ExxonMobil

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Enhancing recycled polypropylene performance and processability

Key benefits

Synergy between Exact™ plastomers and DeltaMax® performance modifiers for PP recycling:

- Maintains **high stiffness**
- Up to **70%** higher impact strength
- Up to **175%** better flow rate
- Unlocks new product **possibilities**

Challenge

Post-consumer recycled (PCR) polypropylene (PP) frequently has low impact strength combined with average stiffness, and often contains non-PP polymer contaminants which can further affect its properties. Many end-use applications for recycled PP, however, including pails and buckets, and larger containers for Home and Garden and DIY goods, require a higher and better stiffness-impact balance than is typically available in the market.

Milliken & Co.'s Chemical Business has grown into a leading supplier of advanced additives, colorants, and specialty and reactive silicone-based intermediates and fine chemicals. Brand owners and converters are using Milliken's plastic additives portfolio to help balance and enhance the properties and processability of mechanically recycled PP.

While flow modifiers can be used to enhance melt flow rate (MFR), it is often at the expense of impact strength. And while impact strength can be enhanced using standard rubber-like impact polymer modifiers, this is often at the expense of stiffness.

Milliken and ExxonMobil collaborated on the development of a solution which would meet the market's requirements. Working together, the companies developed trial formulations that included DeltaMax® performance modifiers from Milliken and Exact™ plastomers from ExxonMobil.

Solution

To help achieve the target impact resistance balanced with the right stiffness and melt flow, 2.5% to 7% of Exact plastomers were added to a formulation which included DeltaMax performance modifiers.

Three compounding trials were conducted. Compounds were molded into dumbbell-shaped samples which were then tested for flexural modulus (stiffness), impact strength and MFR.

Exhibiting rubber-like characteristics, Exact plastomers help improve the impact strength of recycled PP while maintaining a desired level of stiffness for enhanced product properties. DeltaMax performance modifiers increase flow rate for improved processability and can further boost impact strength, especially when used in combination with Exact plastomers.

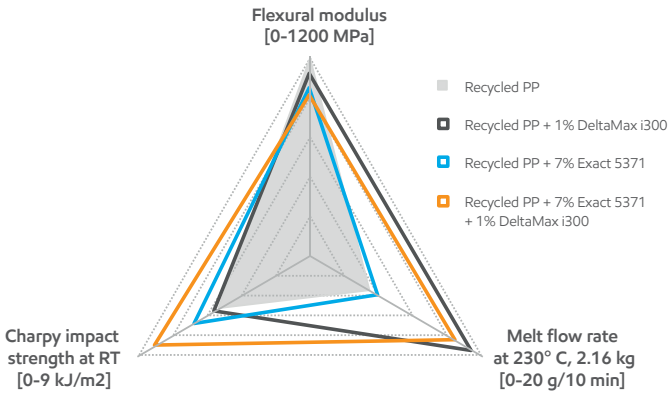
"Working collaboratively, we developed and tested a solution that included recycled PP with Exact™ plastomers and DeltaMax® performance modifiers in the formulation," said Dr. Philippe Scheerlinck, Senior Market Development Manager, Milliken & Company. "Compared with other market reference polymer modifiers, tests proved that the solution delivers a unique combination of enhanced impact strength and high melt flow for excellent processability, while stiffness is maintained."

Results

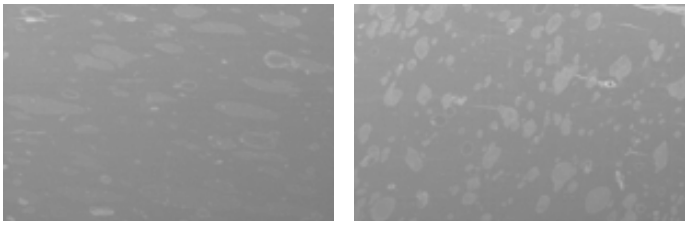
Combining Exact plastomers with DeltaMax performance modifiers offer recycled PP producers and converters the potential to shorten injection molding production cycle times, while making high quality parts with an exceptional stiffness-impact balance.

"The final solution broadens the potential use of recycled PP to more demanding applications, while production output can be increased and cost savings realized through the use of recycled PP," said Scheerlinck. "It just shows the results that collaboration can deliver, and we look forward to helping our value chain customers develop sustainable solutions for a range of demanding applications."

Chart shows strength, stiffness and MFR for various recycled PP formulations



Scanning electron microscopy images show more finely dispersed and uniform size of ethylene-based polymeric islands in the recycled PP matrix when modified with Exact plastomers and DeltaMax performance modifiers (right) compared to unmodified recycled PP (left).



Portfolio of ExxonMobil solutions and properties for recycled PP applications

	Melt flow rate at 230 °C, 2.16 kg (g/10 min)	Density (g/cm³)	Improved impact at RT	Improved impact at -40 °C	Flow rate improvement	Balances stiffness and toughness	Compatibilizes PP and PE
Exact 5171	2.3	0.868	●	●		●	
Exact 5371	10	0.868	●	●		●	
Vistamaxx 6102	3	0.862	●				●
Vistamaxx 6202	20	0.862	●		●		●

Portfolio of Milliken solutions

DeltaMax performance modifiers	Type
DeltaMax i300	Impact enhancer
DeltaMax a200	All Purpose modifier
DeltaMax m100	Melt Flow Modifier

Find out how we can help you with flexible packaging at
exxonmobilchemical.com/exact

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