Applications

INTERNATIONAL BUILDING CODE | Meeting requirements for interior composites

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In a giant leap forward for the composites industry, the 2009 update to the International Code Council's (ICC) *International Building Code* (*IBC*) explicitly permits the use of fiber-reinforced polymer (FRP) in interior and exterior building construction. For the first time, FRP can compete with traditional materials on a relatively level standards playing field. The *IBC* code requires that, for interior use, FRP must be fire tested and meet both flame-spread and smoke-obscuration criteria, says John Rowen of **Avtec Industries** (Hudson, Mass.). *IBC* Chapter 8 specifies the fire test criteria, and *IBC* Chapter 26 requires that FRP components carry an ICC-sanctioned label indicating that the material has passed the required fire tests. These labels are affixed only when the material is listed with an independent product safety testing organization that has certified the fire test results (e.g, Underwriters Laboratories, Southwest Research Institute, Intertek). When an FRP component bears a testing laboratory's label, architects and professional engineers may call out the credentialed FRP in construction plans.

The critical issue, of course, is how to produce FRP parts that can meet *IBC* flame-spread and smoke-obscuration specifications. Rowen and collaborator Nicholas Dembsey of Worcester Polytechnic Institute's (WPI) Department of Fire Protection Engineering (Worcester, Mass.) have developed some specific recommendations for a "systems approach," whereby fire spread and smoke problems are attacked simultaneously.

First, high-viscosity commodity resins are modified with specific additives to reduce the propensity of the finished material to combust. Second, a fire-retardant-coated surfacing veil that dramatically suppresses smoke is added to the part layup, greatly reducing flame and smoke generation. Use of both strategies in concert can produce a part that passes the *IBC* Chapter 8 criteria, declares Dembsey.

"Bromine has been an excellent fire retardant," adds Rowen, "but it produces a lot of acrid black smoke, so bromine additives can't pass the smoke obscuration criterion." Under the new systems approach, one should start with an economical commodity resin in which the styrene content has been reduced to less than 27 percent. Methyl methacrylate (MMA) should be added to reduce resin viscosity so it will accept a high loading of aluminum trihydrate (ATH), anywhere from 25 to 150 parts per hundred parts of resin. To accommodate the high ATH filler loading, a fire-retardant liquid-phosphorus plasticizer, such as that manufactured by **Supresta** (Ardsley, N.Y.), can be added to reduce resin viscosity.

Rowen and Dembsey stress that the ratio of resin to fiber in the part should be reduced as much as possible because more reinforcement means less resin to fuel the fire. The glass content should be 38 percent or more, says Rowen. "Composite parts with less than 38 percent glass," he explains, "are unlikely to pass the *IBC* tests, regardless of how the resin is modified." He adds that typical chopped strand mats should be avoided because they absorb a disproportionate quantity of resin. Woven materials, new high-density mats or stitched woven roving mats should be substituted.

The second step, the addition of an intumescent surface veil at the part surface or just beneath the gel coat or painted surface, slows burning and subsequent smoke generation, says Rowen. Avtec's FireWall veil, **Technical Fibre Products Inc.'s** (Newburgh, N.Y.) TechnoFire and **Regina Glass Fibre Tissue and Veil's** (Ballarat, Victoria, Australia) FireShield are three available products. The Avtec veil provides not only the additional protection of an intumescent additive, which forms an insulating char barrier layer, but it can, depending on part design, enable a Class A surface as well.

Rowen and Dembsey have extensively tested their fireworthy design thesis. A composite test panel constructed in accordance with the systems approach was tested for fire and smoke production, per ASTM E84, "Standard Test Method for Surface Burning Characteristics of Building Materials" (also called NFPA 255 and UL 723). The E84 test is often referred to as the "tunnel test," and it measures flame propagation and smoke obscuration as compared to a sample of red oak flooring. The test panel produced almost no smoke and posted a remarkable flame spread index (FSI) of 20 and a smoke developed index (SDI) of 125, a vast improvement over a typical composite part. The use of this approach for composite building and construction elements should help FRP materials gain wider acceptance with architects and engineers. Complete details of the test program can be found at www.avtecindustries.com/news.html. ■