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Manned Spacecraft Center

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Flame Resistant Elastic Elastomeric Fibers

The problem:

To improve the flame resistance of the elastic elastomeric fibers (flexible urethanes), while maintaining good strength, elongation, recovery, and modulus.

The solution:

Two approaches were successful: synthesis of polyether based urethanes from halogenated urethane monomers, and modification of synthesized urethanes with flame-retardant additives.

How it's done:

Flame retardant polyurethane structures were synthesized from brominated polyesters derived from aromatic polyols and dibasic acids. The products from this process exhibited flame resistance in atmospheric environments with oxygen contents ranging from that of air to 100 per cent.

The most promising composition in this category consisted of a brominated neopentyl glycol which was treated with toluene diisocyanate and used as a conventional diisocyanate in conjunction with hydroxyl-terminated polyethers or polyesters. The elastomeric urethanes thus derived contained about 10 per cent bromine by weight. They would not burn in air, had an oxygen index of approximately 25 (see note 1), and exhibited tensile strength values of approximately 34×10^6 N/m^2 (5000 psi) at 450 per cent elongation.

Aromatic halide additives have been found to be the most efficient flame retardants for urethanes, and the most effective of these were the bromide compounds.

Hexabromobenzene in conjunction with trisbromochloropropyl phosphate (in the ratio 7:3) was an effective flame retardant additive for flexible urethane. Hexabromobenzene has a high melting point and good thermal stability. Trisbromochloropropyl phosphate provided some plasticizing effects to the polymer in addition to imparting flame resistance. The physical properties of the modified polyurethane were directly proportional to the additive present. The oxygen index was directly proportional to the total halogen in the system.

Fluorinated elastomer (in combination with hexabromobenzene and trisbromochloropropyl phosphate) was also found to be an effective additive to other flame retardants. The combination resulted in better physical properties and flame retardancy at the same halogen content than hexabromobenzene and trisbromochloropropyl phosphate alone.

Elastomeric fibers prepared from these compositions exhibited a greater degree of flame retardancy than available in commercial products. However, improvement of the physical properties of these fibers is necessary. The flame resistant fibers have potential industrial, commercial, and household applications in the reduction and prevention of fires and fire hazards. Such fibers may be manufactured into drapes, carpeting, bedding, and upholstery and may find applicability in the manufacture of suits for firemen.

Notes:

1. The oxygen index of a material is defined as the percentage concentration of oxygen in a mixture of oxygen and nitrogen at atmospheric pressure that will support sustained combustion of the material.
2. 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-CR-115227 (N72-28568). Development of a Flameproof Elastic Elastomeric Fiber.

(continued overleaf)

Patent status:

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

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