New approaches for the valorisation of URBAN bulky waste into high added value RECycled products

URBANREC
FINAL Meeting

5-7th November, 2019
BRUSSELS (Belgium)

WP 3- Pre-treated waste materials validation in industrial manufacturing: PU foam, mixed textile, hard plastics and wood.

WP Leader: Rampf

- **WP3 Objective:**

- Demonstrators manufacturing and validation of foam core layer, foam top layer, adhesives coming from bulky waste materials
- Industrial manufacturing and validation of needlefelts
- Design and manufacturing of foam mattress with recycled materials coming from bulky waste.
- Industrial manufacturing and validation of composites
- To manufacture wood plastic composites (WPC) compounds using bulky recycled hard plastics &wood, and validate industrial manufacturing of WPC products

WP 3.1 Industrial production of secondary polyols for PU formulations (adhesives and foams)

Accomplishments and key results:

Acidolysis

Glycolysis

Secondary polyol production in 160 L scale for…

©Eurospuma.

12 pphp recycled polyol

800 kg

©Fraunhofer ICT.

©Rampf Eco Solutions

50 pphp recycled polyol

©Rescoll

50 pphp recycled polyol

15 kg

Accomplishments and key results:

Leader: Eurospuma – Production of viscoelastic mattresses top layer

Step1: Formulation development in laboratory scale

Raw Material	Formulation
Visco Polyol	79.0 pph
Standard Polyol	8.0 pph
Secondary polyol	12.0 pph
Visco Additive	1.0 pph
Tin Catalyst	0.047 pph
Blowing Agent	0.105 pph
Curing Agent	0.151 pph
Surfactant	0.80 pph
Water (total)	2.16 pph
MDI	48.65 pph
Index	73.3

Step2: Industrial trial:

Production information

Information	Result
Foam Produced	6293 kg
Volume Produced	111.6 m^3
Production Time	18.75 min

Accomplishments and

Leader: Eurospuma – Pro *s top layer*

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Pr

Int

Fo

Vo
Pro

Pro

EUROSPUMA – Sociedade Industrial de Espumas Sintéticas, SA
Rua dos Lagos, 242
4500-423 Guetim – Espinho
Portugal

TECHNICAL DATA SHEET (TDS)

Product: Top Layer – UrbanRec Foam

Characteristics

Type of Foam	Polyether / Viscoelastic Polyurethane
Composition	100% PU
Color	Brownish Cream
Main Usage	Top Layer PUR Foam for Bedding

Physical Properties

	Limits	Unit	Internal Procedure	Based on Standard
Density	52.50 ± 5.00	kg/m³	PL018	ISO 845:2006
Compression Hardness CV 40%	1.60 ± 0.30	kPa	PL056	ISO 3386-1:1986 Amd 1:2010
ILD 40%	60.00 ± 15.00	N	PL022	ISO 2439:2008
Resilience	< 9.00	%	PL024	ISO 8307:2007
Elongation	> 100.00	%	PL035	ISO 1798:2008
Tensile Strength	> 35.00	kPa	PL035	ISO 1798:2008
Compression Set at 75%	< 2.00	%	PL021	ISO 1856:2000 Amd 1:2007
Recovery Time	< 2.00	s	PL064	Internal Reference

Rev. 01

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690103

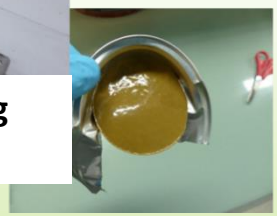
WP 3.1.2 **Adhesives formulation from recovered polyol by solvolysis. Production and validation of adhesives for mattresses application.**

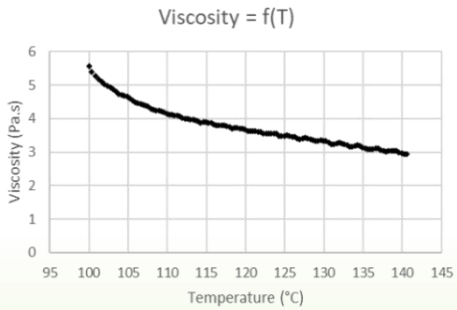
PUR hot-melt adhesive formulation based on secondary polyols

- Shelf-life: at least 9 months
- Softening point: 80 °C
- Curing time: 7 days
- Working T: 120 °C
- T_m: 53 °C / T_g: ´-30 °C

	Hot Melt PSA	Hot-Melt PUR (polyester polyol + recycled polyol)(2)	Hot-Melt PUR (polyester polyol + polyether polyol + recycled polyol) (3)
Peel Strength (on NWT/rigid foam)	CF 0,8 N/cm	SF 0,7 ± 0,3 N/cm	SF 1,4 ± 0,2 N/cm
Peel Strength (on NWT/viscoelastic foam)	CF 1,25 N/cm	SF 3 ± 1 N/cm	SF 3,7 ± 0,4 N/cm

Scale up to 10 kg batch



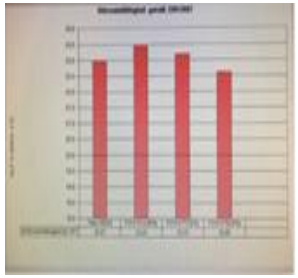
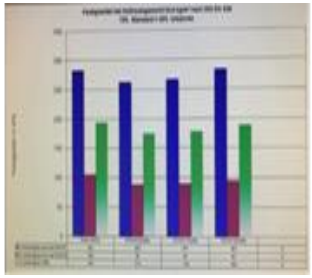
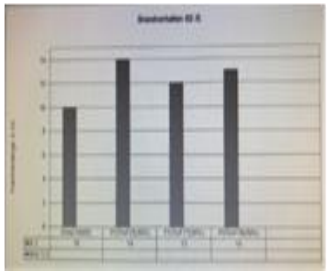


Selected formulation

Raw Material	Formulation (g)
Polyether + polyester polyol	400
Recycpol	400
MDI	250

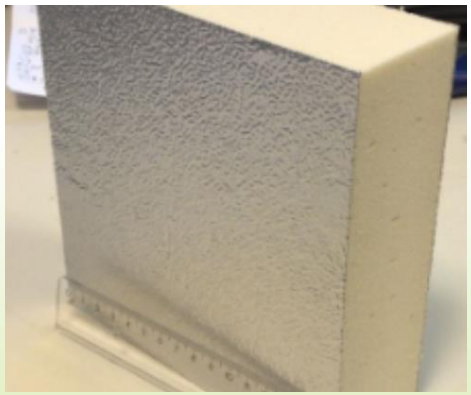
Accomplishments and key results:

Insulation panel based on secondary polyol

	Petol 240	Petol 240 / Urb F78 70/30
Heat conductivity mW/(m*K)	22,97	22,6
Strength / kPa	194	189

heat conductivity	0,0217	W/mK
compression strength	250	kPa
burning test B2	13,5	cm



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Accomplishments and key results:

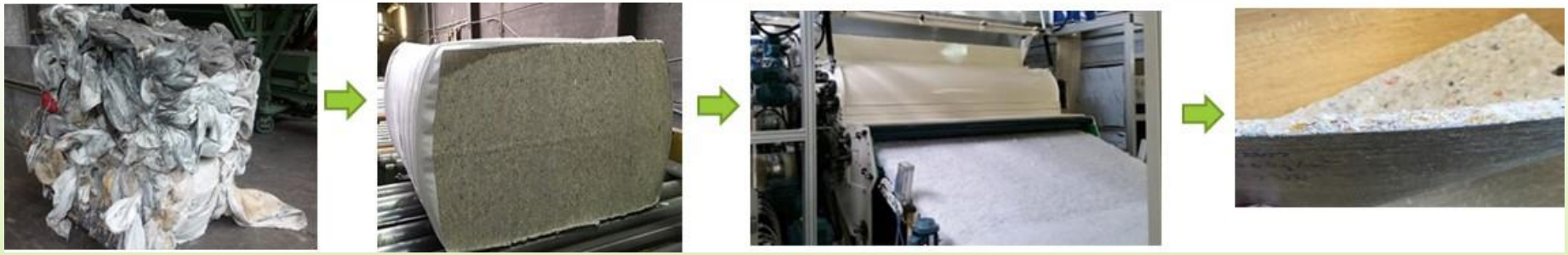
Mattress textile waste were directly processed to obtain long fiber suitable for nonwoven applications

2 textile streams were mainly tested:

- Textile waste coming from Delax partner (mattress producer)
- Textile stream coming from sorting center (Vanheede)

Several nonwoven processes and fiber mixture were evaluated

These nonwovens were subsequently reprocessed to produce the final product: principally insulation panels:



Accomplishments and key results:

Leader: Procotex

Below some examples of samples prepared to prospect the market

Evaluation of all nonwoven samples were made

- Heat conductivity
- Flammability
- Accoustic absorption

@Procotex, Insulation panel

@Procotex, Insulation panel during heat and humidity test

Accomplishments and key results: 92% recycled bulky waste

Visco Soft Layer

©Eurospuma.

©Fraunhofer ICT.

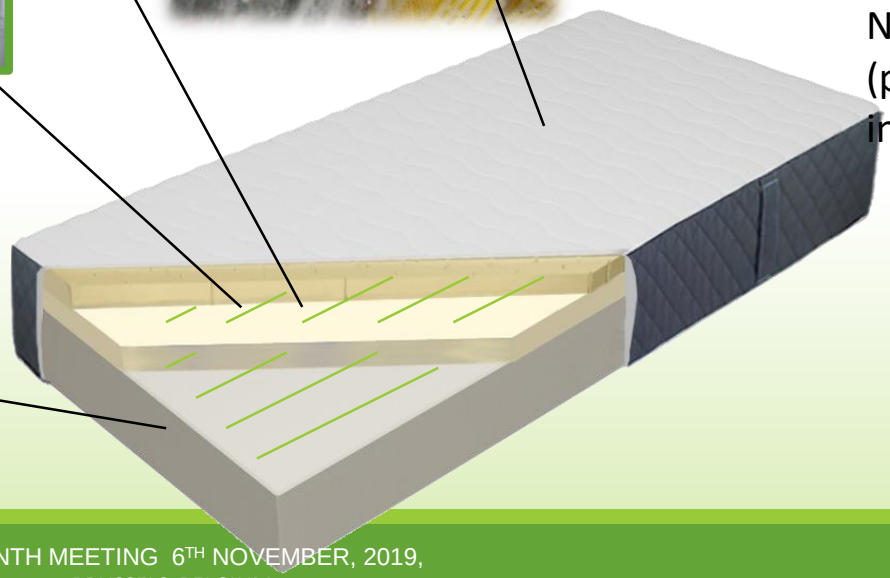
©Rescoll

Polyol Recycled

Hot Melt Adhesive

Rebound PUR

Needlefelt (post industrial)



Achievements checklist

Property	objective	done
Density	25-50	OK
Resilience	10% less than Virgin	OK
Fatigue resistance	10% less than Virgin	Better than virgin
Biohazards Microbio	Not contaminated	OK
Biohazards Chemicals	REACH & OEKOTEX compliance	OK, still in progress
Biomechanical Comfort	10% less than Virgin	OK
Thermal Comfort	10% less than Virgin	OK
Rolling possibilities	standards	Not achieved yet

WP 3.4 Industrial manufacturing and validation of short fibre reinforced PP composites

Filler

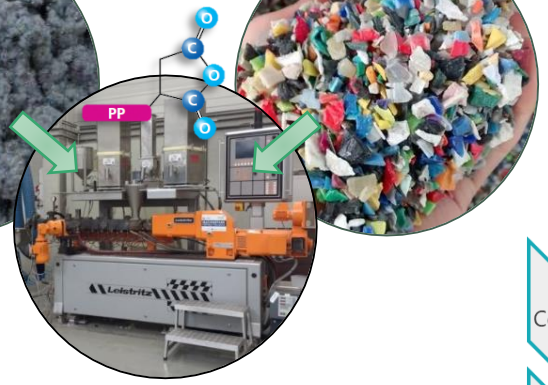
Bulky textile waste:
Carpets, mattress textiles, post-producer textile scraps

Material types
- PI natural and synthetic fibres
- PC mattress PES/cotton blends (fraction of PA, wool and PU foam)

Material requirements
- Large knitted or woven fabrics
- No laminated or glued parts
- No hard pieces (wood, metal, plastic)

Process
- Cutting
- Milling to 1-5 mm

procotex SA CORPORATION NV



Compounding

Pilot scale fibre feeding
= challenging due to the low bulk density of textile fibres

Solution 1: specialized feeder with agitator to prevent fibre bridging

Solution 2: compactor to press fibres into better dosable pellets

Solution 3: under water pelletizer allows higher fibre concentrations

CENTEX BEL

Matrix

Bulky plastics waste:
Garden furniture, crates, boxes, buckets, toys, etc.

Collection
- Mixed rigid plastics
- Contaminants: wood, metals, stones, etc.

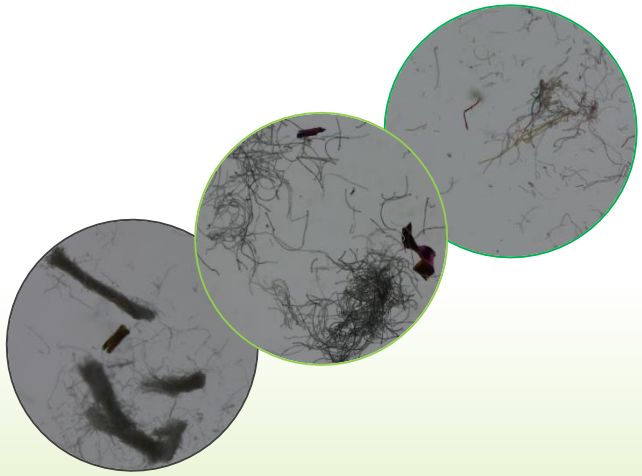
Clean-up 1
- Sorting, metal removal, melt filtration
- 71% PO materials (PP/PE blend)

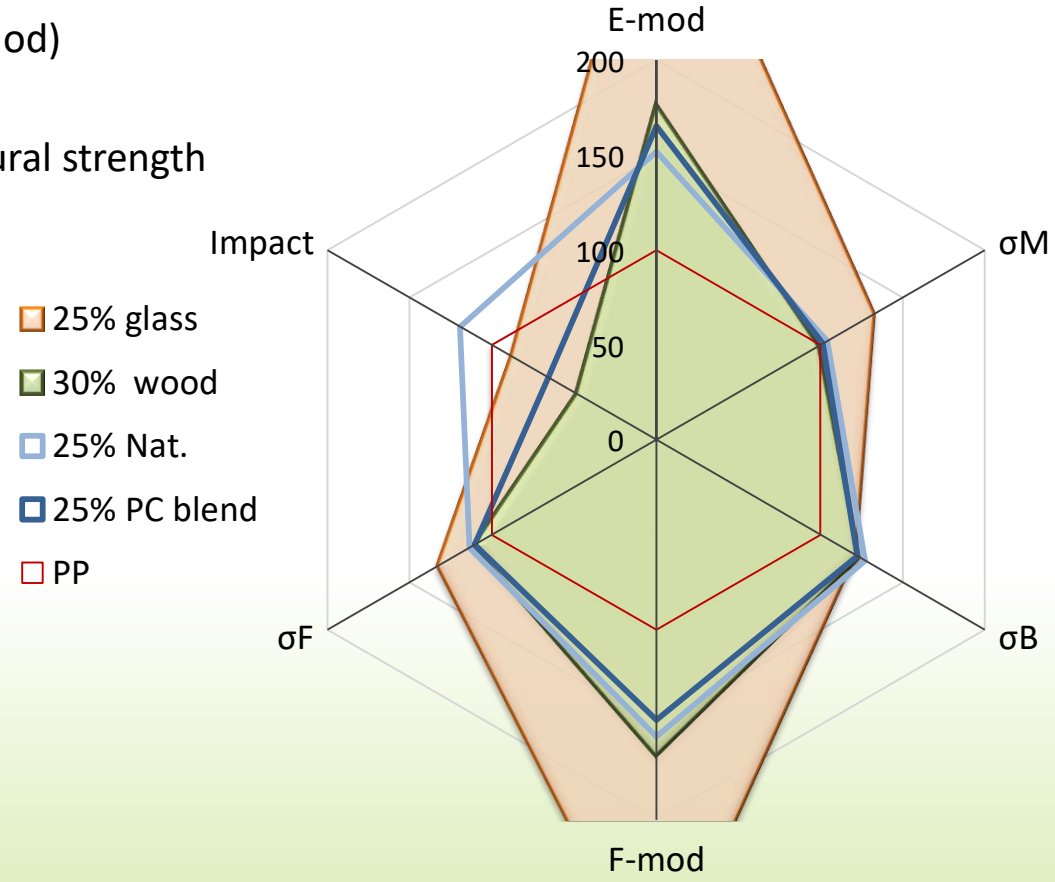
Clean-up 2
- Further sorting
- 98% pure PP

VANHEEDE.COM ENVIRONMENT GROUP

Accomplishments and key results:

- Final properties depend on fibre type, length, morphology…
- Generally: higher stiffness (E- and F-mod)
- Adding suitable compatibilizer
  ➔improved tensile, fracture and flexural strength





Accomplishments and key results:

- Final properties depend on fibre type, length, morphology…
- Generally: higher stiffness (E- and F-mod)
- Adding suitable compatibilizer
  ➔improved tensile, fracture and flexural strength
- Several demonstrators were produced:
  no major adaptations in processing conditions required

➔ Short textile fibres, unsuitable for textile applications, can be applied as plastic reinforcement

Accomplishments and key results: Task 3.5

- **Industrial demonstrations for WPC compounding**

WPC compounds

Parameters Studied:

- Processing temperature
- Polymer concentration
- Wood fiber concentration
- Compatibilizer concentration

Accomplishments and key results: Task 3.5

Industrial Product Trials: 1

Furniture Legs

Industrial Product Trials: 2

Crate (Boxes)

Accomplishments and key results: Task 3.5

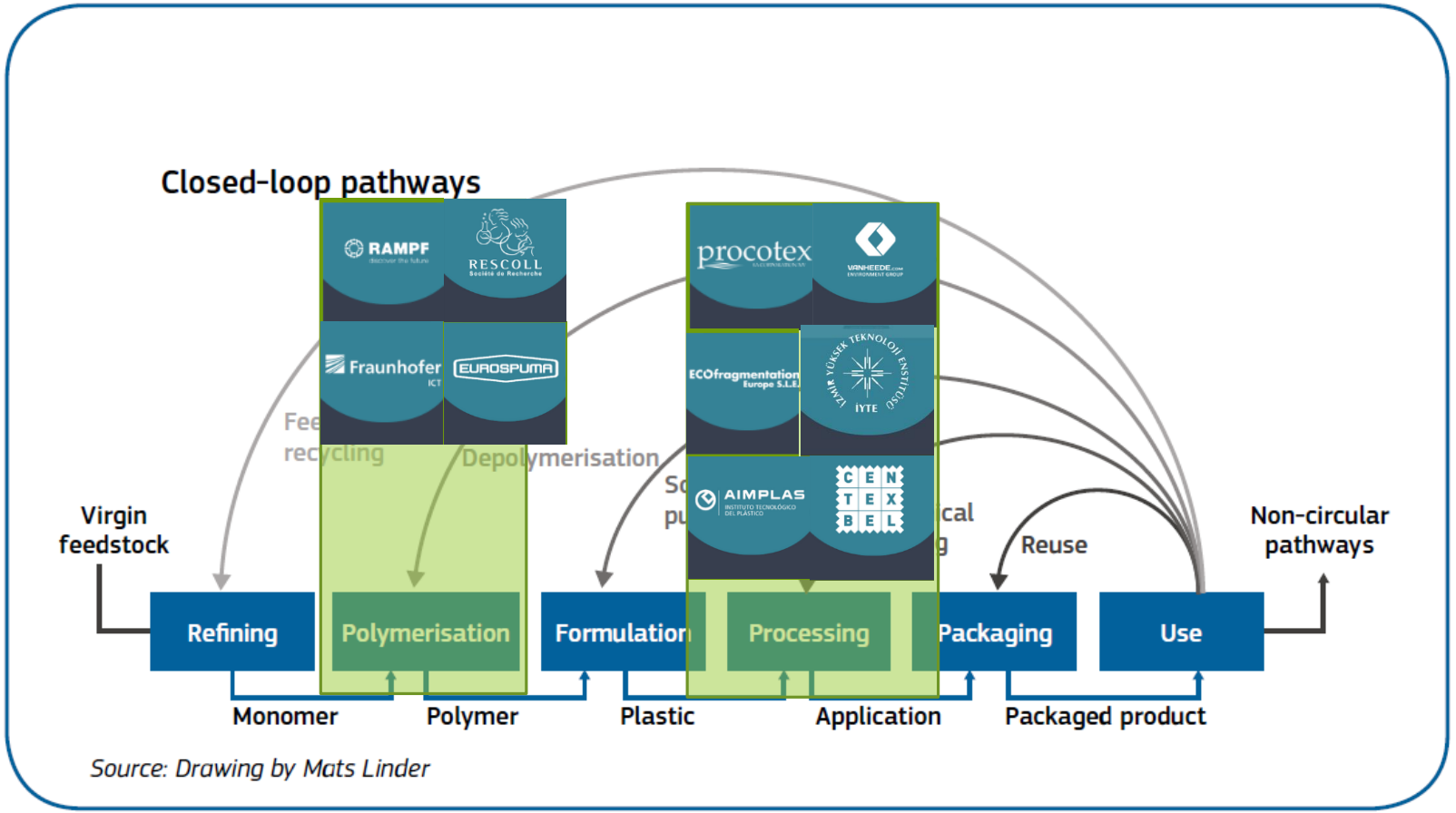
Industrial Production and Validation -WPC

Technical Properties:

Mechanical Properties	WPC URBANREC	WPC MARKET
Tensile Strenght (MPa)	25	10-36
Tensile Modulus (MPa)	1900	2000-2750
Impact Resistance (J/m)	31	12-36
Environmental Resistance Properties		
Water Absorption (%)	=<1	=<1
Size change (swelling) (%)	<0.5	<0.5
Price:	545 Euro	800-2700 Euro/tone

- Comparison of the specifications of the WPC products developed in the project with the specifications in the WPC market

Contribution of Urbanrec of different recycling loops for plastics in a circular economy



Source: A CIRCULAR ECONOMY FOR PLASTICS - Insights from research and innovation to inform policy and funding decisions, p. 141.

Thank you for your attention