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Fire Retardant Foams Developed To Suppress Fuel Fires

The problem:

To develop improved polyurethane foams that will act to retard and suppress fire, especially fuel fires. The foams must be light in weight to enhance their utility in aircraft and spacecraft applications and must be amenable to field installation.

The foam properties desired for fuel fire suppression are:

For Impact Ignition

- (1) Low density void-filling capacity to eliminate atomization of combustible liquids.
- (2) Closed cell foam structure with self-sealing skin to prevent wicking and outpouring of combustible liquids.
- (3) Pyrolyze at a low temperature and high rate to release halogen radicals to inhibit ignition.

For Sustained Fire Protection

- (1) Decompose at a moderate rate to give low molecular weight species to quench flames.
- (2) Have excellent ablation efficiency at heating rate to minimize heat transfer to vehicle structure.

The solution:

A heat insulating and fire retardant and suppressant material in the form of a semirigid or rigid polyurethane foam having uniformly dispersed in it a substantial amount of a halogenated polymer capable of splitting off hydrogen halide upon heating and charring of the polyurethane.

How it's done:

The main structure of the material is a rigid or semirigid polyurethane foam, e.g., one prepared from a polycyclic aromatic polyisocyanate and a highly branched polyol, in which are incorporated one or more materials to impart special properties. One of the

added materials is an alkyl halide resin such as polyvinylchloride which is capable of splitting off hydrogen chloride. Other materials which may be, and preferably are, added are certain inorganic salts, (e.g., potassium fluoborate) and encapsulated volatile halogen compounds such as trifluorotrichloroethane. The density ranges from 2.0 to 50 pounds per cubic foot, and the foam can be sprayed as a liquid. The foam can be placed in areas of limited access by the spray technique. After burning, the foam leaves a stable char which acts as an effective insulator.

Notes:

1. The foam is particularly effective for protecting structures against the destructive action of fuel fires; consequently, there should be many applications in both military and commercial fields.
2. Potential industrial applications probably exist in the construction industry, oil refineries, paint manufacturing, marine installations, chemical plants, natural gas stations, etc.
3. The foam appears to have potential as a low temperature heat shield for entry vehicles. It could prove extremely valuable in such an application because of its light weight.
4. Additional details are contained in the following paper: *Development of Polyurethane as Thermal Protection Systems for Controlling Fuel Fires in Aircraft Structures*, by J. A. Parker, S. R. Ricci tiello, W. J. Gilwee, and R. Fish. Presented at the 25th Annual Conference of the Society of Plastic Industries, May 1-3, 1968, San Francisco, California. Copies of this paper are available from:
Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: B68-10358

(continued overleaf)

Patent status:

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

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