The one and only objective and comprehensive textile group in the Benelux
Cover: Nanofibre filters for environmental challenges (Visual by Timo Meireman)
90 Years of Excellence through Passion & Commitment
‘Centre of Excellence’
for
Textile Science and Engineering
CONTENTS

VOORWOORD ................................................................. 9
FOREWORD ................................................................. 11
GENERAL ................................................................. 13
EDUCATION ............................................................... 18
INTERNATIONAL RELATIONS ................................. 28
RESEARCH AND INNOVATION ............................... 37
SERVICES TO INDUSTRY ........................................... 70
PUBLICATIONS ......................................................... 75
VOORWOORD

Het jaar 2019 was een bijzonder en buitengewoon gunstig jaar voor de textielafdeling van de Universiteit Gent.

Het onderwijs kende een nieuw hoogtepunt met ruime interesse. Het onderzoek floreerde als nooit tevoren met tal van innovatieve en toekomstgerichte activiteiten. Wat betreft de wetenschappelijke dienstverlening werden alle records gebroken: nooit eerder was er zo een grote interactie met de (Europese) industrie en nooit eerder was de impact naar die industrie zo uitgesproken.

De internationale uitstraling van de textielactiviteiten van het textielcentrum was nooit zo groot. Dit werd bevestigd door de deelname aan het congres AUTEX 2019 in Gent onder de titel

Textiles at the Crossroads
www.autex2019.org

Meer dan 300 deelnemers uit nagenoeg 50 landen gaven het beste van zichzelf en bewezen dat textielonderzoek een multidisciplinaire activiteit is, gedragen door een grote mondiale familie met zin voor innovatie en aandacht voor duurzaamheid op het hoogste wetenschappelijke en technologische vlak.

Textiel bouwt verder aan een betere wereld door actief te zijn in domeinen zoals intelligente materialen, biotechnologie, composieten, nanotechnologie, medisch textiel, (beschermende) werk- en sportkledij, geavanceerde polymeren voor nieuwe vezels, duurzaamheid, 3D-printing, geotextiel, enz.

Textiel is een essentieel deel van het leven en verdient erkenning en respect. Textiel wordt gedragen door mensen met een roeping en dit vormt de basis van alle succes in het verleden, het heden en de toekomst. Textiel IS de toekomst.

Prof. Dr. Paul KIEKENS
Voorzitter Vakgroep Materialen, Textiel en Chemische Proceskunde

http://match.UGent.be
2019 was a special and very favourable year for the textile group at Ghent University.

Education reached a new peak illustrated by a large interest. Research flourished as never before with numerous innovative and future-oriented activities. As far as outreach is concerned, all records were broken: an optimal interaction with the (European) industry was realized with an unprecedented impact.

The international image of the textile activities at Ghent University has never been better. This was illustrated by a large participation of different stakeholders in the AUTEX 2019 conference in Ghent with the title Textiles at the Crossroads

www.autex2019.org

More than 300 participants from nearly 50 countries gave the best of themselves and proved that textile research is a multidisciplinary activity, supported by a large global family striving for innovation and focusing on sustainability at the highest scientific and technological level.

Textiles are further contributing to building a better world by operating in areas such as intelligent materials, biotechnology, composites, nanotechnology, medical textiles, work (PPE) and sportswear, advanced polymers for new fibres, sustainability, 3D printing, geotextiles, etc.

Textiles are an essential part of life and deserve recognition and respect. Textiles are carried by people with a mission and this is the basis of all success in the past, the present and the future. Textiles ARE the future.

Prof. Dr. Paul KIEKENS
Head of Department of Materials, Textiles and Chemical Engineering

http://match.UGent.be
Within the Department of Materials, Textiles and Chemical Engineering (MaTCh) of Ghent University, the Centre for Textile Science and Engineering is a key player in the textile world at European and global level.

STRUCTURE OF THE CENTRE FOR TEXTILE SCIENCE AND ENGINEERING

CHEMICAL AND PHYSICAL TEXTILE TECHNOLOGY headed by Prof. Paul KIEKENS

- Advanced and high performance textile materials
  Nanoparticles based products and developments: composites, flame retardancy,

SMART TEXTILES AND MECHANICAL TEXTILE TECHNOLOGY headed by Prof. Lieva VAN LANGENHOVE

- Smart textiles
  Conductive textiles, textile sensors, dressing material, impedance spectroscopy, textile antennas, electrotherapy, medical applications, design-based learning
- Comfort of textiles
  Thermal, tactile and physical comfort
- Modelling of textile structures and processes
  Direct and inverse modelling of physical properties
  Heat and moisture transfer
  Automatic process optimization via HPC
- Carpets
  Automated assessment of carpet wear, carpet resilience, static electricity

FIBRE AND COLOURATION TECHNOLOGY headed by Prof. Karen DE CLERCK

- Fibre production and processing
  Electrospinning, nanofibres
- Fibre characterization
  Fibre and polymer morphology, thermal analysis, spectroscopy, microscopy
- Colouration technology
  Colour-changing materials, dye diffusion processes, dye-polymer interactions

POLYMER TECHNOLOGY headed by Prof. Dagmar D’HOOGE

- Polymer processing and recycling
  Polymer rheology, multi-scale modelling, extrusion, drawing of polymers, injection moulding
- Polymer reaction engineering (in collaboration with the Laboratory for Chemical Technology)
  Polymerisation and depolymerisation kinetics, model-based design, multi-scale modelling, bulk and emulsion polymerisation
- European Research Centre for Artificial Turf (ERCAT) (lic. Stijn RAMBOUR)
  FIFA testing, resilience improvement, new polymers, woven artificial turf
01.02.2019: New Year’s Lunch @ Auberge du Pêcheur, Sint-Martens-Latem
25.03.2019-29.03.2019: FIFA Field Test Round Robin 2019
@ Benalmádena, Spain

From left to right: Prof. Paul Kiekens, Kristof Lannoo, Eddy Liedts, Stijn Rambour
19.02.2019: Ir. Jana Becelaere wins the poster award at FEARS2019

29.11.2019: Aachen-Dresden-Denkendorf International Textile Conference

Professor Paul Kiekens gave a keynote lecture, titled "Flame retardants for advanced textiles in an environmentally demanding world", at the ADD-ITC 2019 in Dresden.
EDUCATION

MASTER OF SCIENCE IN SUSTAINABLE MATERIALS ENGINEERING

The Master of Science in Sustainable Materials Engineering encompasses the study of properties, production or extraction, processing, use and recycling of a whole range of materials. Dealing with limited sustainable resource availability worldwide is an important objective of the course. Important materials dealt with are metals, synthetic materials, textiles, composites and ceramics.

The Major Polymers and Fibre Structures focuses on fibre based structures. Polymers are the main raw material of fibres, next to ceramic and mineral materials. The major covers the materials and their physical, chemical and mechanical processing and treatment.

Polymers, better known as plastics, consist of long chains of small molecules and are widely used for many applications all over the world, including fibres.

The Centre for Textile Science and Engineering has expertise in many aspects of polymer and fibre based materials, including:

- **Smart textiles**
- **Artificial turf**
- **Nanofibres**
- **Modelling**

The diversity of the programme offers many possibilities for graduated students and a degree in Materials Sciences offers one of the best job opportunities (source: Klasse). Research, development, processing, production, management, marketing, consulting, education or academic careers can be envisaged.
EUROPEAN TEXTILE ENGINEERING ADVANCED MASTER (E-TEAM)

Course content

The Master of Textile Engineering is a two-year Master’s programme in the field of textile engineering. The programme was developed in the framework of and with full support of the Erasmus programme of the European Union. It was and still is a unique programme offering advanced education in Textile Engineering in which the latest developments in the textile field as well as contemporary teaching methods are incorporated. The most renowned specialists in the multidisciplinary domain of textiles in Europe and beyond are brought together. The programme benefits from significant industry participation. Graduates have acquired knowledge, skills and attitudes that ensure their impact on technological innovation, creativity, quality and management in industry as well as in academia. The international experience also adds to the graduates’ international network of students, academia and industry.

Course structure

The programme of the Master of Textile Engineering is a full-time programme, organized at different locations, lectured in English. All major universities in Europe and worldwide offering a textile degree participate in the programme. As such, the programme benefits from the strengths of all participating universities, allowing to cover all modern areas related to textiles.

Three semesters (first, second and third) are organized at a different host university.

The fourth and last semester is dedicated to the dissertation at one of the participating universities (to be chosen by the student) under supervision of a tutor, possibly in collaboration with the industry.

Students who are admitted spend one year and a half (three semesters) in three geographically spread regions in Europe, where they are taught by a large number of professors of the participating universities as well as from industry. Each lecturer passes on his or her specific knowledge in a course module covering one or two weeks.

Elective courses allow students to take an internship or to follow specialist courses at one of the host universities.

Next to the traditional lecturing methods, active methods are used, such as blended learning, case studies, projects, practical work in laboratories, etc. To link theory with practice, industry is actively involved.

Career perspectives

The degree Master of Textile Engineering can lead to different careers involving textile knowledge in the broadest sense of the word. Students obtain a thorough understanding of all aspects related to textiles and are hence well-prepared for jobs requiring elaborate knowledge in textiles. Graduates go for a career in academia and industry.

The jobs imply technical functions, R&D functions and (general) management functions mainly in three types of sectors:

• the textile and clothing industry
• sectors that supply textile companies with raw materials, chemical products and machines
• end users, such as transportation (cars, planes, trains), medical products, furniture and many more.

Employment has an explicit international dimension thanks to the international and global character of the programme itself.
The E-TEAM edition 2018-2020 started at ENSAIT, Roubaix, France in autumn 2018 and continued at Lodz University of Technology, Poland (spring 2019) and University of Borås, Sweden (autumn 2019).

The locations for the edition 2019-2021 are: Ghent University, Belgium (autumn 2019); Technical University of Liberec, Czech Republic (spring 2020) and ENSISA, Mulhouse, France (autumn 2020).

As from the next edition, a major revision will be implemented. Apart from knowledge acquisition, personal development and international networking will be addressed more explicitly. This will include for instance design thinking, scientific thinking and multicultural understanding. For the first time, students will have the opportunity to choose between 2 locations in their third semester: Borås (Sweden) or Kyoto (Japan).

Consequently the venues for 2020-2022 are: Ghent University, Belgium (autumn 2020), University of West Attica (UNIWA), Piraeus, Greece (spring 2021) and University of Borås, Sweden or Kyoto Institute of Technology, Japan (autumn 2021).
E-TEAM is a unique two-year international master of science programme in the field of textile engineering, organised as a full time programme, lectured in English.
E-TEAM is organised at multiple locations: each semester the international students move to a different university. This way, they study at minimum three different universities, geographically spread over Europe. The students acquire many non-technical skills such as knowledge of languages, cross-cultural experience, organisational skills and self-reliance.

**CROSS-CULTURAL EXPERIENCE**

Top professors are selected from the worldwide AUTEX platform that is joining more than 200 qualified professors. Modern learning approaches such as blended learning, computational tools and virtual design complement lecturing for individualisation of knowledge acquisition and personal development.

**TOP EDUCATION IN TEXTILES**

The programme fulfils the demands of a global industry continuously striving for technological innovation, creativity, quality and adequate management. Intensive interaction with industry is achieved through participation of industry students and industry lecturers, company visits, industry cases, internships.

**CLOSE LINK TO INDUSTRY**

E-TEAM is the ideal start to an international career in a variety of sectors!
2018 was the final year of the Knowledge4all project. This UGent innovation in education project targeted the exploration of co-creation based learning. The specific aim was to involve assignments of regular courses from several faculties in the co-creation cases. The idea was to explore how such assignments can contribute to solving co-creation challenges in their specific field. The project has been quite successful. The project meetings have contributed to building a UGent co-creation community. From this community the idea of creating the UGent design factory ‘the foundry’ has evolved. Another important achievement of the project is opening the co-creation course to all UGent students, regardless of their discipline. Co-creation is now offered as a university wide elective course.

Knowledge4all has shown the potential of the concept. Over the 4 years, more than 50 students from around 15 different disciplines contributed to solving the cases from the co-creation course. The course is also open to individual students from outside the university. Apart from learning about the phases and steps of co-creation, students acquire a range of soft skills, such as problem definition in a vague context, working in a multidisciplinary team, being entrepreneurial. The input from other disciplines broadens the students’ perspective and makes students aware of their own limitations and the importance of other points of view. The co-creation cases have led to promising results with valorisation potential as well as to new research questions. In the textile area, the prototyping experience leads to a better understanding of the behaviour of textile materials and manufacturing challenges. Textile cases have addressed smart textiles, adapted textiles and recyclability. Targeted applications were for instance monitoring of movements as a support for diagnosis, monitoring of symptoms of lymphedema resulting from breast cancer treatment, monitoring of behaviour of people suffering from specific mental disorders and developing products that suit their behaviour. In 2017-2018, the client of one of the cases actually joined the course and after that she started her business. The case, in which one of the E-TEAM students also participated, was awarded the UGent Big Questions Award in 2018:

In spite of the successes, Knowledge4all also revealed some limitations. Coordination of the course and individual assignments is challenging. The expected effort from students versus what is needed for their case, scheduling, location, are just a few of the challenges they were facing. Part of the problems could be solved by the transformation of the co-creation course into an elective course for all UGent students. Today, a limited number of lecturers still offer their students the possibility to join a co-creation case as part of an assignment, in addition to the students who follow the full course.

Based on the lessons learned and better understanding of how to further expand co-creation based learning in higher education, an Erasmus+ project T-CREPE was successfully submitted.

Contact:
Prof. Lieva Van Langenhove (Lieva.VanLangenhove@UGent.be)
T-CREPE

Co-funded by the Erasmus+ Programme of the European Union

T-CREPE is an Erasmus+ Knowledge Alliance that started on November 1st 2019 and will cover a period of 3 years. It is coordinated by our department. The theme of T-CREPE is co-creation based learning.

Partners of the consortium:

Co-creation is a design methodology in which interaction with the end user (called client) is key. Since a few years CTSE has been playing an active role in stimulating integration of co-creation in education. The co-creation course is fully project based. Stakeholders are invited every year to present their cases for students to choose from. Student teams from all university disciplines define, design and realise solutions in close collaboration with the client, whereby every student contributes in her/his discipline. This approach is fully in line with the so-called T-profile: a broad multidisciplinary layer supported by an in-depth basis.

Students are very enthusiastic about the course and appreciate for instance its contribution to customer-oriented attitude, communication, multi-perspective thinking, working in a multidisciplinary team. The cases resulting from real problems ensure potential for exploitation. Unfortunately, this potential is highly underexploited, although the university centre for entrepreneurship DO! offers various possibilities to support interested students to set up their own business. Case-based learning requires very intensive coaching of the students as well as coordination between all actors involved. This puts pressure on the willingness of lecturers to participate in co-creation based learning and limits upsampling.

T-CREPE addresses the challenges mentioned above. A game-based platform will be developed to support co-creation cases in order to enable lecturers to spend more time on specialised support of the cases. Games will be created to assist the learning process in the various steps and aspects of co-creation. During the project, games will be created and evaluated by the consortium members and in a later phase by other lecturers interested in co-creation. This is to increase the scale of implementation of co-creation based learning.
T-CREPE will also study how entrepreneurial behaviour of students can be stimulated, for instance by stimulating psychological ownership. The findings of this research will be integrated in the games, targeting strengthening valorisation of valuable results of the cases.

The ultimate goal of the T-CREPE game-based platform is to enlarge the implementation of co-creation based learning in higher education and to ensure proper valorisation of its promising results.

Visit our website for more info: www.t-crepe.eu

Partners of the T-CREPE consortium visited Ghent and Kortrijk during the kick-off meeting in November 2019.

The kick-off meeting included an open event with workshops and inspiring talks about co-creation in relation to education, design thinking and entrepreneurship.

Contact:
Prof. Lieva Van Langenhove (Lieva.VanLangenhove@UGent.be)
VISITORS

Visiting students

Several students from abroad stayed at the department to follow lectures, perform research in the framework of their thesis or were involved in different kinds of laboratory tests.

Miss Marta ARROYO AREVALO, Mr. Mario TORIBIO RODRIGUEZ (both from the University of Valladolid, Spain) and Mr. Tommaso SALAMONE (La Sapienza, Rome, Italy) came to the department to concentrate on their thesis.

Miss Agnieszka NOWAK (Warsaw University of Technology, Poland) came to Ghent as an IAESTE-student (01.07 – 11.08.2019). She was involved in scanning electron microscopy of fibres and nanofibers.

Miss Berna SENSU (Istanbul Technical University, Turkey) came to Ghent in the framework of her MSc thesis on the topic “Electrospinning of Biomaterials”.

Visiting researchers

Miss Havva BASKAN (Istanbul Technical University, Turkey) arrived at the department in January 2019 and started her study on “Electrospun Composite Nanofibres with Metal/Metaloxide Nanoparticles”.

Miss Yetanawork WUBNEH TEYEME, Mr. Abreha BAYRAU NIGUSSE, Mr. Granch BERHE TSEGHAH, Mr. Abdella Simegnaw AHMMED and Mr. Bulcha BELAY came to Ghent to work on their PhD in the framework of a cooperation with Ethiopia.

Mr. Tahir HASAN RIAZ (National Textile University, Pakistan) came to the department and registered as a PhD student.

Mr. Zufeng SHANG (Tianjin University, China) and Mr. Nadir HUSSAIN (PhD scholar Shinshu University) came to Ghent to perform research in the framework of their PhD.
THESIS DEFENCES

2nd MASTER (2019)

Mario Toribio: Study of Fabricating Nickel-Coated Carbon Fibre as a Textile Based Thermocouple
Jury: Lieva Van Langenhove, Anto Hardianto

Jente Huybrecht: A New Near-microscale Technique to Simulate Yarn Reinforcements for the Production of Fibre Reinforced Composites
Jury: Karen De Clerck, Wim Van Paepegem, Lode Daelemans, Dagmar D’hooge

Brecht Tomme: Experimental and Numerical Characterisation of the Consolidation Behaviour of Woven Fabrics for the Production of Composites
Jury: Karen De Clerck, Wim Van Paepegem, Lode Daelemans, Dagmar D’hooge

Jan Claeys: 3D Printing for Structural Components Using Fibre Reinforcement
Jury: Karen De Clerck, Lode Daelemans, Sander Rijckaert, Wim Van Paepegem

Marta Arroyo Arévalo: Solvent Electrospinning of Nanofibrous Polymer-API Solid Dispersions for Enhanced Drug Delivery Systems
Jury: Karen De Clerck, Jana Becelaere

Michiel Platteeuw: New Routes to Obtain Moisture-Stable Nanofibrous PEtOx
Jury: Karen De Clerck, Richard Hoogenboom, Jana Becelaere, Joachim Van Guyse, Dagmar D’hooge

Serge Rijssegem: Functionalization and Electrospinning of Poly(2-Oxazoline)s for the Fabrication of Intelligent Wound Dressings
Jury: Karen De Clerck, Richard Hoogenboom, Ella Schoolaert, Ronald Merckx, Dagmar D’hooge

Jury: Karen De Clerck, Lode Daelemans, Eva Loccufier, Klaartje De Buysser

Robbe Denis: Silica Nanofibre Membranes as a Carrier for MOF/COF Supported Ru Nanoparticles for CO2 Methanation
Jury: Karen De Clerck, Klaartje De Buysser, Eva Loccufier, Karen Leus

PHD DEFENCES

PhD Defence Atiyyah HAJI MUSA
Evaluating the Human Tactile Response to Haptic Sensations on Textiles
(27 June 2019)

PhD Defence Ida NURAMDHANI (picture)
Fully Integrated Rechargeable Pedot : PSS Energy Storage Device for Smart Textile Applications
(28 June 2019)

PhD Defence Yin LI
Hydrophylic Water-Stable Nanofibres by Electrospinning and Crosslinking of Poly(2-Ethyl-2-Oxazoline)
(12 December 2019)
INTERNATIONAL RELATIONS

AUTEX stands for the Association of Universities for Textiles. AUTEX is a worldwide network of textile universities and was founded in 1994. Over the years a strong enlargement took place and the Association currently has 37 members from 28 countries.

The current chair is Prof. Mirela Blaga from “Gheorghe Asachi” Technical University of Iasi in Romania. The secretariat is located at Ghent University, Department of Materials, Textiles and Chemical Engineering (Centre for Textile Science and Engineering).

The mission of AUTEX is to facilitate cooperation amongst its members in high level textile education and research.

Its motto is stronger together.

The main success elements include:

- **Creation of a European Master Degree in Textiles (Masters Programme in Textile Engineering):** the programme is delivered by the leading experts in textile education and is organized at different locations in Europe. It was developed under the auspices of the Socrates programme of the European Union and has undergone several revisions to adjust to changing industrial and societal demands.

- **AUTEX Conference:** organized annually (for the first time in 2001). This was a major initiative which in the meantime has become very successful highlighting innovative research and education in textiles and textile related materials. Several hundreds of participants attend each year.

- **AUTEX Research Journal:** focus is on playing a leading role in distributing scientific and technological research results by publishing original and innovative papers. The project became a success thanks to the efforts made by Lodz University of Technology, Poland. The Journal is recognized by Thomson Reuters Web of Science as an al-journal with considerable impact factor.

AUTEX has shown to benefit from an optimal mutual understanding between its members. The annual meetings play a key role in discussing achievements, optimizing cooperation and outlining future strategies. The cooperation allowed the joint development of high level courses, numerous student exchanges, opportunities for staff mobility while also many active research partnerships have been created.
### AUTEX FULL MEMBERS

- Polytechnic University of Tirana, Textile and Fashion Department, Albania
- Universiteit Gent, Department of Materials, Textiles and Chemical Engineering, Belgium
- University of Zagreb, Faculty of Textile Technology, Croatia
- Technical University of Liberec, Faculty of Textile Engineering, Czech Republic
- ENSAIT, Ecole Nationale Supérieure des Arts et Industries Textiles, France
- ENSISA, Ecole Nationale Supérieure des Ingénieurs Sud Alsace, France
- TU Dresden, Institute of Textile Machinery and High Performance Material Technology (ITM), Germany
- University of West Attica (UNIWA), School of Engineering, Department of Industrial Design and Production Engineering, Greece
- Politecnico di Torino, Department of Materials Science and Technical Engineering, Italy
- University of Bergamo, Department of Engineering, Italy
- Riga Technical University, Faculty of Material Science and Applied Chemistry, Latvia
- Kaunas University of Technology, Faculty of Mechanical Engineering and Design, Department of Material Engineering, Lithuania
- ESITH, Ecole Supérieure des Industries du Textile et de l'Habillement, Morocco
- University of Twente, Faculty for Engineering Technology, the Netherlands
- Lodz University of Technology, Faculty of Material Technologies and Design, Poland
- University of Minho, School of Engineering, Portugal
- “Gheorghe Asachi” Technical University of Iasi, Faculty of Textiles and Leather Engineering, Romania
- University of Belgrade, Faculty of Technology and Metallurgy, Textile Engineering Department, Serbia
- University of Ljubljana, Faculty for Natural Sciences and Engineering, Department of Textiles, Slovenia
- University of Maribor, Faculty of Mechanical Engineering, Department of Textiles, Slovenia
- UPC, Universitat Politècnica de Catalunya, Department of Textile and Paper Engineering, Spain
- Universitat Politècnica de València, Departamento de Ingenieria Textil y Papelera, Spain
- University of Borås, the Swedish School of Textiles, Sweden
- ENIM, University of Monastir, Tunisia
- Ege University, Faculty of Engineering, Textile Engineering Department, Turkey
- Istanbul Technical University, School of Textile Technologies and Design, Turkey
- Uludag University, Faculty of Engineering and Architecture, Textile Engineering Department, Turkey
- Heriot Watt University, School of Textiles and Design, U.K.
- University of Leeds, School of Design, U.K.
- University of Manchester, School of Materials, U.K.

### AUTEX ASSOCIATE MEMBERS

- RMIT University, School of Fashion and Textiles, Australia
- Tianjin Polytechnic University, Textile Department, China
- Wuhan Textile University, China
- Kyoto Institute of Technology, Japan
- Shinshu University, Faculty of Textile Science and Technology, Japan
- National Textile University, Faisalabad, Pakistan
- Tashkent Institute of Textile and Light Industry (TITLI), Uzbekistan
- North Carolina State University, College of Textiles, USA
AUTEX group in Corfu, Greece (2017)

AUTEX Lifetime Achievement Award 2019 granted to Prof. Paul Kiekens
AUTEX2019, 19th World Textile Conference – “Textiles at the Crossroads” @ NH Gent Belfort, 11.06.2019-15.06.2019

In 2019, the AUTEX conference was hosted by the Department of Materials, Textiles and Chemical Engineering from 11 to 15 June in NH Gent Belfort Hotel. At the same time, AUTEX celebrated its 25th anniversary. In addition “Textiles” at Ghent University was proud to have covered an impressive 90 years!

During the AUTEX 2019 Conference the latest advancements in textiles (and clothing) were under the spotlight and showed the dynamism and multidisciplinarity of textiles today. The title “Textiles at the Crossroads” speaks for itself.

Conference topics

- Additive manufacturing / 3D-printing
- Advanced dyeing technologies and systems
- Advanced polymers and fibre science and technologies
- Biobased textiles
- Bionic fibres and textiles
- Coating technology
- Comfort in textiles and clothing
- 3D, 4D textiles and composite materials
- Electrospinning
- Fashion and design
- Finishing / surface functionalisation
- Flame retardancy
- Graphene in textiles and clothing
- Medical textiles
- Nanotechnology
- New educational techniques
- Protective textiles
- Recycling, life cycle analysis, sustainability and circularity
- wearable technologies and smart materials
- Various

www.Autex2019.org
Welcome reception in the town hall of Ghent

Social programme: Belgian Cuisine Dinner
Plenary session with renowned and international keynote speakers
7th edition of the International Conference on Intelligent Textiles and Mass Customization (ITMC), hosted by Mohamed Lalou of ESITH in Marrakech (Morocco) from 13 till 15 November 2019

The International Conference on Intelligent Textiles and Mass Customization (ITMC) addresses representatives from various industries and disciplines related to the textile industry. Its interdisciplinary approach is the key to maximizing the potential and development of textile materials and tools for various applications.

The purpose of the conference is to explore new ideas, effective solutions and collaborative partnerships for business growth by catalyzing the creation of a beneficial synergy between designers, manufacturers, suppliers and end users of all sectors and making full use of this potential.

Conference topics

- Advanced manufacturing
- Comfort
- Connected composites
- Design methodologies
- Digital tools
- E-textile and E-commerce
- Education and training
- Funding opportunities
- Internet of Things
- Mass customization
- Smart and functional textiles
- Supply chain management and logistics
- Sustainable production, recycling

On the 13th and 14th of November 2019, inspiring speakers from industries, academies, governments and societies shone the light over new chances and challenges, bringing global statistics and success stories about cutting edge science and technology.

On the 15th of November participants were invited to show their prototypes during the Smart Textiles Salon.
Professor Lieva Van Langenhove (on the right), conference chair and member of the organizing committee of ITMC2019 and Smart Textiles Salon 2019

http://itmc.esith.ac.ma/
The European Textile and Clothing Industry has set up a permanent expert network, the European Technology Platform for the Future of Textiles and Clothing, to develop scenarios and a strategic development agenda for long-term competitiveness of this sector based on research, technology and innovation.

In order to ensure the long-term competitiveness of the European Textile and Clothing industry and to reinforce the position of Europe as a leading global player in the development and manufacturing of fibres, textiles, textile-based products and apparel, the European Technology Platform for the Future of Textiles and Clothing pursues the following key objectives:

- Organisation of an effective European-wide expert network involving industry, research organisations, public authorities, financial institutions and other stakeholders to join forces and coordinate their efforts in the field of research, development and innovation to the benefit of the European Textile and Clothing Industry.
- Definition of common industrial strategies and implementation of a Strategic Research Agenda (SRA) through targeted collaborative research, technology development and innovation efforts within the textile sector and in cooperation with related industries.
- Development of structures and measures to improve the overall research, development and innovation framework conditions of this industrial sector focusing specifically, but not exclusively, on the removal of financial, educational, legal and regulatory obstacles.

European Cooperation in the field of Scientific and Technical Research

The department participates in the following COST action:

**COST Action CA16227 on Investigation and Mathematical Analysis of Avant-garde Disease Control via Mosquito Nano-Tech-Repellents (acronym IMAAC).**

IMAAC aims at investigation and mathematical analysis of the effect of avant-garde control measures in vector-borne diseases involving day-time active mosquitos transmitting diseases like dengue, Zika, chikungunya and yellow fever. The control measures involve new technologies in textile and paint products based on nano- and micro-particles releasing repellents or pesticides in well-portioned dosage. The study will also be expanded to scenarios using vaccines in combination with mentioned control techniques.

Nano- and micro-particles are used in textile production for various purposes, and can be used to release chemicals like repellents and insecticides in a well-controlled rate. First attempts in this direction have been made, but no efficacy studies could be performed yet. The spectrum of combinations of nano- or micro-particles, repellents, insecticides and types of textiles (or paint) has not been sufficiently studied. Especially, efficacy studies in cases using these control measures in combination with vaccines are unchartered territories and mathematical modelling has to be developed.

This Action aims to bring together experts from epidemiology, biostatistics, mathematics, biology, nanotechnology, chemical and textile engineering to implement new techniques to combat mosquito transmitted vector-borne diseases. The key question remains, in how far such avant-garde measures can help to reduce the disease burden, possibly in collaboration with existing vaccines which turned out to have only limited efficacy on their own.

The COST Action IMAAC started on 21 September 2017 and by now already 24 COST countries and 1 COST International Partner Country (India) joined this Action.

Website: [http://imaac.eu/](http://imaac.eu/)
Interreg Project:
GRASS – Gazons aRtificiels Anti-feu Sûrs et durableS (Safe and sustainable flame retardant artificial turf)

(01/04/2018 – 31/03/2022)

The objective of the GRASS project is twofold: to enhance the public awareness of the differences in fire behaviour between natural and artificial grass and to improve the fire behaviour of artificial turf by developing innovative, environmentally friendly and industrially applicable techniques.

In this project there is a constant consultation with a resonance group of "stakeholders": in addition to producers, installers, sports clubs, governments and end users are welcome to participate.

The involvement of this resonance group offers the guarantee that the new techniques from this project will be acceptable to all actors in the artificial turf sector (from production through end use to recycling) and will be implemented in practice.

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SMART TEXTILES AND MECHANICAL TEXTILE TECHNOLOGY

Skills4Smartex : Smart textiles for STEM training [Erasmus+]

(01/10/2018 – 30/09/2020)

This Erasmus+ project has as main goal to improve the knowledge, skills and employability of VET students in STEM (Science, Technology, Engineering and Mathematics) related fields, by providing adequate training instruments to understand multidisciplinary working by means of smart textiles and e-learning. During the second year, the Skills4Smartex finalized an online course aiming at using Smart textiles for STEM training.

UGent provided the skills required to construct smart textile prototypes on the level of VET (vocational education and training) students. All information is available as a free training tool on Skills4Smartex.eu.

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Erasmus+ Skills4Smartex meeting in Maribor, showcasing smart textile prototypes for use in class rooms.

Skills4Smartex JSE meeting in Ghent, at the Centre for Textile Science & Engineering
Smart Textiles Movement Disorders

In September 2019, Micheline De Meyer joined CTSE as an academic consultant. Drs. De Meyer is affiliated with UZ Gent, Department of Oral Health Sciences, Clinic for Dental and Orofacial Dysfunctions. Her expertise includes sleep medicine, sleep-breathing and movement disorders. Her role is to provide medical information and to create a bridge with the medical industry within her area of expertise.

This resulted into a project funded by Parkili VZW, the association of patients suffering from Parkinson disease. The project is entitled: *(Early) detection of sleep problems in Parkinson’s patients in their home situation*. The objective is to develop smart textiles to investigate thermal and physical (dis)comfort parameters during sleep in Parkinson patients. The first part will focus on a questionnaire adapted to problems specific to Parkinson’s, such as: disturbance of muscle tension, REM-sleep-phase and temperature regulation. The second part consists of a study of existing (or adaptable sensors) for monitoring relevant parameters of the person, the bed and the bedroom. The objective is to identify solutions for a smart sleeping environment, leading to better quality of life for both the patient and his/her bedpartner.

CTSE also contributed to the installation of an interdisciplinary platform addressing dystonia, another movement disorder. This platform includes specialists from neurology, physical therapy and control systems engineering from UGent and UAntwerpen.

The main goal of this platform is to improve understanding of the disorder and efficacy of physical therapy. CTSE will contribute by developing smart textiles for monitoring of the effects of various treatment approaches.

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Creating a textile-based thermoelectric generator from carbon fibers integrated into polyester fabric: PhD work of Anto Hardianto

Our previous work shows that it is possible to fabricate a thermocouple from carbon fibers (C) and nickel-coated carbon fibers (Ni). From this finding, we further tried to create a textile-based thermoelectric generator from carbon fibers through electroplating of nickel. We have successfully fabricated a textile-based thermoelectric generator in which the nickel is coated on specific places on the carbon fibers to form a series of C-Ni thermocouples. The textile-based thermoelectric generator is fabricated in a small piece of polyester fabric and can generate a thermo-voltage.

Textile-based thermoelectric generator composed of a series of C-Ni junctions

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Prediction of Fabric Touch Sensations: PhD work of Atiyyah Musa

Our previous work deals with the use of the Fabric Touch Tester (FTT) device and subjective measurement of fabric handle. Since the FTT is meant to measure the fabric properties and make predictions on the fabric handle based on the measurements, the prediction models of the FTT were analysed. An experiment on fabrics was conducted by testing them in two ways i.e. subjectively by human panels and objectively by FTT itself. The results from both methods were compared and they showed some discrepancies, meaning that the predictive comfort model of FTT was lacking. Thus, several new models were generated based on the fabrics to account for differences in indices picked-up by them and also by the FTT model reconstructed earlier.

The newly introduced models were validated by giving them a new set of data from the same type of fabrics, after enduring some wash treatments. The new smoothness model (SMF1) was found to correlate best with surface roughness indices. For softness, SO1 model picks up the bending indices, followed by other terms in the models. The new proposed warmth models seem to associate with thermal index Qmax and also roughness. However, the warmth model was not valid when tested with the validation set of fabrics. Therefore, a further study emphasizing on the tactile-thermal behaviour and haptic perception of warmth is recommended for future work.

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Figure: Predictive power comparisons between the best new models and FTT reduced models.
Fully Integrated Rechargeable PEDOT :PSS Energy Storage Device for Smart Textiles Applications : PhD work of Ida Nuramdhani

The present work was a continuation of the previous study in the Smart Textile research group of Prof. Lieva Van Langenhove, and mainly aimed at improving the device performance and appearance through the improvement of the fabrication techniques and researching the working principle and mechanism of the device. Recent progress on the development of PEDOT :PSS-based textile energy storage device was comprehensively reviewed in this study.

The study of the mechanism has been carried out through several approaches: cyclic voltammetry and electrochemical impedance analysis were used as one of the approaches to investigate ionic and electronic activities in the bulk of PEDOT :PSS and at its interfaces with stainless steel yarn. Study on the effect of the PEDOT to PSS ratio and the configuration of the electrode yarns was another approach to study the principle mechanism of the device.

The device has transformed from its earliest design into its latest form through four different and improved fabrication methods (figure 1 above). The best form of our textile energy storage device was made of only one layer of fabric, which means that it was much thinner compared to the original design and thus more flexible as well as feasible for clothing.

Fastness to washing is one of the basic important quality requirements for wearable textiles and clothing. Our study showed that the TPU-covered device exhibited the best performance, where the capacitive behaviour was still retained after two times of washing 3 (SNI-ISO C06 : 2010) without any significant change in the morphology. The results were promising for further study as well as for further development of application oriented textile energy storage devices.

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Developing Breathable Textile Rectangular Ring Microstrip Patch Antenna at 2.45 GHz: PhD Work of Abdul Wahab Memon

An antenna is a device that is capable of wirelessly transmitting and receiving electromagnetic signals. This is essential for applications like the ones used by rescue workers, firefighters, doctors in hospitals and many more. The planar patch antenna is a type of antenna that serves best to this cause because of its simple planar design, ease of construction, comfort for the wearer during its usage and integration into any garment.

Some basic problems are associated with textile antennas. Textile materials used to construct textile antennas are prone to water vapours. Their electromagnetic properties change when they come into contact with water vapours as the dielectric constant of the textile materials changes. Once the change in dielectric constant occurs, the antenna employing textile material will no longer resonate at the desired frequency. Likewise, human sweat can also alter the dielectric constant and trapped sweat creates discomfort for the wearer.

Addressing these problems is important if textile antennas are to be used for wearable applications. Making a breathable textile antenna by increasing the porosity of a textile patch antenna helps to avoid the above-mentioned problems associated with the textile antenna. Making a textile antenna breathable allows water vapours or human sweat to evaporate into the atmosphere more quickly. A breathable textile antenna was designed which resonates at 2.45 GHz frequency and covers the complete Industrial, Scientific and Medical-ISM frequency band ranges from 2.40 GHz to 2.485 GHz. A breathable textile antenna is constructed using a 3-dimensional perforated knitted spacer fabric with a porous nonwoven conductive fabric. Breathability of the textile antenna is further enhanced by following a novel approach by inserting a large number of holes of 1 mm in diameter into the conductive layers of the textile patch antenna. The resulting porous textile antenna had a maximum air permeability of 510 mm/sec.

Illustrations show one of the developed (a) Front and (b) Back Sides of Breathable Porous Textile Antenna that resonated at 2.45 GHz

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Yarn-Yarn Friction in Textile Structures: PhD Work of Ziyuan Li

The yarn-yarn friction, or the friction between yarns, plays a critical role in the bending, tensile, friction, hand, and comfort properties of textile products. The inter-yarn friction is affected by the surface structure and material properties of yarns and is an important aspect in the relation to the properties of yarns, ropes and fabrics. In order to more precisely model performances of different textile products under certain circumstances, it is of importance to understand how friction behaviour between yarns occurs and influences textile structures (weaving, braiding, twisted rope, etc.).

Friction testing of yarns is normally carried out using a twisted strand method and a capstan method, which indicate specific positional relationships of yarns in different structures.

A twisted strand method and a capstan method

Before a modelling tool like Abaqus FEA is applied for finite element analysis and computer-aided engineering, the element type of the yarns should be decided regarding the structure complexity, so at the stage of generating the model. Due to the large number of yarns and the locations of contact, simpler element types are usually applied e.g. beam elements and truss elements. By tracing each single yarn with the coordinates the yarns are therefore defined.

PyFormex allows to generate large structured sets of coordinates by means of subsequent mathematical transformations gathered in a script, helping to obtain structures of weaving and braiding/twisted ropes. In this PhD work, modelling approaches are investigated to arrive at accurate yarn-yarn friction models.

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Design and virtual prototyping of tight-fit cycling shirts for rectifying lower back pain based on pressure mapping: PhD Work of Yetanawork Wubneh Teyeme (Bahir Dar University, Ethiopia)

Garment design may require graduated variable pressure on the body ranging from normal through increased strain in specific areas for a particular application. Therefore, compression garments need to be customized because body shapes differ and require different strain distribution. The aim of this study was to improve garment pattern design from the aspect of clothing pressure for providing support and enhancing comfort to end lower back pain; and to analyze the impact of fabric mechanical properties on the clothing pressure and fit comfort. The design is based on the pressure mapping technique to measure the compression exerted by compression cycling garments, using a 3D simulation model.

As a tool, CLO 3D was used to analyze virtual tight-fit garments subjected to different fabric mechanical properties. Moreover, pattern adjustments and the impact of fabric types on garment fit have been shown by generating the stress, strain and pressure maps using virtual simulation.

<table>
<thead>
<tr>
<th>Fabric types</th>
<th>Stress simulations maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knit</td>
<td>Stress Map</td>
</tr>
<tr>
<td>Ponte kersey</td>
<td>Strain Map</td>
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<tr>
<td></td>
<td>Fit Map</td>
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Simulation and fit evaluation of virtual prototype garment in CLO 3D

Based on the result, a prototype compression garment is being constructed that will help in reducing back pain. At the same time, smart textile sensors are integrated into the garment, to allow continuous tracking of body posture, in order to provide correct feedback to the wearer.

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Development of EEG Textrode for Monitoring Brain Activity: 
PhD work of Granch Berhe Tseghai (Bahir Dar University and Jimma University, Ethiopia)

The commercial gel dependent metallic electrodes used for EEG acquisition can cause skin irritation. Moreover, the gel gets dehydrated over time which leads to an increase in skin-to-electrode impedance and more noise. Though dry EEG metal discs and needle spikes were recently introduced, their weight and flexibility is still not suitable for long-term wearable monitoring purposes.

As a possible solution to overcome the aforementioned problems, flexible electro-conductive textile fabrics with surface resistances from 297.3 to 332.5 Ω/sq have been developed by coating a PEDOT :PSS/PDMS composite on a knitted cotton fabric via flat screen printing. The presence and extent of PDMS led to a smaller flexural rigidity and greater tensile strength than the PEDOT :PSS alone. The conductive fabrics have next been used to construct flexible and lightweight textile-based EEG electrodes.

Actual EEG Textrode (left), the 10-20 electrode placement (middle) and Montage (right)

EEG waveforms comparable to standard TDE-202-15 Flat EEG Electrodes have been collected from the textile electrodes with an OpenBCI at 30-60 fps, 50-60 Hz Notch and 1-50 Hz BP Filt. Moreover, the EEG waveform frequency (alpha, beta, theta, and delta) was clear at the amplitude of 0.1µV to 1mV.

EEG signals collected from the PEDOT :PSS/PDMS coated cotton fabric electrode

The textile-based dry electrodes could potentially replace the gelled and metal disc standard biopotential electrodes. However, the stability of the conductive polymers over time and the coating homogeneity is still under investigation.

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Development and study of conductive yarn with embedded SMD LED: PhD Work of Abdella Simegnaw Ahmmed (Bahir Dar University, Ethiopia)

The integration of electrical components such as LEDs, resistors, thermistors, capacitors and inductors into smart garments plays an important role in the application of conductive yarns and has been researched broadly in the last few decades. Conductivity in fibres and yarns is being exploited, not only for conducting electricity and for sensing but also in many other applications. Such yarns can be used in wearable electronics manufacturing, leading to flexible and stretchable circuits for medical, fashion and monitoring applications.

The purpose of this research is integration of surface mounted devices (SMDs) into conductive thread and evaluation of the physical and electromechanical properties of the SMD integrated E-yarn.

The optimal integration methods of SMD in yarns is fully reviewed, comparing yarn types and connector types. The results are used to create several demonstrators.

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Design and development of textile-based ECG sensor for long-term monitoring of heart activity: PhD work Abreha Bayrau Nigusse (Bahir Dar University, Ethiopia)

Recently, a lot of textile-based ECG electrodes have been developed by many investigators. But still there are a lot of challenges to be resolved to make them applicable in real-life situations. In this work, textile-based ECG electrodes have been developed by screen printing of silver ink on knitted cotton and polyester fabrics and embroidering of silver-plated polyamide yarn on cotton fabrics at 1.5 mm stitch length.

The ECG detection performance of the developed electrodes was measured by wrapping measuring electrodes on the right and left wrist, and the reference electrode on the left forearm. ECG was derived during sitting, standing and walking conditions using PC 80B ECG portable measuring device. Test results revealed that the textile-based electrodes could potentially replace the gelled standard electrodes for ECG monitoring, especially for long monitoring. Washing stability of the electrodes was also studied.

In the future we will conduct ECG tests on cardiac patients and healthy volunteers to study the subject-to-subject variation. The effect of electrode size and holding pressure will also be studied. Based on the results from the ECG test a wearable t-shirt (for males) and bra (for females) will be constructed by integrating the electrodes and ECG performance will be studied.

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Developing a smart textile sensor for monitoring EMG Bioelectrical signals: PhD Work of Bulcha Belay Etana (Jimma University, Ethiopia)

Athletes undergo bodily stress brought on by the physical demands of competition and performance which pose potential physical risk. Vital monitoring of athletes throughout their performance gives insight into the body’s response to elevated activity and allows for preventive measures. When the body is subjected to stress, it gives various signals ranging from change in breathing rate, bodily electrical signal production, change in pH of the sweat etc.

Efforts to develop conductive textile sensors which can be integrated in clothes as biosensors have gained a lot of interest due to their ability to provide increased levels of comfort and long-term health monitoring. In this research work, we aim to develop EMG electrodes on cotton fabrics via the add-on integration method that requires connecting the electrodes into/onto the wearable system.

To develop an effective textile-based EMG sensor, further investigation is needed to monitor noise happening due to motion artifacts. Different methods to reduce motion artifacts will be implemented, including extra padding, rougher surface, pressure level increase, coating to increase skin adhesion, or others.

Response of textile sensor on muscle activity

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Realization of a Platform for Electrostatic Characterization of Textiles: PhD work of Hasan Tahir

Textiles and other materials can be charged with static energy induced by friction. This can be quite a problem, especially with floor coverings, since people walking on them can be charged to a high voltage. The discharge of built-up static charge can lead to discomfort for people, influence or damage electronic equipment or potentially be dangerous in case of fire hazard.

The aim of our work is the realization and validation of an automatic electronic measurement system to determine the electrostatic characteristics of floor coverings. The original test procedure is performed by a walking person in order to generate the electrostatic charge. The designed system no longer requires a person to be part of the test, which offers advantages in terms of accuracy, consistency and reproducibility. To validate this platform, 3 experimental tests are being performed with carpet samples of variable pile materials, surface structure, pile type, backing and GSM (gram per square meter).

- **Experiment 1**: Comparison between the old test plotter (BBC GOERZ METRAWATT SE 120) and walking mode of the new setup to validate the walking mode of the new setup.

- **Experiment 2**: Comparison between walking mode and automated foot mode of the new setup to check the validity of automated foot in the new setup.

- **Experiment 3**: Comparing different walking patterns with the new setup in terms of consistency and reproducibility of the results.

New setup for electrostatic measurement of floor coverings

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WEAVING TECHNOLOGY

DySiFil – Dynamic Simulation of a Filament

The DySiFil software is a custom designed software for the dynamic simulation of filaments and yarns. It has advanced capabilities not found in other filament simulation codes: yarn-yarn interaction, moving geometries, interaction with fluent for air flow computations, different brake types, a backend that can run on the UGent HPC cluster and more.

The software is used for the investigation of processes where yarns interact with the environment through splicing, weaving, knitting and more.

Example output of DySiFil, top left: pressure data of elastic yarn, top right: yarn-yarn interaction during splicing, bottom: rapier moving through a closing shed.

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FIBRE AND COLOURATION TECHNOLOGY

H2020-project: PolyBioSkin – High performance functional bio-based polymers for skin-contact products in biomedical, cosmetic and sanitary industry

(01/06/2017 – 31/05/2020)

The vision of the PolyBioSkin project is to boost the use of biopolymers that offer unprecedented properties (antimicrobial, antioxidant, absorbency, skin compatibility) for high performance skin-contact applications: sanitary, cosmetics and biomedical (wound care). The impact of the project is an enhanced quality of life and wellbeing of millions of European citizens, a reduced environmental impact and more sustainable end-of-life options, and increased competitiveness of the European sanitary, cosmetics and biomedical sectors. The different sustainability aspects including the renewability of the selected materials (>90% bio-based contents in all applications) will offer a differentiated position on the market to meet the increasing demand of green-minded consumers.

PolyBioSkin focuses on two main classes of synthetic bio-based polymers relevant for the next generation bio-based industry: biopolymesters (such as poly(lactic acid) and poly(hydroxyalkanoates) (PHAs)), being fully renewable and biodegradable; and natural polysaccharides (cellulose/starch and chitin/chitosan), highly available from biomass or waste food, chosen for their peculiar properties, such as absorbency and anti-infectivity.

This research is a collaboration between several companies and universities. The role of Ghent University is to research the formulation and production process of nanofibres from biopolymers with focus on PHAs. To this end a range of different solvents was tested to be able to dissolve the polymers and create nanofibers by electrospinning, schematically shown in the figure above (right). Nanofibres could be successfully produced by using non-toxic solvents and it was possible to reach upscaling of the electrospinning process. Functionalization of PHA nanofibers with Ag nanoparticles, described in the PhD work of Havva Başkan, was carried out to reach antimicrobial properties.

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INTERREG Project: PHOTONITEX –
Development of microstructured textiles
for stimuli-dynamic photonical filters

(01/07/2018-31/03/2022)

Today, textiles exist that can redirect infrared radiation to the human body to ensure better thermal comfort. However, these solutions remain passive and they do not adapt to their environment. The goal of the PHOTONITEX project is to develop a new type of intelligent textiles that will improve individual thermal comfort in an active way. These innovative garments will be able to adjust the infrared radiation reaching the human body as a function of the conditions of use: temperature (body or external) and humidity (perspiration). This functionality is useful for sports enthusiasts as well as for personal protective equipment, insulation or interior textiles. The objective of the PHOTONITEX project is thus to produce active textile materials (membranes, filaments) that are able to adjust their infrared reflectivity depending on the temperature and/or humidity level in order to achieve a better thermal comfort.

The project is a collaboration between several universities and companies. The role of Ghent University is to formulate and produce nanofibres from stimuli-responsive polymers. These polymers respond to external stimuli, such as pH, temperature or light and then exhibit a transition in their physical/chemical properties. Via electrospinning thermo-responsive nanofibrous membranes are produced combining the unique properties of nanofibres with the switching behaviour of the thermo-responsive polymers (SEM image of nanofibres in figure above).

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Did you know that in 2015, the global textiles and clothing industry was responsible for the consumption of 79 billion cubic meters of water, 1715 million tons of CO₂ emissions and 92 million tons of waste? At the moment, waste recycling processes are still tackled inappropriately in the E.U., while landfill and incineration rates remain high. One of the main problems is that recycled materials are often of inferior quality to virgin materials because of contamination, treatments and inherent degradation. The REACT project thus aims to address this issue for acrylic textiles originating from the outdoor awnings, umbrellas and furnishings sector. While these textiles are but a small part of the global chain, studies show that acrylic fibers are definitely worth recycling, even more so than cotton!

The objectives of the REACT project are:

• Remove 90-95% of those hazardous substances that could adversely affect the quality of the recycled material or prevent their recycling.
• Treat up to 99% of all sewage impurities obtained from the removal steps (e.g. in waste water).
• Obtain a final textile product with yarn coming from 100% recycled acrylic fibers.
• Use the recycled acrylic fibers as a raw material for other production cycles in combination with virgin fibers, to prevent 30% of waste from the outdoor sector (3600 tons).
• Produce recommendations for production chain implementation (management and recovery of production scraps) and design and manufacturing of materials to enhance recyclability, recommendations for technology transfer (to other products and applications), and recommendations for standards.

The first step in the REACT project is the collection, sorting and classification of any acrylic textile waste. In a crucial next step, we will analyse this fabric and treat it to remove finishing substances and colorants that affect the recycled material's quality. Once the harmful substances have been removed and safely disposed of, we will implement a mechanical recycling process to obtain new yarns and eventually fabrics. To maximize the impact of the project, we will transfer any new designs, technology, standards, process implementation, etc. to other industrial sectors.

Figure 1: Schematic representation of the REACT project steps and work packages.
At Ghent University, we analyse the waste fabric and the chemicals applied on to them and remove these chemicals. To do the characterization, we use different techniques. Modulated differential scanning calorimetry and thermogravimetric analysis provide information respectively on glass transition temperatures and degradation temperatures. Fourier transformed infrared and Raman spectroscopy clearly identify chemical structures that need to be removed, while UV-Vis spectroscopy provides supporting information and quantifies colour.

We remove harmful substances from the waste acrylic textiles by means of chemical treatments. For example, multiple resin hydrolysis reactions are carried out under varying environmental conditions. The aforementioned spectroscopic techniques are then used to evaluate the effectiveness of the proposed finish and colorant removal treatments. Tensile tests at the fiber level also give insight into the mechanical properties of the original fibers, and any damage that may be done to the fibers during chemical treatment (which is minimized during process optimization). Finally, scanning electron microscopy visually clarifies what happens to the fiber surfaces.

Figure 2: Fourier transformed infrared spectrum of an acrylic textile sample subjected to a finish removal treatment. Almost all the finish is clearly removed from the textile surface, because the peaks that identify the finish disappear. This simplifies evaluation at a chemical level.

Funded by the European Commission’s Horizon 2020 programme, the REACT project involves 7 partners in 5 European countries: Centrocot (Italy), Ghent University (Belgium), Parà (Italy), Soft Chemicals (Italy), Jak Spinning (Hungary), CETI (France) and Martel (Switzerland). The project is coordinated by Roberto Vannucci (Centrocot) and is expected to take 3 years. Ghent University started its involvement in September 2019.

Topic: CE-SC5-01-2018

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Colorimetric nanofibers for sensor applications: how tiny threads visualize threats: PhD work of Ella Schoolaert

Have you noticed how your phone “senses” the proximity of your ear so it turns off your screen when you are calling? You don’t have to look very hard indeed; a world without sensors is unthinkable. From smoke to food freshness detectors, we strongly rely on them to warn us whenever something is wrong. And although the basic understanding of a sensor remains the same – it senses something – today’s society wants them to be smarter, lighter and faster than ever. On top of that, sensor signals should be easy to understand, because we would all like to use them in our daily lives. With our research on colorimetric nanofibers we are trying to fulfill these requirements.

During the electrospinning process, nanofibers are created. Upon incorporation of a stimuli-sensitive dye, a colorimetric nanofibrous sensor is designed which reversibly responds to a specific analyte via a change in colour.

Nanofibers are fibers with a diameter at the nano-scale, a thousand times thinner than a human hair. They can be produced by a unique process called electrospinning, in which they are drawn from a viscous polymer solution under influence of an electrical field. The unique properties of nanofibers happen to be ideal for sensor applications: they are versatile, meaning they can be used in many different circumstances, they are light, so they are easy to handle, and most importantly, they are very porous, which provides a high contact area with whatever they need to sense.

So how do we turn these nanofibers into sensors? By adding stimuli-sensitive dyes, small molecules that are capable of absorbing different parts of the visible light spectrum depending on the state of their environment. Examples are halochromic dyes which have different colours at different pH values. If such a stimuli-sensitive dye is incorporated into a viscous polymer solution and subsequently electrospun, colorimetric nanofibers are created. They are designed to change colour in response to a specific external stimulus.

Designed indeed, because there are a few steps to consider in the process. First of all, the stimuli-sensitive dyes can be incorporated physically or covalently into the nanofibrous matrix. Secondly, understanding the chromophore of the dye – the molecular unit responsible for the colour change – is crucial as this allows us to manipulate the final colorimetric response of the nanofibers. In-depth analysis of the optical behaviour of different dye-polymer systems helps us to understand which, often unexpected, interactions between dye and polymer occur which, in turn, allows us to tune them. Of course, depending on the foreseen application, the dye best suited for the job should be combined with the most appropriate polymer carrier, having specific properties of its own. At the end of the optimization process, a sensor meeting the end user’s wishes is created, consisting of very small fibers, yet capable of warning you against small or even large threats in a visual, easy-to-understand way.

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How nanofibers can heal you faster: Nanofibers for oral drug delivery: PhD work of Jana Becelaere

Oral drug delivery remains the most convenient way of getting medication into your body, but it is getting more and more challenging to find an efficient formulation for new drugs on the market. Through solvent electrospinning we have found that it is possible to incorporate these drugs inside nanofibers. Not only does this lead to time-stable formulations, we have succeeded in obtaining a formulation which is 5 times more efficient compared to conventional formulation techniques.

For oral drug delivery, nanofibrous formulations are a vital advancement. Over 60% of all active pharmaceutical ingredients – drugs – suffer from a low water solubility. This can mainly be attributed to their crystalline structure, which you can envision as a highly ordered and rigid structure composed of little drug molecules. To break it up requires a lot of energy. Sadly, those little drug molecules have to be separated in order to get them solubilized, else the drug won't have a therapeutic effect. Luckily, another structure is possible: the amorphous structure. In this form, all drug molecules are arranged in a less ordered manner, meaning they can move more freely inside the structure. To break up such an amorphous arrangement requires a great deal less energy compared to breaking up the crystalline formation. Consequently, making the drug amorphous means that the aqueous solubility is improved.

How do we achieve this change in solid structure? Solvent electrospinning. This polymer processing technique enables the drawing of a polymer solution into a nanofibrous membrane with average fiber diameters below 500 nm. It is a versatile and upscalable technique which leads to nanofibers with advantageous properties such as a very large specific surface area, which is beneficial for speeding up solubilization. Based on our results, we believe that the most promising aspect of solvent electrospinning is its rapid solvent evaporation. We start from a solution where both a polymer and a drug are dissolved in a common solvent. During the process the solvent evaporates so fast that the drug molecules don't get the time to arrange themselves. They get frozen into place randomly and thus amorphously. The result is a membrane made of nanofibers with the more soluble drug well-dispersed inside of it. These nanofibrous membranes are consequently tested for their time stability and release rate. Our results show that in one hour, five times more drug gets released when it is solvent electrospun compared to the drug in its crystalline form.

This highly interdisciplinary research is based on collaborations between the Centre for Textile Science and Engineering, the Supramolecular Chemistry group and the Laboratory for Pharmaceutical Technologies, all at Ghent University. The collaborations allow for in-house analysis of the formulation, including modulated differential scanning calorimetry, X-ray diffraction, infrared spectroscopy and UV-Vis spectroscopy.

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Long-term stable organosilica nanofibrous membranes functionalized for advanced engineering applications: PhD work of Eva Loccufier

Electrospun nanofibrous membranes are increasingly used for various advanced engineering applications. Examples are scaffolds in tissue engineering, protective textiles, advanced composites, air filtration and membranes in affinity separation. This interest in electrospun membranes is related to some specific characteristics, such as high surface to volume ratio, high porosity and high interconnectivity of the pores. Depending on the application, the membrane needs to be hydrophobic or hydrophilic, resistant against high temperatures or even resistant against harsh chemical environments. Electrospun hybrid nanofibrous membranes, a very promising novel material, are able to meet these demands due to their possibility to tune the membrane on a molecular level. Due to their bi-material nature, they can provide the best of both organic (flexible, tear resistant) and ceramic materials (stiffness, chemical and thermal resistance).

In this PhD project, focus is placed on electrospinning of various ceramic and hybrid nanofibrous membranes by using sol-gel technology. By tuning the composition, properties such as the flexibility, hydrophobicity and thermal resistance can be tuned. In this way, various applications requiring a flexible, chemical and thermal resistance membrane are targeted. Two examples published over the last years are the gravity-based separation of heterogeneous azeotropes using highly hydrophobic or superhydrophilic silica nanofibrous membranes, and the photocatalytic degradation of the micro-pollutant isoproturon using TiO$_2$-functionalised hydrophilic silica nanofibers allowing safe reintroduction into the environment.

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Understanding the mechanical and microstructural properties of novel, continuous fibre reinforced composites produced through additive manufacturing: PhD work of Sander Rijckaert

Recent advances in 3D printing technology have allowed for the production of continuous fibre reinforced composites through additive manufacturing. These materials provide an interesting middle ground between highly modifiable 3D printing and the mechanical prowess of composites, but the fundamental insight needed to improve them still needs to be developed.

Fibre reinforced polymer (FRP) composite materials are already a go-to engineering material in industries like aerospace or wind energy, but the high cost and production complexity associated with the molds needed to make them, discourages the use for small, complexly shaped objects. Combining the excellent mechanical performance with the dimensional freedom provided by additive manufacturing, a novel material can be introduced to fill this gap in production capability.

As this kind of material is still brand new, our research focuses on the correct characterization of samples, and using this information to form new insights in the correlation between the fibre impregnation process, printing parameters and mechanical performance.

Results have shown that reinforcing these composites with polymeric fibres, such as aramid or PBO, is a far easier process than with ceramic materials such as glass and carbon fibre. During the printing process, these fibres experience high abrasion wearing by being pulled through the printing nozzle, meaning that these polymeric fibres with high abrasion resistance have a lower chance to break during composite production. Further research however will focus on adapting the production cycle, so that ceramic fibres can also be used in 3D printing composites.

Examples of printed composites. Carbon fibre reinforced PETG only succeeded for 1 layer

From this research, it was also shown that pre-impregnation of the fibres, i.e. first making a fibre reinforced polymer filament which is then printed in a standard desktop 3D printing setup, yields better results than in-nozzle impregnation. This is due to the lack of an active force, meaning the polymer is not actively forced into the fibre tow, resulting in a low impregnation quality and bad fibre adhesion.

The mechanical performance of 3D printed composites has so far proven to be quite high in tensile testing, but the imperfect impregnation of fibres results in a lower than expected flexural and delamination resistance.

This research is performed in co-operation with the Mechanics of Materials and Structures research group led by professor Wim Van Paepegem which is specialized in composite testing. The materials have been tested for their tensile and flexural modulus and strength, and delamination resistance under static loading.

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Delamination and impact resistant composite materials using toughening veils : Timo Meireman and Lode Daelemans

New toughening technology increases the delamination and damage resistance of composites up to 200% without any increase in mass. It is based on the incorporation of tough nano- and microfiber non-woven veils in between the reinforcing plies of the composite material.

Fiber reinforced polymer (FRP) composite materials are already a go-to engineering material in industries like aerospace or wind energy, but their poor delamination and impact tolerance remains a problem for many applications. Our research has proven that interleaving toughening veils that are based on electrospun polymer nanofibers or microfibers is a very efficient technique to create delamination and damage resistance. By incorporating the toughening veils, the weak and brittle interlaminar region between the reinforcing plies becomes very tough, which in turn toughens the composite as a whole. Our results show improvements of the delamination resistance up to 200%, a 50% increase of the Barely Visible Impact Damage limit and a 50% reduction in internal damage produced by low-velocity out-of-plane impact events.

Toughening veils made from very fine fibers are interleaved between the reinforcing plies and result in a composite with increased damage resistance without added weight.

Adding nano- and microfibrous toughening veils is thus a very effective way of increasing the damage resistance of the composites without negatively affecting other mechanical properties. These veils can either be incorporated as stand-alone membranes (high permeability veils pose no problem for resin infusion) or even directly deposited during the electrospinning process onto the reinforcing plies themselves. As such, these materials are much easier to integrate into current production routes and parts in comparison to other toughening nanotechnologies such as graphene or carbon nanotubes. Furthermore, they pose no health hazards as they come as a flexible bulk membrane while the fibers themselves are continuous and their diameter (100 – 1000 nm) is large enough to not penetrate the human body through contact.

The toughening veils can be made from a wide range of polymers. We have successfully used polycaprolactone, polyamides, polyster and several commercially available co-polymers. The veils are produced through electrospinning and can be manufactured continuously either as a stand-alone product or deposited onto existing reinforcing plies or other carrier structures. After composite consolidation, the nanofibers are embedded in the matrix material and act as crack stopping agents. They are inherently tough and well suited to absorb impact energy, for example from tool drops, hail or other collisions.
Nanofiber toughening in action: microscopic image of crack progression in a nanofiber toughened composite. The nanofibers bridge the crack halves and absorb a lot of energy making the material more ductile and damage resistant.

This research is performed in co-operation with the Mechanics of Materials and Structures research group led by professor Wim Van Paepegem which is specialized in composite testing. The materials have been tested for their delamination resistance under static and fatigue loading, low-velocity impact resistance, compression after impact strength, tensile/flexure/shear properties, etc.

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Advanced micromechanical analysis of fibre reinforced composites from individual constituents to full scale specimens: PhD Work of Olivier Verschatse

The demand for fiber-reinforced polymer (FRP) composites is surging in many industries as a substitute engineering material for metals due to their fantastic mechanical performance and low structural weight. However, all benefits aside, the production and design of composite parts remains a time-consuming process, especially requiring a lot of experimental iteration. One of the main obstacles in composite design is that the bulk behaviour (especially in nonlinear and damage behaviour) is not well understood due to the complex microstructure of composites. Composites typically consist out of a stack of plies, wherein each ply contains millions of fibers (diameter 5-20 µm) embedded in a polymer matrix. The fiber and polymer properties, as well as their interaction at the micro-scale, dictate how the end part behaves at the bulk scale. Fracture of composites starts at the individual ply scale and builds up towards total fracture.

We try to overcome this lack of knowledge via measuring and analyzing the microscale deformation behaviour of composites and their constituents. In a first phase, focus is put on microscale matrix samples and fiber-matrix interaction. In a second phase, we analyze single layer composites and in realistic composite layups. We combine the testing of microscale samples with in-situ observations. In this aspect, our state of the art table-top SEM with in situ tensile stage is crucial. This combined with in situ polarized light microscopy, enables us to study microscale composite behavior at a new level.

The results of this research project will be two-fold, firstly, a better understanding of the (micro)mechanics of composites will be achieved. Secondly, with the obtained knowledge it will be possible to have a more accurate finite element modelling of composite behaviour. To obtain the best possible results, this research is based on a close collaboration between the Centre for Textile Science and Engineering and the Mechanics of Materials and Structures research group which are both connected to the Department of Materials, Textiles and Chemical Engineering at Ghent University.

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Functionalised nanofibrous organosilica membranes for advanced affinity-based separation applications: PhD work of Bianca Swanckaert

Challenges in clean water availability have risen over the years, and especially third world countries are in great need of localised, low-cost water purification techniques, such as separation membranes. Membranes consisting of electrospun nanofibers offer the advantages of high surface to volume ratio and high porosity. By producing hybrid nanofibrous membranes containing both organic and inorganic parts, a wide range of different properties can be obtained by altering the molecular structure. This results in separation membranes with high thermal and chemical resistance as well as tunability towards, amongst others, hydrophobicity for the use in affinity-based separation applications in harsh environmental conditions.

In this research, the focus is on the production of various hybrid organosilica nanofibrous membranes with different organic linkers. In a first step, the production process of these nanofibers is investigated. Starting from a sol-gel synthesis, organosilica nanofibrous membranes can be produced by electrospinning. By tuning this molecular structure, it is expected that the mechanical robustness can be altered. This is investigated by looking at the influence of the flexible organic linker on the mechanical properties of these membranes by means of tensile tests and burst tests. An understanding of this behaviour can allow for a variety of nanofibrous membranes to be used with desired mechanical properties and that can withstand harsh conditions.

For the membranes to be used as affinity-based separation units, not only a mechanical robustness is needed, but they should also be tunable in their polarity. The molecular structure of organosilica allows, here as well, for a solution because they can be easily functionalised. This research focuses on functionalising organosilicas with a variety of groups and investigating their effect on the hydrophobicity of the membranes.

This research is done in view of obtaining membranes that can be used in separation applications such as the treatment of waste water (in collaboration with the Centre for Microbial Ecology and Technology, CMET) and recovery of high-purity solvents (in collaboration with the Laboratory of Chemical Technology, LCT).

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Electrospun Nanofibers with Silver Nanoparticles for Antimicrobial Applications: PhD work of Havva Başkan

Nanocomposite materials are of great interest due to their advantage of combining the properties of two or more different materials. Nanocomposites can be generated by using nanometals, metal nanoparticles, conductive polymers etc. There has been an increasing interest in the deposition of the composite of nanometals and conductive polymers onto polymer latexes since polymers are regarded as excellent binding materials for the formation of stable colloidal dispersion of metals.

Silver (Ag) is a non-toxic metal for humans but a toxic element for micro-organisms. It has been effectively used as antibacterial agent due to the ability of binding to microbial DNA, hence, blocking the bacterial replication.

In the scope of this PhD, silver nanoparticles were integrated into the electrospun nanofibers by both chemical (in-situ) and physical (dip-coating) processes. As host polymers, poly(acrylonitrile-co-itaconic acid) copolymer, synthesized by emulsion polymerization, and polyhydroxyalkanoate-based polymer (supplied from H2020 project PolyBioSkin) were utilized.

Prior to the production of electrospun poly(acrylonitrile-co-itaconic acid)/Ag nanofiber, silver nanoparticles were obtained in-situ from the reduction of silver nitrate in the presence of poly(acrylonitrile-co-itaconic acid) polymer and solvent. Afterwards, electrospinning was applied in order to obtain nanofibers. As a result, it was observed that incorporation of silver nanoparticles to the nanofiber membranes led to bactericidal/fungicidal activities against S. aureus, E. coli, P. aeruginosa, and C. albicans for both PAN/Ag and P(AN-co-IA)/Ag nanofibers.

On the other hand, PHA nanofibers were obtained by electrospinning and then Ag deposition onto PHA nanofibers was achieved via dip-coating as shown in figure 2. Related to the antimicrobial activity studies, it can be said that PHA-Ag nanofibers were able to upregulate proinflammatory cytokines and may have a role in wound repair processes. This study was conducted under the H2020 project PolyBioSkin.

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Post-functionalization of silica-based nanofibrous membranes to tune their hydrophobicity: PhD work of Minglun Li

Electrospinning is a relatively simple, versatile technique for the production of nanofibrous membranes from various materials including polymers, metals and ceramics. Our research group has a vast expertise on the electrospinning of nanofibres via sol-gel technology to produce silica-based nanofibrous membranes. These membranes combine the advantageous properties of nanofibres such as a high specific surface area, high porosity and high interconnectivity of pores, with the unique properties of ceramics, high temperature and chemical resistance.

Previous research showed the unique hydrophobic/hydrophilic properties of these membranes, which can be advantageous for advanced applications such as separation membranes. After production these silica-based membranes are highly hydrophobic, but this hydrophobicity is not stable in time due to the continued reaction of the sol-gel network.

The focus of this PhD work has been on the post-functionalization of these silica-based membranes to obtain reproducible membranes with a stable hydrophobicity in time. Various surface modifiers have been used and their influence on the wettability was evaluated. Moreover, the stability of the hydrophobicity of these functionalized membranes in time and towards heat, humidity, acids/bases has been tested. The evaluation of these membranes for separation of miscible and immiscible liquids is researched.

Silica-based nanofibres are produced via electrospinning and after a heat treatment modified to obtain stable hydrophobicity in time. The surface modification has no impact on the microstructure of the nanofibres.

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Polymer Engineering and Design – a multi-scale research strategy

The application properties of polymeric materials and specifically fibrous materials are determined by (i) the composition and topology of individual polymer molecules at the molecular scale; (ii) the morphological interactions at the meso-scale defining the polymer microstructure; (iii) and macroscopic features at the macro-scale, hence, final product scale. A true design of these materials requires a fundamental understanding of both the polymer synthesis and the polymer (post)processing steps, i.e. the transition from chemicals to the final application needs to be studied via a modular approach, starting from the basic chemicals. Since phenomena at different scales, ranging from the molecular to the macroscopic one, are occurring with many parameters influencing the material performance, a multi-scale modelling approach is recommended.

In collaboration with the Laboratory for Chemical Technology (LCT), the Centre for Macromolecular Chemistry (CMaC) of Ghent University and several (inter)national academic and industrial partners an advanced multi-scale model is developed, allowing design of well-defined (co)polymers during their synthesis up to industrial scale. Focus is on the control over chain length, composition, topology and functionality of the individual polymer molecules, benefiting from the development of novel pioneering algorithms to store and visualize/map detailed microstructural information and of novel techniques to properly account for diffusional limitations induced by viscosity changes. At the reactor scale inhomogeneities due to concentration and temperature gradients are accounted for. Attention is focused both on homogeneous (e.g. bulk) and heterogeneous (e.g. emulsion) polymerisations, taking into account the impact of scale-up on the overall polymer product homogeneity.

In collaboration with the Centre for Polymer Materials and Technologies (CPMT) of Ghent University and again several (inter)national academic and industrial partners. Currently, an analogous multi-scale model is being constructed for polymer processing, making a differentiation between solution-based (e.g. electrospinning) and melt-based (e.g. extrusion of filaments) methods. The ultimate goal is the development of a powerful and fast tool to control the product homogeneity and the application properties by identifying the most suited process parameters (e.g. temperature and pressure profile for extrusion), taking into account economic constraints and variations in the polymer structure and feed composition. This research is multidisciplinary and involves the linkage of knowledge on material science, chemical and mechanical engineering, physics and polymer chemistry.

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Bicomponent extruder

The department has a semi-industrial coextrusion line for the production of monofilaments for textile applications (e.g. artificial turf). The setup allows scientific research on monofilaments produced under industrial conditions. Research is planned into new coextruded monofilaments, new polymer combinations for the production of these multilayer monofilaments and a new form of the stalk of grass for sports applications. Material choice and the optimal combination of polymers are emphasised. For the research on artificial turf, the aim is to integrate more sports-technical properties, optimisation of the resilience, static and dynamic transformation of the monofilaments, friction coefficient, weather resistance and recycling of the monofilaments.

The research into multilayer monofilaments must lead to a further breakthrough in the acceptance of artificial turf for sports applications and a better temperature control of the artificial turf fields.

The bicomponent extruder is developed in cooperation with the company Oerlikon Barmag and is equipped with:

• 2 extruders with a 30 mm diameter and a 24 L/D relation;
• a barrier screw for the extrusion of polyester and polyamide
• a barrier screw for the extrusion of polyethylene and polypropylene
• 2 melting pumps
• 2 filters
• a spinning plate for monocomponent filaments
• a spinning plate for bicomponent filaments
• a water bad
• a dry system for the filaments
• 2 stretching units with 300 mm rolls
• a 3 m oven for the drawing of the monofilaments,
• a spinfinish applicator and a winding unit

The coextrusion line is available for research activities in consultation with the research group "Polymer Technology". For more information, please contact Stijn.Rambour@UGent.be
SERVICES TO INDUSTRY

TESTING AND CONSULTANCY

As a university knowledge centre, we consider our Services and Testing for industry an essential part of our mission. Producers, traders and end-users from all over the world can rely on us for testing and advice on a wide range of parameters such as strength, wear, abrasion, chemical and UV-resistance, electrical and thermal conductivity, fire resistance, chemical composition, colour fastness, polymer analysis etc.

These parameters can relate to a wide variety of products such as fibres, yarns, fabrics, carpets, artificial turf, automotive textiles, but also plastics, wood, composites and other materials.

Apart from standard testing, companies also consult us for problem solving and brainstorming on improvement of products or production processes. Our experience and scientific background are a guarantee for reliable and evidence based advice and solutions.

CTSE also actively participates in the development of new test methods and standards as well in the field of floor coverings and construction products, smart textiles, as artificial turf.

The Centre for Textile Science and Engineering plays a leading role in testing artificial turf fields all over the world, through its separate unit called ERCAT (European Research Centre for Artificial Turf). ERCAT is also closely involved in the development of new test methods for artificial turf. See separate chapter on ERCAT.

ACCREDITATION

We aim for the same high standard when it comes to quality management of our services. For over 25 years now we operate according to the strict rules of ISO 17025 accreditation. The latest version of ISO 17025 standard has been put in line with ISO 9001 (2015), with more focus on risk assessment and improved effectiveness. Consequently we are moving more and more towards online document control, reporting and invoicing.

This accreditation applies to physical, chemical, floor coverings, flammability tests as well as to field and laboratory tests for football (FIFA), hockey (FIH) and rugby (IRB).

The Centre is a member of BELAB, the Belgian Chamber of Eurolab and Eurachem. As a member of its board, we are in close interaction with BELAC, Belgium’s National Accreditation Body (NAB) and we actively participate in Eurolab meetings.
NOTIFICATION

CTSE is Notified Laboratory in the framework of the European construction products regulation (CPR 305/2011) for testing of carpets according to EN 14041, wood flooring according to EN 14342 and surfaces for sports areas according to EN 14904. The European Notification Number is NB 1611.

The Centre also performs tests under notification for CE-labelling of geotextiles.

STANDARDISATION

The department is an active participant in the standardisation activities on floor coverings within ISO TC 219, CEN TC 217 and CEN TC 134 and on geotextiles in CEN/TC 189 and ISO/TC 221.

Floor coverings

EN 14041: this harmonized standard is developed for assessing conformity to European construction product regulation (CPR). It was last revised by CEN in 2018. However this revision has not been accepted by the European Commission and thus it was never published in the Official Journal of the European Commission. Therefore, it may not be used for CE-labelling of floorcoverings. Hence, The EN 14041:2004/2006 is still the valid version. The EC has been confronted with some legal issues concerning the CE-labelling for CPR. They are therefore in the process of changing the criteria for evaluating new CEN standards in the construction sector. This is a lengthy process, causing a lot of discussion between member states and a lot of delay, confusion and uncertainty in the sector.

Light reflectance EN 17317:2020: This standard has been approved in 2019, though Belgium questions the reliability of the measurement.

New reference carpets for vacuum cleaners? Performance of vacuum cleaners is tested on outdated carpet types. A task force between the TC59 and TC134 was established in order to find more up to date carpets for evaluation of vacuum cleaners. So far they didn’t succeed in proposing new carpets, since there is quite some reluctance within TC59 to adapt their test methods.

EN 1307 (Classification of wall-to-wall textile floor coverings): The standard is being completely redrafted in order to develop one standard that is easier readable for marketing purposes, preferably with the same tests regardless of the production technique of raw materials used. For the determination of the use class, a shift is proposed: from evaluating the aspect after a fixed number of turns, to counting the number of turns that leads to a change of aspect equal to grade 4.

As for the Vettermann and hexapod drum, the discussion on the availability of studs and reliability of results is still ongoing. Several producers of polymeric studs have been asked to propose alternatives to the materials currently described in the standard (a.o. Polyurethane or polyester studs).

ISO 4918 was rejected by the laminate producers at FDIS stage. Hence, the EN 985:2001 (castor chair test) had to be reinstated at European level, after being withdrawn last year.

CEN has decided to install a new working group ‘modular mechanical locked floor coverings’ with the scope defined as ‘modular floor coverings’. They need to find testing solutions for mechanically locked floorcoverings that are designed for a floating installation (e.g. carpet on hard board), to which existing test methods do always be apply.
Work on ISO level:

ISO 2424 textile floor coverings – terminology: definitions related to hand made / hand knotted / machine made carpets: is being prepared for a future revision.


Revision of ISO 1763 Carpets – Determination of number of tufts and/or loops per unit length and per unit area. Text ready for the DIS vote.

Revision of ISO 8543 Textile floor coverings – Methods for determination of mass. Text ready for the DIS vote.

Revision of ISO 12951 Textile floor coverings – Lisson test methods: DIS published for voting.


ISO 6356 Textile and laminate floor coverings – Assessment of static electrical propensity – Walking test. The aim is to ‘harmonize’ between ISO and AATCC, before starting a revision of the ISO document. Two main problems: differences between test shoes from Europe and from AATCC, and the fact that in the near future the prescribed BAM rubber for the test shoes will no longer be available.

ISO 10874 Resilient, textile and laminate floor coverings – Classification: deletion of class 22+

Geotextiles – CEN/TC 189 and ISO/TC 221

WG1 (requirements): mandated requirements (essential to safety of the product) should be strictly separated from voluntary quality classification tests. Therefore all application standards will have to be replaced. But the discussion between CEN standardisation institute and the European Commission on what should be in the mandate and how it should be answered by TC 189 is still ongoing. This blocks the progress of the work to a great extent.

WG 1 also looks into sustainability and all related issues like recycling, re-use, circular economy etc.

WG 3 (mechanical testing) has been working mainly on prEN 17323 for tensile properties of geosynthetic barriers. There was a heavy discussion whether an extensiometer should be used or not. It was decided to make this dependent on the type of material and to perform interlab trials.

In WG 3 prEN 17323 (Tensile properties for barrier layers), there are a lot of discussions on these standards, with a strong push from the HDPE producers. One issue related to the definitions, here the ones from EN ISO 10319 were not accepted by all experts. Another issue was the test method. Interlaboratory testing was conducted which led to agreement, so the documents are prepared for formal vote.

WG 4 (hydraulic properties)
- EN 17445 (rain fall erosion): draft ready for CEN enquiry
- EN 16416 (clay barrier): review started
WG 5 (durability)

- PrEN 12447 resistance to hydrolysis: under revision; interlab showed huge differences between labs. This should be further explored.
- prEN 12225 soil burial test for microbiological resistance: was sent out for enquiry
- prEN14414 chemical resistance for landfill applications: discussions are ongoing on how to test materials with protective coating on (e.g. a metal grid) for damage during installation first.

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European Research Centre for Artificial Turf (ERCAT)

ERCAT is the artificial turf research and testing centre at the Centre for Textile Science and Engineering of the Department of Materials, Textiles and Chemical Engineering (Faculty of Engineering and Architecture) of Ghent University.

ERCAT is accredited for field and lab tests for the sport government bodies of FIFA for football, World Rugby for rugby and FIH for hockey.

Lab Tests

ERCAT is accredited by FIFA, World Rugby and FIH to perform lab classification of football, rugby and hockey products. In the ERCAT laboratory, we test and investigate new artificial turf structures and yarns before fields with these materials are installed. ERCAT is testing the ball-surface and player-surface interaction, but also the wear of artificial turf. In October 2015 FIFA changed their manual and requirements. This was a huge change with a much more severe wear test, reduced ball roll with timing gates, infill splash with high speed camera. Skin friction and skin abrasion after Lisport XL is added to the lab testing.

Field Tests

ERCAT is accredited by FIFA, FIH and World Rugby to carry out field tests all over the world. In these field tests, the interaction between the ball and the surface, and between the player and the surface is examined. This test is a guarantee for the quality of the artificial turf and the playing characteristics of the field. ERCAT is also doing the complete follow-up of the installation of pitches, from subsoil to foundation layers to the installed grass and can also help you with the technical requirements for tenders. In 2017 ERCAT was recognised by NOC-NSF to do field tests in the Netherlands on subbase and on the installed field.

Research

ERCAT is more than a testing laboratory. For many years, the department has been performing intense research into the new artificial turf fibres and structures. The most recent knowledge of polymer and fibre technology is appealed to, supported by an extensive set of testing and measuring devices for both laboratory and field tests. ERCAT is working on new test methods and materials: new sliding test, light weight rotational resistance tester, new infill materials, ...

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PUBLICATIONS

Articles published in the Web of Science (WoS)


### Articles published in journals (not mentioned above)


### Chapter in books


### Conference papers


Conference abstracts


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2019

Department of Materials, Textiles and Chemical Engineering (MaTCh)
Centre for Textile Science and Engineering

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