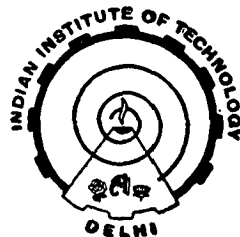


**FLAME RETARDANT FINISHES FOR
POLYESTER/CELLULOSIC BLEND FABRICS**

by
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DEPARTMENT OF TEXTILE TECHNOLOGY

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

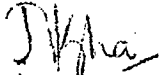


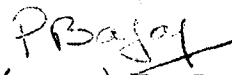
TO THE
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
JULY 1984

CERTIFICATE

This is to certify that the thesis titled "FLAME RETARDANT FINISHES FOR POLYESTER/CELLULOSIC BLENDS FABRICS", being submitted by Mr. S. Chakrapani, 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. S. Chakrapani has worked under our 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 a pleasure thanking Prof. (Miss) P. Bajaj, Head, Textile Technology Department and Prof. N.K. Jha, Head, Chemistry Department, Indian Institute of Technology, Delhi, for their encouragement and guidance throughout the course of this work. I am grateful to them for their constructive criticisms and valuable suggestions without which the thesis would not have seen its present form.

I am highly indebted to Dr. Amitabh Jain, Asstt. Professor, ITMMEC, for the co-operation and help he offered unhesitatingly in effectively utilizing the IR and DSC facilities of his laboratory for the present work.

I gratefully acknowledge the understanding and encouragement I received from my colleagues and friends, especially Mr. M. Karuppusamy for helping me in the computer work.

I also thank the technical staff of the Departments of Textile Technology, Chemistry and ITMMEC, for their co-operation throughout this investigation. I am particularly thankful to Mr. V.K. Kala, Textile Technology Department for his help in some of my experimental work.

My special thanks are due to M/s-M. Padmanaban and C. Ramesh, for their ungrudging help in the compilation of the manuscript, and to Mr. A.C. Misra for the valuable discussions I had with him, many of which I had incorporated in the thesis.

The financial assistance provided by the CSIR, India and the Indian Institute of Technology, Delhi, for carrying out this research programme is gratefully acknowledged.

I am also thankful to Mr. Rajesh K. Arora for his elegant typing and Mr. K.G. Padam, for the neat tracings.

S. Chakrapani

(S. CHAKRAPANI)

TO THOSE INNUMERABLE LIVES LOST TO
THE FURY OF FLAMES

ABSTRACT

Plain-weave cotton and polyester/cellulosic blends were flame retarded using P-N, Sb-X and P-Sb-X FR systems. IR spectral investigations of the FR-treated samples were conducted to identify the structures formed on the fabric. Thermal studies were carried out to examine the pre-ignition interactions in the FR-treated systems. Flame retardancy of the samples was evaluated by measuring their oxygen index (OI), burning rates and resistance to surface ignition.

In the P-N system of flame retardants, N-methylol agents, viz., urea-formaldehyde (UF), trimethylolmelamine (TMM), dimethylol ethylene urea (DMEU), and dimethylol dihydroxy ethylene urea (DMDHEU) were applied as post-treatments to study their effect in enhancing the FR properties of phosphorylated cotton and polyester/cellulosic blends. UF was found to be effective on cotton, when used as a post-treatment and also when applied in a single step with diammonium phosphate, in enhancing the OI of the system.

Phosphorylated polyester/viscose blend fabrics were also post-treated with $ZrOCl_2/Sb_2O_3$, $TiOSO_4$, and Na_2SnO_3 to improve their resistance to deactivation by hardness ions. The post-treated fabrics were subjected to four hard-water

laundering cycles using 220 ppm hard-water. All these metal complexing agents rendered the phosphorylated blend resistant to deactivation by hardness ions throughout the four cycles of wash.

Antimony-halogen systems - triphenyl stibine dibromide, its tribromophenol and pentachlorophenol derivatives, and Sb_2O_5 /tetrahalophthalic anhydrides - were evaluated on cotton, polyester, phosphorylated and control polyester/viscose blend fabrics. Sb_2O_5 /tetrabromophthalic anhydride post-treatment of phosphorylated polyester/viscose blend recorded the highest OI encountered in the entire investigation. The structural response of the control and FR-treated polyesters/viscose blend fabrics to exposure to a standard flame were investigated by scanning electron microscopy.

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