

Borealis – Best practice in the Circular Economy

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BOREALIS

بروج

Borouge



Borealis advances circular economy solutions by leveraging on unique combination of virgin polymer and recycling know-how

Borealis pledged to more than quadruple its recycled plastics volumes by 2025

Strong engagement in new recycling technologies

Borceed™
plastomers and elastomers

Special compounding know-how

Product and quality consistency

Proprietary **Borstar®**
multimodal technology

Own mechanical recycling assets (mtm, Ecoplast)

Focus on product safety

Borstar® Nucleation Technology

EverMinds™

Thinking Circular

10 Codes of Conduct



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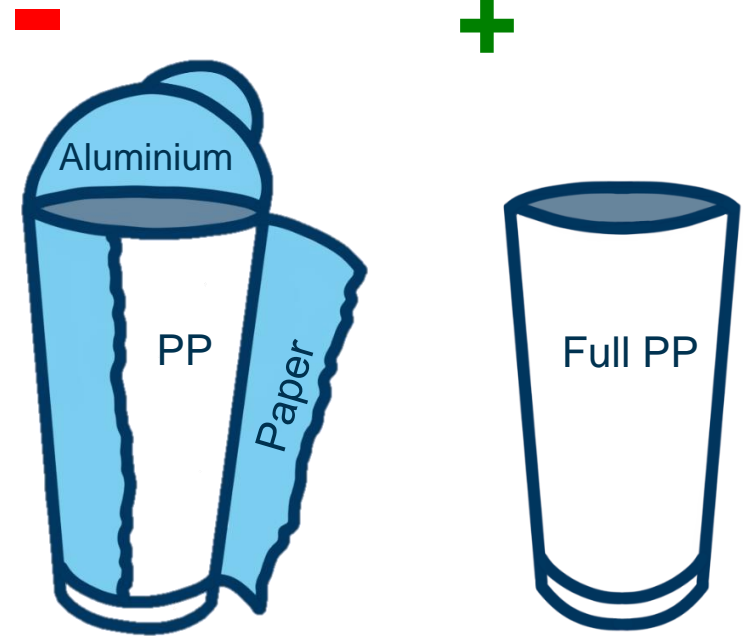
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1. Use PE or PP whenever possible to form a flexible or rigid packaging body

Mono-materials are more easily recyclable than multi-material packaging. Generally speaking, the most efficient and widespread collection, sorting and recycling systems are currently in place for **PE, PP and PET**. While collection and sorting systems for other plastics do exist in certain regions, they are not yet available on an industrial scale.



multi-material

mono-material

4. Use compatible and separable combinations of polymer types, barrier layers, dyes and adhesives

Minimising incompatibilities produces a recycle with better properties and therefore more suitable for a second life in consumer goods packaging. We recognise that in certain cases there are markets where incompatible resins are necessary to match an application's requirements. For these types of packaging it is necessary to design the packaging so that it can easily be **separated from the PE and PP recycling streams during the washing process** (owing to the difference in densities).



- PVC (main body)
- PVDC
- PET-layers
- PA
- Paper
- PET non-bottle main-body
- PS (main body)
- EPS (main body)
- Silicone



- EVOH
- AlOx
- SiOx
- Metallisation
- Ties
- PE
- PP
- PET (bev.-bottles)

6. Follow specific density guidelines when selecting pack components, including labels, sleeves and metallisation

In the recycling process **polyolefins are sorted by density** in a water-based float sink system. This cleanly separates waste streams according to polymer types, such as PE, PP or PET. However, if barrier layers, foaming agents or fillers are used, they change the density of the polymers and this may lead to incorrect sorting. As the type of labels used also affects density, labels and sleeves should ideally be removable and separable by density.

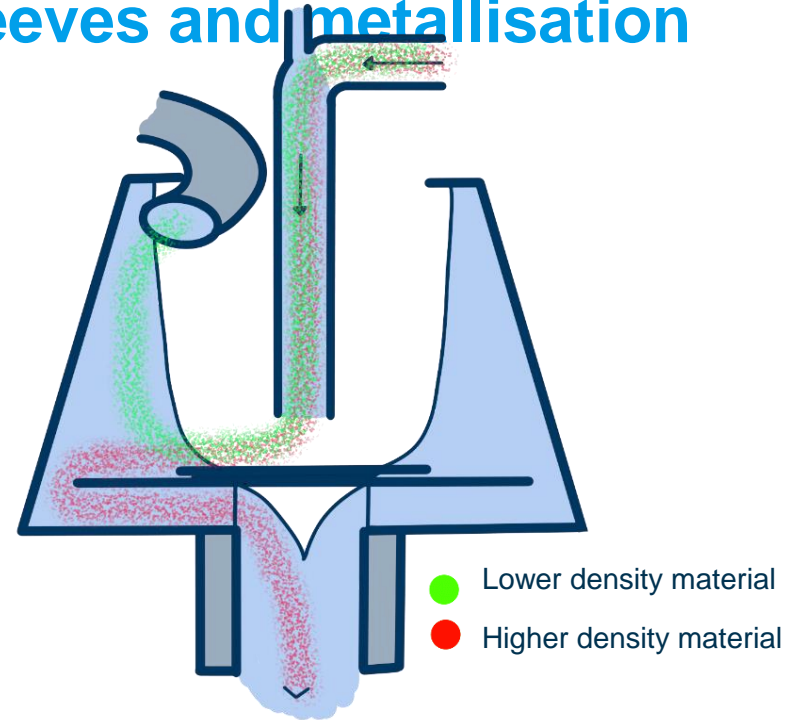
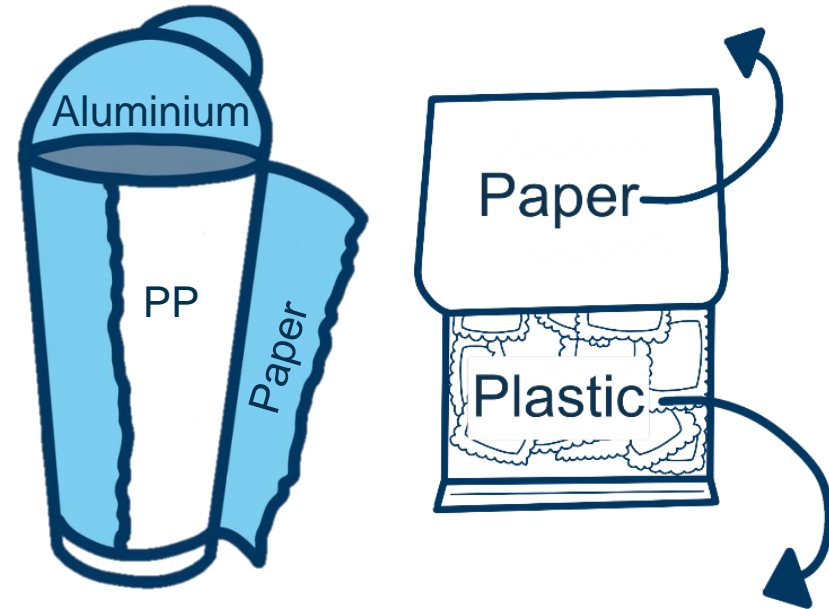


Illustration of a water-based density separator

10. Ensure that when paper is designed in combination with plastics on a single pack, it must be separable and separated from the main plastic body by the end user in order to access the contents

Paper fibres cannot be effectively removed in the recycling process as it clings to polymer flakes and degrades under heat, setting off gasses, and otherwise causing discolouration and odours. It is essential that the end user can **separate the paper from the main plastic body of the pack**.



High effort to separate

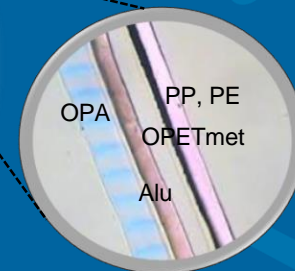
separate during use

Multi-material flexibles currently cannot be recycled economically (and often also technically)

EXAMPLES	SHARE OF PLASTIC PACKAGING MARKET % BY WEIGHT	PRIORITY SOLUTIONS
SMALL-FORMAT Lids, tear-offs, caps, sachets and generally all items smaller than 40 x 70mm	~10%	REDESIGN packaging formats and/or delivery models (and after-use systems)
MULTI-MATERIAL Packaging with inseparable layers of different materials	~13%	INNOVATE in materials and reprocessing technologies
UNCOMMON MATERIALS Uncommon plastic packaging materials like PVC, EPS, PS	~10%	Actively explore to REPLACE as a priority PVC, EPS, PS by known alternatives
NUTRIENT-CONTAMINATED Coffee capsules, organic waste bags, takeaway food packaging	NOT QUANTIFIED	SCALE UP compostable plastics for targeted applications to help recover nutrients of packaging contents

FUNDAMENTAL REDESIGN AND INNOVATION is needed for
 >50% of plastic packaging (by no. of items),
 or >30% of plastic packaging (by weight)*

Ellen MacArthur Foundation; The New Plastics Economy.
Catalysing Action (2017)



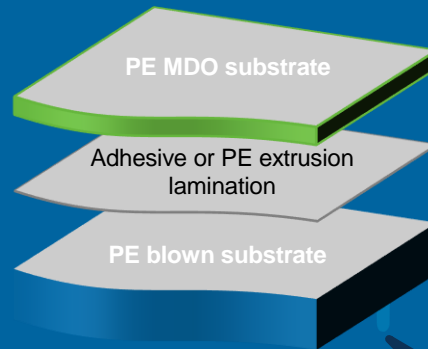
Example of multi-material stand-up pouches

- Global material consumption: 1,36 Mio ton with a growth rate of 4-5% p.a.
- Multi-material structures using multiple layers of aluminium, OPET, PA, BOPP, PE, PP,...
- Transfer a countless different pouch applications to recyclable structures
- Meet the technical requirements with mono-material structures

The Circular Economy challenge



The Full PE Laminate' is a machine direction oriented (MDO) PE / blown PE lamination structure



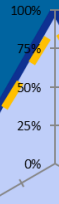
MDO-PE film

- Very good optical properties
- Reverse printed in flexo or rotogravure lines
- High **rigidity/stiffness**
- Good web planarity for efficient conversion
- High **toughness** for pack integrity

Blown lamination film

- Very good **sealing performance** with Anteo / Queo blends
- High toughness for **pack integrity**
- Excellent processability and packaging **efficiency**

Packaging integrity



Total penetration energy / Tensile strength MD	
OPET /PE reference	2.0 J / 67 MPa
MDO PE / PE	2.3 J / 83 MPa

Gloss 60°

MDO PE / PE 118%

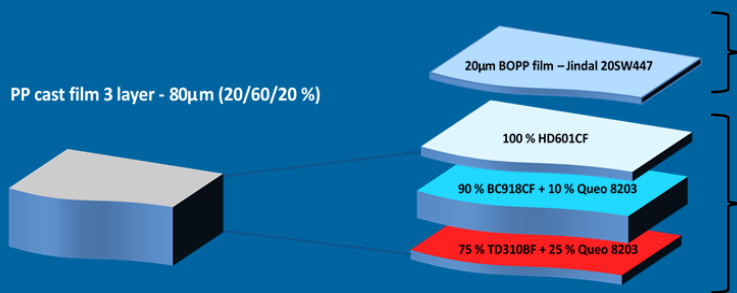
Print quality and aesthetics

Sealing performance

Max sealing force	
OPET /PE reference	22 N
MDO PE / PE	23 N

■ MDO PE (25μm) / PE (60μm) ■ OPET(12μm) / PE (60μm)

Concept of full PP laminate for pouch applications



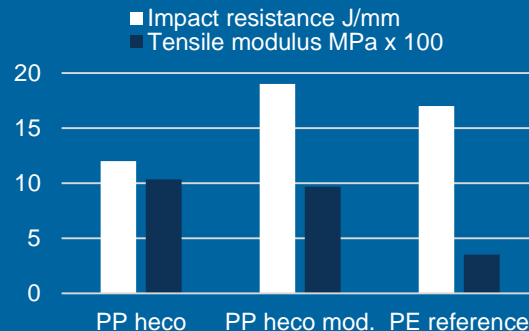
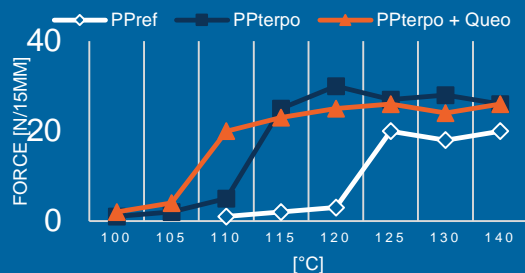
BOPP film

- Print = promotion
- Barrier = shelflife

Cast PP film

- Packaging integrity and efficiency
- Temp. Resistance = hot fill, pasteurization

SEALING CURVE



Borealis' development portfolio for rigid packaging – meeting sustainability targets, whilst providing traceability and consistency

Integrated virgin/recycled PP solutions – list of development resins with indicative typical properties

Resin name	MFR	Tensile modulus (MPa)	Charpy 23°C (kJ/m2)	Recycling content	Type of applications targeted
Integrated virgin/recycled PP solutions with mechanical properties similar to homo PP, based on Borstar Nucleation Technology					
UF551MO	18	1600	3,5	50%	Hinge caps with a robust cap design, dosing caps, screw caps, housing of pumping system, which require high stiffness
UF251MO	19	1700	3	25%	
Integrated virgin/recycled PP solutions with mechanical properties similar to block PP, based on Borstar Nucleation Technology					
UG522MO	22	1500	6	50%	Dosing and screw caps with high impact performance requirement, particularly suitable for e-commerce environment
UG222MO	27	1600	6	25%	
XJ050SY	43	1450	4,5	50%	Thin wall packaging, pails and lids
Integrated virgin/recycled PP solutions with some level of translucency					
UE201MO	14	1150	4,5	25%	Caps requiring some level of translucency, low stress whitening and good hinge performance

Acquisition of Ecoplast deepens our commitment of plastics recycling within the circular economy

- Founded in 1989, part of the Borealis group since 2018
- Leading European post-consumer recycler for flexible polyolefins
- Production site in Wildon, Austria with 55 employees
- On-going expansion project will increase processing capacity to approx. 70,000 tonnes per year
- Own waste water treatment system thermal energy from biogas plant





Let's make the circular economy happen together!