View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by NASA Technical Reports Server

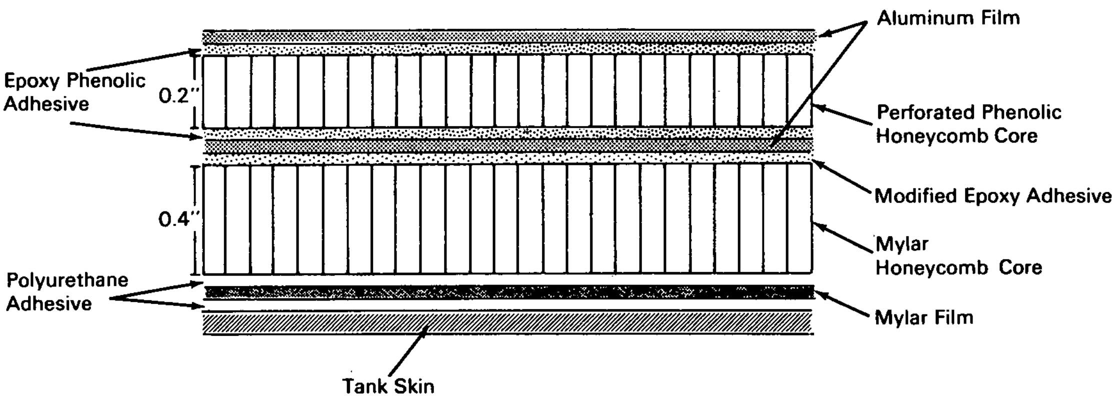
June 1966

Brief 66-10183

NASA TECH BRIEF

NASA Tech Briefs are issued to summarize specific innovations derived from the U. S. space program and to encourage their commercial application. Copies are available to the public from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Insulation for Cryogenic Tanks Has Reduced Thickness and Weight



The problem:

To develop a thin, lightweight insulation for use on external surfaces of cryogenic propellant tanks. In a particular application, the outer surface of the insulation will be exposed to aerodynamic heating which will raise its temperature to approximately 400° F for a short time, while the inner surface, approximately 0.6 inch away, will be at the temperature of liquid hydrogen (–423° F).

The solution:

A dual seal insulation having a weight of approximately 0.5 lb/ft^2 and a thermal conductivity of 0.2 Btu/in./hr/ft^2/°F. The dual seal insulation consists of an inner layer of sealed cell Mylar honeycomb core and an outer helium purge channel of fiberglass reinforced phenolic honeycomb core. Each cell in the Mylar honeycomb core is a hermetically sealed unit so that gases cannot permeate cell to cell.

How it's done:

The operating principle of this system is based upon the self-evacuation of the sealed cells, which is accomplished by the condensation (cryopump) of the air trapped within them when the back surface of the insulation reaches –423°F as the propellant tank is filled with liquid hydrogen.

The honeycomb core used in the helium purge channel is perforated during fabrication, resulting in a 1/16-inch-diameter hole in each side of the cell. These holes allow helium to flow through the entire outer channel. This channel is separated from the inner core by a low permeability aluminum film which is bonded to the inner and outer cores. Another aluminum film, which serves as the outer skin of the insulation, is bonded to the phenolic core with an epoxy phenolic adhesive. A Mylar film is bonded with a polyurethane adhesive to the bottom surface of the Mylar core to form the sealed cell lower insulation. The polyurethane adhesive is also used for bonding the insulation to the tank wall.

In the event that both the outer and inner seals are punctured, helium gas from the outer core will flow through the puncture in the outer seal, preventing air from entering the insulation until repairs are

(continued overleaf)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.

made. The helium will also enter any damaged cells in the lower core through the puncture in the inner seal. However, since each cell in the lower core is individually sealed, the helium is confined to the affected cells. Thus there is no degradation in thermal conductivity in large areas due to local damage.

Notes:

1. The sealed cell Mylar honeycomb is the part of the system that provides the cryogenic insulation. However, the Mylar core softens at a little over 200° F. The heat resistant, phenolic honeycomb core or purge channel portion, is provided to protect the Mylar core from higher temperatures due to aerodynamic heating.
2. Effective applications would require the backface temperature to be low enough to condense the air entrapped in the sealed cells to create a vacuum. It has been found that by fabricating the sealed cell portion in a carbon dioxide or fluorocarbon gas environment, the system could be used for insulating liquid nitrogen or liquid oxygen containers.
3. This material has been applied to surfaces with compound curvatures and around cryogenic transfer lines or pipes down to 1.5 inches in diameter.
4. Further information concerning this invention is given in NASA SP-5030, "Symposium on Technology Status and Trends," Huntsville, Alabama, April 21-23, 1965, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia, 22151. Inquiries may also be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama, 35812
   Reference: B66-10183

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C., 20546.

Source: R. L. Middleton, J. T. Schell,
P. E. Dumire, J. M. Stuckey, et al
(M-FS-326)