STUDIES ON TEXTURING AND SETTING OF CELLULOSE DIACETATE AND TRIACETATE YARNS

by

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CERTIFICATE

This is to certify that the thesis entitled "STUDIES ON TEXTURING AND SETTING OF CELLULOSE DIACETATE AND TRIACETATE YARNS" being submitted by R. Narayanasamy to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy is a record of the bonafide research work carried out by him under our guidance and supervision.

To the best of our knowledge this thesis has reached the requisite standard. The material presented in this thesis, in part or full, has not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Cellulose diacetate and triacetate yarns are commonly solution spun and are available as continuous filament yarns. It is widely known that texturing imparts the filament yarns a soft feel and stretch, and these functional advantages have increased the consumer acceptance. It is, thus, of interest to investigate the texturizability of cellulose acetate yarns. Since setting forms an important event of texturizing and fabric creasing, in the present studies the setting behaviour of acetates are also investigated. The most commercially employed process for texturing thermoplastic fibres like polyester and nylon is based on the twist-set-detwist principle which forms the basis for all false-twist texturing machines. The process essentially consists of, simultaneously, twisting and heating a multifilament yarn and subsequently reverse twisting (detwisting) it by the same degree after cooling. The combined actions of thermal and mechanical forces break the secondary valency bonds resulting in partial decrystallization and the secondar valency bonds are reformed, on cooling, in the deformed configuration and the polymer recrystallizes. Thus, a memory of the deformation is set onto the filaments by thermal energy. The setting is also achieved by the actions of solve on the mechanically deformed filament. The basic mechanism

of solvent-texturing is very much the same as thermal-texturing involving the same three rate processes, i.e., bond breaking, structural stabilization by chain relaxation, and bond reformation. In this investigation, texturizability of acetates by thermo-mechanical and chemo-mechanical methods are investigated.

The cellulose acetate yarns are heat-stabilized in CS-12 minibulk machine, and their mechanical and structural properties are studied. It is found that the triacetates set at higher temperatures develop a limited amount of morphological order while the diacetates do not because of molecular structural irregularity which is a prime criterion for setting and crystallization. The acetate yarns are textured and the properties of the textured yarns with variou texturing parameters are investigated. The degree of texturi zability of triacetate yarns are higher due to ease of settir during texturing. A new method of continuous chemo-texturing of acetate yarns is evolved. This involves the immersion of the yarn in the solvent and passing through the false-twis texturing machine with a reduced heater temperature to evaporate the imbibed solvent. The properties of solvent-textured triacetate yarns are superior than thermal-textured yarn.

The textured acetate yarns show a multiplicity of breaks which lead to the lowering of bundle tensile properties. The asymmetric configurations of the individual filaments comprising the multifilament yarn lead to uneven load-sharing among the filaments resulting in the deterioration of the tensile properties of the textured acetate yarn. The absence of any development of morphological order following texturing in both di and triacetates show that the stability of the crimped configuration in these yarns is not due to ceystallization. The primary setting mechanism in textured acetates appears to be a set through chain stiffenin The set achieved through this mechanism is highly stable in case of acetates due to very high T_g of the polymers.

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