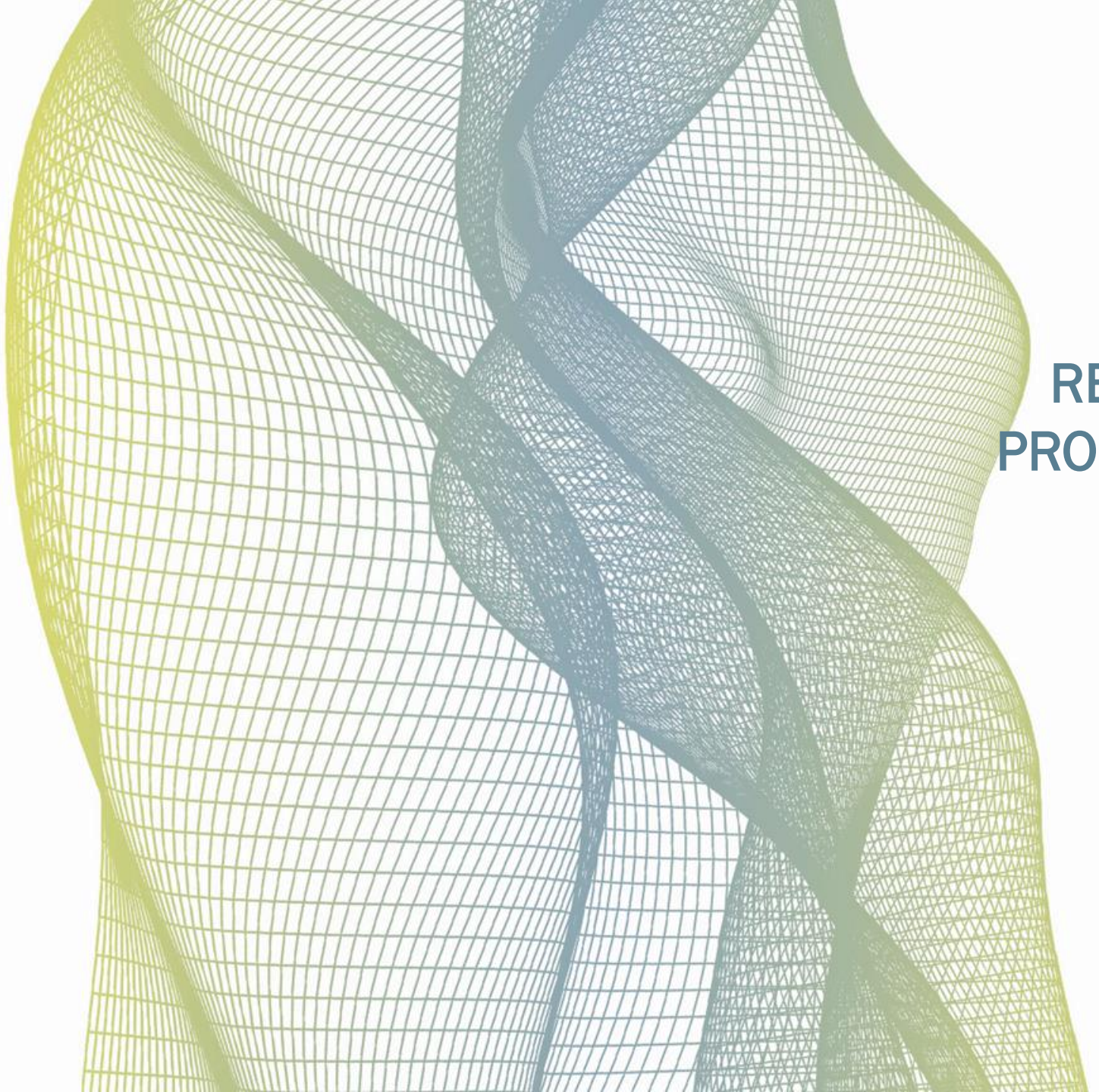

REACT A TOOL FOR IMPURITIES PROBLEMS IN OUTDOOR SECTOR RECYCLING

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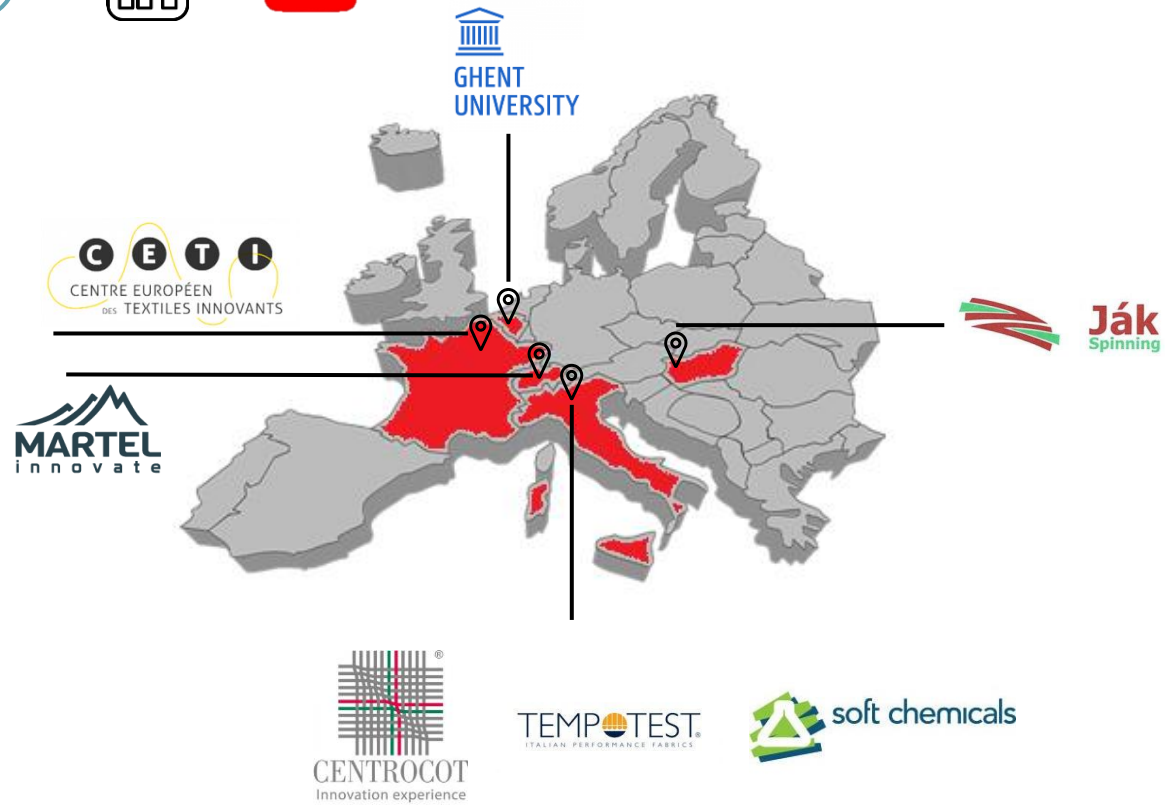
REACT – GENERAL PROJECT INFORMATION

H2020-SC5-2018-2019-2020: Methods to remove hazardous substances and contaminants from secondary raw materials

- **36 months duration**
  (June 2019 – May 2022 → September 2022)

- **Consortium:**
  7 partners for 5 EU countries



REACT - THE PROBLEM

In the 'awning and outdoor furnishing' textile market, acrylic is still the main material used (more than 90% of production) **thanks to its unmatchable performance** (combination of weatherability, UV resistance and mechanical strength).

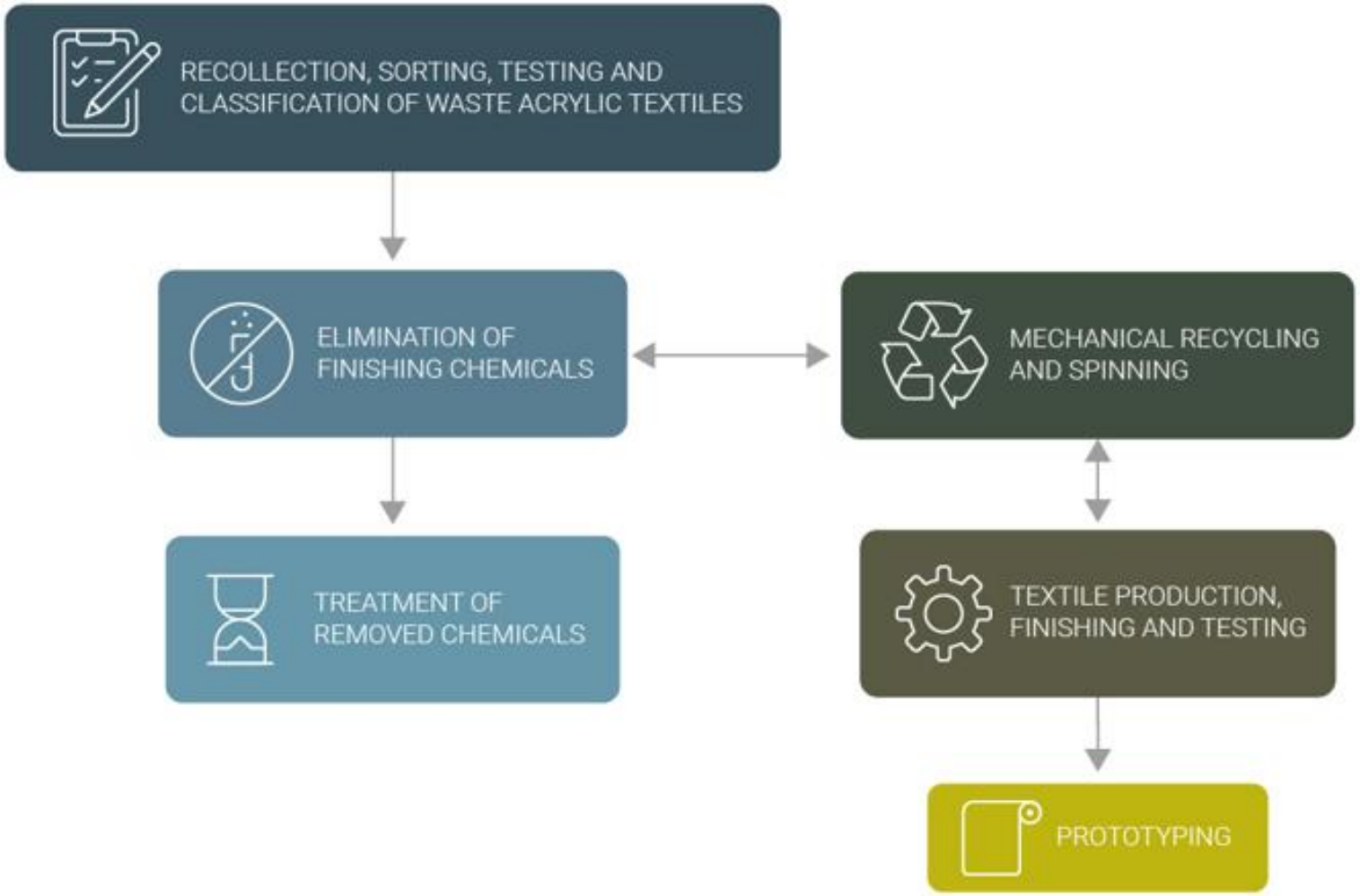
- 11'000 tonnes/year of outdoor acrylic textiles
- 2.5 million awnings installed in Europe

IT IS ESTIMATED THAT EVERY YEAR, IN EUROPE, ABOUT 7'700 TONNES OF ACRYLIC TEXTILE WASTE ARE DISPOSED OF BY LANDFILL OR INCINERATION

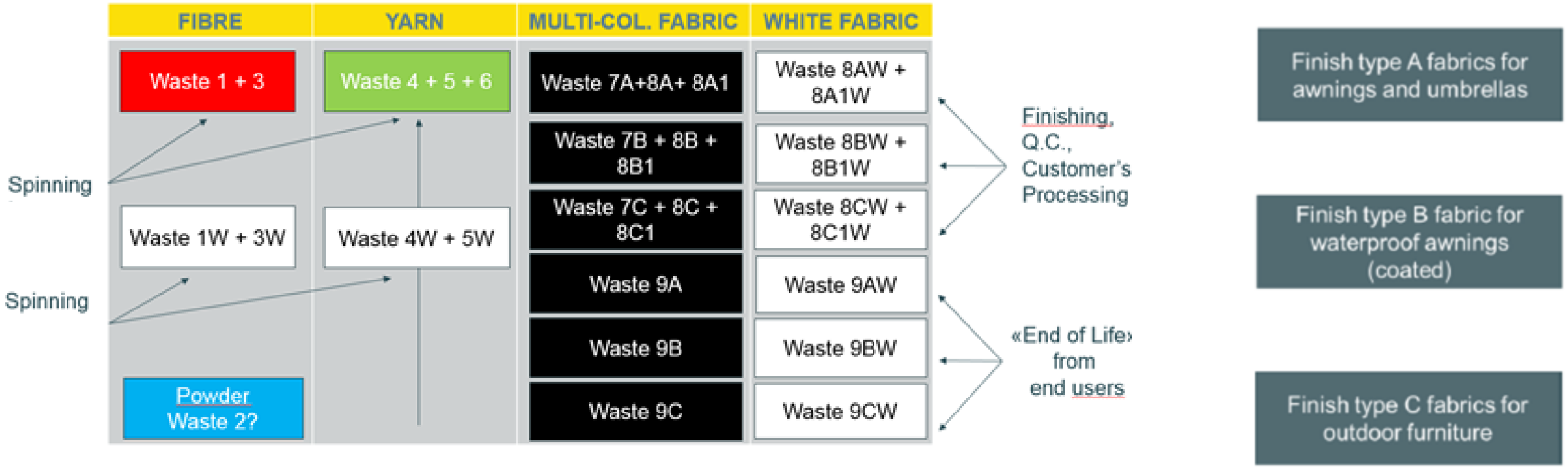
REACT GOAL

- **to reach a removal rate** of **90-95%** of chemicals/substances that prevent their recycling
- to treat up to **99% of all** sewage **impurities** obtained from removal steps
- to obtain a final textile product with yarn coming from **100% recycled fibre**, mixing regenerated fibres from card, winding opened thread and waste material collected fibre, each up to 33%
- to re-use the acrylic textiles as raw material for other production cycles, to reach 30 % **of waste prevented** from disposal **(3.600 tonnes total)** for the outdoor sector (awnings and furnishing)

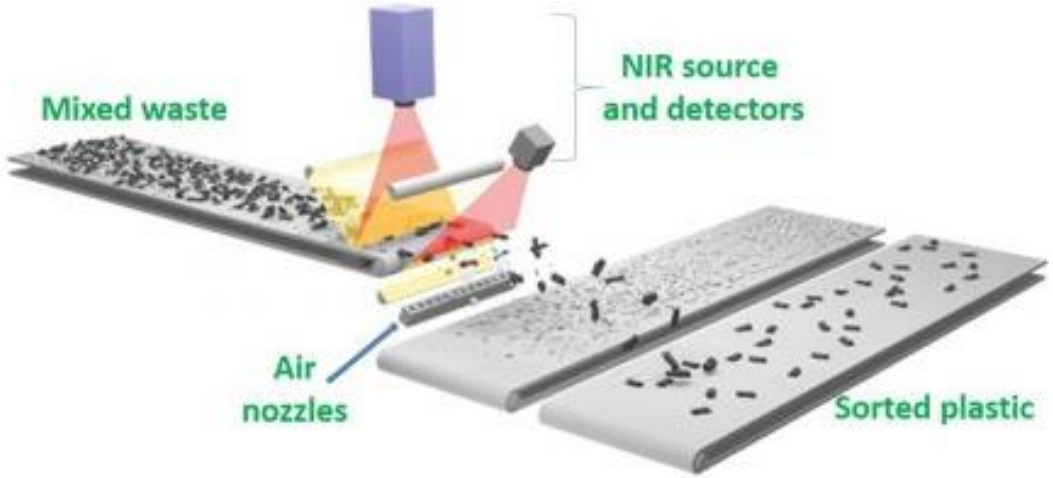
REACT STEPS


RECOLLECTION, SORTING, TESTING AND CLASSIFICATION OF WASTE ACRYLIC TEXTILES
ELIMINATION OF FINISHING CHEMICALS
MECHANICAL RECYCLING AND SPINNING
TREATMENT OF REMOVED CHEMICALS
TEXTILE PRODUCTION, FINISHING AND TESTING
PROTOTYPING

REACT: COLLECTION AND SORTING



REACT: COLLECTION AND SORTING



Fast analysis (~ 1 minute)

Non-destructive

- **Raw fabrics**
- **Pre-consumer fabrics**
  - **Finishing A**
  - **Finishing B**
  - **Finishing C**
- **Post-consumer fabrics**
  - **Finishing A**
  - **Finishing B**
  - **Finishing C**

REACT: REMOVING RESULTS

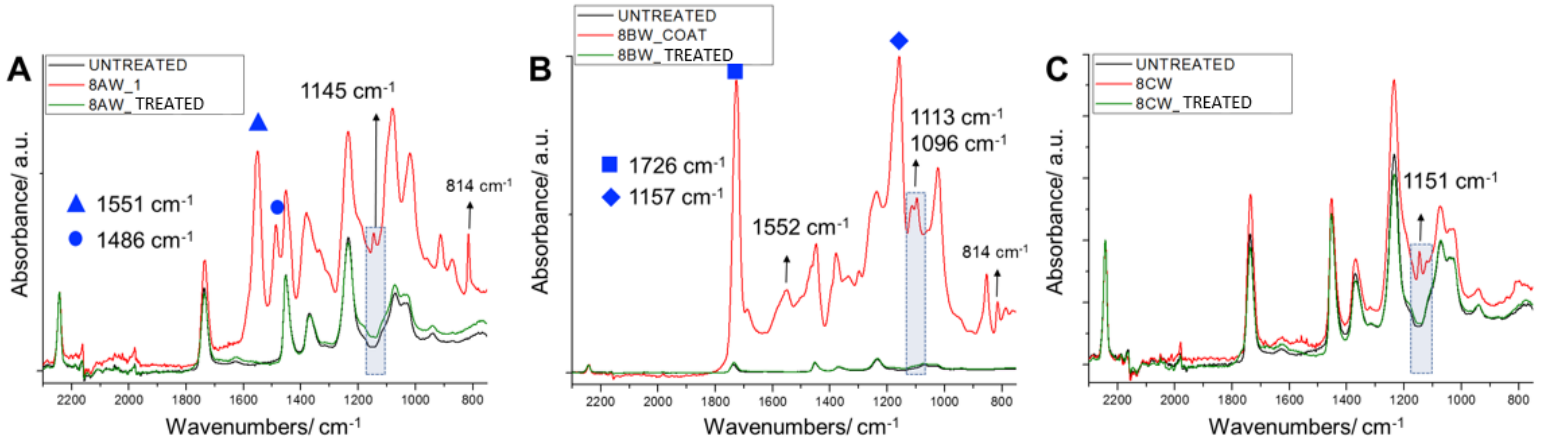
How to remove hazardous chemicals from acrylic fabrics: chemical approach

- Combined chemical-mechanical washing
- Acid hydrolysis
- Alkaline hydrolysis

Chemicals ZDHC certified

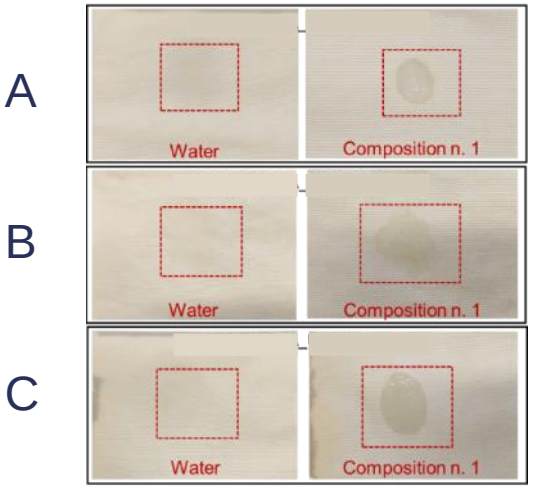
To remove resins **chemical attacks** were investigated, involving wetting and dispersing agents, studying the pH influence.

REACT: REMOVING RESULTS



Sample	Termosetting resin removal [%]	Water-repellent resin removal [%]	Waterproof coating removal [%]	Softener removal [%]
A	98.94	89.86		
B	99.42	99.33	99.24	
C		91.22		100.00

Water and oil repellency



oil repellency according with AATCC 124-2018

Initial oil repellency degree 5

REACT: WASTEWATER TREATMENT

Sludge impurities

Ultrafiltration

Biological

COD after 20 days
370 mg/l

COD reduction 98,6%

Parameters	Analytical value [mg/l]
TSS	76
BOD_5	7993
COD	56300

Parameters	Analytical value [mg/l]
TSS	< 10
BOD_5	6320
COD	27100

COD reduction 52%

99,3%

REACT: SPINNING

Two approaches: Open-end and Ring spinning

Performance yarns:
unfinished fabrics > finished fabrics > EoL fabrics

Increased properties:
mixing recycled fibres with raw materials
at least 30%

		Finished fabrics 60% + raw acrylic 40%	Finished fabrics 70% + raw acrylic 30%	Finished fabrics 50 % + unfinished fabrics 50%
Tensile strength	Average cN	821	734	726
	Min cN	699	510	637
	Max cN	990	876	817
Breaking elongation	%	21.7	20.9	20.9
C.V. strength	%	5.4	8.2	5.0
C.V. breaking elongation	%	4.8	9.0	4.0
Average breaking toughness	cN/tex	13.1	25.5	12.6

100% recycled yarns is possible!

REACT RESULTS

LIFE CYCLE ASSESSMENT

Objective

To evaluate the environmental impact of an outdoor awning made with virgin acrylic textile compared to the same product with a partially recycled textile.

Two product systems developed:

1. Virgin acrylic awning: solution dyed acrylic textile made of virgin fibre.
2. Recycled acrylic awning: the core processes of the textile production account for the mechanical recycling process (from pre-consumer waste) including a chemical removal treatment. The final composition of the acrylic fabric is: 70% recycled, 30% virgin.

Cradle-to-grave study: raw material supply, fabric manufacturing, awning assembly, distribution, use, EoL (all transports included)

LIFE CYCLE ASSESSMENT RESULTS

Outcome from the comparison between the two fabric (1 kg). Cradle-to-gate results.

INDICATOR	COMPARISON
Climate change	
Ozone depletion	
Human tox, non-cancer	
Human tox, cancer	
Particulate matter	
Photoch. Ozone formation	
Ionizing radiation	
Acidification	
Eutrophication freshwater	
Eutrophication marine	
Eutrophication terrestrial	
Ecotox freshwater	
Land use	
Water scarcity	
Resource use, energy carriers	
Resource use, mineral and metal	

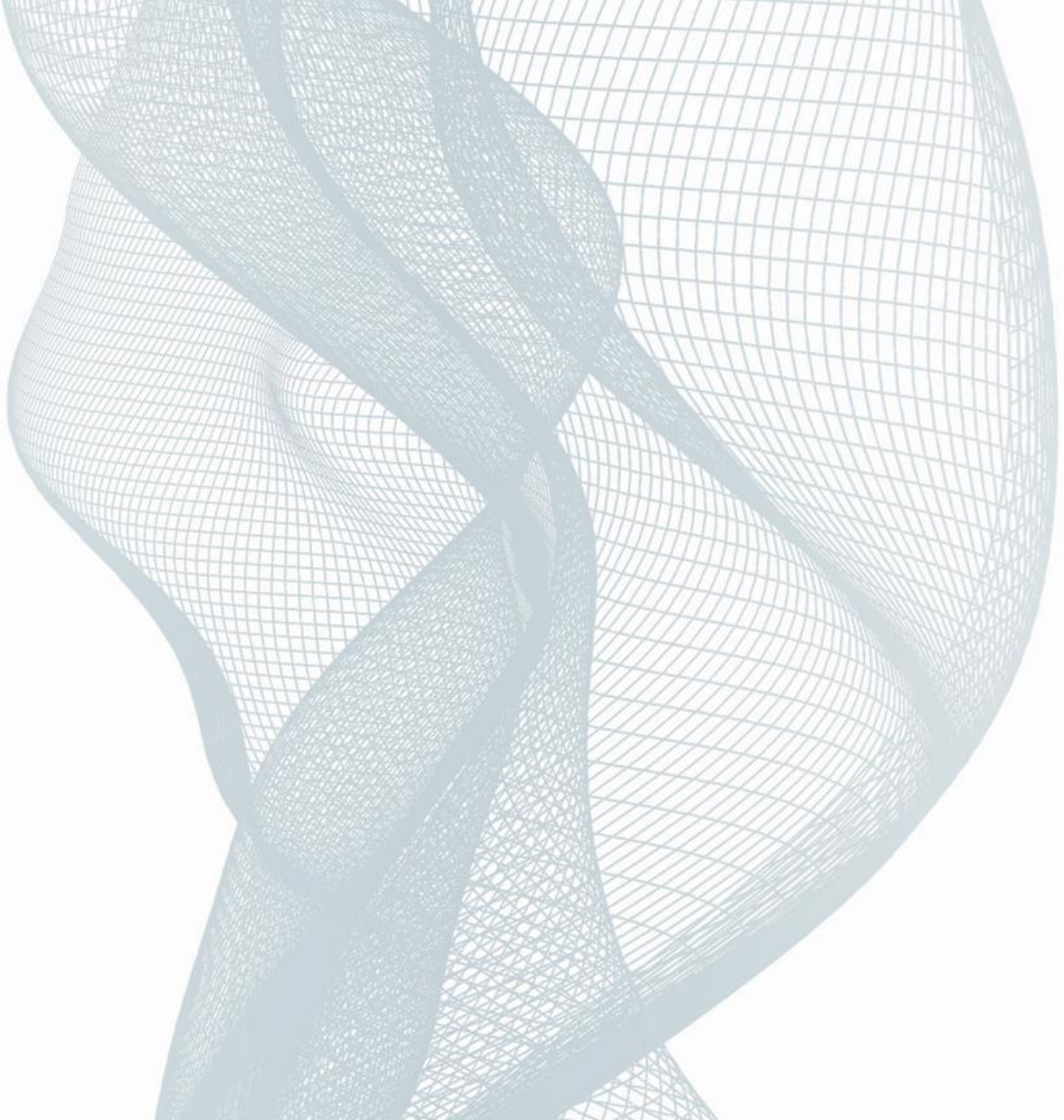
Color key:

- > 15% decrease
- 1% - 15% decrease
- 1% - 15% increase
- > 15% increase

REACT RESULTS

- Increased purity and quality of secondary raw materials
  - Our project aims to a **90% removal of chemicals of the finishing** process
  - The mixing with the virgin regenerated fibre, the final purity of the recycled fibre will reach 90-95%

- Reduced risk of retaining hazardous substances in recycled materials
  - A reduction of hazardous substances in recycled materials
  - Reduction of hazardous substances in landfill



THANK YOU FOR YOUR ATTENTION

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LIFE CYCLE ASSESSMENT RESULTS

INDICATOR	UNIT	FABRIC BASELINE	FABRIC INNOVATION	DIFFERENCE (%)
Climate change	kg CO_2 eq.	1.05E+01	7.62E+00	-27%
Ozone depletion	kg CFC-11 eq.	6.88E-06	2.55E-08	-99.6%
Human tox, non-cancer	CTUh	9.56E-08	9.65E-08	1%
Human tox, cancer	CTUh	2.22E-09	2.67E-09	20%
Particulate matter	Disease incidences	1.30E-07	1.15E-07	-11%
Photoch. Ozone formation	kg NMVOC eq.	2.27E-02	1.64E-02	-28%
Ionizing radiation	kBq U235 eq.	1.38E+00	2.54E+00	84%
Acidification	mol H+ eq.	2.14E-02	1.59E-02	-26%
Eutrophication freshwater	kg P eq.	2.13E-04	3.30E-04	55%
Eutrophication marine	kg N eq.	8.38E-03	6.28E-03	-25%
Eutrophication terrestrial	mol N eq.	8.42E-02	5.98E-02	-29%
Ecotox freshwater	CTUe	7.80E+01	8.48E+01	9%
Land use	Pt	2.33E+01	1.82E+01	-22%
Water scarcity	m^3 world equiv.	1.42E+00	1.13E+00	-20%
Resource use, energy carriers	MJ	2.17E+02	1.92E+02	-11%
Resource use, mineral and metal	kg Sb eq.	5.78E-06	3.95E-06	-32%