R&D Q&A

EASTON MATRIX COMPOSITE — NUMBER SEVEN

ENTER THE MATRIX

Fabricating carbon composite tubes is becoming almost commonplace. But what happens when the component isn't a tube? Get ready to enter a brave, new dimension in carbon composite fabrication — Easton Matrix Composite.

In R&D/Q&A #2 (June, 2002 issue), we talked about different types of carbon materials. We also covered several of the manufacturing processes that are used in making bicycle components. Today's article is going to talk about a unique carbon fiber material and an advanced molding process. This material, Easton Matrix Composite (EMC), is brand new and is just now making its first appearance in bicycle components.

Before we talk about EMC, let's review some of the more common materials and processes used in making truly fine bicycle components.

Versatile Carbon

On the material side we talked about how carbon fibers are used to make some of the world's lightest and strongest bicycle components. The most common method of fabrication involves using individual carbon fibers which are bundled into larger strands called "tow". The tows are laid out unidirectionally side by side and pre-impregnated with a resin system to create plies or sheets called pre-preg. Then multiple plies are stacked together to create a laminate. The orientation of the plies determines the characteristics of the laminate. Plies placed in the longitudinal direction add to the stiffness of the design; fibers placed at 90 degrees reinforce hoop strength; and fibers placed at 45 degree angles allow some compliancy or flex in the component.

Easton Matrix Composite (EMC) seat post head is the first application of Easton's new composite compression molding technology.

"To make high-strength composite component such as a seat post head with vastly differing cross-sections you need a different, more advanced process."

We also covered the almost limitless differences in strength and weight properties of the various pre-preg materials. (See R&D/Q&A #2).

Generally speaking handlebars, seat post quills and frame tubes are made using a bladder molding process. The bladder molding process utilizes a two-piece mold to control the outer shape of the component. An internal bladder is inflated with air to compress the laminate and mold the component into shape.

Resin transfer molding (RTM) and roll wrapping are other common processes that are useful when making thin-walled tubes with uniform wall thickness. Bladder molding with pre-preg has an advantage over these processes because it allows for reinforcing of the walls with extra material in strategic locations.

All of these methods work

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great on tubular structures like bars, seat posts and frame tubes. But what happens when you have a component that requires great variations in cross-sectional thickness? Take a seat post head for example. If you look at the various sections of a seat post head you can see that in the area where the head bonds onto the quill the walls are quite thin. But the section where the saddle cradles sit on top of the seat post head is amazingly thick (see Figure 1).

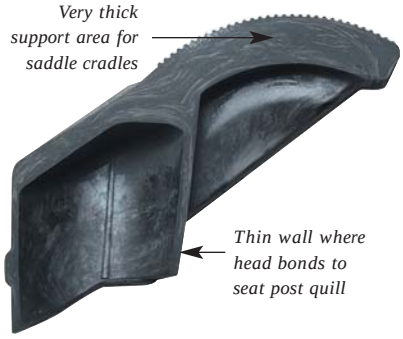

Figure 1

Injections Anyone?

To make a high-strength composite component such as a seat post head with vastly differing cross sections you need a different, more advanced process.

Let's take a minute to clarify a point. People frequently use the term composite when referring to injection-molded parts. Why? Because they often combine dissimilar materials. For example powdered fiberglass might be combined with nylon or plastic to reinforce a component.

With injection molding, plastics or nylons are heated until they become liquid and are then forced into a mold under pressure. Injection molding is useful because it allows the making of parts with great differences in cross section.

Easton Matrix Composite is comprised of extra-long, interlocking graphite fibers in a resin matrix. The prepreg sheets are laid out in a random overlapping pattern. This ensures uniform strength throughout.

"The coolest thing about this material is that rather than small dissimilar particulate, Easton adds long carbon fibers to the resin."

Adding a particulate like pulverized fiberglass to the plastic or nylon in an effort to increase the components strength is called *discontinuous reinforcement* (DR). However, DR has some drawbacks. The particulate can cluster and may not be uniformly distributed throughout the molded part leaving some areas weaker than other areas.

An example of DR is aggregate concrete. While the addition of small rocks adds strength and durability to the concrete, the rocks are dispersed in a random fashion. Cracks can form and easily spread through the concrete by traveling around the rocks.

Pressure to Perform

This brings us to a process developed by Easton called *compression molding*. Think of this process as 3-D forging of composites. Now it's possible to create super-high-performance properties at an incredible weight savings.

The most significant advantage of compression molding over injection molding is that it allows the use of a new long-fiber carbon composite material.

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EASTON MATRIX COMPOSITE

So what is this new material? It's called Easton Matrix Composite (EMC). Easton Matrix Composite, like prepreg, is comprised of a resin matrix and extra-long, interlocking graphite fibers. It's pure carbon baby!

"The part that comes out of the mold is made of the same materials that are used in Easton's legendary composite handlebars and seat posts, unadulterated and without fillers."

The coolest thing about this material is that rather than small dissimilar particulate, Easton adds *long* carbon fibers to the resin.

The Matrix Method

EMC's long fibers are compressed uniformly throughout the mold cavity under heat and extreme pressure. The resulting component has interlocking whole carbon fibers that benefit from *continuous reinforcement* (CR).

A good example of a CR is the combination of rebar and concrete. When reinforcing concrete structures such as bridges, buildings or walls, builders pour wet concrete around a skeleton of long steel bars (rebar) and allow the concrete to harden. This *continuous* reinforcement yields great strength properties because both materials are sharing the load.

Easton's new EC90 road post (155 g) is the first all-composite post that utilizes Easton Matrix Composite (EMC) and Easton's new compression molding technology.

This is also the magic of Easton Matrix Composite. The part that comes out of the mold is made of the same materials that are used in Easton's legendary composite handlebars and seat posts, unadulterated and without fillers.

Now it's possible to create highly-detailed, three-dimensional shapes with complex geometry and differing cross sections — without sacrificing strength.

Quasi-Isotropic What?!!

Since EMC's fibers are evenly dispersed in a random, interlocking orientation, *quasi-isotropic* properties are achieved. This means that stiffness characteristics are the virtually the same in all directions.

I think you get the idea — the possibilities are limitless. Stay tuned for more great components made with this great new technology.

Component junkies around the world will be looking forward to entering the matrix.