National Aeronautics and
Space Administration

Materials and Coatings

High-Temperature, Low-Melt Resins for Liquid Molding

Fabricating resin transfer molding (RTM) composites with zero emissions

NASA's Glenn Research Center invites companies to license or establish partnerships to develop its patented high-temperature, low-melt imide resins for fabrication of automotive components. Produced by a solvent-free melt process, these resins exhibit high glass transition temperatures (Tg = 370 to 400°C), low-melt viscosities (10 to 30 poise), long pot-life (1 to 2 hr), and can be easily processed by low-cost RTM and vacuum-assisted resin transfer molding (VARTM). These RTM resins melt at 260 to 280°C and can be cured at 340 to 370°C in 2 hr, without releasing any harmful volatile compounds.

BENEFITS

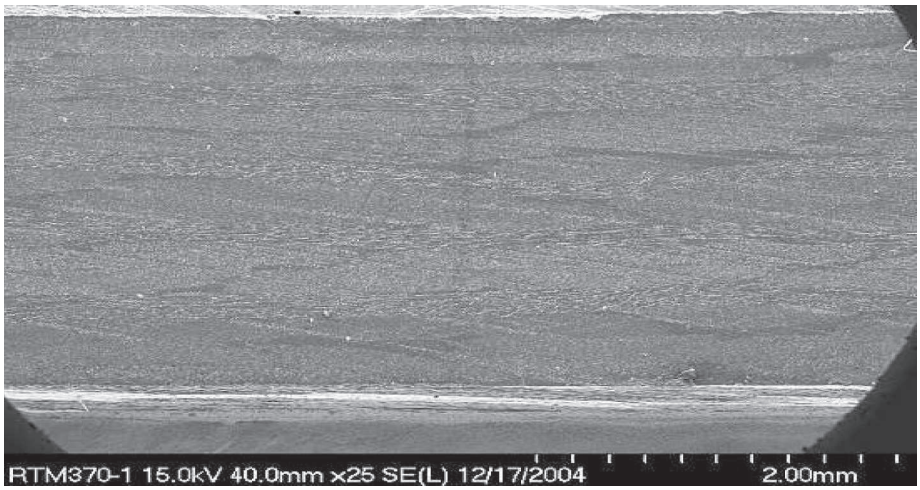
- Clean and green technology
- Adaptable - compatible with advanced manufacturing techniques
- Longer pot life - 1 to 2 hr
- Long shelf life - resins do not deteriorate over time at ambient temperatures
- Suitable for high-temperature application - performs above 300°C
- Efficient
- Low maintenance - self-lubricating when chopped carbon fibers are added
- Lightweight - provides up to 20 percent in weight savings over metallic components
- Improved safety
- High quality - solvent-free melt process yields a more consistent product and lowers the danger of contamination in the final resin product
- Cost effective

technology solution

THE TECHNOLOGY

This technology was developed to make polyimide resins from novel asymmetric dianhydrides (a-dianhydrides) and kinked diamines to achieve low-melt viscosities that are amenable to low-cost RTM and VARTM, while retaining high-temperature finished product performance above 300°C. These a-dianhydride-based RTM imide resins display low-melt viscosities (10 to 30 poise), which cannot be achieved using normal symmetric dianhydrides.

RTM imide resins can be melted at 260 to 280°C, and injected into fiber preforms under pressure (200 psi) or vacuum (VARTM). The resins also can be made into powder prepregs with lengthy out-time by melting the resin powders so that they fuse onto fibers. RTM imide resins display high softening temperatures (370 to 400°C) and excellent toughness, as evidenced by the RTM370 resins open-hole compression strength. The resins also possess significant thermo-oxidative stability by long-term isothermal aging at 288°C (550°F) for 1000 hr. The unique melt process without a solvent provides a manufacturing advantage over the expensive high boiling solvents previously needed to produce oligomers. This process also eliminates the need for tedious and high-cost solvent removal.



Scanning Electron Microscope cross-section of a composite using RTM-370 as matrix material

APPLICATIONS

The technology has several potential applications:

- Injection molding of parts, such as trim, structural support plastics, gears, etc.
- Injection molding of wire and structures
- High-temperature engine components; for example, bushings and bearings
- Selective laser sintering for prototypes
- Composite ducts and tubes
- Self-lubricating parts with chopped fibers

PUBLICATIONS

Patent No: 7,015,304; RE43,880; 7,381,849; 8,093,348; 8,993,710; 7,425,650; 6,784,276

More Information

National Aeronautics and Space Administration

Technology Transfer Office

Glenn Research Center

21000 Brookpark Road
Cleveland, OH 44135
216.433.3484
grc-techtransfer@mail.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

NP-2014-08-1119-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LEW-17618-1, LEW-17618-1-REIS, LEW-17904-2, LEW-18236-1, LEW-18236-2, LEW-17904-1, LEW-17291-1
TOP3-404