7th International Textile Conference

November 10th-11th, 2016, Tirana, ALBANIA

BOOK OF PROCEEDINGS

Organized by
Polytechnic University of Tirana
Faculty of Mechanical Engineering
Department of Textile and Fashion

Department of Textile and Fashion

Head of Department: Prof. Dr. Genti GUXHO

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PREFACE

The Textile and Fashion Department at the Mechanical Engineering Faculty, Polytechnic University of Tirana (PUT) since 2004 every two years organizes the textile conference with the participation of the professors/lectors of the Department of Textile and Fashion, other departments at PUT, University of Tirana and foreign universities with similar research areas in textile technology and textile materials.
The Department of Textile and Fashion in PUT is full member of AUTEX since 2008.
The mission of AUTEX (Association of Universities for Textiles) is to facilitate cooperation among members in research and teaching in textile field at the top level. Full members and associates members are consolidated reputable universities in higher education and research in the field of textile. AUTEX was established in 1994. Currently there are 34 members from 28 countries. PUT, Department of Textile and Fashion is accepted as full member in June 2008. The current president is Professor Vladan Koncar, ENSAIT, Roubaix, France.

The First Conference of Textile Tirana *was organized in July 2004. At the first conference that coinciding with the 20th anniversary of the Textile Department at the Faculty of Mechanical Engineering there were presented 12 papers. (Proceedings book, Scientific Library FIM)*

The Second Textile Conference in Tirana *was organized in July 2006. At this conference there were presented 12 papers. (Proceedings book, Scientific Library FIM).*

The Third International Conference of Textile in Tirana *was organized on November 20, 2008 in the framework of FP6 "RETEXRESALB", in which the Department of Textile and Fashion was the coordinator. The primary objective of conference was technology transfer. There were presented 14 papers. (Proceedings Book ISBN* 978-99956-16-27-4*).*

The Fourth International Conference of Textile in Tirana *was organized on November 19, 2010. At this conference there were presented 26 papers. (Proceedings book, Scientific Library FIM).*

The Fifth International Conference of Textile in Tirana *was organized on December 7, 2012 at this conference there were presented 20 papers. (Proceedings book, Scientific Library FIM).*

The Sixth International Conference of Textile in Tirana *was organized on November 20, 2014 at this conference there were presented 37 papers. (Proceedings book, Scientific Library FIM).*

In ***the Seventh International Conference of Textile in Tirana,*** *November 10-11, 2016 organized by the Department of Textile and Fashion in PUT, the participants will be from:*

ALBANIA
Polytechnic University of Tirana
Faculty of Mechanical Engineering,
Department of Textile and Fashion
Department of Production and Management
Department of Energy
Faculty of Mathematical Engineering and Physical Engineering
Department of Engineering Physics
Faculty of electric Engeneering
Department of Electrotechnics
Department of Automation Industry
Faculty of Information Technology
Telecommunication and Electronic Department
Faculty of Geology and Mining
Department of Earth Sciences

University of Tirana
Faculty of Natural Sciences
Department of Industrial Chemistry
Faculty of Economy

Agricultural University of Tirana
Department of Mathematics and Informatics

EPOKA University
Faculty of Architecture and Engineering

POLIS University
Department of Architecture and Design

Albanian Institute for the Research and Education in Information Technology (ISSETI)

Ministry of Education and Sports, National Agency for Examinations

Institute of Cultural Anthropology and Art Studies

Institute for Educational Development

General Directory of Metrology

BELGIUM
Ghent University
Department of Textile

BOSNIA AND HERZEGOVINA
University of Bihać

CROATIA
University of Zagreb, Zagreb
Faculty of textile technology
Department of Clothing technology

CZECH REPUBLIC
Technical University of Liberec
Department of Clothing

FRANCE
University of Haute Alsace
Laboratory of Mechanical and Physical Textiles

GERMANY
Bielefeld University of Applied Sciences,
Faculty of Engineering and Mathematics, Germany

GREECE
Piraeus University of Applied Sciences
Department of Electronic Engineering

ITALY
Politecnico di Bari, Italy
Dipartimento di Meccanica, Matematica e Management

MACEDONIA
University of Saint Cyril and Methodius
Faculty of Technology and Metallurgy
University Goce Delčev
Faculty of Technology, Štip

NORTH CYPRUS
Cyprus International University

ROMANIA
"Gheorghe Asachi" Technical University of Iasi
Faculty of Textiles, Leather and Industrial Management

TURKEY
Ege University
Department of Textile Engineering, Izmir
Erciyes University
Department of Textile Engineering
Namık Kemal University
Department of Textile Engineering Corlu
METU BIOMATEN Center of Excellence in Biomaterials and Tissue Engineering, Ankara,

TOPICS OF THE CONFERENCE

Garment Manufacturing

Textile Testing and quality control

Textile Processing

Biopolymers and Biotechnology

Comfort and Wellbeing

Developments in Textile Machinery

E-activities and E-commerce

Ecology and Environment in Textile Production

Fibre Physics and Textile Mechanics

Finishing, Dyeing and Treatment

Medical Textiles

Modelling and Simulation

Nanotextiles

Smart and Interactive Textiles

Supply Chain Management and Logistics

Technical and Protective Textiles

Textile Design and Fashion

Textile Education

INFORMATION ON THE DEPARTMENT OF TEXTILE AND FASHION, PUT

The Textile and Fashion Department (TFD) is unit of the Faculty of Mechanical Engineering at the Polytechnic University of Tirana. The Textile Engineering was established in 1968 in Berat as The Branch of Textile in the Faculty of Engineering at the University of Tirana.

The curricula was based on a 3 years part-time system. In 1984 the department was renamed The Chair of Textile at the Mechanical and Electrical Engineering Faculty, University of Tirana when it changed its curricula into a four and half year's program in textile engineering. In 1994 it was renamed to The Department of Textile. The academic program covered all the required subjects for the Textile Engineering Diploma.

The '90s were a challenge for the economy, politics and society and also for university education in Albania. In 1991 the group of the engineering oriented faculties created the Polytechnic University of Tirana. During the 90s, the Department of Textile and Fashion started the transformation process of the curricula, syllabuses, and the organization structure and strategy for transforming this department not only into a university teaching units but also into a research and development centre in the field of textile industry. During these years many improvements and modifications have been occurred such as: the introduction of new subjects in the 5-year study cycle e focusing in the garment manufacturing, garment design and marketing of the Textile Laboratory (1996), participation in several Tempus projects etc.

The period 2000 – 2012 was for the Department of Textile and Fashion the transformation decade of curricula and organization in the education system of textile and fashion branch in accordance with the Bologna Declaration signed by the government of the Republic of Albania.

The curriculum in textile and fashion engineering is organized in three study systems:

- *Bachelor degree (3 years study) in "Textile Engineering and Fashion" with three orientations*
- *Master degree (2 years study) in "Textile Engineering and Fashion"*
- *Doctorate (PhD) school in "Materials Science" orientation "Textile materials" (at least 3 years study and PhD thesis)*

It was a great effort and exceptional work of the relatively medium size department for seeking the harmonization of some specific requirements for this study:

- *Provision of similar studies with those of western universities*
- *Adaptation of the academic curricula to the needs of the Albanian labour market.*
- *Qualification of the staff.*

During 2000 - in the curriculum, the focus of our work has been in the staff qualification and research. Thus, only during the last fourteen years have been developed and approved nine micro theses, six doctorates in the textile area. Two achieved in Western universities, one in our

Department other five PhD studies are in process, and 12 post-graduate students, compared to only one PhD thesis during 90s.

The Textile laboratory was accredited under the new standard for accreditation of testing laboratories ISO/IEC 17025 and expanded its activities with the pilot testing of the chemical nature of textiles and leather materials. But during these years the Department of Textile and Fashion has participated and ran five national research projects funded by the Albanian government,, two projects " Quality and Equity in Higher Education" funded by the World Bank, an EU FP6 Project. The Department has also participated in a number of Tempus projects, FP7, CARDS and technical expertise in special fields.

The history of the Textile and Fashion Department is closely linked to the enormous work done by its dedicated academic staff. This dedication has resulted in the development of the academic programs, the teaching process, the effort put in scientific research and the publishing of scientific papers.

Since the establishment of the Textile and Fashion Department hundreds of specialists have been graduated in the fields of spinning, weaving, knitting and garment industry. The first group of lecturers were graduates of the Polytechnic University of Lodz, Poland. Among the most celebrated were such figures as Prof. Dr. Taxhedin Baholli, M.Sc Eng. Kozma Xhero, M.Sc. Eng. Eva Budina, M.Sc Eng. Shega Shapllo, M.Sc. Eng. Magdalena Ktona, etc.

The staff has since expanded to accommodate new lecturers. Most of them are graduates of the Polytechnic University of Tirana but there are also graduates of international universities.

TFD has also participated in many national and international cooperative projects, conferences and workshops.

INFORMATION ON TIRANA

Tirana is the capital of Republic of Albania since 1920. Polytechnic University of Tirana (1951), University of Tirana (1957), Agricultural University (1951), Academy of Science (1972), National Library (1922), as well as many museums, among which Museum of National Culture, Museum of Natural Sciences (1948), Museum of Archeology (1948) and Museum of National History (1981) are in Tirana.

Tirana has the only international airport "Nene Tereza". Tirana is only 40 km away from the most important harbor of Albania (Durres). In 2000 the center of Tirana, from the Polytechnic University's Main Building to Skanderbeg Square, was declared Cultural Heritage.

Geography. Tirana is located 110 meters above the sea level. The average height of the Tirana region is 521 m, while two high mountains near Tirana are Dajti and Mali me Gropa, respectively 1612 m and 1828 m high. The area of the city of Tirana is around 31 km². In Tirana prevails subtropical-Mediterranean climate.

For more information:

Department of Textile and Fashion: www.upt-tekstilmoda.org

AUTEX: www.autex.org

Faculty of Mechanical Engineering www.fim.edu.al

Polytechnic University of Tirana www.upt.al

CONTENTS

FIRE RESISTANCE OF INSULATION STRUCTURE FROM POLYESTER CUTTING WASTE

S. Jordeva[1], E. Tomovska[2], D. Trajković[3] and K. Zafirova[2]

[1] Faculty of Technology, University "Goce Delcev"- Stip, Macedonia
[2] Faculty of Technology and Metallurgy, University "Ss. Cyril and Methodius"- Skopje, Macedonia
[3] Faculty of Technology, Leskovac, University of Niš, Serbia

Keywords: apparel cutting waste, fire resistance

Abstract

The EU priorities of creating products with improved ecological footprint have led towards research for developing new insulation materials. Evaluation of the performance of insulation materials is a multi-criteria problem, which has to be carried out with respect to: physical properties, health and environmental protection, applicability as building elements and their cost. This paper investigates the fire resistance of an insulation structure made of apparel cutting waste. Hot metal nut test was selected as appropriate for insulation structures, as it represents most closely the conditions under exploitation. The results indicate that polyester is convenient for use in internal insulation structures as it is not conductive of flame.

Introduction

One of the dominant environmental problems for the clothing industry is the production of waste during the cutting processes. Although all contemporary waste management systems consider landfilling as the worst waste removal option, it remains the preferred manner of textile waste removal [1]. None the less, recycled textile waste has already found commercial application as insulation material, but so far only waste that is easy to open down to fibers, e.g. cotton waste, has been used [2]. According to Jørgensen & Jensen [3] 55% of world production of textiles and apparel are based on synthetic fibres, mainly polyester. Standard mechanical recycling is not an option when it comes to textile waste from polyester woven fabrics, as it requires opening the fabric. The opening process of fabrics necessitates a loose structure with lower tensile strength (e.g. knits, woven fabrics from natural fibres). The use of greater mechanical force on polyester fabrics may cause melting; therefore alternative mechanical processing should be sought. Few experimental studies have begun tackling the problem of creating insulation materials from apparel waste. Valverde et al. [4] used waste from the knitting industry; however they applied foamy PES/PU bra padding, rather than fabric to obtain the insulation structure. An insulation

structure made from recycled fabrics - polyester cutting waste stabilized by stitching was obtained by Jordeva et al. [5].

The performance of insulation materials is a multi-criteria problem, which has to be carried out with respect to: physical properties, health and environmental protection, applicability as building elements and their cost [6]. Fire resistence is an important criterion which has to be met in order to apply the insulation materials in construction. Fire resistance refers to the ease of ignition and sustained burning after ignition. Thermoplastic synthetic fibres, like polyester, are moderately flammable, shrink during burning, melt and drip on the contact with a flame, causing the textile to stop burning [7]. This paper investigates the fire resistance of insulation materials made from polyester cutting waste.

Materials and Methods

Materials. PES fabric with different masses and structured have been used as materials for the insulation structures. Fabric A structure and C and D differ greatly. Fabric D differs from A and C because of its raw material content because it contains 5% Lycra fibers. The characteristics of the used fabrics are shown in tab.1.

Table 1. Structural characteristics of used fabrics

Fabric	**A**	**C**	**D**
Thickness (mm)	0.16	1.20	1.60
Cv (%)	2.17	1.80	1.38
Mass per unit area (g/m^2)	92	245	272
Cv (%)	3.13	1.16	1.38
Warp density (cm^{-1})	74	37	44
Weft density (cm^{-1})	45	25	28
Warp count (tex)	7.4	36	36
Weft count (tex)	7.4	36	36

Sample B obtained from PES knitted fabric partly in the form of fiber has been used for comparison. Encasings made of 100% polypropylene were filled with these materials. The samples have length and width (60x60cm) and height (thickness) of 50, 70 and 100 mm. The insulation blankets were stitched to stabilize the structure. The finished structure is shown on Figure 1. This is done with 10 differently prepared samples. (tab. 2).

Method. Fire resistance methodology - BS 4790: 1987 (hot metal nut test) was selected as appropriate for insulation structures, as it represents most closely the conditions under exploitation. The samples for testing fire resistance were obtained by stabilizing textile waste with sewing between two carrier foils, i.e. between pieces of nonwoven textile material. In this method, the standard M16 non-corrosive steel hexagonal nut is heated in a muffle furnace at 900℃, and then placed on the sample for three seconds. Any changes during the test were

monitored and recorded and the time of burning was measured. In the end, the largest radius and depth of the impaired (burned) surface was measured.

Fig.1 Polyester cutting waste insulation structure

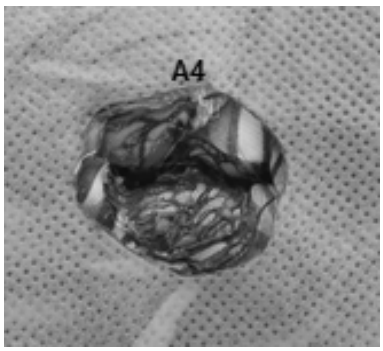

Fig. 2 Visual appearance of the samples after the Hot Metal Nut test

Table 2. Samples characteristics and ways of preparing

Sample	Type of material	Raw material content (%)	Preparation of the samples
A_1	cutting waste	100 PES	partially cut, pieces with different sizes
A_2	cutting waste	100 PES	cut into small pieces with different sizes
A_3	cutting waste	100 PES	in original form without preparation
A_4	cutting waste	100 PES	in original form without preparation
B	knitted fabric partially in the form of fibers	70/25/5 PES/cotton/Lycra	mechanical recycling
C_1	cutting waste	100 PES	cut, pieces with average dimensions 6x4cm
C_2	cutting waste	100 PES	cut, pieces with average dimensions 8x4cm
D	cutting waste	95/5 PES/Lycra	cut, pieces with average dimensions 8x4cm
ABC	cutting waste -fabric A knitted fabric partially in the form of fiber -fabric B cutting waste -fabric C		A- cut, pieces with different sizes B- knitted fabric partially in the form of fibers C-cut, pieces with average dimensions 6x4cm
ABD	cutting waste -fabric A knitted fabric partially in the form of fibers -fabric B cutting waste -fabric D		A- cut, pieces with different sizes B-knitted fabric partially in the form of fibers D- cut, pieces with average dimensions 8x4cm

Results and Discussion

The fire resistance test showed that the samples were not conducting flame. In case of 9 samples there was no flame at all, but melting occurred. Only in sample B for a very short time (two seconds) after removing the nut weak sparks of flame were observed, as a result of the presence of cotton.

To further asses the samples the radius - *r* (cm) and the depth - *H* (cm) of the impaired (burnt) place were measured (Table 3). In addition, the visual appearance of the samples at the place where the heated nut was put was examined (Figure2).

For samples composed of single fabric cuttings the radius was in the range of 1.60cm for sample D to 2cm for samples A_1 and A_2, while the depth ranged from 0.3cm for sample D to 1.3cm for samples A_1 and A_2. The least impairment was recorded in sample D, composed of fabric with the largest surface mass. The largest radius and depth of the impaired area were recorded in samples from fabric A. The Pearson correlation coefficient between fabric surface mass and radius (-0.67); as well as surface mass and depth (-0.75) confirms the reverse relationship between fire resistance and fabric mass. When looking into samples from fabric A, it can be seen that the heated nut penetrated deeper and created a circle with a larger radius in the samples made of cut waste (A_1 and A_2) compared to samples made of waste in its original form (A_3 and A_4). In both samples of apparel waste from fabric C values for the radius and depth of the impaired area were the same.

With sample B, composed of partially fibrous material, a part of the circle surface was melted, a part burned and the depth of impairment was very small, 0.4 cm. In combined samples ABC and ABD there was a slightly higher impairment in ABC, resembling the impairment in samples from fabric A, while in sample ABD the impairment resembled the one in sample B. The visual appearance of combined samples resulted from the component dominating at the place of contact. Shrinking of the material during melting occurred in all 10 samples, but it was best visible in samples of waste from fabrics C and D, i.e. fabrics with a greater surface mass.

The results indicate that polyester is convenient for use in internal insulation structures as it is not conductive of flame.

Table 3. Fire resistance

Sample	*r* (cm)	*CV* (%)	*H* (cm)	C_V (%)
A_1	2	2.5	1.3	3.8
A_2	2	2.5	1.3	1.9
A_3	1.75	0.57	1.1	3.6
A_4	1.75	0.57	1.1	3.6
B	1.75	1.7	0.4	1.25
C_1	1.75	1.7	1	4
C_2	1.75	1.14	1	4
D	1.6	3.12	0.3	4
ABC	1.8	2.22	0.6	3.8
ABD	1.75	1.14	0.5	3.8

Conclusion

One of the main environmental problems in the clothing industry is the production of remnant waste derived from cutting processes. This research is focused on using polyester cutting waste derived from the clothing industry as an insulation material with minimal pre-treatment, without converting the fabric to fibre. The results indicate that polyester is convenient for use in internal insulation structures as it is not conductive of flame.

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