STUDIES ON FALSE-TWIST TEXTURISATION OF NYLON 6

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

February 1978

Dedicated to my beloved Parents

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to my revered teachers Prof.A.K.Sengupta and Dr.A.K.Mukherjee, of the department of Textile Technology for their keen interests and valuable guidance constantly throughout the present investigation.

My sincere thanks are due to:

Prof.D.S.Varma, Head, Department of Textile Technology for providing the necessary facilities in the Department.

Prof.V.B.Gupta of the department of Textile Technology for the valuable suggestions in computing x-ray crystallinity data.

Dr.V.V.Chipalkatti of J.K. Synthetics, Ltd., Kota for supplying the nylon-6 yarn and Dr. S.N. Chakraborty of BAYER(I) Ltd., for the antioxidant sample used in the present study.

Dr.N.E. Dweltz, ATIRA, Ahmedabad and Dr.N.B. Patil, CTRL, Bombay for their guidance in carrying out the x-ray investigations.

Dr. Venkatesh, ATIRA, Ahmedabad for his help in conducting optical properties' measurements.

Dr. Allen Hepworth for his help in SEM Studies.

Dr.B.R. Handa, Deptt. of Mathematics, I.I.T. for his valuable guidance in statistical analysis.

Dr.N. Debnath Ray, Mr. S. Kumar, Miss Achla Gupta, Mr. P.K. Ganguli and friends for their invaluable help extended in various ways.

Mr. M. Mortazavi and Mr.P.I. Reddy for their help in printing SEM photographs.

Mr.K.G. Padam for tracing the figures very neatly.

ABSTRACT

False twist texturisation of nylon 6 is a complex thermo-mechanical process involving fundamental changes in the properties of the polymer. An attempt has been made to study the nature of these changes and to relate them with the properties of the textured filament.

It is observed that as a consequence of texturisation, there is a drop in average intrinsic viscosity of the polymer and a broadening of its molecular weight distribution. A change in the distribution affects the tensile properties considerably more than the change in the average intrinsic viscosity. A broader distribution results in a poorer breaking stress and a higher breaking strain. The nature of the distribution is influenced by both chain scission and repolymerisation which occur more or less simultaneously. Of the degradative forces operative during texturisation, the mechanical force is the most predominant followed by thermal and thermo-oxidative forces. The thermal force is both reformative and degradative in nature. The thermo-oxidative force is beneficial to the effect that it tends to retard the reformative process and in so doing has a restrictive influence on the breadth of the distribution curve. The degradative influences do not result in any detectable change in the chemical entity of the polymer.

The thermal stability of the polymer is only influenced marginally by the texturisation process. The IPDT is changed considerably only under extremely severe texturisation conditions. There appears to be a relationship between IPDT and amount of lower molecular weight fraction and between weight loss before IDT and IDT.

X-ray crystallinity, crystal size and density all improve with texturisation, the thermal history during texturisation having the most predominating influence over these parameters. Optical birefringence, sonic modulus, crystalline orientation all decrease showing the disorienting influence of texturisation. The lower initial modulus of a textured yarn is related to the decrease in over all orientation as established from the relationship between birefringence and initial modulus. Crimp rigidity, which is a measure of the degree of set improves with the enhancement of x-ray crystallinity. Breaking stress and breaking strain do not show any definite relation with the change in structure.

The average breaking stress of individual filaments for any process condition is higher than the bundle breaking stress. This is due to strain asymmetry in the individual filaments. The shapes of the breaking strain distribution curves of individual filaments as well as the viscosity distribution curves have been assessed in a semi-quantitative manner with the use of Scherer's shape factor. It is observed that the inhomogeneity in the properties of constituents forming an aggregate has important influence on the failure of the aggregate and that shape factors of both the distribution curves have similar influences on the breaking stress of textured yarns.

CONTENTS

Mr. Rajesh Arora and Mrs. V. Menon for neatly typing the manuscript of the thesis.

All the members of the staff of various laboratories in the department.

Lastly I would like to thank the C.S.I.R. (New Delhi) for granting the necessary finance for the project.

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CHAPTER III to VIII

RESULTS AND DISCUSSION