Magneti Marelli's First-Ever Carbon Fiber Steering Knuckle Slashes Weight

Magneti Marelli collaborated with thermoplastic supplier Solvay to create this first-of-a-kind carbon fiber part.

Dan Carney | Apr 28, 2021

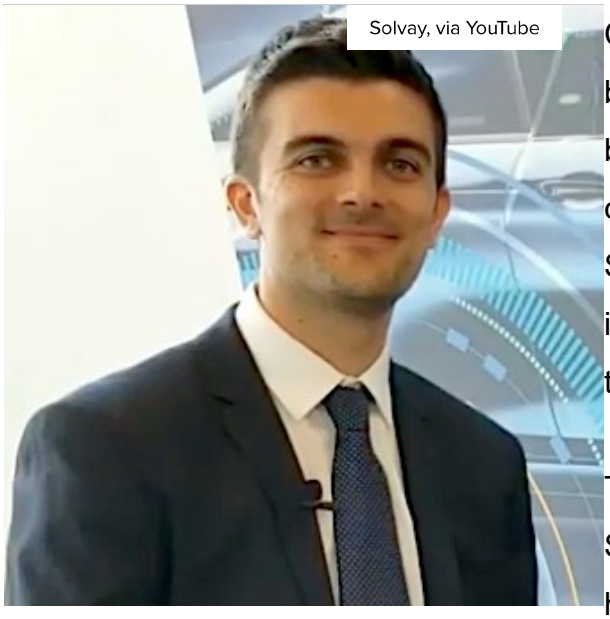
As carmakers leap to reach increasingly higher-hanging fruit in the effort to trim weight from new vehicles, advanced materials and manufacturing processes confront cost constraints.

Magneti Marelli's solution is to employ carbon fiber that includes 40 percent recycled material. As there is not an abundance of carbon fiber products returning from the end of their useful lives, recycled carbon fiber is normally excess material recovered from manufacturing processes for other parts.

Automotive steering knuckles, also known as hub carriers or suspension uprights, are typically heavy parts because of the forces involved supporting the car's weight and withstanding steering and braking forces that transfer through the part.

These have traditionally been made of cast iron, and cast aluminum is a rarely seen lightweight alternative used mostly in expensive sports cars. With that cost constraint in mind, the idea of moving on to carbon fiber could be unrealistic, but Magneti Marelli says it thinks it has a solution with this component.

"Our first idea with this project was to combine the really high mechanical performance of carbon fiber laminates with the very complex geometry that can be achieved with injection molding," explained Salvatore Sottile, Advanced Materials Application Engineer, Composite Specialist, and Project Leader for Magneti Marelli. "The use of recycled carbon fiber enables us to reduce the cost of the product itself and to decrease our environmental footprint during the manufacturing process. Besides the possibility to achieve the lightweight target compared to the aluminum counterpart."



Salvatore Sottile, Advanced Materials Application Engineer, Composite Specialist, and Project Leader for Magneti Marelli.

Casting is normally used for steering knuckles because of their complex shapes, an attribute that brings additional challenges to the idea of using carbon fiber. Magnetti Marelli worked with Solvay's Composite Materials Global Business Unit in an effort to marry the strength of composites with the shapability of injection-molded materials.

The carbon fiber knuckle is made using Advanced Sheet Molding Compression (ASMC), which is a high-volume, high-pressure method suitable for molding complex, high-strength materials. The resulting part is as strong as traditional carbon fiber and is even more resistant to cracking. Compared to the usual cast iron, the Magneti Marelli knuckle is 50 percent lighter and is even25 percent lighter than the aluminum equivalent.

Of course, the durability of those traditional materials is well established, so Magneti Marelli's Ride Dynamics team has performed extensive testing, analysis, and validation to confirm the

durability of the suspension knuckle, developing prototypes using a 1500-ton press.

The combination of chopped carbon fiber with ASMC permits complex structural parts that meet performance requirements that can be produced in a one-shot, net-shape process, resulting in cycle times that Magneti Marelli describes as suitable for automotive production.

The part employs compression molding and overmolding processes using a combination of Solvay's Amodel PPA thermoplastic compound and Evolite PPA thermoplastic composites. These products were developed specifically for high-temperature automotive functional applications such as this steering knuckle.

"We are proud of our contribution to this prototype. This is a successful combined application of Solvay's Amodel and Evolite PPA thermoplastic composite technologies which meets the rate and process flexibility expected by automotive manufacturers" said Gerald Perrin, Global Automotive Director at Solvay Composite Materials Global Business Unit.

Now, we have to wait to see the first production application of the component. Given Magneti Marelli's longstanding ties to various low-volume Italian sports car manufacturers, one of those companies seems a likely candidate to debut the carbon fiber steering knuckle.