TEXTURING
OF
CELLULOSICS AND POLYESTER-CELLULOSIC BLENDS

BY

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DEDICATED

to someone who
DRAGGED & NAGGED
perpetually

to put me thro' this
ORDEAL

CERTIFICATE

This is to certify that the thesis entitled "TEXTURING OF CELLULOSICS AND POLYESTER/CELLULOSIC BLENDS", submitted by Mr. Kushal Sen to the Indian Institute of Technology, Delhi, for the award of degree of DOCTOR OF PHILOSOPHY is a record of the bonafide research work carried out by him. Mr. Kushal Sen has worked under our guidance for the submission of this thesis, which to our knowledge has reached the requisite standard.

The thesis or any part thereof, has not been submitted to any other University or Institution for the award of any Degree or Diploma.

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ABSTRACT

The production of textured yarns from the synthetic fibres has reached a high level of development. Though, textured thermoplastic yarns possess stable high bulk and good retractability, they suffer from poor hygroscopicity and high level of proneness to static charge development. On the other hand, though, cellulosics provide desirable comfort properties, the texturing of cotton, using the crosslinking resins, brings a considerable drop in strength properties. Moreover, the crimp stability of textured cellulosics is also poor, and the fabrics made from these show poor recovery at the critical areas of strain, demonstrating poor retractability. To overcome this problem, texturing of polyester/viscose blends has been attempted.

Texturing of the blended yarn faces new challenges due to the complex behaviour of the bicomponent yarn. The setting of deformation in the polyester component requires heat setting around 200°C, while the setting of the cellulosic component is accomplished through crosslinking, by conventional pad-dry-cure process, at 140°-160°C. Accordingly, the texturing of polyester/cellulosics becomes a two-step batch process. The texturing of blended yarns, could be of commercial interest, if both the components are set simultaneously.

In the present investigation, texturing of the blended polyester/viscose yarns has, therefore, been accomplished via the "twist-set-detwist" (batch), or the "false-twist" (continuous) process. The setting of the two components was done through the following two routes :

1. Simultaneous setting of both, the polyester and the viscose components by rapid curing ($210^{o}C$), where polyester is set by thermally induced crystallization and viscose is set by collapsed crosslinking. Various resins used were, Finish KVS Liquid New (Sandoz), Textile Resin U-4750 (BASF) and DMDHEU.

2. Simultaneous setting of the components by immersing the yarn in a mixture of crosslinking agents (e.g., epichlorohydrin and hexamethylene diisocyanate) and highly plasticizing solvents (e.g., tetrachloroethane and dimethylformamide). In this process, polyester is set by solvent-induced crystallization, and viscose by wet crosslinking.

In the first process, an attempt has been made to bring the crosslinking time and temperature, as close to the requirements of polyester heat setting as possible. This envisages the selection of suitable catalysts with considerably enhanced efficiency, than hitherto employed in resin finishing. Efficiency of various crosslinking catalysts, like phase-separation catalysts, self-limiting catalysts, basic aluminium chloride, mixtures of glycollic. acid and magnesium chloride, etc., has been studied in conjunction with DMDHEU to produce textured viscose yarns. It was observed that magnesium dihydrogen phosphate and basic aluminium chloride are the most efficient catalysts for producing textured viscose yarns of high crimp rigidity and good strength. These catalysts were then employed to texturize polyester/viscose blended yarns using DMDHEU. Finish KVS Liquid New (Sandoz) and Textile Resin U-4750 (BASF), have also been used for the texturing of the blended yarns. The effect of the blend composition on the performance of the textured yarns, in both dry and wet state, has also been studied.

After evaluating the performance of the textured yarns using the batch process, magnesium dihydrogen phosphate was used for continuous texturing of the polyester/viscose yarn, using false-twist technique. The effect of the residence time in the heater, and the heater temperature, have also been investigated.

The post-dyeing of textured blended yarn is a problematic process because, firstly, it is a bicomponent yarn, and secondly, the crosslinking of viscose tends to reduce the dye uptake and leads to non-uniform dyeing. To overcome this problem, simultaneous dyeing and texturing of blends, using mixtures of the reactive and the disperse dyes, has been attempted for the first time.

The second process is an entirely new method for the texturing of the blends, and employs solvent-induced setting of polyester in conjunction with wet crosslinking of viscose. The crosslinking agents used in this process are epichlorohydrin and hexamethylene diisocyanate while the solvents employed are tetrachloroethane and dimethylformamide.

A comparison of the properties of the textured yarns, obtained by the two methods, shows that while the crimp rigidity and strength of textured yarns are more or less similar, the disperse dye uptake of the yarns textured through solvent system is phenomenally high.

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