

Process Optimization of Bismaleimide (BMI) Resin Infused Carbon Fiber Composite

Joshua W. Ehrlich
National Aeronautics and Space Administration
NASA
Building M7-0355, Mail Code: NE-L1
Kennedy Space Center, FL 32899

LaNetra C. Tate, Sarah B. Cox, Brian J. Taylor, M. Clara Wright,
Patrick D. Faughnan, Lawrence M. Batterson, Anne J. Caraccio, Jeffery W. Sampson
National Aeronautics and Space Administration
NASA
Kennedy Space Center, FL 32899

Engineers today are presented with the opportunity to design and build the next generation of space vehicles out of the lightest, strongest, and most durable materials available. Composites offer excellent structural characteristics and outstanding reliability in many forms that will be utilized in future aerospace applications including the Commercial Crew and Cargo Program and the Orion space capsule. NASA's Composites for Exploration (CoEx) project researches the various methods of manufacturing composite materials of different fiber characteristics while using proven infusion methods of different resin compositions. Development and testing on these different material combinations will provide engineers the opportunity to produce optimal material compounds for multi-disciplinary applications. Through the CoEx project, engineers pursue the opportunity to research and develop repair patch procedures for damaged spacecraft.

Working in conjunction with Raptor Resins Inc., NASA engineers are utilizing high flow liquid infusion molding practices to manufacture high-temperature composite parts comprised of intermediate modulus 7 (IM7) carbon fiber material. IM7 is a continuous, high-tensile strength composite with outstanding structural qualities such as high shear strength, tensile strength and modulus as well as excellent corrosion, creep, and fatigue resistance. IM7 carbon fiber, combined with existing thermoset and thermoplastic resin systems, can provide improvements in material strength reinforcement and deformation-resistant properties for high-temperature applications. Void analysis of the different layups of the IM7 material discovered the largest total void composition within the $[+45^\circ, 90^\circ, 90^\circ, -45^\circ]$ composite panel. Tensile and compressional testing proved the highest mechanical strength was found in the $[0^\circ_4]$ layup. This paper further investigates the infusion procedure of a low-cost/high-performance BMI resin into an IM7 carbon fiber material and the optical, chemical, and mechanical analyses performed.