NASA TECH BRIEF

Lyndon B. Johnson Space Center

Polymer Compositions Suitable for Use in Enriched Oxygen Atmospheres

The problem:

Current flame-resistant fibrous materials developed for spacesuit outer cover layer are inorganic and have poor abrasion resistance and durability. Organic materials, on the other hand, could be used to improve these characteristics but they do not meet the flame resistance requirements.

The solution:

Four organic polymer systems have been developed which meet the flame resistance requirements.

How it's done:

Of the four organic polymer systems, three are based on a copolymer of chlorotrifluoroethylene, ethylene, and tin-based flame retardants. Each system contains, respectively, a different tin-based flame retardant as follows: 15 percent stannic oxide hydrate, 10 percent stannous oxalate, and 5 percent stannous phosphate. The fourth system is a copolymer of chlorotrifluoroethylene (CTFE) and tetrafluoroethylene (TFE) in the composition range of 40 to 70 mole-percent CTFE and 60 to 30 mole-percent TFE. This polymer system, referred to as the ECS copolymer, contains no stabilizers or flame retardant additives. Fibers produced from the ECS copolymer have shown best fire retardant properties in a 70-percent oxygen and 30-percent nitrogen environment.

A typical 50/50 copolymer used for the fire retardant material is prepared as follows: A 1-gallon (3.8-liter) stainless steel autoclave is charged with 2 liters of deareated 1,1,2-trichloro-1, 2,2-trifluoroethylene. The reactor then is sealed and evacuated. After evacuation, 500 grams of chlorotrifluoroethylene are introduced into the reactor where they condense followed by enough tetrafluoroethylene gas to obtain a liquid phase composition of 50 mole-percent of each monomer. An organic peroxide initiator dissolved in 100 cm^3 of chloroform is then introduced and the reaction is carried out for 6 hours. At the end of this period, the reactor is vented, and the polymer is discharged as a thick slurry in the solvent. It is filtered and washed with excess methanol and dried for 20 hours to obtain 300 grams of polymer melting at 242° C. The polymer is analyzed to approximately 50 mole-percent of each monomer and has a melt index of about 4.2 at 300° C with a load of 2160 grams.

Note:

This technique is described in the following report:
"Flame Resistant Fibrous Materials"
Reference: NASA CR-134062 (N74-18192).

This report may be obtained from:
National Technical Information Service
Springfield, Virginia 22151
Single report price $6.50
(or microfiche $1.45)

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:
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