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NASA TECH BRIEF

Lewis Research Center

Rigid Open-Cell Polyurethane Foam for Cryogenic Insulation

The problem:

To devise an effective spacer material for the construction of self-evacuating multilayer insulation panels for cryogenic liquid tanks. The function of the spacer material is to separate the radiation shields with a barrier that minimizes conductive and convective heat transfer between the shields. The spacer material must have a high thermal resistance and must be capable of internal evacuation in order to ensure negligible heat transfer across the material by gaseous convection and conduction.

The solution:

A strong, rigid, lightweight, open-cell polyurethane foam assembled in panels.

How it's done:

Each panel consists of several layers of thin, aluminized polyester (Mylar) films (which serve as thermal radiation shields) separated by sheets of the polyurethane spacer material, all enclosed in a gas-tight, aluminized polyester (Mylar) jacket. Each multilayer panel is then filled with a gas (e.g., carbon dioxide) that condenses (cryopumps) to provide a satisfactory vacuum when one face of the panel is exposed to the cryogenic liquid (e.g., liquid hydrogen).

The polyurethane foam specially developed for the insulation panels has a uniform cell size and spacing (approximately 43 per centimeter) and a compressive strength which will withstand a loading of up to 138 kN/m^2 (20 psi). The foam can be readily sliced to a thickness of 0.508 cm (0.020 in.), can be easily handled even in the thin slices, and can be manufactured in large blocks up to 2.4 x 1.2 x 0.6 m (8 x 4 x 2 ft).

In addition to use in cryogenic insulation panels, the foam can be used for: (1) lightweight filters for low-temperature liquids; (2) stiffening members for structures or devices that must be permeable to various fluids (in the gaseous or liquid state); (3) lightweight, large-area (e.g., whole-room), first-stage or primary filters for air conditioning and pollution control; and (4) reinforcing members for flexible foams now used as low-density, high-porosity, ballistic-shock attenuators in fuel systems.

Notes:

1. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference:
   NASA-TM-X-52332 (N68-26274), Rigid Open Cell Polyurethane Foam as a Cryogenic Multi-Layer Insulation Component

2. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B71-10079

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

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