National Aeronautics and
Space Administration

technology solution

Materials and Coatings

High-Performance Polyimide Insulation Technologies

Improved fire resistance from low-density foams

NASA's Langley Research Center has developed a family of foams based on more than 25 innovative polyimide chemistries. The technology can take the form of foam or microspheres that can be used as additives. Langley refers to this technology, and associated international patents, as TEEK. The strong, low-density foam can be processed into neat or syntactic foams, foam-filled honeycomb, or other shapes, while offering excellent thermal and acoustic insulation and high-performance structural support. NASA has successfully licensed this technology and continues to offer non-exclusive licenses.

BENEFITS

- Low thermal conductivity from cryogenic to elevated temperatures (see Figure 1)
- Flame (NHB 8060.1), chemical, solvent, and hot water resistant
- Low density ~0.008 g/cc (ASTM D-3574 [A])
- Highly resilient and durable with high compressive and tensile strength (see Figure 2)
- Low coefficient of thermal expansion
- High glass transition temperature (DSC)
- Low dielectric constant 1.026 to 2.125
- Hydrolytic stability and limiting oxygen index (42% to 51%)
- Ability to foam in place during installation and repair
- Nontoxic and nonfuming

NASA Technology Transfer Program
Bringing NASA Technology Down to Earth

THE TECHNOLOGY

NASA Langley developed the polyimide foam technology to meet an aerospace industry demand for high-performance structural foam with increased stiffness but without large weight increases that could operate over a large temperature regime -253 degrees Celsius to 232 degrees Celsius. The process for this foam begins with a monomeric solution with salt-like properties to yield a homogenous polyimide precursor solid residuum. The resulting precursor can be processed into polyimide neat or syntactic foams, microspheres, and filled structures like honeycomb. Each form enables production of useful articles through normal foaming techniques. Foam production is based on reacting a derivative of a dianhydride (e.g., ODPA, BTDA, PMDA) with a diamine (e.g., ODA, PDA, DDS). Foams can be fabricated to densities from 0.008 g/cc to 0.32 g/cc. Microspheres can be produced with diameters ranging from 1001,500 microns. These microspheres can be used for foam-in-place applications or as additives to make less expensive materials more fire resistant.

NASAs foam technologies received these awards:

-- 2003 Turning Goals into Reality award for Technology Innovation jointly with Kennedy Space Center, Lockheed Martin Michoud Space Systems, Boeing Huntington Beach, RTI, and Sordal.

-- 2002 NASA LaRC Richard T. Whitcomb Award for Aerospace Technology Transfer

-- 2001 R&D 100 Award.

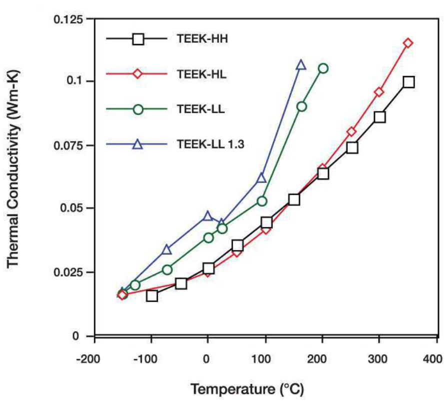

FIGURE 1: Thermal conductivity data for varied forumlations/densities

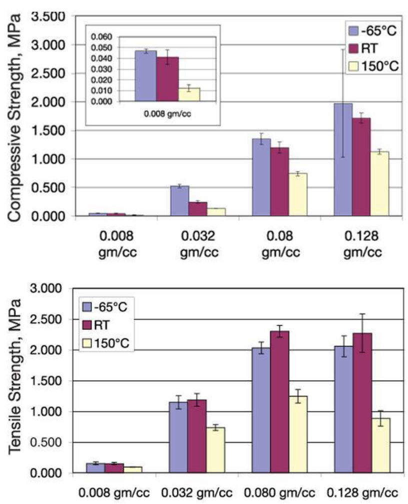

FIGURE 2: Compressive strength of TEEK-L foams (top) and flatwise tensile strength of TEEK-L foams (bottom).

APPLICATIONS

The technology has several potential applications:

- Transportation - aerospace, aircraft, marine, automotive
- Industrial and construction

  -- Fire-resistant materials

  --Improved insulation

  -- Soundproofing materials

  -- Honeycomb core replacement and filler

  -- Vibration damping pads

  -- Ablative components

  -- Abradable seals

  -- Water penetration barriers

  -- Radomes

PUBLICATIONS

Patent No: 6,133,330; 6,180,746; 5,994,418; 6,235,803; 6,222,007; 6,084,000

More Information

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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.

LAR-15977-1, LAR-15767-1, LAR-15831-1, LAR-15831-2, LAR-15745-1, LAR-15831-3