PREPARATION AND PROPERTIES OF ACRYLONITRILE-HALOAKYL ACRYLATE/METHACRYLATE COPOLYMER FIBERS

by

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DEPARTMENT OF TEXTILE TECHNOLOGY

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Dedicated to my beloved brother

Shri MUNIRATHINAM DHAMOTHARAM
of
ERUKKAMBUT

CERTIFICATE

This is to certify that the thesis entitled "Preparation and Properties of Acrylonitrile-Haloalkyl Acrylate/Methacrylate Copolymer Fibers", being submitted by Mr. M. Padmanaban, to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy in the Department of Textile Technology, is a record of bonafide research work carried out by him. Mr. M. Padmanaban has worked with my guidance and supervision and has fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Acrylonitrile was copolymerized with haloalkyl acrylates/methacrylates namely, 3-chloro, 2-hydroxypropyl acrylate (CHPA), 3-chloro,2-hydroxypropyl methacrylate (CHPMA), 2-chloroethyl acrylate (CEA), 2-chloroethyl methacrylate (CEMA), 2-bromoethyl acrylate (BEA), and 2-bromethyl methacrylate (BEMA). Halogen containing comonomers were chosen with a view to study the effect of these comonomers on the flame retardancy of the copolymers apart from improving the moisture sorption and dyeability of the fibers. The kinetics of copolymerization was studied and the reactivity ratios were calculated by Kelen-Tüdös method.

Viscometry, IR, NMR, density, and X-ray diffraction techniques have been used to characterize the copolymers. The ^{13}C nmr spectra are interpretted in terms of steric configurations of triad AN units. The sequence distribution of comonomers in polymers containing higher amounts of 3-chloro,2-hydroxypropyl acrylate and methacrylate (12-14 mol%) is discussed. The thermal characteristics of the copolymers were studied using differential scannining calorimetry (DSC) and thermogravimetric analysis (TGA). A possible mechanism

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for the nitrile oligomerization in the copolymers is proposed based on DSC, TGA and IR studies. The flammability behavior of the copolymers has been assessed based on their oxygen index (OI) values.

Copolymers containing 2-10 mol% of the comonomers have been wet-spun on a laboratory scale bench model spinning unit using 1:1 V/V DMF-water coagulant at 5°C. Density, X-ray crystallinity and orientation, sonic modulus, moisture sorption and tensile properties of the fibers were measured. Tensile properties of the fibers are related with the morphology and the physical properties. The dyeability of the fibers has been studied using three basic dyes viz., Panacryl Brilliant Red 2B, Basacryl Red 2GL, Basacryl Yellow 5GL and two disperse dyes, Supracet Fast Brown 5R and Cibacet Orange 2R. The rate of dyeing was determined and the diffusion coefficients have been related to the molecular size of the dye molecules as well as to the structure of the copolymer fibers. The light and color fastness data of the dyed fibers have also been presented.

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