Introduction to Masterbatch & Custom Color Advanced Solutions
2022
A look at the LyondellBasell portfolio

LEADING

#1
Producer of polypropylene compounds globally
Licensor of polyolefin technologies globally
Producer of polyethylene in Europe
Producer of polypropylene in Europe and North America
Producer of oxyfuels in Europe and North America

GLOBAL
Every day, our employees work around the clock to safely advance solutions to our world’s biggest challenges.
LyondellBasell has the scope and scale to serve global markets

Note: Information as of December 31, 2020.
Our diverse portfolio is used to create customizable products including:

- Reduced GHG emissions & improved fuel economy
- Delivering potable water
- Quality healthcare
- Agricultural efficiency
- Food safety & access
- Sustainable & modern living

Catalloy
Polybutene-1
Specialty Powders
Polypropylene Compounds
Engineered Composites
Engineered Polymers
Color Concentrates
Masterbatches

Delivering potable water
Quality healthcare
Agricultural efficiency
Food safety & access
Sustainable & modern living
Masterbatch & Color Concentrates

Application Areas

Packaging  Building & Construction  Transportation  Agriculture  Consumer Goods  Appliances

Key Properties

<table>
<thead>
<tr>
<th>Processing Additives</th>
<th>Functional Properties</th>
<th>Optical Appearance &amp; Aesthetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Anti-oxidant</td>
<td>▪ Slip, Anti-blocking, De-nesting, Release agent</td>
<td>▪ White, Black</td>
</tr>
<tr>
<td>▪ Processing aid, Lubricant</td>
<td>▪ Anti-static, Anti-fog</td>
<td>▪ Matt, Synthetic paper, Soft-touch</td>
</tr>
<tr>
<td></td>
<td>▪ Filler, Nucleating agent, Blowing agent, Flame retardant,</td>
<td>▪ Colors, Pearlescent, Metallic</td>
</tr>
<tr>
<td></td>
<td>▪ UV stabilizer, Anti-oxidant, UV and IR absorber</td>
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Core portfolio:
Our Masterbatch portfolio addresses modern customer needs

- Polybatch Color Concentrates: Standard Colors, Custom Colors, Special Effects
- Polyblak Black
- Polywhite White
- Polybatch Additives

Advanced Solutions addressing:
Plastic Waste / Climate Change / Thriving Society

- Circulen
  - CirculenRecover
  - CirculenRevive
  - CirculenRenew

Carriers – A variety of different carriers are available

- PP, PE, EVA, Styrenics, PET, PETG, PA, Bio-resins, Technical polymers

- Sustainable Polymers + Sustainable Ingredients
- PCR, PIR, r-PET, Bio-renewable feedstock, Advanced recycling
Global Masterbatch Asset Footprint

- Global production network with 20 masterbatch manufacturing sites
- Masterbatch technology centers in each region
- Local color development centers with application specialty
- Standardized manufacturing and laboratory process providing flexible and consistent service
- Extensive materials expertise, analytical laboratories and pilot process capability to support customer developments and innovation
- Certified quality standards; supporting global regulatory requirements
Our approach to Sustainability

**PLASTIC WASTE**

- 2 million metric tons of recycled and renewable-based polymers will be marketed and produced annually by 2030
- 100% of plastic packaging worldwide is reused, recycled and/or recovered by 2040*
- Zero plastic pellet loss to the environment from our facilities and supply chain
- Millions of tons of plastic waste diverted through Alliance to End Plastic Waste projects

**CLIMATE CHANGE**

- Net zero emissions from global operations by 2050
- 30% absolute emissions reduction from operations by 2030**
- 50% minimum of electricity procured from renewable sources by 2030

**THRIVING SOCIETY**

- Zero Incidents, injuries and accidents
- Build diverse teams that reflect the communities where we operate
- Invest in programs that strengthen our communities, our planet and tomorrow’s workforce
LyondellBasell supports circularity in the value chain with its Circulen family of products.
LyondellBasell’s *Circulen* Portfolio Helps You Reduce Your Carbon Footprint and Address Plastic Waste

- Made from plastic waste through a **mechanical recycling process**
- Made from* **renewable feedstocks** such as used cooking oil
- Made using* an **advanced (molecular) recycling process** to convert plastic waste into feedstock to produce the new polymers, which have a wide range of uses

*Using a Mass Balance approach
LyondellBasell’s *Circulen* Portfolio Helps You Reduce Your Carbon Footprint and Address Plastic Waste

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*Using a Mass Balance approach
LyondellBasell CirculenRecover Recycled solutions contain post or pre-consumer recyclate as carrier resin

- Many OEMs and brand owners have committed to increasing recycled content in their end products
- CirculenRecover masterbatch grades with post-or pre-consumer carrier help our customers reach their recycled content goals
**CirculenRecover - Masterbatch solutions with post-consumer recycyte carrier resin**

**Application***
- Rigid Packaging
- Flexible Packaging
- Agriculture
- Building & Construction

**Key Benefits**
- Support in maximizing recycled content in final article
- Maintaining packaging integrity
- Supporting circularity, preparing packaging for further recycling loop
- Ensuring vibrant, colorful design is maintained with recycyte resins

* Non-food contact applications
# CirculenRecover - Masterbatch solutions with post-consumer recylcate carrier resin

<table>
<thead>
<tr>
<th>Product</th>
<th>Properties</th>
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<tbody>
<tr>
<td>CirculenRecover MB White</td>
<td>TiO2 masterbatch</td>
</tr>
<tr>
<td>CirculenRecover MB Black</td>
<td>Carbon black masterbatch</td>
</tr>
<tr>
<td>CirculenRecover MB Additive</td>
<td>Additive masterbatch for improvement of processing or properties when using PCR resin</td>
</tr>
<tr>
<td>CirculenRecover MB Color</td>
<td>Color masterbatch; including special effect and NIR detectable colors matched in PCR resin</td>
</tr>
</tbody>
</table>

- **Optics**
- **Resistance**
- **Mechanical**
- **Processability**
- **Circular Solution**
LyondellBasell supports brand owner commitments to ensure that **100% of plastic packaging is designed to be fully reusable, recyclable, or compostable.**

LyondellBasell and its mechanical recycling joint venture QCP have developed **packaging made from recycled plastic waste** for beauty and household brands.

LyondellBasell collaborated to develop sustainable solutions that don’t **compromise on quality** and meet the target to reduce the use of virgin plastic and maximize the content of post-consumer mechanical recycled resins.

*Circulen*Recover MB ZAP92450 based on PCR carrier resin was developed to be used in *Circulen*Recover HD5603 Grey HDPE blow molded bottles to provide packaging with the **maximum PCR content.**

*Circulen*Recover MB ZAP92450 is also designed for sorting by NIR technology in waste plastic sorting centers.
LyondellBasell Solutions support intelligent design of articles to improve recyclability of a given product

- Design for circularity is optimizing packaging design which supports sorting and recycling processes
- Mono-material packaging, ease of sorting and the use of additives play an important role in determining the recyclability of a given product and eventual quality of the recyclate
Design for Circularity: Material solutions to address the challenge of designing functional and aesthetic packaging which can be more easily sorted and mechanically recycled.

Mono-material packaging
- Re-design complex and difficult to recycle multi-material packaging to mono-material alternatives while maintaining desired properties and performance.
- *Polybatch* additives for processing of orientated PE films used in food packaging.

Near-infrared (NIR) sortable packaging
- NIR detectable masterbatches for a range of polymers to enable sorting of black and dark colored plastic articles in post-consumer waste streams.
- *Polybatch* 73641 NIR with COTREP certification

Masterbatches for Recyclates
- Masterbatch additives for recyclers and converters to improve processing and quality of recycled material.
- Enables recyclates for multiple recycling loops.
### Design for Circularity: Mono Material and NIR Solutions

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Properties &amp; Applications</th>
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<tr>
<td>Anti-blocking</td>
<td>Prevents blocking of film; enhances vacuum deposition process for metallized film</td>
</tr>
<tr>
<td>Slip</td>
<td>Reduces the coefficient of friction to enable faster packaging line speeds</td>
</tr>
<tr>
<td>Anti-static</td>
<td>Prevents build-up of electrostatic charge; improves powder filling and reduces dust attraction</td>
</tr>
<tr>
<td>Anti-fog</td>
<td>Prevents condensation on the film surface; reduces spoilage of packed foods and improves appearance</td>
</tr>
<tr>
<td>Processing Aid</td>
<td>Improves polymer extrusion with multi-layers, reduces dies deposits, enhances film quality</td>
</tr>
<tr>
<td>Antioxidants</td>
<td>Protects polymer from thermal degradation during extrusion; reduces gels and yellowing</td>
</tr>
<tr>
<td>Modifiers</td>
<td>Facilitates extrusion and stretchability of polymers; enhances appearance, stiffness and barrier properties</td>
</tr>
<tr>
<td>Matt</td>
<td>Specialty compounds to provide matt surface appearance or soft-touch haptics</td>
</tr>
<tr>
<td>Colors</td>
<td>Standard and custom colors; brand identity</td>
</tr>
<tr>
<td>NIR Colors</td>
<td>Alternatives for black and dark colors to enable for NIR sorting</td>
</tr>
</tbody>
</table>

**Optics**  
[Eye icon]

**Resistance**  
[Muscle icon]

**Mechanical**  
[Gear icon]

**Processability**  
[Chemical structure icon]

**Circular Solution**  
[Planet icon]
Design for Circularity: The Recycling Flow and Challenges

- There is growing demand for mechanical recycled polyolefins with the requirement for higher recycled material content in packaging applications.

- Recyclers face several challenges to provide higher quality and easily processed recycled material to plastics converters.

Challenges with recycling polyolefins:
- Thermal degradation
- Loss of mechanical performance and rheology
- Reduced aesthetic quality (gel formation, yellow color and increased odour)
- High moisture and volatiles content
Design for Circularity: Masterbatch for Recyclates

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<td>Protection of the polymer from thermal degradation to control melt rheology, reduce gels and yellowing</td>
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<tr>
<td>Desiccant</td>
<td>Absorbs moisture and allows for higher recyclate content</td>
</tr>
<tr>
<td>Odor Absorber</td>
<td>Reduces the odor of recycled polymer</td>
</tr>
<tr>
<td>Acid Scavenger</td>
<td>Reduces corrosion and odor by neutralizing acidic degradation products from EVA copolymers</td>
</tr>
<tr>
<td>Blue Toner</td>
<td>Improves color when using recycled transparent polymer</td>
</tr>
<tr>
<td>Compatibilizer</td>
<td>Improves the compatibility and properties of mixed PE-PP recyclate</td>
</tr>
<tr>
<td>Processing Aid</td>
<td>Improves processing and quality when processing with recycled polymer</td>
</tr>
<tr>
<td>Slip Absorber</td>
<td>Regulates slip properties when using recycled polymer</td>
</tr>
<tr>
<td>Color</td>
<td>Improves the color and color consistency of recycled polymer</td>
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Optics | Resistance | Mechanical | Processability | Circular Solution
LyondellBasell’s *Circulen* Portfolio Helps You Reduce Your Carbon Footprint and Address Plastic Waste

*Using a Mass Balance approach

- Made from plastic waste through a mechanical recycling process
- Made from* **renewable feedstocks** such as used cooking oil
- Made using* an **advanced (molecular) recycling process** to convert plastic waste into feedstock to produce the new polymers, which have a wide range of uses
LyondellBasell Masterbatch and Color Concentrates based on renewable resources offering the same properties as their virgin counterparts

- Masterbatch based on renewable non-fossil fuel carriers are ideal drop-in solutions for sustainable food packaging, toys and cosmetics.

- The products can be applied, with no restrictions, to the same applications as fossil-based equivalents offering lifetime performance and especially recyclability.

*Using a Mass Balance approach
# CirculenRenew - Masterbatch solutions with renewable-based resource carrier resin

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<td>TiO2 masterbatch</td>
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*Using a Mass Balance approach*
Personal Care Products packaged in renewable-based plastic

- In 2019, LyondellBasell achieved the first parallel production of polypropylene and low-density polyethylene made from renewable raw materials as an alternative to fossil-derived resources.

- Since that time, we have expanded our renewable-based polymers to help our customers create packaging that appeals to consumers who prioritize sustainability.

- For a known personal care brand our renewable-based polymers made sense. In 2021, they have launched a baby & intimate product range, including shower gels and shampoos packaged in LyondellBasell’s CirculenRenew high density polyethylene polymers.

"The most innovative results come from working together with our customers to design effective solutions. It is our ambition to not only offer a vast range of materials, but also sustainable solutions to advance their goals."

Richard Roudeix
Senior Vice President of Olefins & Polyolefins, Europe, Middle East, Africa and India for LyondellBasell
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*Using a Mass Balance approach*
LyondellBasell *CirculenRevive* grades unlock the circular promise of plastics

- *CirculenRevive* brings waste back to life in new plastic products, over and over again by providing perpetually recyclable polymers of high quality. This way of advanced recycling is increasingly reaching scale.

- *CirculenRevive* products are currently available in small quantities only.
**CirculenRevive - Masterbatch solutions with advanced recycled carrier resin**

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**Properties**

- **Optics**
- **Resistance**
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- **Circular Solution**
LyondellBasell Advanced Polymer Solutions

Leading global supplier of high-performance plastic compounds, masterbatches and resins

Providing innovative solutions to exactly meet customer application requirements

One-Stop shop for color and additive masterbatches

Raw materials harmonization to ensure consistent quality and supply, worldwide

Specialized color competence and masterbatch technology centers

Sustainability is a core value and a driver
Thank you

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Circulen is a trademark owned and/or used by the LyondellBasell family of companies.
2nd Generation Renewable feedstock which contains only waste and residues and therefore not in competition with the food chain and unsuitable for human consumption

Masterbatch based on renewable non-fossil fuel carriers are ideal drop-in solutions for sustainable food packaging, toys and cosmetics.

- C14: Masterbatch (upon request) can be produced with measurable renewable content
- Mass Balance: Masterbatch Sites to be ISCC+ certified in H2 2022

Customers can use these certificates to verify compliance with sustainability and traceability requirements
### CirculenRenew and CirculenRevive

Masterbatch solutions with renewable-based resource carrier resin

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