed onto polyester films under high pressure. Textile products produced by using silvery yarn are subjected to various effects during production, usage and washing. It is important to test the metallized films intended for the specified effects and evaluate the obtained data in order to solve the problems that may arise due to the use of silvery yarns in textile products and develop their resistance against friction, washing and heat. In this study it is aimed to evaluate the washing resistance of metallized films used in production of silvery yarns against the repetitive washings. For this purpose, five different metallized films produced with metallizing method; (1) chemical coated metallized film, (2) protective lacquer applied metallized film, (3) both sides dyed metallized film, (4) standard metallized film-1 and (5) standard metallized film-2 were provided from the producer companies and washed repeatedly according to the ISO 6330 standard. The surfaces of the metallized films were evaluated visually by magnifying 100 times after the first, third, fifth, seventh and

tenth washing cycles in order to evaluate the effect of repetitive washings on film surface. As a result of evaluations, chemical coated metallized film was found as the sample which has the best washing resistance and it is determined that the standard metallized film-2 has the worst washing resistance. At the end of the work, it is revealed that application of protective lacquer and dye onto metallized films will also develop the washing resistance of silvery yarns in the positive direction.

Key Words: Silvery yarn, metallized film, washing resistance, repetitive washings

REFERENCES

[1] http://vox.com.tr/sim-iplik.html
[2] http://www.hirasim.com/tr/product/hirasim-m-1#.WQB_dtLyiUk
[3] http://www.machangx.com/en/product/index2.htm

EVALUATION OF SEPARATION EFFICIENCY OF OIL/WATER EMULSION BY POLYPROPYLENE SPUNBOND NONWOVEN MEDIA

Gamze D.Tetik[1], Fulya Yılmaz[2], Gizem Celep[3]
[1] Uşak University, Faculty of Engineering, Department of Materials Science and Nanotechnology Engineering, Uşak, Turkey
[2] Uşak University, Graduate School of Natural and Applied Sciences, Uşak, Turkey
[3] Uşak University, Faculty of Engineering, Department of Textile Engineering, Uşak, Turkey
fulya.ozdemir@usak.edu.tr

Nowadays contamination of water resources is a major problem and finding clean water sources will be harder in the future. Therefore, importance of recycling water and reusing the gain drastically increase. The oil wastes may have destroying effects that 1 liter of oil can contaminate 1 million liters of water. For this purpose, lots of researchers converged to study on separation of oil from water by various kinds of techniques. One of these methods is passive separation that is very cost-effective. Nonwoven media made from synthetic oleophilic fibers are indispensable elements of these passive separation method. Kocherginsky et al. (2003) studied about microfiltration membranes for demulsification of oil-in-water emulsions. They demonstrated that separation process depended on droplet interactions with the membrane surface [1]. Shin and Chase (2006) investigated the water-in-oil emulsion seperation by using glass fiber filter media contributed with nano-sized polyamide fibers. Their results showed that contribution of polyamide nanofibers improved separation efficiency significantly [2]. Bansal et al. (2011) were the group studied about effect of fibrous filter properties (such as surface energy, pore size) on separation of oil-in-water emulsions. They stated the importance of air permeability effect on emulsion inflow velocity and pressure drop. According to their results surface energy did not have any effect [3]. Al-Alawy, and Al-Musawi (2013) worked about microfiltration membranes for separating oil/water emulsions and analyzed the results according to some parameters (feed oil concentration, feed flow rate, temperature). They have found out that when the flow rate was increased, rejection percentage of oil was also increased. However, when they increased oil concentration, the separation rate decreased [4]. Zhu et al. (2015) studied on super repelling polypropylene fabrics by using solvent swelling method which meant leaving mat in cyclohexane/heptane mixture at 80 °C. Recrystallization of the macromolecules on the fiber surface provided submicron behavior formation. This resulted in an increase in surface roughness and finally the fabric demonstrated superhydrophobic behavior. With this simple method, they suggested because of its fast and low cost method properties [5]. Krasiński (2016) studied about separation oil in water emulsions, with this aim he used fibrous mats made of polypropylene, polyester, polyamide as a primary coalescence layer. He stated that high efficiency rates were obtained with the structures produced from finest fibers and the maximum coalescence efficiency was obtained by lowest mass/unit area. When he compared the polymer mats, polypropylene had the highest separation efficiency since it is an oleophilic media [6]. Jha et al. (2017) reviewed the latest achievements about oil/water separation materials. They stated that a range of droplet sizes from the micrometer to the nanometer range played a very important role to obtain high efficiency rates [7].

In this study polypropylene (PP) spunbond nonwoven structures were chosen for the separation of virgin olive oil-water emulsions. Mass per unit area of PP nonwovens were chosen as 15, 30, 50 and 100 g/m^2 in order to compare effectiveness of separation. Two different virgin olive oil/water percentage ratios (75/25, 50/50) were used for preparation of emulsions. Density of virgin olive oil used was 0.916 g/cm^3. Preparation of virgin olive oil-water emulsions were made by blending with the help of magnetic stirrer for 5 min at 700 rpm. PP spunbond nonwoven samples were placed strainedly on glass funnel and then virgin olive oil-water emulsion poured on the nonwoven surface. After 10 min the amount of oil that was penetrated to nonwoven media and accumulated in the eaches were measured by analytical balance. Total separation percent was calculated by addition of these two values.

According to the results, for 50/50 emulsion ratio oil separation efficiency of the heaviest (100 g/m^2) PP Spunbond medium was the highest with a value of 96.9% (Fig I). The amount of penetrated oil on media is increased according to the increase in the amount of oleophilic fiber increase. Also, the lightest media (15 g/m^2) allowed the highest amount of oil to accumulate in each. It can be concluded that both the highest and lightest PP Spunbond nonwoven media can separate 50/50 oil/water emulsions efficiently.

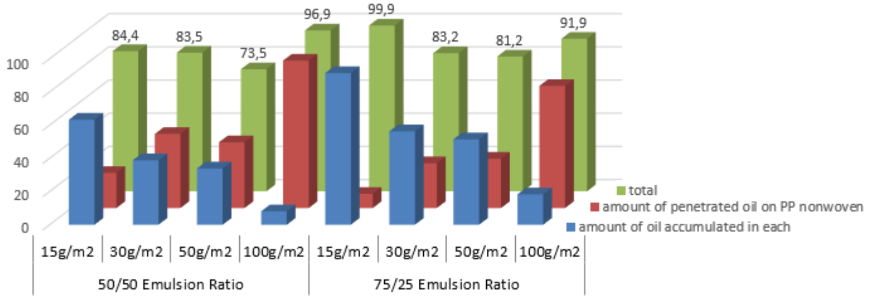


Figure 1. Separation efficiency of PP Spunbond nonwovens

When 75/25 oil/water emulsion was considered, the lightest PP medium was the one who approximately reached 100% value (Fig.I). The amount of oil accumulated in each was 91.3%. This mass per unit area can be used for effective separations of 75/25 oil/water emulsions. As in the same manner as 50/50 emulsions the heaviest one has also a high efficiency (91.9%).

In this study effect of the mass per unit area of the PP spunbond nonwoven structures on oil separation efficiency were investigated and compared. It was found that oil separation efficiency was strongly affected by mass per unit area of the nonwoven media. The maximum loading capacities of PP nonwoven media may be studied and lifetimes of media may be considered in further studies.

Key Words: Oil water emulsions, separation, polypropylene, spunbond nonwoven

REFERENCES

[1] Kocherginsky, N. M., Tan, C. L., & Lu, W. F. (2003). Journal of membrane science, 220(1), 117-128.
[2] Shin, C., & Chase, G. G. (2006). Journal of dispersion science and technology, 27(4), 517-522.
[3] Bansal, S., von Arnim, V., Stegmaier, T., & Planck, H. (2011). Journal of hazardous materials, 190(1), 45-50.

[4] Al-Alawy, A. F., & Al-Musawi, S. M. (2013). Iraqi J. Chem. Petrol. Eng, 14, 53-70.
[5] Zhu, T., Cai, C., Duan, C., Zhai, S., Liang, S., Jin, Y., and Xu, J. (2015). ACS applied materials & interfaces, 7(25), 13996-14003.
[6] Krasiński, A. (2016). Environment Protection Engineering, 42(2).
[7] Jha A, Sarma KSS, Chowdhury SR (2017) Advancement of Oil/Water Separating Materials: Merits and Demerits in Real-Time Applications.

REAL TIME VIRTUAL CLOTHING SIMULATION WITH MOTION SENSORS

Meliha Oktav Bulut, Hakan Yüksel
Süleyman Demirel University, Isparta, Turkey
hakanyuksel@sdu.edu.tr

The common use of computer and the development in information technologies cause many changes in our daily life and habits. 3D modeling in computer science and use of virtual reality techniques play an important role in especially fashion industry, production methods and customer centered systems. With the help of CAD- CAM systems used in textile sector for years, the new generation simulating techniques have been promoted.

In this study, the virtual clothing simulation has been developed with the motion sensor used commonly in human motion capturing and processing in academic and commercial activities. The human captured by the motion capturing sensor can try on the clothes on the system with the controlling of body motions. The developed system is expected to show positive effects on both producer and consumer side with regard to the effort and time the consumer lost during the shopping.

Key Words: Virtual clothing simulation, motion capture sensors, software

LIST OF AUTHORS

A

B

C

Ç

D

E

G

H

İ

J

K

M

N

O

V

Y

Z

www.itas2017.com

XIV^th INTERNATIONAL İZMİR TEXTILE AND APPAREL SYMPOSIUM

SCIENTIFIC SECRETARIAT
E. Perrin AKÇAKOCA KUMBASAR
Ege University Faculty of Engineering
Department of Textile Engineering
Bornova / Izmir - 35100 Turkey
Telephone: +90 (232) 339 92 22
Fax: +90 (232) 339 92 22
perrin.akcakoca@ege.edu.tr

ORGANIZATION SECRETARIAT
Hüseyin ÇALGAV
Dahlia Tourism Organization Company
Kazım Dirik Mah. No 1, 3728. Sk.,
Bornova / Izmir - 35100
Telephone: +90 (232) 464 88 30 (Pbx)
Fax: +90 (232) 464 88 31
huseyin@dalyatur.com **www.dalyatur.com**