

INJECTION MOLDING WITH MUCELL

MuCell microcellular foam bubbling up in a variety of automotive applications

By Tony Deligio

What do airbag covers, engine-valve covers, and a one-piece sunroof frame have in common? All have recently applied Trexel's MuCell microcellular foaming process to improve aesthetics and strength, use less material, and allow injection molding on smaller machines.

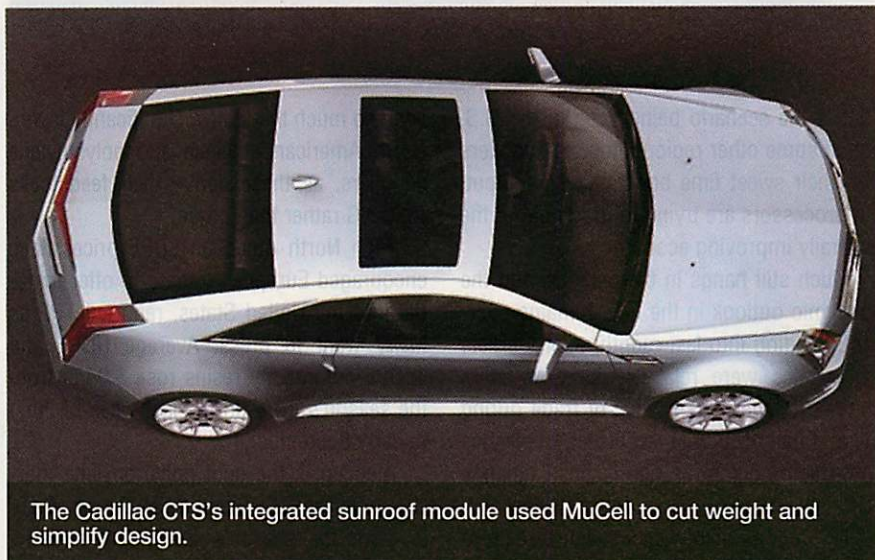
The Woburn, MA company earlier this year posited just how much automakers could trim carbon footprints of cars through the use of its MuCell technology, estimating that for a fleet of 100,000 cars, vehicles that feature optimized MuCell component applications could cut fuel use by more than 6.3 million gallons of gasoline, along with carbon dioxide reductions of nearly 65,000 tonnes over the course of a 150,000-mile life span.

Those benefits, as well as the structural and appearance improvements possible through MuCell, have gotten the attention of OEMs like Porsche, Volkswagen, and Cadillac for the aforementioned parts created by tier suppliers TRW Automotive, ElringKlinger, and Inalfa Roof Systems Group.

Trexel wins new auto applications for MuCell

This August, Trexel announced that the Cadillac CTS integrated sunroof module used MuCell to create a new large one-piece frame. Designed by Inalfa Roof Systems Group (Auburn Hills, MI), the front beam, rear beam, and two guides for this frame were consolidated into one part that measures 1m². Typically, sunroof openings for midsize and large cars are multipart assemblies. Trexel says this is also the first integrated sunroof module assembly molded from short-glass-filled polypropylene.

The finished part has metal inserts and four metal tubes, which preclude



The Cadillac CTS's integrated sunroof module used MuCell to cut weight and simplify design.

the possibility of any material shrinkage since the parts would have unacceptable warp. Compared to a traditional four-piece design, the one-piece MuCell component weighed 12% less and since the number of tools and checking fixtures were dramatically reduced, the total capital investment required was sliced nearly in half, along with a considerable reduction in component cost. Assembly time was reduced by more than a minute (67 seconds), with a molding cycle time reduction of 15 seconds.

"I'm happy, my company is happy, and we intend to use MuCell again"

Felice Bonucci, director of value management for Inalfa, was introduced to MuCell in Europe. Now based in the United States, he decided the process was

a fit for the Cadillac sunroof project. Using a Chinese toolmaker and running a number of Moldflow simulations, the project represented a complex engineering challenge, and Bonucci says that the total time elapsed from initial design to finished parts was less than a year—significantly shorter than would normally be expected. As far as the company's impression of MuCell: "I was sure the MuCell process would help us, and it has. I am happy, my company is happy, and we intend to use the MuCell process again."

Given that Inalfa is one of the world's largest providers of vehicle-roof systems, supplying them for OEMs including Ford, BMW, Volkswagen, GM, Volvo, Citroën, Daimler, Chrysler, Chevy, and Nissan, among others, that's certainly good news for Trexel.

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"Until recently," Trexel president and CEO Steve Braig says, "most decisions to use the MuCell process were made on a piecemeal, part-by-part basis. However, the [automotive] industry is now recognizing the immense strategic potential that MuCell holds for reducing vehicle weight and costs."

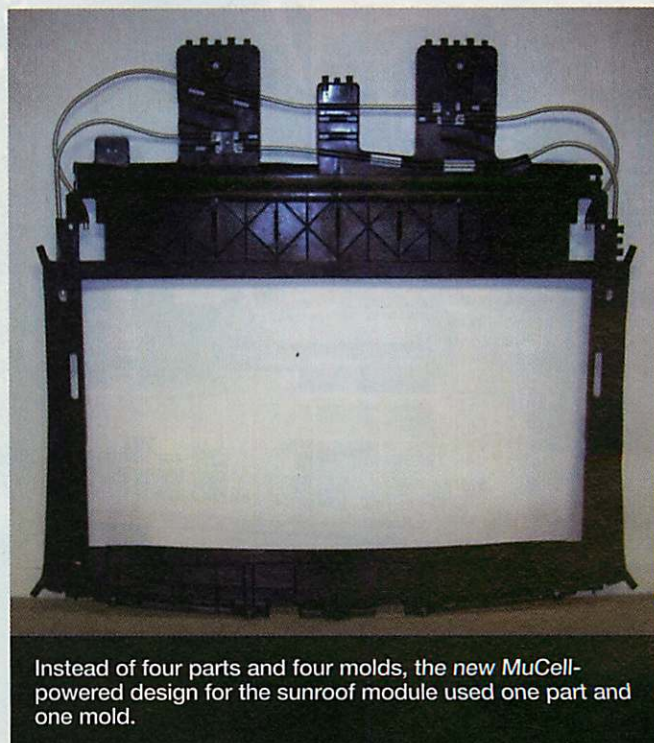
Airbag covers eliminate secondary laser work with MuCell living hinge

TRW Automotive is creating a dimensionally stable passenger-side front airbag cover that it says is free of sink marks, readily paintable, and able to be molded on smaller presses. Key for Volkswagen and Porsche is the fact that the components reportedly perform exceptionally well in low-temperature environments down to -35°C, key for airbag deployment in cold-weather climates. MuCell has also allowed designers to

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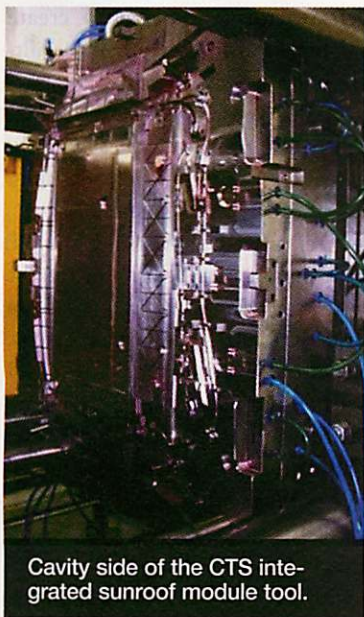
thin-wall sections at the tear seams for the bag, eliminating the need for laser cutting.

In addition to painted front-side passenger airbag covers, TRW Automotive in Europe has used MuCell for painted rear torso airbag covers for Volkswagen and Porsche. The airbag cover for Volkswagen's Tiguan was molded on a 300-ton press compared to the 500-ton machine needed for a non-MuCell design.



Instead of four parts and four molds, the new MuCell-powered design for the sunroof module used one part and one mold.

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Cavity side of the CTS integrated sunroof module tool.

From a design standpoint, TRW eliminated the secondary laser-cutting operation to the back side of the airbag cover by using MuCell to mold in a tear seam line for the airbag deployment and a living hinge constructed with the use of variable wall thicknesses.

Trexel also points out that when solid injection molding is used with different airbag cross-sections, the molded parts are subject to different shrink rates arising from different pressures in the mold. These can cause

variations in dimensional stability that result in sink marks and warpage that can't be hidden by painting.

Additionally, in a conventional molding process, part design can be constrained by the need to push plastic from the gate to the end of the part without freezing off. Because of this, the part needs to be packed along the entire flow length to obtain the uniform shrinkage required for dimensional stability, and to eliminate sink marks and vacuum voids. These processing limitations restrict design and affect the ability to reduce wall thickness, eliminating the possibility to apply a living hinge.

With MuCell, microcellular foaming in the mold replaces the traditional pack phase so a process doesn't have to fill the mold from thick to thin. Trexel says this allows applications to be designed for function, not for traditional plastics processes, where rib-to-wall-thickness ratios can be optimized for performance, not just for sink mark elimination, for example.

Engine valve covers kept flat, visually appealing

ElringKlinger (Dettingen, Germany) applied MuCell to mold engine-valve covers for Volkswagen 1.6- and 2.0-liter common rail diesel engines, which are available for all Volkswagen car models. Part flatness is an absolute necessity for valve covers and these require dimensional stability. ElringKlinger was working with a high-flow polyamide material to meet the requisite mechanical properties.

Because this was a two-piece valve-cover design, the dimensional stability advantages provided by the MuCell process were equally important since any warpage could negatively affect the hot nitrogen gas welding process ElringKlinger employed to join the valve-cover pieces together. MuCell also ensured a finished part with outstanding surface appearance. As was the case with the airbag covers, MuCell allowed the molder to use smaller machines and run shorter cycles. Given this program's success, ElringKlinger reports that it will go into series production on additional MuCell valve cover programs in 2010.

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via Manzoni, 46 - 20020 MAGNAGO (MI) - ITALY
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U.S.A Office: 55 Haul Road Wayne, New Jersey 0740
Phone: +1-973-696-4330 or Toll Free: 1866-696-4330
Fax: +1-973-694-0551
E-mail: extruder1@usa.net or sales@atstc.com