Strengthened by collaboration: ExxonMobil and Milliken offer enhanced performance polypropylene compounds incorporating recycled content that can meet automotive material standards

Challenge:

Over the past few years, the successful use of recycled polypropylene (rPP) content in non-critical auto parts has helped drive automotive original equipment manufacturers (OEMs) to turn their attention to high-performance functional parts.

OEMs have interest in rPP compounds that can meet application requirements for impact resistance at various temperatures and stiffness benchmarks. Those compounds must also be designed for fast injection molding cycle times which can help address cost concerns.

This ask seems reasonable, but the reality is that this is not easily achieved: both post-industrial and post-consumer rPP content, even when originating from end-of-life vehicle waste, typically struggles to meet such demanding automotive OEM specifications.

Solution:

Milliken & Company and ExxonMobil have a long history of working together. As a leading supplier of transformative chemical solutions that deliver essential performance, Milliken routinely helps brands and converters balance and enhance the properties and processability of mechanically recycled polypropylene content. ExxonMobil manages a portfolio of performance products that can provide the building blocks to help meet growing global demand for essential products.

Critical automotive OEM parts, such as front fascia deflectors, must meet flexural modulus (stiffness), tensile strength, and impact strength specifications, so formulations that incorporate rPP content would have to meet these physical property requirements without compromising final performance or negatively impacting the injection-molding process.

Each company brought a unique skill set to help address the challenge. The companies developed trial formulations built around Milliken's DeltaMax® performance modifiers and ExxonMobil's Exact™ polyolefin elastomers (POE). The technical team conducted seven compounding trials using up to 25% Exact™ POE enhanced with DeltaMax® and post-consumer rPP content containing approximately ~15% polyethylene.

The seven test compounds were molded into dumbbell-shaped samples, which were then tested for flexural modulus, tensile strength, impact strength at 23 °C and at –20 °C, and for melt flow rate (MFR).

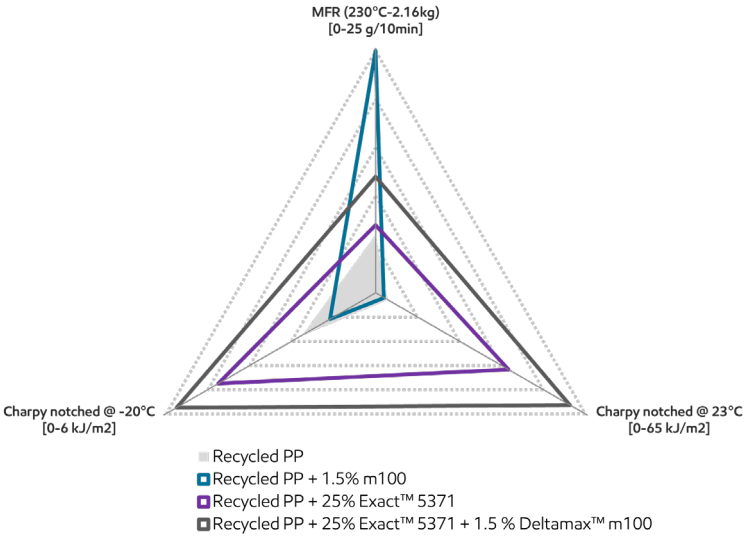
Results:

The test results showed that Notched Charpy impact of 50 kJ/m² at 23°C and 4 kJ/m² at -20°C could be achieved with a flexural modulus of approximately 900 MPa and a tensile strength significantly above the target — passing the first hurdle of balancing mechanical performance. The MFR was improved more than two-fold over the initial rPP content compound, which has the potential to help reduce part processing costs by decreasing operating temperatures and lowering cycle time which can lead to lower energy consumption in the manufacturing process and a lower carbon footprint of the final part.

These results come from the innovative formulation enabled by Milliken and ExxonMobil's collaboration:

- The rubber-like behavior of Exact™ POE can help improve impact strength and can help limit drops in stiffness compared to virgin recycled PP.
- DeltaMax® performance modifiers can help improve flow rate and help boost impact further over recycled PP with Exact POE through compatibilization of the matrix-rubber interface, thus helping to facilitate particle dispersion and small particle size.

"We harnessed the synergy between Exact™ polyolefin elastomers and DeltaMax® to help enable the development of critical automotive parts that incorporate post-consumer rPP content," shared Dr. Philippe Scheerlinck, Senior Market Development Manager for Milliken's Chemical Business. "The creation of viable compounds that incorporate rPP content is a major win, and we're proud to play a role in solving this challenge together with our collaborators at ExxonMobil."



Data from tests performed by or on behalf of ExxonMobil

"Collaboration between Milliken and ExxonMobil is key to helping unlock the opportunities of developing automotive parts that incorporate post-consumer rPP," said J. Dow, Global Market Development Manager at ExxonMobil. "Creative solutions that can help boost the performance of PP compounds that incorporate post-consumer rPP are highly desired by automotive OEMs as they can help the OEMs meet their sustainability goal of increasing the incorporation of recycled content in their products."

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