

E-Beam Curing Benefits Auto Industry

Research conducted by ORNL with several industry partners has demonstrated the feasibility of using electron beam (e-beam) curing to manufacture composite automobile panels more energy-efficiently and more quickly than the thermal curing technique currently used. The research also identified technical challenges that must be resolved to make the process attractive to the auto industry.

Polymer matrix composites (PMCs) are strong, lightweight materials that can be used to reduce the weight of vehicles by replacing heavier metal components. Although PMCs are used routinely in aircraft bodies, the demands of high-volume auto manufacturing, with cycle times measured in seconds or minutes, have been a barrier to their use in automobile structures. The conventional process for curing PMCs includes heating for up to several hours in an autoclave. E-beam curing, which uses high-energy radiation instead of heat to cure the polymer resins in PMCs, works more rapidly than thermal curing and in many cases uses less energy.

GM is using a carbon-fiber-reinforced polymer (CFRP) hood for its 2004 Corvette Z06 commemorative edition—the first time a North American automaker has used a painted CFRP exterior vehicle panel. The CFRP hood is lighter by 10.6 lb—more than a third—than the standard fiberglass hood. GM's supplier for the CFRP hood is using an improved, faster thermal curing process. ORNL tested the e-beam curing process on a prototype of the Corvette hood. The results indicate that e-beam curing could be scaled up to produce the component faster and at a higher volume than the process GM is using, and an approximate cost analysis suggests that the cost of e-beam curing would be lower. However, to fully exploit the advantages of e-beam curing, other technological advances are needed, including rapid upstream manufacturing processes and techniques for achieving a Class A finish.

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