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NASA TECH BRIEF

Ames Research Center

Fiber-Modified Polyurethane Foam for Ballistic Protection

The problem:

To provide a foam material for filling voids around fuel cells in aircraft. The material must prevent leakage of fuel and spreading of fire in case of a ballistic incendiary impact and also must protect the fuel cell in case of an exterior fire; ideally, the material should be self-supporting and provide an insulative char residue.

The solution:

A closed-cell, semirigid, fiber-loaded, self-extinguishing polyurethane foam material.

How it's done:

The foam is made of a polyurethane resin which incorporates a fire-retardant material and plane-oriented, randomly-distributed, chopped glass fibers. The foam is a white or light amber solid with a fibrous texture, having a density of 0.040 to 0.045 g/cc and an open-cell content of less than 15%.

The formulation is adjusted to have a cream time of about 9 seconds, a rise time of about 17 seconds, and tack-free time of about 45 seconds at an ambient temperature of 24°C and relative humidity of 50%. Then a chopper for the glass fibers is appropriately installed on a spray machine; the chopper is to be run while the foam spray head is operating. The foam ingredients are loaded into the spray machine and the convergence of fibers and the foam spray is made to occur at a distance of 30 to 38 cm from the spray nozzle. The foam-fiber layup is accomplished by moving the spray head in an uniform side-to-side motion about 46 to 61 cm from the mounting substrate. The speed at which the passes are made must be controlled; if the passes are made too fast, the previously-deposited foam will not have creamed and risen, and a nonplanar fiber distribution will result. On the other hand, if the passes are made too slow, the foam becomes tack-free between passes, resulting in interlaminar separation.

Note:

Requests for further information may be directed to:

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Reference: TSP 75-10062

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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