The ability to cost-effectively produce ultra-high performance, carbon fiber wheel rims in the quantities demanded by the automotive market has been an elusive goal for manufacturers. Today, ESE Carbon Company, Miami, Florida, is utilizing a new epoxy resin system to infuse and autoclave-cure all-carbon fiber wheel rims with unprecedented results.

The new one-piece E1 rims combine the lightweight for which carbon composite wheels are known with greater strength and fracture toughness at higher temperatures than previously available with conventional epoxy resins. Moreover, the viscosity and handling properties of the resin system from Huntsman Advanced Materials, The Woodlands, Texas, provide for faster, more consistent infusion and curing with ESE Carbon’s Next Generation Autoclave Processing (NGAP) technology. Resulting rims are void-free and feature a high-gloss, Class A surface directly from the mold with virtually no rejects or need for labor-intensive secondary finishing.

“We are beginning to achieve the throughput speed needed for economical production of high-quality composite rims without any loss in the high-performance properties, meeting the high standards we have set for our E1 wheel,” says Carlos Hermida, CEO of ESE Carbon.

**Road to New E1 Rims**

ESE Carbon Company was founded in 2011 by a small group of people with the vision of making carbon fiber composites more widely available to a volume market. Today, the ESE team includes engineers and business professionals who have worked to position the company as one of the leading manufacturers of carbon fiber composite materials, including the innovative E1 composite wheel rims for the automotive market.

The achievements and rapid growth of the company have been based on intensive research in advanced composite materials and cost-effective manufacturing methods. In 2012, ESE introduced its unique, patented Next Generation Autoclave Process (NGAP), the key differentiator reducing production time and costs in the manufacture of high-quality, high-performance carbon fiber composite parts. Based on its NGAP technology, in 2016, the company unveiled its E1 line of lightweight, ultra-tough, all-carbon fiber wheels at a price significantly less than comparable composite rims.
Since its original wheel design, ESE Carbon has used several different epoxy resin chemistries and suppliers. Seeking to refine and upgrade its processing and production methods, ESE met with resin distributor D. B. Becker, Clinton, New Jersey, and learned about a new nano-toughened epoxy. The new product, manufactured by Huntsman Advanced Materials, met all of the requirements for ESE Carbon's NGAP technology. Subsequent testing of the Araldite® infusion epoxy demonstrated that by using the new resin system, ESE Carbon would improve their E1 wheel.

Wheel Design
E1 carbon fiber wheels feature elegant curved spokes that highlight a sleek, glossy resin/fiber design. Outer surfaces feature aesthetically placed carbon plies, with various weave design options, while inner layers are comprised of structural carbon fiber layers. After injection and cure with the new, Araldite® epoxy, the one-piece wheels are stiff, ultra high-strength structures that are among the lightest production carbon wheels available.

Performance and on-road testing demonstrate that the new E1 wheels promote outstanding automobile handling with consistent traction, fast acceleration and deceleration, excellent fuel efficiency and a smooth, quiet ride.

ESE Carbon manufactures its line of E1 rims in 18 – 21 inch diameters that weigh as little as 13 lbs. Recently passing their SAE certification, ESE continues to finalize their designs further expanding their product line to reach SUV load ratings.

Nano-toughened Epoxy
By switching to the Huntsman Araldite® resin and hardener system, ESE was able to enhance their production and increase E1 rim strength even at the elevated temperatures to which wheels are exposed during braking. The new epoxy combines improved elongation and higher fracture toughness than conventional epoxy resins with high glass transition temperatures (Tg). It produces lightweight composite rims with excellent fatigue resistance that is key to durability in wheels that are exposed to repeated cycling/stresses during vehicle operation.

Infusion and NGAP Curing
The Huntsman epoxy resin system also supports ESE Carbon’s processing requirements. The toughened material is formulated with a low mixed viscosity. To more closely tailor the resin system to its specific requirements, ESE Carbon’s engineering team worked with Huntsman technical representatives to determine the ideal component ratios to attain a work life long enough for injecting multiple wheel molds before the epoxy begins to gel. “Open communication with ESE Carbon’s engineering team, facilitated by our distributor, D.B. Becker, helped us understand the unique requirements of the NGAP technology
and molding strategy for the E1 carbon fiber wheels,” said Bob Farris, Huntsman Technical Service. “This allowed us to suggest molding conditions based on computer simulation to allow sufficient infusion time and minimize cycle time with our new nano-toughened, high Tg infusion epoxy.”

Hermida reports, “The Huntsman epoxy is ten times easier to infuse and process with our NGAP curing technology than the materials we previously tried. The resin provides for complete and controlled fiber saturation even in hard-to-fill areas where spokes join the wheel barrel and hub. As a result we have virtually no rejects.”

The NGAP process used at ESE Carbon virtually eliminates air voids that can compromise durability and mechanical performance, while enhancing consistency in the composite wheels.

Once demolded, rims are coated with a clear, hard, ceramic-based protective coating to resist scratches and UV degradation and further enhance thermal stability.

“The combination of production-quality processing and the high-performance Huntsman epoxy infusion system produces carbon fiber wheels that will satisfy the automotive industry’s search for lighter weight wheels priced suitably for the mass market,” Hermida concludes.

About Huntsman:
Huntsman Corporation is a publicly traded global manufacturer and marketer of differentiated and specialty chemicals with 2017 revenues of approximately $8 billion. Our chemical products number in the thousands and are sold worldwide to manufacturers serving a broad and diverse range of consumer and industrial end markets. We operate more than 75 manufacturing, R&D and operations facilities in approximately 30 countries and employ approximately 10,000 associates within our four distinct business divisions. For more information about Huntsman, please visit the company’s website at www.huntsman.com.

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