

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

by
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Submitted
in fulfilment of the requirements of the degree of
DOCTOR OF PHILOSOPHY



TO THE
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
May 1984

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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ACKNOWLEDGEMENTS

It is difficult to mention the names of all those who helped me during the various stages of the present thesis. However, I wish to record my gratitude in particular, to Dr. (Miss) P. Bajaj, Professor & Head, Department of Textile Technology, Indian Institute of Technology, Delhi, for her keen interest, constant encouragement, and painstaking efforts to complete this dissertation. I am specially thankful to her for helping me finish the work even after office hours without minding the discomfort.

I am thankful to the Departmental Research Committee and the authorities of IIT, Delhi for providing the financial support.

I take this opportunity to thank Dr. K.V. Datye, Director, SPRC, Kota, Prof. R.P. Gandhi, Chemistry Department, Dr. Amitabh Jain, Asstt. Professor, ITMMEC and Dr. Thangaraj, Physics Department for helping me in some of my experimental work.

My sincere thanks are due to Mr. H.C. Sharma of IDDC, and technical staff of Glass Blowing Section, NMR, X-ray and SEM Laboratories for their co-operation.

I wish to record the names of some of my friends, viz., Chakrapani, Mishra, Manjeet Kaur, Siddhartha, Ramesh, Rajan, Murali, Sukumar and Balu out of which many helped and

few disturbed me during my work. It gives me pleasure to thank Subramani . and Krishnamoorthy for informing me about the happenings in my native, which I liked most.

My special thanks are due to Surya Kumari, Manjeet Kaur and Ramesh Bapu for enabling me to compile the present manuscript.

I am indebted to Shri S.R. Krishnan and Shri A.N. Krishnan families, for I disturbed them whenever I felt homesick during my stay in Delhi.

I am also indebted to my mother & sisters for their encouragement with love and attachment to finish the work. And also to my uncles, G.C.G. Naidu and B.V. Naidu and my cousin brother K. Dhakshinamoorthy and other relatives for their interest in my studies.

Finally I would like to acknowledge the expert tracings by Mr. K.G. Padam and typing by Mr. R.K. Arora for all my research communications. And Mr. Mast Ram for expert and neat duplication.

M. Padmaraban
14/5
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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 interpreted 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 scanning 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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