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## RECYCLING OF WASTE ACRYLIC TEXTILES

# D7.5: Roadmap for exploitation after REACT

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PU	Public, fully open, e.g. web	✓
CI	Classified, information as referred to in Commission Decision 2001/844/EC	
CO	Confidential to REACT project and Commission Services	

\* **REPORT**: Document, report (excluding the periodic and final reports)

**DEM**: Demonstrator, pilot, prototype, plan designs

**DEC**: Websites, patents filing, press & media actions, videos, etc.

**OTHER**: Software, technical diagram, etc



## EXECUTIVE SUMMARY

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The REACT Work Package 7, WP7, is dedicated to “Dissemination, Communication and Exploitation” and aims at defining, maintaining and coordinating the appropriate mechanisms and tools ensuring broad visibility and impact of the project’s work and results. The main objective is to promote the developed project’s concepts and technologies.

This deliverable describes joint exploitation plan for REACT, that will include the individual exploitation plans and, in agreement with the rules defined in the Consortium Agreement, joint exploitation plans between academic partners and industrial partners.

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## 1 INTRODUCTION

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Key scope of the REACT is to decouple human impact from resource consumption and achieve increased competitiveness in Europe. Bringing together all actors along the full value chain (from raw material supply through industrial transformation into intermediate products and applications) and re-use waste streams within the textile sector – including recovery and recycling of post-consumer waste – are the main topics addressed by REACT proposal.

An industrial resource efficient process must avoid, valorize, and recycle waste streams from industry as well as post-consumer end-of-life materials. Within this perspective, the REACT project demonstrated solutions that increase waste collection rates, increase recycling rates, reduce the generation of waste, increase the yield and the quality of recycled materials, and enable access to and use of waste and low yield materials through improved processes for dyed acrylic textiles for awnings and outdoor furniture.

Also, it is necessary to underpin recycling by developing innovative collection, recycling schemes and business models for eco-innovation, thus making recycling more efficient, easier to handle and transparent for consumers, industries and recycling companies. For this purpose, it is possible to learn from best practice for collection and reuse schemes from other industries, such as other kind of textile collection and recovery.

In the REACT Project, the goal of making circular market for outdoor acrylic fabrics has led to the formation of a production chain of recycled material, engaging all the players involved in this process. Starting from the recovery of pre-consumer waste material and establishing and / or suggesting methods for the recovery of post-consumer material, identifying the problems and possible solutions. The identification of the contaminants present on the fabrics and all the mechanical processes to obtain a yarn and subsequently a recycled fabric that can be reused in the same sector complete the acrylic supply chain.

The greatest exploitation of the results obtained comes from the patenting of the finishing removal process, the main objective, which will lead to developments both in economic terms and in the possible establishment of waste material recovery chains in the outdoor sector but also in others.

## 2 REACT ROADMAP EXPLOITATION

Creating a roadmap and, in parallel, developing a policy recommendation for research on advanced acrylic fiber recycling in Europe mean:

- to improve advanced research on recycling textiles in Europe;
- to build lasting partnerships with academic, industrial, government and community stakeholders;
- to establish active interactions among the various stakeholders (companies, local administrations, governments) in order to verify the obstacles and problems to be submitted to the policy makers and, at the same time, verify how the policies orient new projects;
- to improve awareness and training skills and develop recycling textile waste skills.

The work carried out in this project action was set to make the project public and visible. The purpose of the communication / dissemination and exploitation actions was to create an interest among the subjects that treat and manage textile waste, starting from specific focus on acrylic textiles from awnings and outdoor furniture. A key element is the analysis and removal of finishing substances (fluorocarbons, melamine and acrylic resins, anti-mold agents) that affect the purity of the secondary raw material and their management.

In this framework, the project objectives were achieved by following three main “Action Lines”:

- Network between Projects by Plastic Circular Multiplier Initiative;
- Scientific conference;
- Patent.

As regards the analysis and removal of finishing substances to obtain second-life fibers and fabrics, the three Action Lines had as their main objective the management of waste acrylic fabrics from awnings and furniture, defining and supporting a roadmap for the exploitation of project results and policy recommendations.

The three Action Lines will work and develop individually, bringing technological and non-technological solutions to interested stakeholders and policy makers. They will be able to exploit the knowledge developed in the project to establish new models of circular economy. Beyond this, they will be able to learn from the obstacles and limitations encountered and implement plans to change infrastructures and policies, to make the transition from a linear to a circular economy more flexible and streamlined.

This Project's Exploitation Roadmap was developed to provide information on project results that have potential exploitation that can outline general and specific exploitation strategies and tools at national and European level. The roadmap was developed to consider and elaborate the contributions of all the partners, included in the deliverables 7.6 Policy. (Reference to the "Partners '& Stakeholders' Interest" tables).

RESULTS	Network between projects and PCM (Plastics Circularity Multiplier) Initiative	Scientific conference	Patent
Plan design of waste storage and classification system	x		
Acrylic textile waste characterization	x		
Chemical removal		x	x

Predictive model of NIR analysis		x	
Industrial level chemical removal (scale-up)		x	
Lab-scale wastewater treatment		x	
Yarn made of recycled fibres	x	x	
Mechanical recycling of acrylic fibre	x	x	
Fabrics made of recycled fibres	x	x	
New and environmental friendly finishing		x	
Prototypes and demonstrators	x	x	
LCA of acrylic fibres		x	
<b><u>Ways to go to maximize access and reuse of scientific and non-scientific data generated by the REACT project.</u></b>	<i>To create points of connection between researchers and policy - makers involved at international level in European projects to carry out moments of exchange and favor strategic choices also through the implementation of new multidisciplinary scientific-methodological approaches.</i>	<i>To create connection points with different researchers and the university world to consolidate the results of the REACT project and discuss possible new developments</i>	<i>To create connection points between project partners, researchers, companies to strengthen the European scientific and technological base, promote social well-being and obtain a more effective exploitation of the economic and industrial potential of innovation, research, and technological development policies.</i>

Table 1: Results &amp; Exploitation



## 3 PARTNERS ROADMAP

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### 3.1 Centrocot

Centrocot is a R&D Centre, located in one of the most important textile industrial areas of Italy (Lombardy Region). It can provide all kind of tests needed by the textile and clothing companies: Technological, Chemical and Ecological; Certification and PPE, Electromagnetic Measurement; Biological, UV Protection and Comfort; Instruments Calibration. Centrocot carries out a role of connection between the Institutional Research Centres and the companies and, through constant contacts with International Partners, it promotes and realizes research projects with direct and significant technological benefits for the enterprises.

Centrocot offers services on sustainability development, such as: Life Cycle Assessment (LCA, according to ISO 14040 series), Environmental Product Declaration (EPD) and Product Environmental Footprint (PEF), REACh Regulation, Green Public Procurement (GPP), STeP by Oeko-Tex® (Sustainable Textile Production), Traceability TFashion. Other activities are consultancy related to the binding technical legislation within the international markets and technical and managerial training and seminar activities, UV Standard 801.

Centrocot has a wide experience in collaborative projects by participating in European, national and regional research and innovation projects aimed at the use of innovative textile products and processes in various industrial sectors. Centrocot is the Lead Partner of Life M3P project (LIFE15 ENV/IT/000697), that develops an industrial waste valorization system, using an on-line platform dedicated to combining materials, technologies and waste. Through the tangible pilot cases, it develops an action model in favor of the local business to enhance / convert the processing waste into resources and secondary raw materials. Centrocot is also the Lead Partner of ENTeR project (CE1136) focused on reducing waste from the T&C industry and on improving the processes of reuse and recycling of textile materials to prevent the consumption of non-renewable resources. Furthermore, in the Life PREFER project (LIFE12 ENV/IT/000393) it collaborated for the implementation of PEF within the regional textile district.

In order to respond to the market needs, Centrocot has launched the Multi-Lab (Multisectoral Experimental Laboratory). It is a new space completely dedicated to research, development, and training to support companies to face new innovation trends, related to the issue of recycling materials and products and performance verification, and, more generally, to the topic of the Circular Economy.

Through the Multi-Lab it is possible to study the specific properties of the material:

- Recognition: NIR station
- First treatment for recycling: Fraying machine, shredder, fiber opener, mill
- Polymers recyclability: Single- and twin-screw extruder, injection moulding, workstation for polymers study (MFI, DMA)
- Finishing and prototyping: smart textiles workstation, fused deposition 3D printers
- Innovative controls: biodegradation, composite materials tests, Semi-anechoic acoustic and electromagnetic chambers

#### 3.1.1 Roadmap for exploitation

Centrocot, Textile R&D partner of a former project (ETF), developed novel methods to characterize flax fibre composition using NIR based equipment. On basic of result of ETF project, NIR technology was further investigated on REACT project as an innovative alternative for characterizing textile materials. The challenge was to implement in the developed system a NIR automatic method to identify and subsequently classify fabrics according on finishing. The gorgeous results of project have confirmed at Centrocot the potential of technology and the idea to transfer NIR methods at another textile substrates. The technology is already used in other projects where Centrocot is involved (Circular Textile and Materia) and will be inserted in next proposals to continue the knowledge exploitation. Indeed, Centrocot is interested to develop NIR neural networks models for the identification of

chemicals or other contaminants on clothing as an input for development of recycling processes. The model developed in the project will be the intelligence of a sorting machine of clothes, not only in according of composition but also finishing and potential hazardous substances. This knowledge developed by Centrocot will be brought to attention of stakeholders in the call for Innovation of process and organization of production and service chains and industrial productive and economic ecosystems in Lombardy, as a starting point for a recycling hub and route the clothes in appropriate recycling ways.

The participation of Centrocot at patent of removing process will allows both to study the potential application of this technology on other textile substrates (polyester, cotton, etc.), and other sectors with same or similar problematic (such as PPE) and to transfer the technology to other contexts that use similar chemical resins. In addition, expertise on technology and research management will allow Centrocot to increase the possibility of networking and access at European or national research calls.

## 3.2 Parà

Parà Industrial Group is a family company founded in 1921, which for three generations has been producing textiles with outstanding aesthetic and technical qualities. With six manufacturing plants and significant market penetration, Parà Group is present in 3 specific business sectors: sun protection, indoor and outdoor furnishing accessories, and marine.

Parà Group has won a reputation on the market as a manufacturer of high-quality textiles, strictly "Made in Italy" with close monitoring of the entire production cycle, vertically integrated from the spinning to the weaving stages, from printing to dyeing, from coating through to finishing.

Parà is one of the largest European manufacturers of fabric for awnings and holds important positions in major markets such as Italy, where it is the undisputed leader with a market share of over 30%, and Germany where it is a supplier of the major operators in the sector.

The availability of goods in stock also includes the presence of reliable suppliers that pay attention not only to the quality of raw materials but also to the logistic organization (production planning, transports, communication). Parà has a R&D department that is always in touch with both suppliers of raw materials, for a continuous improvement of the quality products, and research institutes for a constant updating on new products and control methodologies to anticipate market needs regarding quality and product sustainability.

Participation in the Italian and European technical committees (Assotende and Esso European Solar Shading Organization) and CEN working groups (TC3 / WG5) allows Parà to be a reference point for its customers for updating on European standards active on sun protection devices.

The Parà Tempotest brand has become synonym of awning thanks to the high standards of product and service and to a persistent and continuous sponsorship and communication campaign of the brand transmitted through national radio and television networks. The fabrics for sun protection represent the core business, while the fabric for outdoor furniture represent a small percentage of the production made with acrylic yarn.

Thanks to its widespread sales network, Parà is continuously in contact with the manufacturers and distributors, therefore always updated on the needs of the final customers

### 3.2.1 Roadmap for exploitation

In the last years, Parà has launched a new collection of recycled polyester fabrics for a sustainable sun protection, the new fabrics are GRS certified. In the wake of this, Parà will exploit the results of REACT project to develop and introduce on the market a new brand made of acrylic recycled fabrics. The first step will be using the selvages to make recycled fabrics of acrylic for sun protection, and after a consolidation of market and developed the industrial plant to remove finishing will use other waste coming of production chain. These ones will allow Parà to reduce production costs, because the increment of raw material price and the already high price of acrylic can be a market input for implement a circular economy. In addition, the participation of patent of Parà will be an economic advantage in this context.

Moreover, the knowledge developed in collection, classification and management of waste will be brought at attention of stakeholder in the call for Innovation of process and organization of production and service chains and industrial productive and economic ecosystems in Lombardy. Furthermore, the obstacles found will be submissive at policy makers to streamline the procedures of management waste and termination of waste definition in favor of secondary raw materials definition. In the Lombardy idea of recycling hub, Parà will be stakeholder as a final user of products developed, with this role will be able to explain the problematic of market requests and the necessity of secondary raw materials with high purity to reach compliance of products in according to uses.

### 3.3 Soft Chemicals

Based in Marnate (VA, Italy), Soft Chemicals specializes in textile auxiliaries and offers chemical solutions for fabric treatment for various applications, developing special skills in the treatment of textile fibres for clothing, interior, exterior design, and blackout curtains.

As supplier of auxiliary chemicals to the textile industry (preparation, dyeing, finishing, coating and garment treatments) it has an in-depth knowledge of the relevant chemistry and technology which allows technological improvements, costs saving and process controls of many aspect of the textile productive sector.

#### 3.3.1 Roadmap for exploitation

The major exploitation of Softchemicals arise from the patent participation, as a chemicals supplier and developer of the chemicals used to remove finishing, the patenting of process will be converted in know-how for Softchemicals. Moreover, the application of technology for acrylic fibre circularity but also for other fibres or other sectors that uses similar resins, will result in an increase of market for Softchemicals. In addition, the possibility of improving products used for removing finishing will be a push to further reduce the impacts and customize the chemical mix and process in according of user needs.

In addition, the development of new ecofriendly finishing alternative at substances with content of formaldehyde and fluorocarbon compounds, will open a new market for company. Softchemicals will be able to offer at them customers an alternative solution with performances similar at the actual products. Furthermore, the participation of call for Innovation of process and organization of production and service chains and industrial productive and economic ecosystems in Lombardy, will be useful for stakeholder to have a solution and Softchemicals expertise to best solutions to preparation at recycling of fabrics and final adding finishing with opportune properties.

### 3.4 CETI

The Centre Europeen des Textiles Innovants (CETI) is a non-profit organization dedicated to conceiving, experiment and prototype innovative textile materials and products. CETI's core business is to show proof of innovation by doing demonstrators on the technological platforms through private R&D projects and collaborative R&D projects. Presently the staff of CETI is 24 persons including a majority of senior engineers and experienced technicians. Since the creation of the CETI in 2012, one of its major strategic axes is sustainable development. The importance of this implication, for a more virtuous fashion or technical textiles, makes it possible to palliate the lack of natural resources and the use of toxic products. By reinventing the end-of-life of textile products, we feed the textile industry with a secondary raw material. Our duty is to preserve our resources and improve our processes to stay at the forefront of technology. Eco-design is also an important focus of our offer. By accompanying our customers from the upstream to the downstream, we enable them to find technical solutions for more responsible textile items. The sustainable development department supports industrials and retailers in their efforts to consider the end-of-life of their textile waste. Thanks to our industrial recycling line, we can prototype the products of the future. The DNA of CETI is the prototyping of innovation in textile processing, upcycling, and future apparel experience. The capacity to prototype quickly some products reduces the risk of failures and improve the speed of development. The CETI is covering the Technological Readiness Levels between 4 and 8. CETI is providing proof of innovation from the idea

to the industrial transfer but also helping in successful introduction on the market thanks to its tools of innovation valorisation. The strategic axis of activity are:

- The performance of materials processed through extrusion, filament spinning, nonwovens processing, yarn spinning, weaving, and finishing.
- Digital transformation to serve products.
- Eco responsible development.

CETI is in charge to transform the fabrics that have been clean up from hazardous products into fibres and then to spin the fibres. To achieve this work CETI uses its pilot lines composed with a tearing line, a line for preparation of fibres to the spinning and an open-end spinning line. The yarn is then delivered to Para S.p.A. to be woven.

### 3.4.1 Roadmap for exploitation

CETI's participation in the mechanical treatment and spinning process will allow us to deepen and study future applications closely related to the treatments developed with the REACT project. Furthermore, both the technological lines and the skills acquired in the management of the H2020 project will allow CETI to access European or national partnerships and increase the opportunities for networking and to be included as a partner in European calls.

## 3.5 UGent

Ghent University is one of the major universities in the Dutch-speaking region of Europe. Today Ghent University attracts over 50,000 students, with a foreign student population of about 6,000.

Ghent University is the only Belgian university in the top 100 of both the Shanghai and Times ranking. The University has participated in more than 200 research projects in the EU's Sixth Framework Programme (2002-2006) and in 260 projects in the Seventh Framework Programme, of which 78 ERC grants. Ghent University coordinated 42 collaborative projects in FP7. The university is one of the fastest growing European universities in terms of research capacity and productivity, and its commitment to European research excellence is reflected by the recent extension of the 'European Office' in its Research Office, i.e. the department overseeing, guiding and administering research projects. In this particular project the Department of Materials, Textiles and Chemical Engineering (MaTCh) from the faculty Engineering and Architecture is involved.

The Department of Materials, Textiles and Chemical Engineering offers education at national and international level, is involved or coordinates numerous national, European and international research projects and renders technical and scientific services to the materials, textiles and chemical industry. For the present project the research units 'Center for Textile Science and Engineering (CTSE)', 'the Centre for Polymer and Material Technologies (CPMT)' and the Department of Green Chemistry and Technology (DGCT) will be the active partners.

### 3.5.1 Roadmap for exploitation

UGent's participation in the patent removal process will allow us to deepen and study future applications closely related to the treatments developed with the REACT project. Furthermore, both the technological lines and the skills acquired in the management of the H2020 project will allow UGent to access European or national partnerships and increase the opportunities for networking and to be included as a partner in European calls.

## 3.6 Jak spinning

Jak Spinning Kft is a Hungarian company founded on April 2006. It is an autonomous textile manufacturing enterprise qualified in spinning activity covering the whole spinning cycle. It is specifically specialized in spinning of acrylic fibres used especially for awnings, also in cooperation with Parà.

Today, it is an independent production facility with more than 30 employees and several ring-spinning and twisting lines. Working h24, 7 days a week, it mainly works on acrylic fibres intended for awnings and outdoor furniture fabrics.

Ják Spinning is a textile manufacturing enterprise qualified in spinning activity covering the whole spinning cycle. It is specifically specialized in spinning of acrylic fibres used especially for awnings, also in cooperation with Parà. Among its facilities, it counts two complete spinning lines and a quality control laboratory.

### **3.6.1 Roadmap for exploitation**

The common spinning process used to produce acrylic yarns for outdoor application is the ring spinning, a process where Jak is expert, but in the project, despite the best performance of this process confirmed by analysis the spinning has some difficulties. Instead, with open-end spinning made by CETI results easier to produce recycled acrylic yarns. For these reasons, Jak is interested in investment of new machinery to remedy. Jak will decide if investment in a new technology of spinning by inserting in its company an open-end spinning machinery and introduce new personal with specific expertise or investment in a fraying machinery similar to CETI and work on optimize the fraying process to obtain a fibres useful for ring spinning. The two possibilities will open different scenarios for Jak. Indeed, the first one, will open the possibility to expand the market of Jak at new kind of fibres, instead, the second one, continue will specialize for the acrylic yarn production with the introduction of a new products made of acrylic recycled yarn in its catalogue.

## **3.7 Martel**

Martel is a dynamic digital innovation agency with more than 25 years' experience empowering organisations across Europe and worldwide throughout their journey from novel ideas to technological implementation, media and market strategy. After more than one hundred cutting-edge projects, Martel has grown from its origins as a small consulting agency into a thriving organisation with offices in Switzerland and in the Netherlands.

Building on its foundation in the management of European Commission funded projects and EU consulting, Martel's business has diversified to include research and development activities in several advanced domains, but also a broad palette of communication, marketing, media and training services.

With a skilled and passionate international team, Martel helps its customers and partners achieve ambitious innovation goals in an impactful and sustainable way. Martel offers support and guidance spanning from securing funds and providing expertise in selected ICT domains, to strategic communication, marketing and engagement plans.

Martel also offers dedicated training on European funding rules and mechanisms, on media and communication for science and technology, and on advanced topics in Cloud Computing, Edge Computing, Internet of Things, Artificial Intelligence and open-source Software Engineering.

### **3.7.1 Roadmap for exploitation**

The consolidated skills of the partner and those acquired in the REACT project will allow Martel to access European or national partnerships and increase networking opportunities and to be included as a partner in European calls both as a partner dealing with communication and dissemination and in exploitation