



6th INTERNATIONAL TEXTILE CLOTHING & DESIGN CONFERENCE
October 7th to October 10th, 2012, Dubrovnik, CROATIA

Magic World of Textiles

BOOK OF PROCEEDINGS

Organized by:
University of Zagreb
Faculty of Textile Technology
Zagreb, CROATIA



Under the auspices of:



MINISTRY OF SCIENCE,
EDUCATION AND SPORT
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CROATIAN ACADEMIC AND RESEARCH
NETWORK
Zagreb, Croatia

ISSN 1847-7275

Book of Proceedings (International textile, clothing & design conference)

Book proc. (Int. text. cloth. des. conf.)

ISSN 1847727-5



9 771847 727009

Publisher: Faculty of Textile Technology, University of Zagreb, Zagreb, Croatia

Editor in Chief: Zvonko DRAGČEVIĆ

Editors: Anica HURSA ŠAJATOVIĆ & Edita VUJASINOVIĆ

Editorial Board: Zvonko DRAGČEVIĆ, Anica HURSA ŠAJATOVIĆ, Dubravko ROGALE, Ivo SOLJAČIĆ, Darko UJEVIĆ, Edita VUJASINOVIĆ, Nikola VULJANIĆ

Logo of ITC&DC created by: Ratko JANJIĆ - Jobo

Cover & WWW site of ITC&DC designed by: Natali KRMPOTIĆ KOLIĆ

Printed by: Zelina d.d., Zagreb, Croatia

Graphic design: MIŠ d.o.o, Zagreb, Croatia

Editor's Note

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After this Book of Proceedings ITC&DC 2012 has been published, the authors and other persons/institutions wishing to publish reference or in some other manner use the papers published here, are kindly requested to explicitly identify prior publication in the Book of Proceedings of the ITC&DC 2012, including the ISSN number above and page numbers concerned.

The proceedings of the International Textile Clothing and Design Conference have been indexed in the Conference Proceedings Citation Index- Science (CPCI-S), while a selection of the papers from the 6th ITC&DC 2012 will be published in the following publications: AATCC Review (ISSN 0040-490X), Journal of Natural Fibres (1544-046X – electronic; 1544-0478 - paper), International Journal of Clothing Science and Technology (ISSN 0955-6222), International Journal of Simulation Modelling (ISSN 1726-4529), Kemija u industriji (ISSN 0022-9830) and Tekstil (ISSN 0492-5882).

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PREFACE

Dear colleagues, dear friends!

The Faculty of Textile Technology, University of Zagreb, has organised the 6th International Textile, Clothing and Design Conference – Magic World of Textiles in Dubrovnik, which makes this conference, now we can be sure and proud of it, a traditional one.

Scientists and experts working in the field of textile and clothing technologies in Croatia celebrate two important anniversaries this year:

- sixty years of uninterrupted publication of the magazine *Tekstil*, one of the oldest scientific-professional publications in Croatia, and
- twenty years of the Faculty of Textile Technology working as an independent institution and 50 years of the university education in the field of textiles in Croatia, with a special issue of the magazine *Tekstil* dedicated to this anniversary, *Tekstil* **60** (2011), No. 9.

Of the papers received this year, the members of the International Reviewer Committee have accepted 124 papers for the 6th ITC&DC and all of them are published in this Book of Proceedings. It witnesses to the fact we are all sure of - that the scientific research in the field of textiles is attractive, interesting, and a “cool” field.

Our big ITC&DC family has grown out of the six ITC&DC conferences organised up to now, and it includes more than 2000 authors from 36 countries of Europe and all over the world. As every decent family, we have found, thanks to the hospitality of the Centre for Advanced Academic Studies (CAAS), our home here in Dubrovnik.

I am sure everybody is eagerly looking forwards to meeting the old friends here in Dubrovnik, or just to see who would come and get some new acquaintances. I am personally grateful to all the colleagues who attended previous ITC&DC for coming again to the beautiful town of Dubrovnik. However, I am sincerely happy for those who are here in Dubrovnik and Croatia for the first time. Welcome home, all of you! Dubrovnik is the city everybody falls in love with. Once you have seen it, you return.

For a number of important reasons, the ITC&DC is organised in Dubrovnik. Historically speaking, at the time of the Dubrovnik Republic (from the early Middle Ages to the time of the Napoleonic Wars) the ships of the Republic sailed world-wide, and Dubrovnik even had its colonies (not many people know that Goya in India used to be a Dubrovnik colony). The part of the town called Pile, where our Conference is held, used to be the centre of textiles in the Dubrovnik Republic, and the peasants in the nearby Konavosko polje reared silkworms and produced silk until the mid-nineteenth century. Dubrovnik is also a city of exceptional cultural and historical monuments and is included in the UNESCO World Heritage List. It is also a city with a millennium (or almost two millennia) history, where everybody can find his/her true self. *Those who seek paradise on Earth should come to Dubrovnik and see Dubrovnik*, as Bernard Shaw once said. This is why we are in Dubrovnik.

I would like to express my sincerest thanks to all the participants for their valuable contribution and readiness to spend a part of their time in Dubrovnik, making the picture of the Magic World of Textiles more valuable and more real.

My special thanks go to the Government of the Republic of Croatia, as well as to the international scientific associations that have accepted to be the patrons of the conference, proving it to be necessary, justified and useful.

My gratitude also goes to all the individuals and institutions that have helped organising the 6th ITC&DC.

Zvonko DRAGČEVIĆ

Final report for ITC&DC Conferences – Magic World of Textiles

1st ITC&DC 2002

<i>Date & Place</i>	October 6-9 th 2002, Dubrovnik, Croatia
<i>Under the Auspices</i>	DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; University of Zagreb, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), A.P. Cavaco (PT), Z. Dragčević (HR), J. Geršak (SI), B. C. Goswami (US), P. K. Hari (IN), B. Katalinić (AT), D. Katović (HR); P. Kiekens (BE), I. Krucinska (PL), J. Kurz (DE); A. Marcincin (SK), J. Militky (CZ), P. Offermann (DE), K. Slater (CA); Z. Sukang (CN), N. Starszakowna (GB), G. Stylios (GB), C. Q. Yang (US).
<i>Publication</i>	Book of Proceedings of the International Textile, Clothing & Design Conference, ISBN 953-96408-8-1
<i>Editor</i>	Zvonko Dragčević
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology, Zagreb, Croatia
<i>Authors / Papers</i>	239 / 129
<i>Number of Countries Participants came from</i>	26
<i>Referred /Indexed in</i>	Conference Proceedings Citation Index – Science (CPCI-S), World Textile Abstracts, Textile Technology Digest, Textile Global/Net, Chemical Abstracts
<i>Selected Papers published in Journals after Conference</i>	International Journal of Clothing Science and Technology, 15 (2003) 3/4, (ISSN 0955-6222)
<i>Organising Committee</i>	Z. Dragčević – president, N. Vuljanić – vice president, D. Grundler, A. Hursa, N. Krmpotić, T. Rolich, D. Rogale, E. Vujasinović

2nd ITC&DC 2004

<i>Date & Place</i>	October 3-6 th 2004, Dubrovnik, Croatia
<i>Under the Auspices</i>	Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Ministry of Economy, Labour and Entrepreneurship, Zagreb, Croatia; Croatian Chamber of Economy, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; Croatian Academy of Engineering, Zagreb, Croatia; Croatian Society of Chemical Engineers, Zagreb, Croatia
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<i>Publication</i>	Book of Proceedings of the 2 nd International Textile, Clothing & Design Conference, ISBN 953-7105-05-9
<i>Editor</i>	Zvonko Dragčević
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology, Zagreb, Croatia
<i>ISBN</i>	953-7105-05-9
<i>Authors / Papers</i>	352 / 180
<i>Number of Countries Participants came from</i>	29
<i>Referred /Indexed in</i>	Conference Proceedings Citation Index – Science (CPCI-S), World Textile Abstracts, Textile Technology Digest, Textile Global/Net, Chemical Abstracts
<i>Selected Papers published in Journals after Conference</i>	International Journal of Clothing Science and Technology, 17 (2005) 3/4, (ISSN -955-6222)
<i>Organising Committee</i>	Z. Dragčević – president, N. Vuljanić – vice president, A. Hursa, N. Krmpotić, B. Mauser, I. Petrunić, T. Rolich, E. Vujasinović

3rd ITC&DC 2006

<i>Date & Place</i>	October 8-11 th 2006, Dubrovnik, Croatia
<i>Under the Auspices</i>	Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Ministry of Economy, Labour and Entrepreneurship, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; American Association of Textile Chemists and Colorists, Research Triangle Park, United States of America; Croatian Society of Chemical Engineers, Zagreb, Croatia; International Federation of Knitting Technologists, Reutlingen, Germany; Croatian Chamber of Economy, Zagreb, Croatia; INA Oil Industry, Zagreb, Croatia; City of Dubrovnik, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), M. Akalin (TR), M. Duarte de Araujo (PT), S. K. Batra (US), K. Dimitrovski (SI), Z. Dragčević (HR), J. Geršak (SI), B. C. Goswami (US), P. K. Hari (IN), A. R. Horrocks (GB), B. Katalinić (AT), I. Krucinska (PL), S. Kukle (LV), A. Marcincin (SK), H. J. Mencer (HR), J. Militky (CZ), R. Postle (AU), D. Rogale (HR), E. Schollmeyer (DE), H. Shosenji (JP), N. Starszakowna (GB), G. Stylios (GB), X. Tao (CN), R. Wardman (GB), C. Q. Yang (US).
<i>Publication</i>	Book of Proceedings of the 3 rd International Textile, Clothing & Design Conference, ISBN 953-7105-12-1
<i>Editor</i>	Zvonko Dragčević
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology Zagreb, Croatia
<i>ISBN</i>	953-7105-12-1
<i>Authors / Papers</i>	414 / 183
<i>Number of Countries Participants came from</i>	31
<i>Referred /Indexed in</i>	Conference Proceedings Citation Index – Science (CPCI-S), World Textile Abstracts, Textile Technology Digest, Textile Global/Net, Chemical Abstracts

<i>Selected Papers published in Journals after Conference</i>	International Journal of Clothing Science and Technology, 19 (2007) 3/4, (ISSN 0955-6222), Kemija u industriji, 56 (2007) 11, (ISSN 0022-9830), Tekstil 56 (2007) 2, (ISSN 0492-5882)
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4th ITC&DC 2008

<i>Date & Place</i>	October 5-8 th 2008, Dubrovnik, Croatia
<i>Under the Auspices</i>	Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Croatian Chamber of Economy, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; Society of Dyers and Colourists, Bradford, United Kingdom; Croatian Society of Chemical Engineers, Zagreb, Croatia; INA Oil Industry, Zagreb, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), M. Akalin (TR), M. Duarte de Araujo (PT), A. Curteza (RO), K. Dimitrovski (SI), Z. Dragčević (HR), J. Geršak (SI), B. Katalinić (AT), I. Krucinska (PL), S. Kukle (LV), A.V. Kulichenko (RU), A. Marcincin (SK), H. Mattila (FI), J. Militky (CZ), R. Postle (AU), H. Rödel (DE), E. Schollmeyer (DE), N. Starszakowna (GB), G. Stylios (GB), X. Tao (CN), D. Ujević (HR), L. Wadsworth (US), C. Q. Yang (US).
<i>Publication</i>	Book of Proceedings of the 4 th International Textile, Clothing & Design Conference, ISBN 978-953-7105-26-6
<i>Editor</i>	Zvonko Dragčević
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology, Zagreb, Croatia
<i>ISBN</i>	978-953-7105-26-6
<i>Authors / Papers</i>	438 / 200
<i>Number of Countries Participants came from</i>	34
<i>Referred /Indexed in</i>	Conference Proceedings Citation Index – Science (CPCI-S), World Textile Abstracts, Textile Technology Digest, Textile Global/Net, Chemical Abstracts
<i>Organising Committee</i>	Z. Dragčević – president, N. Vuljanić – vice president, S. Bogović, A. Hursa, B. Mauser, M. Runkas, N.K. Simončić, E. Vujasinović

5th ITC&DC 2010

<i>Date & Place</i>	October 3-6 th 2010, Dubrovnik, Croatia
<i>Under the Auspices</i>	President of the Republic of Croatia Prof. Ivo Josipović, Ph.D.; Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Croatian Chamber of Economy, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; Croatian Society of Chemical Engineers, Zagreb, Croatia; American Association of Textile Chemists and Colorists, Research Triangle Park, United States of America; International Federation of Knitting Technologists, Reutlingen, Germany; ESCORENA Poznan, Poland; CARNet, Zagreb, Croatia

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<i>Publication</i>	Book of Proceedings of the 5 th International Textile, Clothing & Design Conference, ISSN 1847-7275 [Book proc. (Int. text. cloth. des. conf.)]
<i>Editors</i>	Zvonko Dragčević, Anica Hursa Šajatović, Edita Vujasinović
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology, Zagreb, Croatia
<i>Authors / Papers</i>	423 / 168
<i>Number of Countries Participants came from</i>	36
<i>Referred /Indexed in</i>	Conference Proceedings Citation Index – Science (CPCI-S)
<i>Selected Papers published in Journals after Conference</i>	Tekstil, 59 (2010) 12, (ISSN 0492-5882)
<i>Organising Committee</i>	Z. Dragčević – president, N. Vuljanić – vice president, A. Hursa Šajatović, Z. Kovačević, B. Mauser, B. Šaravanja, T. Tisaj, S. Vlatković, E. Vujasinović

60 years of the scientific-professional journal Tekstil (ISSN 0492-5882)

Scientific-professional journal Tekstil celebrates this year an important anniversary - 60 years of uninterrupted publication, which makes it one of the technical journals with the longest tradition of uninterrupted publication in Croatia. From the very beginning to present days, the journal is issued once a month, the publisher being Croatian Association of Textile Engineers, the central association of Croatian scientists and experts in the fields of textile and garment technologies.

Tekstil publishes papers in the scientific and professional fields of textile and garment technologies and fashion design, as well as the papers from the fields in some way associated with textile and garment technologies and other areas of work present in textile and garment industries. The journal has helped present Croatian textile science and scientists globally, and has also become a platform to promote and present global scientific achievements to domestic readers, through established cooperation with renowned world institutes and establishments in the field of textiles. It is the only scientific-professional publication in the field in Croatia, and is quoted in numerous bibliographic databases - ISI, Web of Knowledge, Web of Science, Scopus, SCI, EBSCO, World Textile Abstract etc., which witnesses to its high level of scientific merit. It should also be noted that Tekstil has been referred to as a SCI publication by The Institute of Science Information (Thomson Reuters at the time) since 1993.

The scientific-professional journal Tekstil was founded in 1952 by the Society of Engineers and Technicians of Croatia, an institution which included all the elders and founders of textile science and profession at the time, and has been developed ever since by generations of authors and collaborators, who invested a great deal of their scientific and professional knowledge into it, together with their notable organisational abilities and effort.

In the past sixty years, numerous scientific papers, reviews and professional papers have been published, not only by Croatian authors, but by renowned European and world scientists and experts as well. This has contributed to the significant international character of the magazine, aided by the publication of papers in English. Its tradition, reputation and broad scope of topics, as well as the number of authors from Croatia and abroad, all have ensured the place of Tekstil in the family of highly respectable, renown and valuable scientific professional, technical and generally cultural publications.

The Tekstil journal has constantly been developed since its beginnings, and has been an important factor in promoting scientific and professional activities in the fields of textiles, as well as a significant link with the industry, due primarily to its high level of excellence in both technical aspect and contents. It was an active and influential factor in the development of textile and garment industries, in professional education for textile experts, as well as in the development of textile science and education, not only in Croatia but in the region as well. During the sixty years of its existence, Tekstil has been a strong support to the development of textile studies and the establishment of the independent Faculty of Textile Technology (in 1991), the institution that is an established part of the University of Zagreb and a well known and internationally respected institution of high learning.

Generally, the editor's policy of Tekstil is to keep and improve its high quality, primarily through constant changes as an answer to changing economic conditions and innovations in the field of scientific and professional publishing. It also strives to continue encouraging professional education of textile experts and transfer new technical and technological knowledge to its readers.

Celebrating our anniversaries, we congratulate The Faculty of Textile Technology fifty years of the university studies of textiles and twenty years of independent work. We are proud to be able, through our common effort, to realise the wishes and ideas of generations of textile experts and enthusiasts, who have woven their scientific and professional work and knowledge into the magic world of textiles.

Editor in Chief
Prof. Zvonko DRAGČEVIĆ, Ph.D.

Editor
Agata VINČIĆ, mag.ing.text.techn.



CONTENTS

PLENARY LECTURE

POSTLE Ron

Mechanics and Physics of Soft Matter: Knitted Fabrics* 3*EXPERT FOCUS LECTURE**

KURZ Josef

New Developments in Medical Textiles: Health Care – Hygiene – Implants* 17*SECTION A: TEXTILE FIBRES AND ADVANCED MATERIALS**AKBARI Somaye; HAGHIGHAT KISH Mohammad; MAZAHERI Firoz Mehr ; TAHERI
OTAGHSARA Mir Reza***Application of Permanent Fragrant into Worsted Fabric using Dendritic Material
and Monitoring its Release by E-Nose*..... 25**

AUDZEVIČIŪTĒ-LIUTKIENĒ Inga; MASTEIKAITĒ Vitalija & SACEVIČIENĒ Virginija

***Analysis of Knitted Fabrics Deformation using Uniaxial Tension Methods* 30**

BALTIMA Ilze; ZAMUSKA Zaiga; STRAMKALE Veneranda & STRAZDS Guntis

***Hemp Fibres, Their Properties and Usage Possibilities*..... 36**

CZAPLICKI Zdzisław & KOZŁOWSKI Ryszard

***The Fibrilising Cereal Straw and Application Possibilities*..... 42**

FREIVALDE Liga; KUKLE Silvija & RUSSELL Stephen

***Comparative Analysis of Thermo Bonded and Needle Punched Hemp Nonwoven
Material Properties* 47**

GUDRO Ilze; SIRVAITYTE Justa; VALEIKA Virgilijus & ULME Andra

***Short Term Raw Hide Storing using Vacuum Preservation Method*..... 53**

HARDIN Ian R.; WILSON S. Susan & ZHANG Ming

***Creation of Fibers With High Conductance and Capacitance Properties* 59**

KALANTARI Mahsa; KISH Mohammad Haghghat & AKBARI Somaye

***Preparation and Release Behavior of Microcapsules Containing Rosewater with Polystyrene
or Poly Lactic Acid Shell Material*..... 64**

KOZŁOWSKI Ryszard & CZAPLICKI Zdzisław

***Comparison of Polish Alpaca Wool to the Properties of Sheep Wool, its Structure and
Possibilities of Application*..... 70**

KUKLE Silvija; STRAMKALE Veneranda; KALNINA Dace & SOLIZENKO Rita

***Comparison of Hemp Fibre Properties* 76**

LAWES Stephen; SCHOELLER Katrin & GAAN Sabyasachi

***Stable Conductive PEDOT:PSS Coatings on Single Polymer Fibers for Use as Smart Textiles* 81**

PEIXOTO Joaquim; FLORES Paulo & SOUTO António Pedro

***Breathable, Impermeable and Odourless Lining for Orthopaedic Footwear Application* 87**

RYBA Jozef; UJHELYIOVÁ Anna; HORBANOVÁ Ľuba & MICHLÍK Peter

***Properties of Modified PP Fibres for Reinforced Concrete* 93**

SOMOGY ŠKOC Maja; PEZELJ Emira & ĐUKIĆ Ana

***Epoxy-Silica Organic-Inorganic Hybrid Textile Materials and Antibacterial Activity*..... 98**

SWAN Paul & MINAZIO Pier-Giorgio

***Wellness Attributes of Wool Textiles – A Review* 104**

ŠURINA Ružica; ANDRASSY Maja; BUTORAC Jasminka & SILAJ Barbara

***Influence of Maturation on the Chemical Composition of Flax Fibres* 110**

ŠURINA Ružica; ANDRASSY Maja; BUTORAC Jasminka & VUKSAN Terezija Three-Years of Flax and Flax Fibres Research	116
UJHELYIOVÁ Anna; HORBANOVÁ Ľuba; MICHLÍK Peter & VENCELOVÁ Petronela Effect of Nanoadditive on the Thermo-Mechanical and Mechanical Properties of Filled Polypropylene Fibres	122
VIHODCEVA Svetlana; KUKLE Silvija; BLUMS Juris & BARLOTI Janis Metal Deposition on Textile Fabrics from Natural Fibres by Magnetron Sputtering	128

SECTION B: MANUFACTURE OF YARNS, FABRICS AND NONWOVENS

BEDEZ UTE Tuba & KADOGLU Huseyin Regression Estimation of Yarn Hairiness of Cotton Sirospun Yarns from AFIS Fiber Properties	137
BRNADA Snježana; KOVAČEVIĆ Stana & DIMITROVSKI Krste Investigation of Lateral Fabric Shrinkage Due to Longitudinal Extension to Breakage	143
DAS Subhasis; GHOSH Anindya & BANERJEE Debamalya Selection of Parameters for Engineering Design of Woven Fabrics using Particle Swarm Optimization	149
DIMITROVSKI Krste; KOSTAJNŠEK Klara; GÜNDÜZ Ajberk; TANYELY Mert & AKLEYLEK Ahmet Properties of Cotton-Like Woven Fabrics Containing Different Types of PBT Yarns in the Weft	153
ELTAHIR Hafiz A.; XIA Zhigang & XU Weilin A Study of the Effect of Component Location on Yarn Properties in Embeddable and Locatable Spinning System	159
KOPITAR Dragana; SKENDERI Zenun & RUKAVINA Tatjana Mechanical Properties of Needleponched and Calendering Nonwoven Textile from Polypropylene and Polyester Fibres	164
ZHAO Bo Numerical Simulation and Experimental Study of the Fiber Diameter of Melt Blowing Nonwovens Process	170

SECTION C: TEXTILE FINISHING, DYEING AND CARE

BORISOVA Anna; REIHMANE Skaidrite & SMITKINA Ilze A Method of Surface Modification and Physical Properties Improvement of Cotton/Polyester Fabric	179
BUSCHMANN Hans-Jürgen; AMERI DEHABADI Vahid & GUTMANN Jochen S. Multi-Functional Finish of Cotton using Polyaminocarboxylic Acids	185
CHARUCHINDA Sireerat & LERDKAJORNUSUK Panistha Durability on Flame Retardancy of Polyester Fabric Finished with Bentonite, Phosphorus Compound and Aluminium Hydroxide	191
DAVODIROKNABADI Abolfazl; AYAZIYAZDI Sahar & ZOHOORI Salar Selfcleaning of Cotton Fabric Treated with Nano ZnO/TiO₂	197
DEKANIĆ Tihana; SOLJAČIĆ Ivo & PUŠIĆ Tanja The Impact of Fluorescent Compounds on the Whiteness Quality of Washed Textiles	202
FAKIN Darinka; KUREČIĆ Manja; HRIBERNIK Silvo & OJSTRŠEK Alenka Colloidal Dispersions' Characterization of Various TiO₂ Core-Shell Nanoparticles for Textiles Functionalization	208
FIJAN Sabina; PUŠIĆ Tanja; ŠTANC Darko & ŠOSTAR TURK Sonja Determination of the Disinfection Effect of Low Temperature Laundering Procedures using Novel Agents	214

FLINČEC GRGAC Sandra; KOVAČEVIĆ Zorana; BISCHOF Sandra; MORÓN SOLER Moisés & PAUL Roshan Non Halogen Phosphorus Containing Flame Retardants for Cotton	220
GRANCARIC Ana Marija; KOVACEK Ivancica; BOTTERI Lea; KNEZEVIC-JONJIC Neda & BAZULIC-STIMAC Zeljka Antimicrobial Protection of Nonwoven Composite	226
JUCHNEVIČIENĖ Žaneta; JUCIENĖ Milda; URBELIS Virginijus & RADAVIČIENĖ Svetlana The Effect of Laser Treatment on Colour of the Denim Fabric before and after Washing	232
LUXBACHER Thomas; PUŠIĆ Tanja; PETRINIĆ Irena; BUKŠEK Hermina & BISCHOF Sandra The Zeta Potential for Monitoring the Kinetics of Adsorption of Fabric Softeners on Knitted Fabrics	238
OJSTRŠEK Alenka; BOŽIČ Mojca & FAKIN Darinka UV Protective Properties of Cotton Modified with TiO₂-SiO₂ Core-Shell Nanoparticles	244
OLIVEIRA Fernando Ribeiro; FERNANDES Marta; STEFFENS Fernanda; CARNEIRO Noémia & SOUTO António Pedro Functionalization of Textile Materials by Double Barrier Discharge Plasma	250
OTTER Walther den; SEVEREN Maarten van & GROOSMAN Maarten Smart Laundering With SMILES	256
PARAC-OSTERMAN Durdica; FICOVIC Antonio; DURASEVIC Vedran & SUTLOVIC Ana Process of Obtaining and Analyses of Purple Dye from Murex Trunculus	262
PUŠIĆ Tanja & SOLJAČIĆ Ivo Novel Bleaches for Low Temperature Washing	266
PUŠIĆ Tanja; GUJIĆ Nikolina; ISKERKA Barbara; MATIJEVIĆ Iva; VOJNOVIĆ Branka & VUJASINOVIĆ Edita Durability of Wellness Finishing	272
RACANÉ Livio; CERIĆ Helena & TRALIĆ-KULENOVIĆ Vesna Synthesis and Tautomerism of Two Benzothiazoyl Azo Dyes	278
SOKMEN Nihal & YUKSELOGLU S. Muge Hydrogen Peroxide/Microwave Assisted Bleaching of Linen Fabrics	283
STEFANOVIĆ Bojan; KOSTIĆ Mirjana; ROSENAU Thomas & POTTHAST Antje Wrinkle Reduction Sprays and Means to Analyze Their Performance	287
TALEBIAN Aazam & TAVAKOLI Mina The Effect of Dyes on UV-Protection of Wool	291
UYGUR Ayse & YUKSEL Dilek Printing Styles on Different Fabrics by using a Striped Design	296
VENCELOVÁ Petronela; UJHELYIOVÁ Anna; RYBA Jozef; ČERNÁKOVÁ L'udmila & MIKULA Milan Change of Colour Properties and Rubbing Fastness after Plasma Treatment of Wool Textile Materials	301
YILDIRIM Fatma Filiz & GOKSEL Funda A Study on Natural Dyeing of Silk Fabric	306
YUKSELOGLU S. Muge The Use of DOE Method in Assesment of Mechanical Properties of Wool Fabrics Dyed by Ultrasonic Energy	311

SECTION D: CLOTHING TECHNOLOGIES AND ENGINEERING

ABDELSALAM ABDELKADER HASSAN Eman The Impact of Identify the Flat Pattern of Design in Development Draping on Dress Stand Skill	319
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AKÇAGÜN Engin; DAL Vedat & YILMAZ Abdurrahim Using Lean Manufacturing Techniques in Denim Trousers Finishing Line	324
AKÇAGÜN Engin; DAL Vedat & YILMAZ Abdurrahim Using Value Stream Mapping at Apparel Industry: A Case Study	330
DRAGČEVIĆ Zvonko; HURSA ŠAJATOVIĆ Anica & ŠARAVANJA Bosiljka Investigation and Analysis of Workers' Norm in Garment Manufacturing Processes	336
FIRŠT ROGALE Snježana; ROGALE Dubravko & MAJSTOROVIĆ Goran Thermoinsulation Properties of Intelligent Clothing with Adaptive Thermal Protection	342
HURSA ŠAJATOVIĆ Anica; DRVAR Nenad; ŠOMOĐI Željko & ROGALE Dubravko The Influence of Buttonhole Reinforcement Design on Deformation Distribution in Textiles ..	348
KIRIN Snježana & DRAGČEVIĆ Zvonko Investigation of Workers' Load in the Technological Cutting Process	354
LEKECKAS Kęstutis; STRAZDIENĖ Eugenija; SACEVIČIENĖ Virginija; SCHACHER Laurence & ADOLPHE C. Dominique The Effect of Fabric Fusing in 3D Clothing Simulation	360
MEHROTRA Riti & ANAND Noopur Contoured Garments for Women with Big Busts	365
MIKUČIAUSKIENĖ Dalia; KLEVAITYTĖ Ramunė & JARAŠŪNIENĖ Meilutė Determination of Woven Fabric Drape for Women's Shirt and Construction of its Marker Patterns	371
NAMIRANIAN Behnam & JABARPOUR Mahdiye Design and Production the Heating Fabric by Sewing Technique	377
PETRUNIC Igor; HARRIS Roberta & NEWCOMBE David CAD System for Compression Garment Construction and Integration with the Data Entry and Production System	383
RADAVIČIENĖ Svetlana & JUCIENĖ Milda Investigation of the Influence of Fabric Properties on Accuracy of Embroidered Element Dimensions	389
RADAVIČIENĖ Svetlana & JUCIENĖ Milda Influence of Interlining Properties on Quality of the Embroidered Element	395
RADAVIČIENĖ Svetlana; ČEPUKONĖ Lina & JUCIENĖ Milda Investigation of the Influence of Stitch Density on Embroidered Element Colour	401
RAMASWAMY INBARAJU Sathya & VENKATRAMAN Subramaniam Effect of Seams on Drape of Knitted Fabrics	407
ROGINA-CAR Beti; BRNADA Snježana & KOVAČEVIĆ Stana Impact of Fabric Weave and Density on Thread Slippage in Stitched Seam	412
SELKO Urška & RUDOLF Andreja Influence of Body Shape and Size Number on Clothes Selection	418
SHAFI Arman; YOSOUF Khaldon; SCHACHER Laurence & ADOLPHE C. Dominique Effect of Stitch Density on Shear Properties of Embroidered Metallic Circuit & Impact of Pressure on Sensor During Movement	424
SHAHTA Ingrida; BALTINA Ilze & PUCE Madara Testing of the Electrical System Components Integrated in the Textiles	430
SHEHI Ermira; PRIFTI Luella & FUNDI Akli Anthropometric Data for Developing Industrial Standards in Apparel Manufacturing for the Home Market	436
SMACHYLO Oksana; SUPRUN Nataliya & TARASENKO Anna About some Aspects of Utility Comfort of Textile for Clothes	441
ŠARAVANJA Bosiljka; PUŠIĆ Tanja; VUJASINOVIĆ Edita & UJEVIĆ Darko Characterization of Interlinings for Silk Fabrics	447

YILMAZ Abdurrahim; AKÇAGÜN Engin & DAL Vedat Analyzing Sample Production Processes in the Apparel Industry and a Model Proposal	453
YILMAZ Abdurrahim; AKÇAGÜN Engin & DAL Vedat Impact of Ergonomically Designed Work Places on Productivity in Apparel Industry	459
ZIEMELE Inese; BELAKOVA Dana & ALEKSEYEVA Jekaterina Determining Time of Technological Operations in CAD/CAM Department for the Clothing Producer	465

SECTION E: ANALYSIS, TESTING AND QUALITY CONTROL

ALIŠAUSKIENĖ Diana; LAURECKIENĖ Ginta & MIKUČIONIENĖ Daiva The Dependence of Compression Properties of Orthopaedic Supports on Washing and Drying Procedure	473
BRNADA Snježana; KOVAČEVIĆ Stana & ROGINA-CAR Beti Investigation of Tensile Forces in Two Directions in Stitched Fabrics	479
ERCEGOVIĆ RAŽIĆ Sanja & ČUNKO Ružica Impact of Nature of the Gases on some Mechanical Properties of Plasma-Treated Cellulosic Fabrics	485
GÖKSEL Funda A Case Study - Investigation of Extension Properties of Seat Fabrics	491
GUDLIN SCHWARZ Ivana & KOVAČEVIĆ Stana Comparative Analysis of Bamboo and Cotton Yarns and Fabrics	495
HARPA Rodica Approach to Evaluation of the Sewing Threads Designed for Leather Products	500
HARPA Rodica Cotton Yarns' Weavability Assessment: Investigation on Raw Material Properties for Denim	505
JAKUBČIONIENĖ Živilė; MASTEIKAITĖ Vitalija & KLEVAITYTĖ Ramunė Evaluation of Bonded Fabrics Deformation using Hanging Loop Method II	511
KLEVAITYTĖ Ramunė; JANULEVIČIENĖ Danguolė & MASTEIKAITĖ Vitalija Analysis of Quality of Outer Fabrics and Their Fused Systems	516
MALAŠAUSKIENĖ Jolanta & MILAŠIUS Rimvydas Short – cut Method of Electrospun Nanofibres Diameter Distribution Estimation	522
MASTEIKAITĖ Vitalija; DOBILAITĖ Vaida & SACEVIČIENĖ Virginija The Influence of Wet Treatments on the Mechanical Properties of Cotton Fabrics	526
MICKEVIČIENĖ Agnė & TREIGIENĖ Rasa The Influence of Antimicrobial Treatment Conditions on the Structure of Plain Plated Knit ...	532
MIKUČIONIENĖ Daiva & BIVAINYTĖ Asta Influence of Shrinkage on Physiological Comfort Properties of Double-Layered Weft Knitted Fabrics	538
MILITKÝ Jiří; MANGAT Muhammad Mushtaq & HES Luboš Thermal Transport Properties of Cotton Denim Fabric in Wet State	544
NAMIRANIAN Behnam; KHODARAHMI Elahe & SALAMATBAKHSH Mohammad Evaluation Tensile Strength Behavior of Fused Fabric Seam	550
PENAVA Željko & ŠIMIĆ Diana Analysis of Different Weaves Impact on Apparent Elasticity Constants of Woven Fabrics	555
PFUELLER Thomas; ILLING-GUENTHER Heike; NAUMANN Romy; FRANITZA Petra; KOVAČEVIĆ Zorana; MAGOVAC Eva; FLINČEC GRGAC Sandra & BISCHOF Sandra Investigation of Thermal Behaviour and Ageing of Thermoplastic Polymers used for Protective Textiles	561

SACEVIČIENĖ Virginija; MASTEIKAITĖ Vitalija; LISAIUSKIENĖ Jolanta; ZAPPAROVA Akmaral; GERASIMOVIC Tatjana; SCHACHER Laurence & ADOLPHE Dominique C. Analysis on Some of the Mechanical Properties of Woven Fabrics Used for Uniforms	567
SALOPEK ČUBRIĆ Ivana & SKENDERI Zenun Heat and Water Vapour Resistance of Fabrics in Different Climatic Conditions	572
SOMOGYI ŠKOC Maja; PEZELJ Emira & MATANOVIĆ Ivana Characterization and Sorption Properties of Bamboo – A Multifunctional „Green Fibre“	577
STANKOVIC Snezana; POPOVIC Dusan & POPARIC Goran Thermal Behaviour of Rib Knitted Fabrics as a Function of Yarn Structure	583
TOMLJENOVIC Antoneta; DELALIĆ Alma; ŠURINA Ružica; PAUL Roshan & BROUTA-AGNÉSA Marolda The Influence of Ageing Simulation on Polyamide 6.6 Netting Yarns for Fishing Nets	589
URSACHE Mariana Investigation on the Effect of Yarn Count, Loop Length and Relaxation on the Curling Behavior of Single Jersey Fabrics	595
VUJASINOVIĆ Edita; PUŠIĆ Tanja; VOJNOVIĆ Branka; MATIJEVIĆ Iva; ISKERKA Barbara & GUJIĆ Nikolina Qualitative Characterization of Vitaminized Cotton Textiles	601
WONG Wai-yin & LAM Jimmy K.C. Effect of Stretching on UV Protection of Knitted Fabrics	607

SECTION F: DESIGN AND MARKETING OF TEXTILE AND CLOTHING

CABRAL Isabel & SOUTO António Pedro Colour Spread: Light, Thermochromics and Conventional Pigments	615
CHANGIZI Shida & SHARAFAT Hamid Reza The Ground Cloth "Zilu" in Architectural Dimensions	621
FERREIRA Ângela; NEVES Manuela & RODRIGUES Cristina S Textile Handcraft: A Lesson of Sustainability	626
JEMO Danijela & ROLICH Tomislav Application of Computer Graphics in Textile Conservation during the Documentation Process	632
KITCHINGS Kimberley S. Consumers' Perceptions of Quality Hinge on Fiber and Fabric Construction	638
KUNŠTEK Ana & BULAT Barbara Red Cap – Croatian "Lika" Cap	644
NASERI Forough & BABAEI Mohammad Reza A Study on the Demographic and Psychological Factors of Fashion-Oriented Consumers in Clothing Industry	650
NOVAK Ivan & ŠARAVANJA Bosiljka Analysis of the Impact of Opportunities for Corporate Uniforms in Tourist Accommodation Facilities and in Tourist Destinations	656
PETCU Ioana; CURTEZA Antonela; AGRAWAL Pramod; BRINKS Ger & TEODORESCU Mirela & CALIN Monica Thermal Profile of Paralytic Legs in the Development of Highly Functional Clothing for the Physically Disabled	662
RAMOS KALMAR Elizabeth Ecodesign in Fashion: Design Accessories from the Reuse and Recycling of Textiles - Case Study	668
RAMOS KALMAR Elizabeth Blog Design: A Virtual Learning Environment and Knowledge to Design, Textiles and Fashion Globally	674

SIMONCIC Katarina Nina <i>The Question of Continuity and Discontinuity in Fashion</i>	679
STRACENSKI KALAUZ Maja; TRATNIK Miroslav; NENADOV Aleksandar; LJUBAJ Tihana & GRILEC KAURIĆ Alica <i>The Analysis of Jeans Purchase Factors and Consumption Choice among Students Population of Zagreb University</i>	685
VUJASINOVIĆ Edita & PAVUNC Marijana <i>Preventive Conservation of Felted Wollen Vest from Collection of Samobor Museum</i>	691

SECTION G: ENVIRONMENT PROTECTION, ECOLOGY AND ENERGY MANAGEMENT

DENİZ Sabahattin; KÖK YETİMOĞLU Ece & AYDIN Adnan <i>Decolorization of Colored Waters Containing Reactive Blue 19 and Reactive Red 21 by Advance Oxidation Methods</i>	699
KORENAK Jasmina; BOTIĆ Tanja; KNEZ Željko; Čurlin Mirjana & PETRINIĆ Irena <i>Treatment of Real Textile Wastewater in an Anoxic - Aerobic Membrane Bioreactor</i>	704
MIHELIĆ-BOGDANIĆ Alka; BUDIN Rajka & SALOPEK ČUBRIĆ Ivana <i>How to Utilize Flue Gases in Polymerization Process</i>	710
NEVSKY Alexander & SHARNIN Valentin <i>Resource-Saving Chemical Processes of Textile Plants Water Management Systems</i>	716
SEILE Arta & KUKLE Silvija <i>System of Used Textiles Collection</i>	722
SMELCEROVIC Miodrag; DJORDJEVIC Dragan; STOJILJKOVIC Dragan & STOJMENOVIC Slavisa <i>Thermodynamics of Reactive Dye Adsorption from Aqueous Solution on the Fly Ashes</i>	728
VOJNOVIĆ Branka; PUŠIĆ Tanja & VUJASINOVIĆ Ivona <i>Application of HPLC Method for Na-DBS Determination in Detergents and Laundry Wastewaters</i>	734
LIST OF AUTHORS	743
LIST OF SPONSORS	