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## Formula One Teams Refine Composite Usage

Unlike the mainstream automotive industry, composites make up a significant part of Formula One racing cars. According to Renault F1 engineer Ian Goddard, the lightweight and high-strength properties of carbon fibers are essential for the ultimate performance car. "To give you an idea of composite usage, around 80 percent of the car by volume is carbon fiber composites, but it contributes only 20 percent to the total weight," he says.

Even though F1 has been on the forefront of composites implementation, teams must still find new ways to utilize composites each season in order to reduce weight and stay competitive. Renault had been utilizing software from VISTAGY in previous years on smaller components, but for 2009, the two sides worked together to refine the design of bigger car parts.

The team identified the composite chassis as the single most complex composite part they manufacture, containing over 1,300 plies. Goddard wanted to reduce the chassis design time by 60 percent. "The software also works in the downstream manufacturing process by creating electronic data transfer of the sole design to the manufacturing workshop," he said. "For example, the layout time was reduced by 75 percent simply by using laser placement data. The system provided significant gains that we were keen to roll to the other parts of the car."

The technology was also applied to the car's rear diffuser. Though VISTAGY is primarily a software company, they also worked on technical details with Renault. Technical representative Paul Moulard recalls how they worked on this part. "The configuration of the car had to change, as Fédération Internationale de l'Automobile (FIA) keeps changing the rules



Brawn GP implemented Innegrit's new S fiber in its racing season.

to slow the car down due to safety concerns. The whole company is driven by getting the car to go as fast as it can."

Meanwhile, the Brawn GP team took a step forward by utilizing a new fiber entirely. The team implemented a new fiber from Greenville, S.C.-based Innegrit to augment carbon fiber used in its cars.

Carl Flesher, formerly of BMW and director of the Clemson University International Center for Automotive Research (ICAR) in Greenville, S.C., introduced Innegrit to some Formula 1 engineering leaders, including Gary Savage at Honda F1. "Dr. Savage took the lead in incorporating Innegra S fiber into their composite structures. The initial focus was improved safety from increased impact resistance and damage tolerance," said business development manager Mark Shiolen.

To test the new fiber, Brawn used a falling-weight impact test machine, where the instrument was clamped in the test rig and hit multiple times with a 10mm diameter hemispherical metal tup with a mass of 10 kilograms at a velocity of 5 meters per second. The test pieces were hit on the top, the front and the rear because



Renault is one of several Formula One teams continually looking to refine composite usage in their vehicles.

the team believed these areas have the potential to cause the most damage. A second test, involving hitting a part at random with a mallet, was designed to simulate the randomness of impact situations.

The Brawn GP team decided to adopt the material after evaluating the resistance to damage and reduction of debris. "During this season, the Brawn GP team has driven away from incidents that in prior years would have resulted in fractured parts, debris on the track and an immediate pit stop for repairs. The composites allow the damaged parts to hold together after impact" said Shiolen.

The fiber was not developed specifically for Brawn, but Innegrit worked closely with the fabric weaver, composite prepreg manufacturer and Brawn GP on processing and design issues. Under a new technical partnership agreement, Brawn GP and Innegrit will work together to generate data and applications for new fiber that provides increased toughness and damage tolerance, while reducing weight. "This and the promise of new developments from our ongoing partnership will bring benefits to the overall composites industry," he said.