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.

Source: P. J. Perkins and J. R. Faddoul of
Lewis Research Center,
and G. E. Nies, C. R. Lindquist, and
L. R. Niendorf of
Union Carbide Corp.
under contract to
Lewis Research Center
(LEW-11220)