

Polyimide Foam Insulation Materials for Aerospace Vehicles and Spaceport Applications

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Advancements in high temperature materials by NASA have led to the development of polyimide foam systems with very attractive properties. The properties generated demonstrate the suitability of these materials for use as insulation for cryogenic fuel tanks on next generation vehicles, commercial and military ships, and potentially commercial aircraft. The significance of structural polyimide foams can be realized with a reduction in the overall weight of a launch vehicle. Due to a polyimide's high operating temperature (~260°C) structural polyimide foams can potentially reduce the amount of Thermal Protection System (TPS) and TPS integration structure that is required on launch vehicles. The low-temperature elasticity of other polyimide foams is an enabling feature for many new cryogenic applications. These high performance materials also have properties that fulfill the demanding upcoming needs in ground support equipment for a Spaceport Technology Center.

In a research study performed by Kennedy Space Center (KSC) and Langley Research Center (LaRC), polyimide foams were investigated for their physical, mechanical, thermal, and flammability properties. Variations in chemical structure, cell surface area, cell content and density on the resultant physical properties of the foams were studied. Data generated from this research revealed vital information involving foam technology and the interplay of factors such as foam density, open-closed cell content, surface area, and cell structure on the overall performance of the material. By controlling these parameters, new thermal insulation systems based on polyimide foam materials can be designed to meet demanding applications for spaceports and space vehicles.