Recycling of mixed plastics and polymer blends: challenges and possibilities

Green Chemistry & White Biotechnology - (Bio-)Polymers and Ecocircularity:
From Challenges to Opportunities

Technical and Scientific Textile Centre

CENTEXBEL

Centexbel

Technical and Scientific Textile Centre

independent and objective advice, research and testing

the expertise of 180 highly educated collaborators

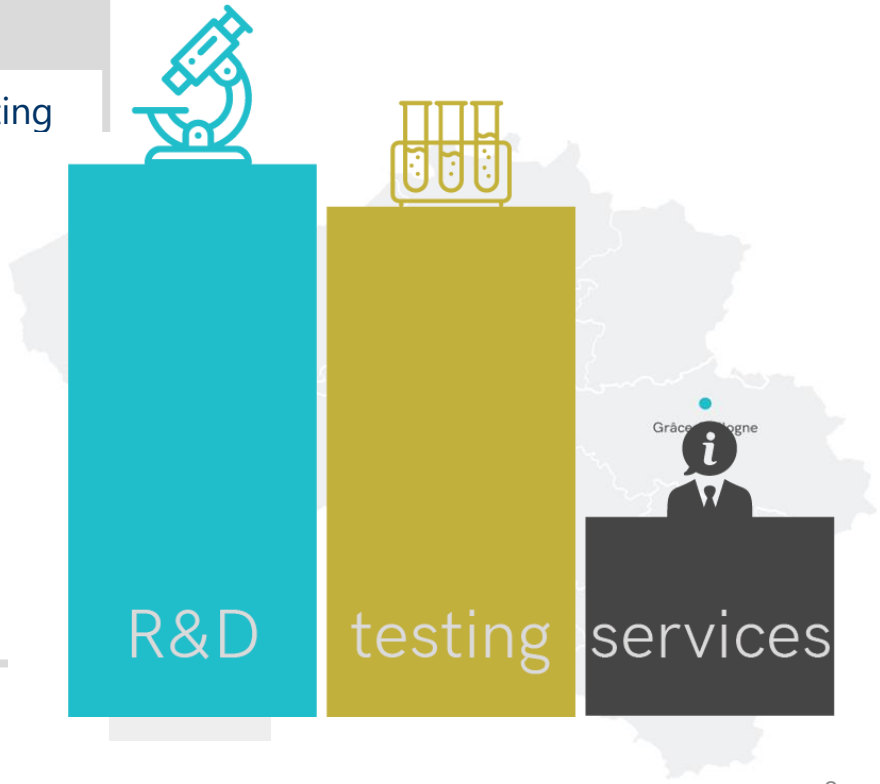
transsectorial and international networking

focus on sustainable development

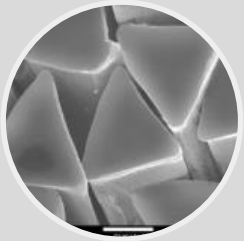
practice-oriented support

partnership

an open approach

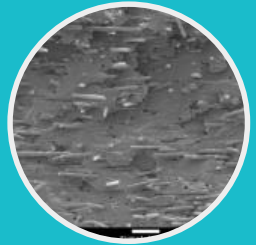


R&D



Functional thermoplastic textiles

- Meltprocessing of polymers in textiles and composites

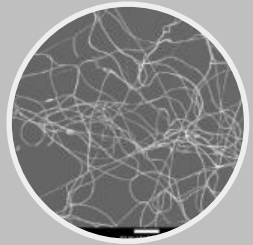


Plastic processing

- Material characterisation
- Plastic processing technologies
- Recycling

Textile functionalisation and surface modification

- Coating, finishing and surface modification for new and superior functional performances



Health, safety and security

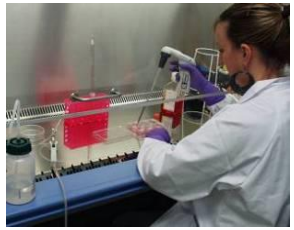
- Textile products for health, safety and security purposes

Testing

BELAC
056-TEST
056-PROD

ISO 17025 Accredited Laboratories

fire	physical	chemical	microbiological
FR - properties	abrasion	permeation	barrier properties
flame propagation	color fastness	heavy metals	cleanroom
fumes	anti-static	emission	anti-microbial
smoke density …	waterproof …	fibre identification …	cytotoxicity …



Certification and Services

certification

PPE

Toys

Carpet

Coaches

floor- and wall coverings

CE

textiles and
harmful substances

sustainable production processes

recycling

CONFIDENCE IN TEXTILES
Tested for harmful substances
according to Oeko-Tex® Standard 100
00000000 Centexbel

GUT
CARPETS TESTED FOR A BETTER LIVING ENVIRONMENT

services

consultancy

training

standardisation and legislation

patent support

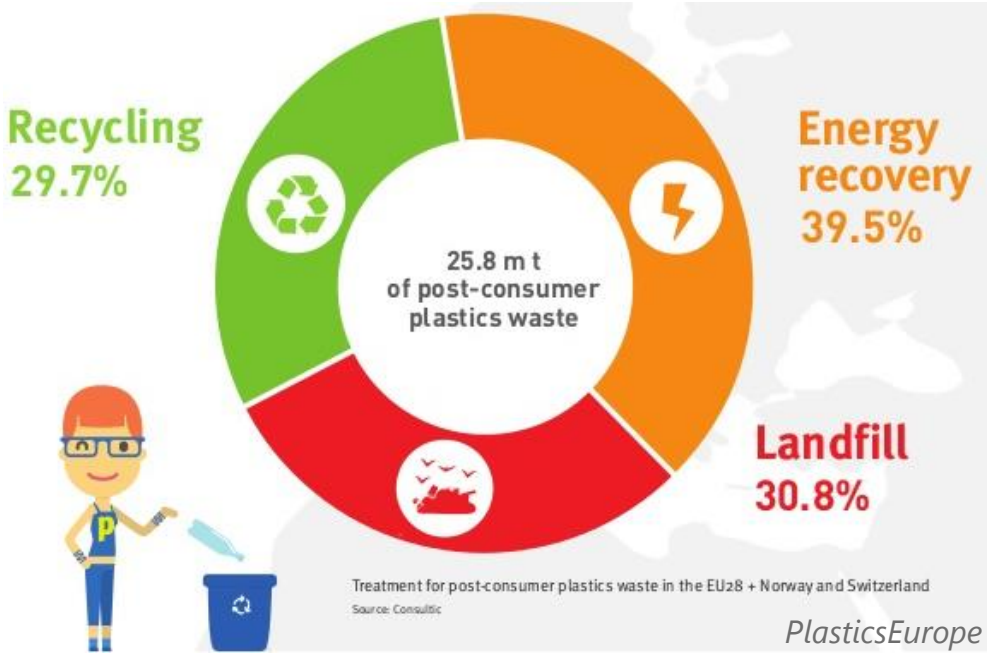
publications – website –
brochures – social media - …

facebook

LinkedIn

PLASTICS IN A CIRCULAR ECONOMY

Plastics waste in Europe

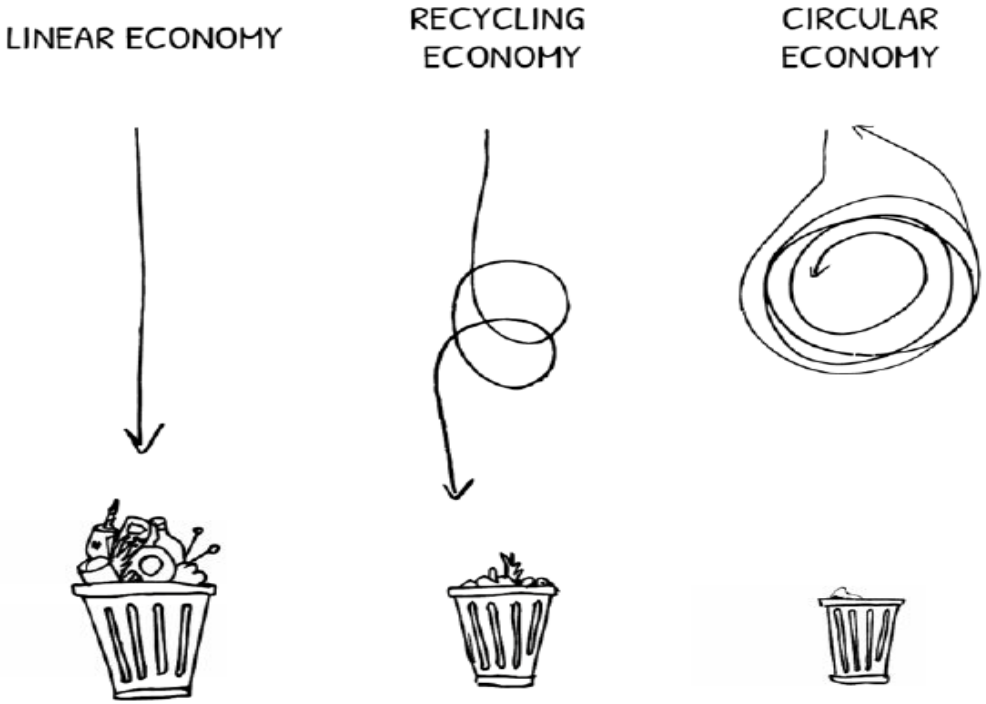


PlasticsEurope

Highest recycling rate for **plastic packaging** (39.5%)

➔ Represented >80% of total recycled quantities

From linear to circular economy



Plastics recycling

- Emphasis on sustainable manufacturing
  - ecologically responsible use of raw materials
  - re-use of plastic waste
- Increasing demand for high quality recyclates

➔Pure post-industrial polymer waste recycling is already maximized

Challenges and possibilities

RECYCLING OF MIXED PLASTICS AND POLYMER BLENDS

Case 1: polyester recycling

Reclaimed post-consumer packaging

➔ ↑high value, ↑availability, ↓cost, easy to recycle

➔ R-PET from colourless bottle waste for textile app.s

Multifilament extrusion = feasible with

= processing parameters as v-PET

≈ mechanical properties

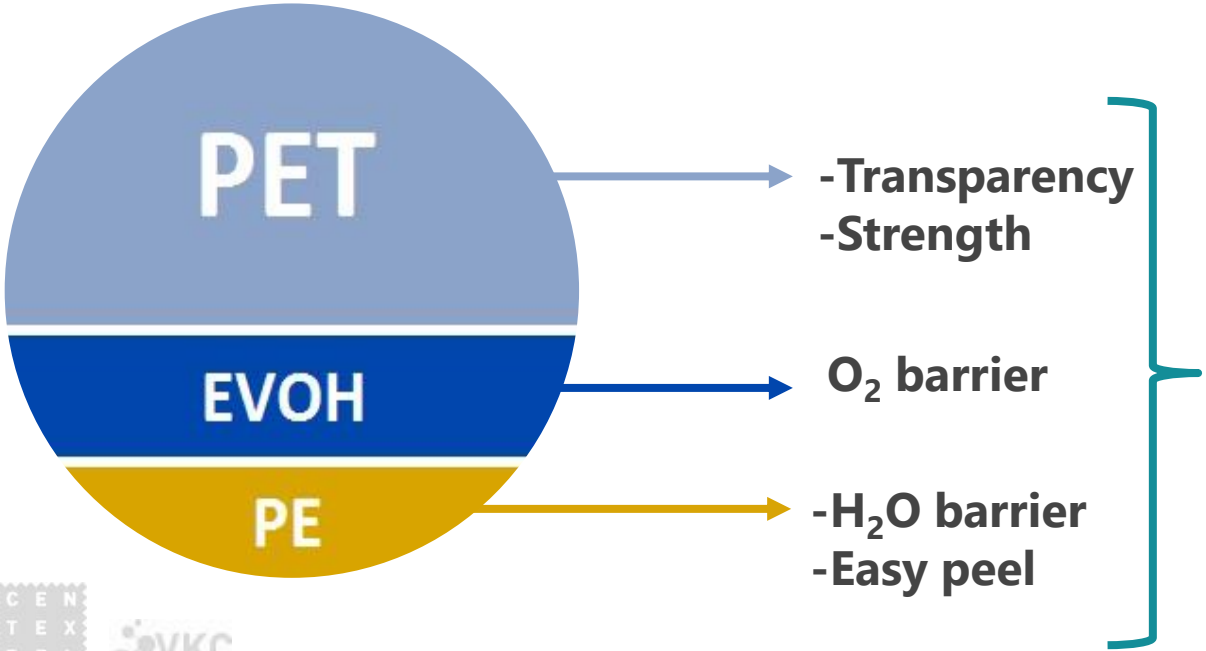
Plastic recycling

- Plastic waste = mix of different polymers
- Incompatible polymers: immiscible
  - inferior mechanical properties
  - not suited for high-quality products

➔UNRECYCLABLE ???

Case 2: PET-PE packaging

Multilayer sheet



Excellent food packaging

Case 2: PET-PE packaging

Multifilament extrusion trials

- adaptation processing parameters
- only small bobbin
- with very low mechanical properties

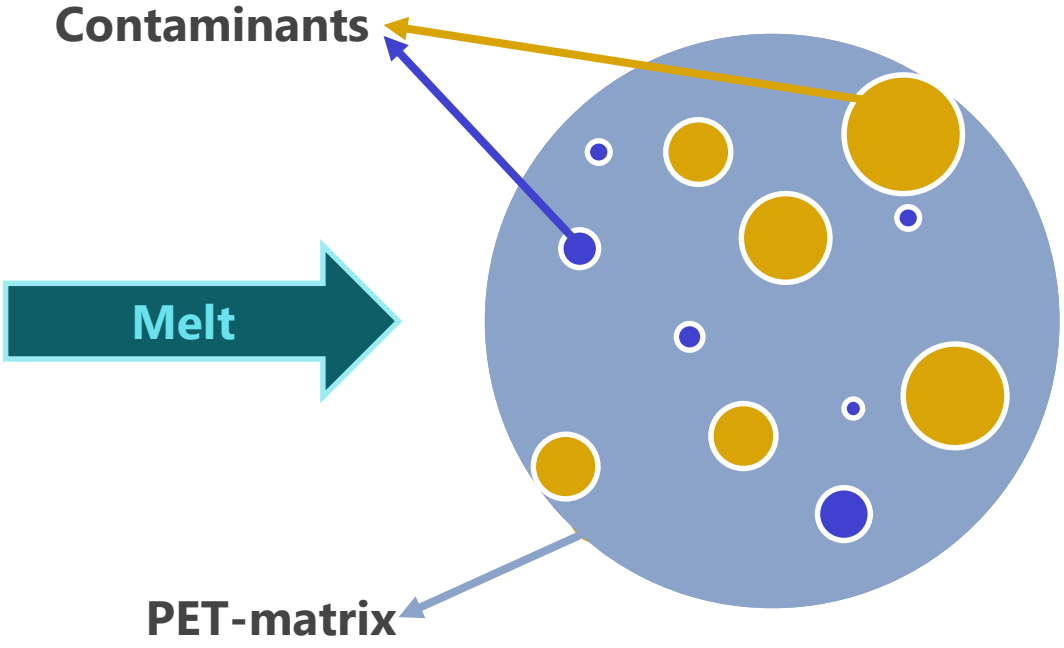
➔no industrial relevance

➔Unrecyclable ?

Case 2: PET-PE packaging

Multilayer sheet

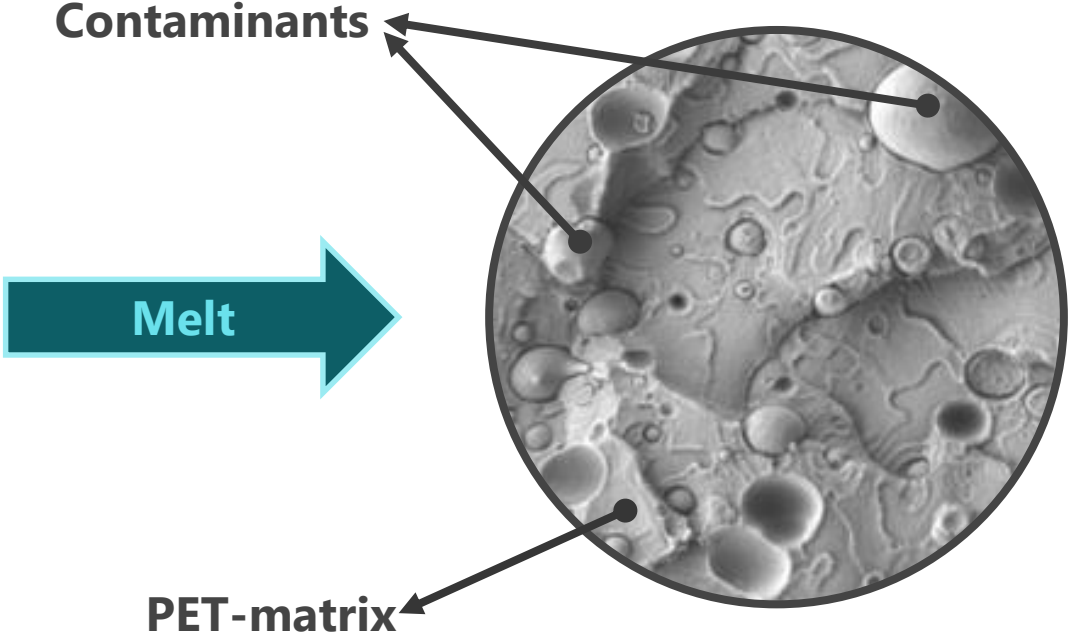
Melt



Case 2: PET-PE packaging

Multilayer sheet

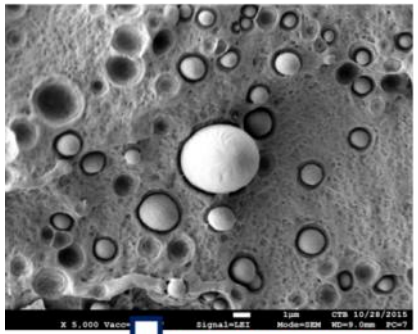
Melt

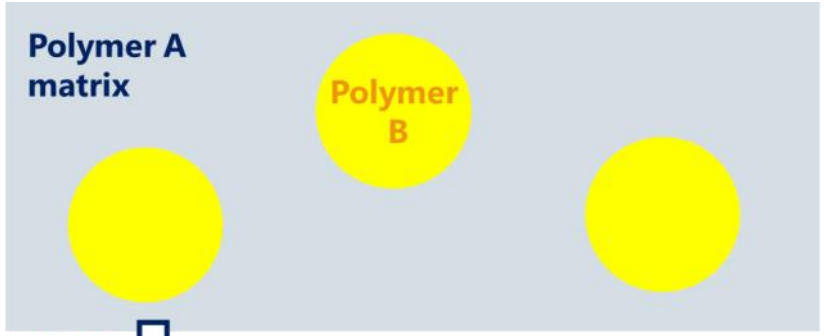


Case 2: PET-PE packaging

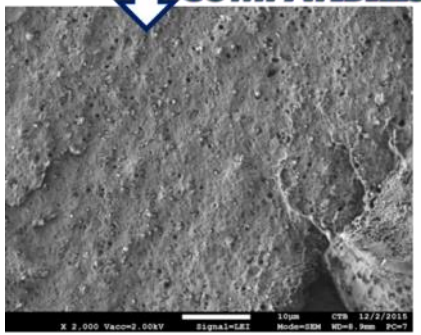
Unrecyclable?

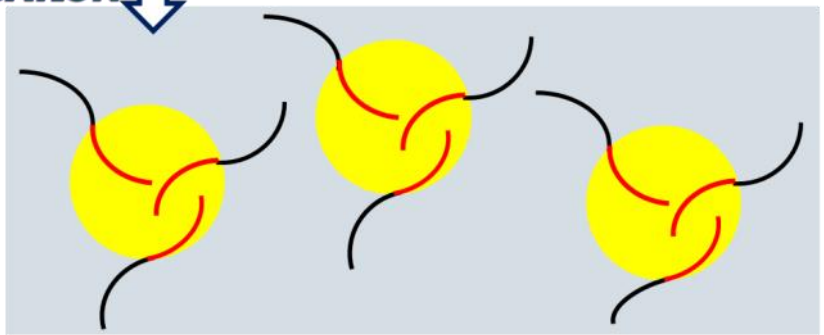
➔Use of compatibilisers





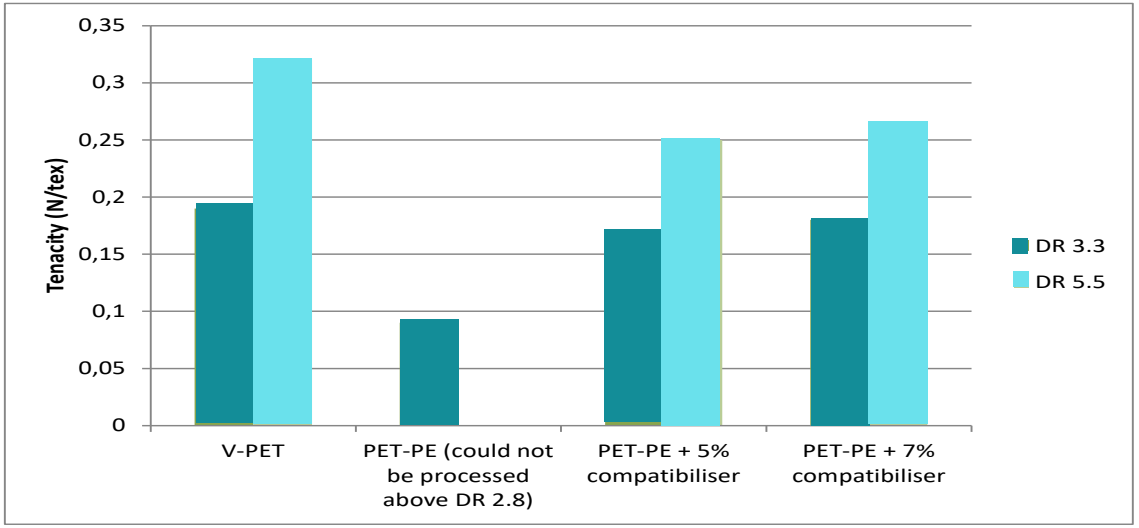
COMPATIBILISATION





Case 2: PET-PE packaging

With compatibiliser → increase in tenacity, comparable to virgin PET



Case 2: PET-PE packaging – part 2

ReFOIL

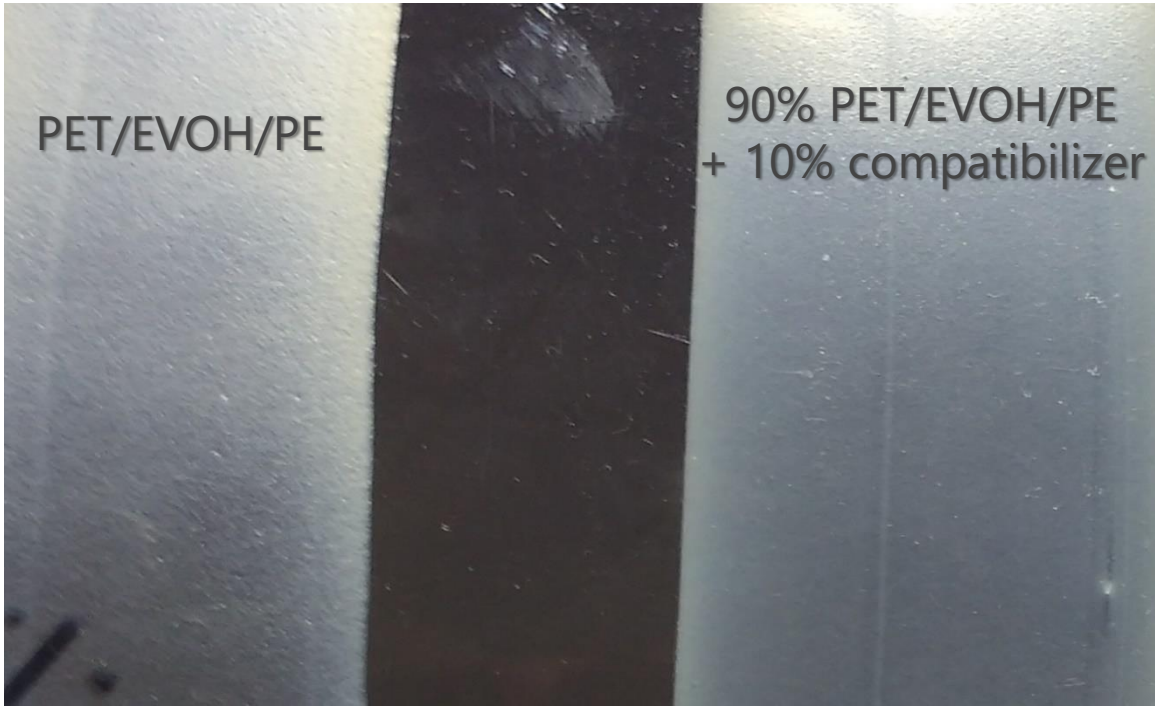
Reusable bag
Mono/multifilament extrusion

Collapsible crate
Injection moulding

Case 2: PET-PE packaging

Tape extrusion trials

Tape extrusion
= feasible
➔Less critical
process

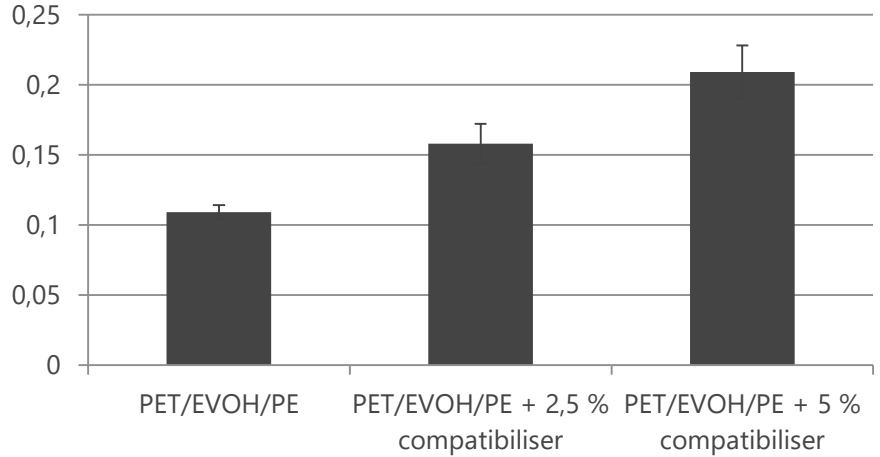


But with
compatibilizer:

- Easier processing
- Smoother tapes
- ↑ Draw ratio
- ↑ Strength

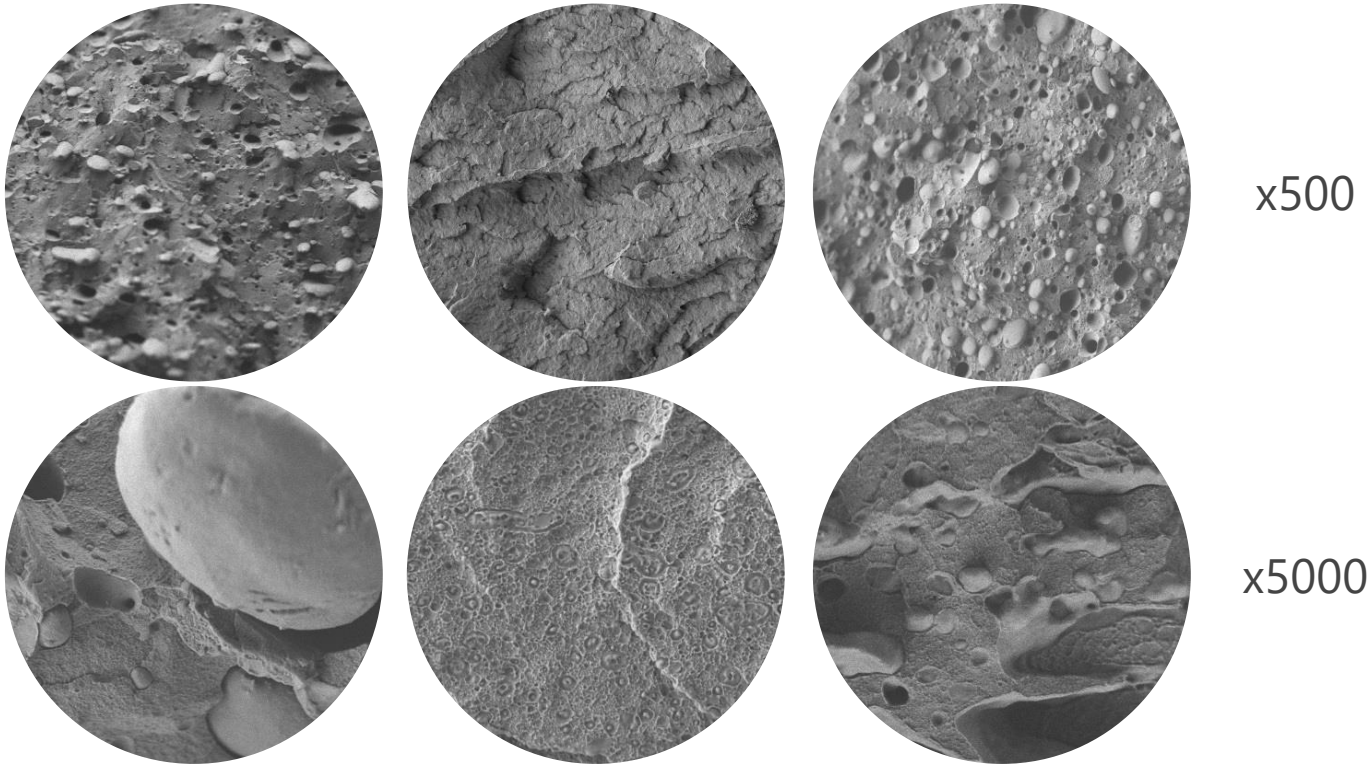
Case 2: PET-PE packaging

With compatibiliser
→ increase in tenacity



Case 2: PET-PE packaging

100% PET/PE + 10% comp 01 + 10% comp02

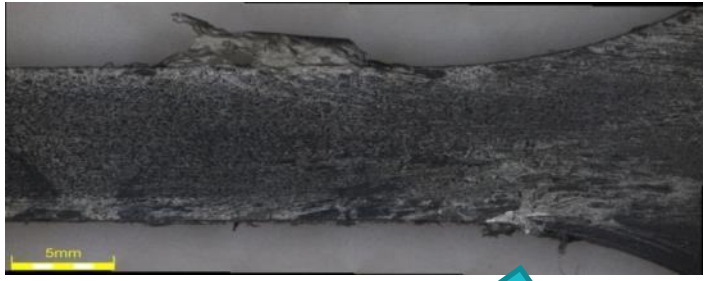


x500

x5000

Case 3: PP-PET carpet waste

Sample	MFR_{mean} [g/10’]
PP-PET waste	195,46
PP-PET waste + 10% comp	53,05



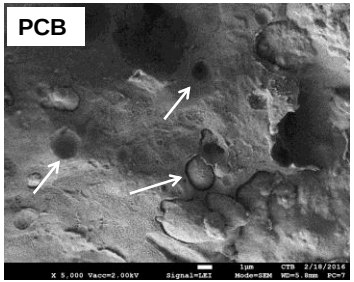
Compatibilisation

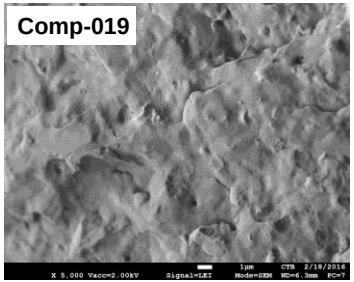
Case 4: PP-PET post-consumer

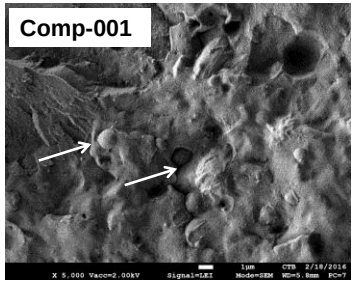
Plast - i - com

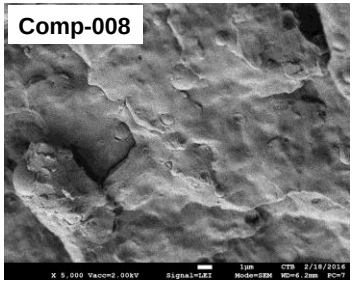
Compatibilisation

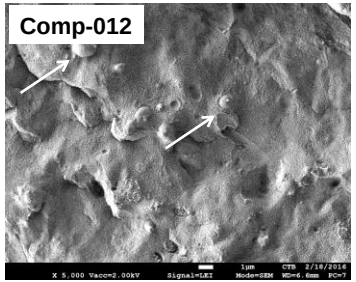
- ↓Young's modulus
- ↑ Strength,
- ↑ ↑ Elongation







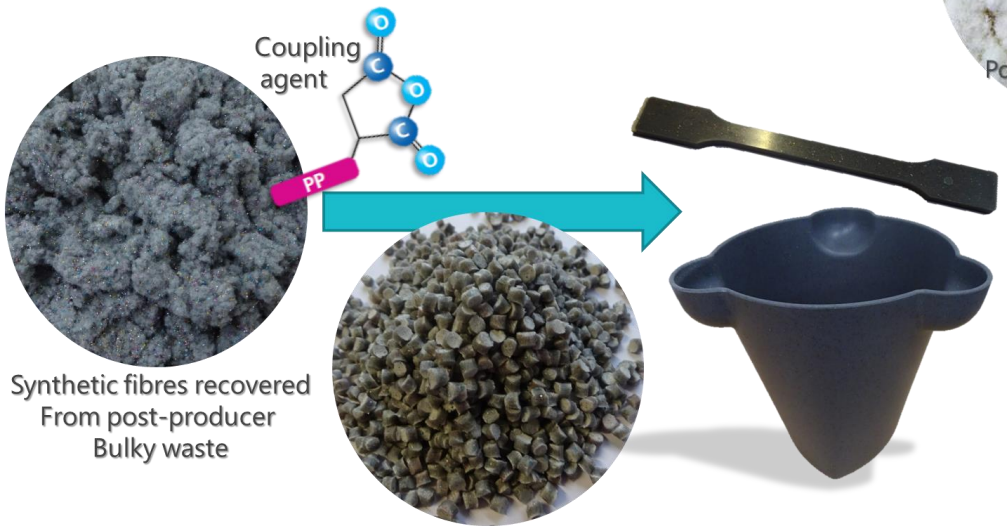


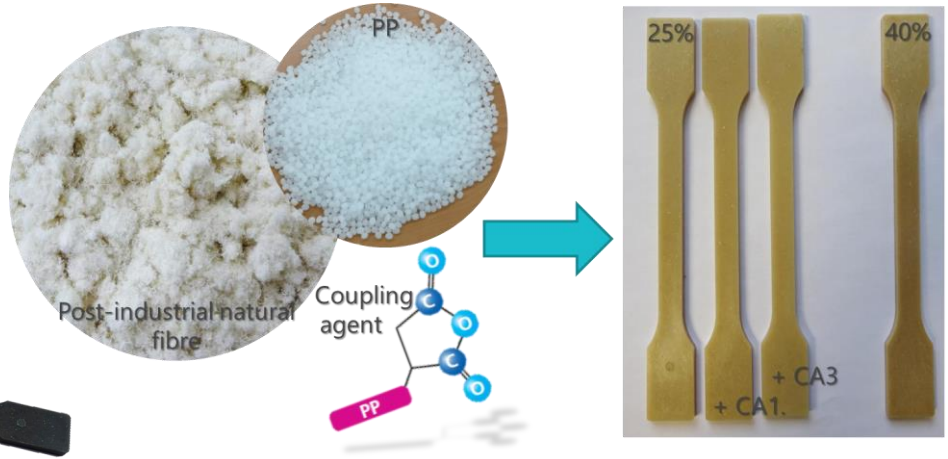


Material	Et (Mpa)	σ_{max} (Mpa)	ε_{max} (%)	σ_B (Mpa)	ε_B (%)
Post-consumer blend	**1568** ± 15	**21** ± 0	**3** ± 0	**19** ± 0	**9** ± 2
PCB + comp-019	**1251** ± 16	**23** ± 0	**7** ± 0	**22** ± 1	**11** ± 2
PCB + comp-001	**1550** ± 8	**24** ± 0	**3** ± 0	**22** ± 0	**6** ± 1
PCB + comp-008	**1395** ± 7	**25** ± 0	**6** ± 0	**24** ± 1	**10** ± 1
PCB + comp-012	**1281** ± 15	**24** ± 0	**7** ± 0	**23** ± 1	**10** ± 1

Case 5: Textile reinforcement

Short fibre reinforced composites





- ↑ Stiffness
- Influence of fibre type
- + Compatibilizer
  ➔ ↑ Strength

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URBAN ReC BULKY WASTE MANAGEMENT

Make the impossible possible

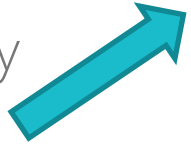
CONCLUSIONS

Conclusions

- Recovery & recycling of mixed polymers = limited, yet there are solutions

- Challenges
  - Collection & sorting
  - Consolidation of streams to reach critical volumes of consistent quality
  - Variety of materials (not all plastics)
  - Application development
  - REACH compliancy

DeCOAT



CREATOR

REMADYL

Questions? ➔Come visit our booth!

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