New Rapid Infrared Curing Process

Background

The Ford Motor Company manufactures the Lincoln LS vehicle, which has a welded seam in the middle of the C-pillar located between the rear door and the back light. In order to obtain a smooth surface suitable for painting, five manual grinding stages are required to finish the joint. After Ford's body-in-white process, this seam is cosmetically covered by stitch MIG welds and a thermal-sprayed silicon bronze material in preparation for the paint process. Due to the high porosity in the thermal-spray coating, an additional step is taken in the paint shop to apply a gray glaze and anti-chip material to the vehicle in order to produce a high-quality finish. In addition to the operator-dependent, manual process of welding and painting this seam, the process is susceptible to quality concerns and production issues. In an effort to eliminate numerous steps and cut down on cost and production steps, Ford decided to investigate a one-component epoxy material to replace the thermal-sprayed silicon bronze. Although the epoxy material is conductive to the e-coat, is fully paintable and sandable, and has very low material porosity, no efficient and robust in-line heating source was found to accomplish the curing process.

The Technology

A Ford Motor Company researcher, contacted the Oak Ridge National Laboratory (ORNL) to discuss the potential development of improved joining/brazing and resin curing technologies for this application. Ford had been familiar with previous work performed at ORNL on rapid infrared processing sponsored by the U.S. Department of Energy's Automotive Propulsion Materials Program. A Metals Processing Laboratory User (MPLUS) project was established at ORNL to observe both rapid brazing of aluminum and rapid curing of epoxy joints. Although several technologies were investigated, a focused tungsten halogen lamp line heater showed the most promise. Developed in ORNL's Infrared Processing Center, the infrared line heater can be operated from cold to full power in less than one second, converts electrical power into radiant power at 90 percent efficiency, and targets the energy to only the area which needs curing. The lamp was found to provide sufficient curing in very short process cycles.

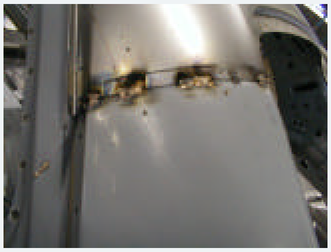
Full commercial-scale process trials were completed by Ford Motor Company, and the durability test was passed. The curing of the epoxy material was performed in only 90 seconds with the use of the infrared lamp. Set up from a distance of 6 inches and covering a 10-inch wide region, the lamp achieved a 98-percent cure, which is suitable for grinding and sanding. The cure is completed later in the e-coat oven.

Commercialization

The infrared lamp technology developed by ORNL has been adopted in one of Ford's assembly plants. The Ford Motor Company has targeted this process for Job 1 production in the near future.

Benefits

- **Cost savings of $28 per vehicle over the traditional process**
- **Less porosity in the coating, which eliminates additional surface preparations**
- **Reduces initial cycle time by 2 minutes**
- **Reduces energy consumption as a result of eliminating several steps in the production process**



The joint of Ford's Lincoln LS C-pillar before (top) and after the rapid infrared curing process.

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