STUDIES ON THE INFLUENCE OF SOME RAW MATERIAL AND OTHER PARAMETERS ON THE STRUCTURE AND PROPERTIES OF AIR-JET TEXTURED YARNS

by

R. S. RENGASAMY

Department of Textile Technology

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CERTIFICATE

This is to certify that the thesis entitled 'Studies on the Influence of Some Raw Material and Other Parameters on the Structure and Properties of Air-jet Textured Yarns' submitted by Mr. R.S. Rengasamy 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 Mr. R.S. Rengasamy. He has worked under our guidance for the submission of this thesis, which to our knowledge has reached the requisite standard.

This thesis or any part thereof, has not been submitted to any other University or Institution for the award of any degree or diploma.

(A.K. Sengupta)
Professor

(V.K. Kothari)
Asstt. Professor

Thesis Supervisors
Department of Textile Technology
Indian Institute of Technology, Delhi
New Delhi-110 016.

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(R.S. Rengasamy)

Dedicated to

My

Parents

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ABSTRACT

In the air-jet texturing process, the action of fluid forces causes the filaments of continuous filament yarns to separate, forces them to form loops of various configurations and to entangle. The form and frequency of loops are expected to influence the appearance and properties of fabrics made with the air-jet textured yarns. Many methods of analysis of the structure and measurement of the more important properties of these yarns such as instability and bulk have been reported, without agreement regarding the suitability of these methods. This has led to differences in the interpretation of the texturing behaviour.

A method of analysing the structure of air-jet textured yarns is described. This method is used to quantify the structural parameters such as configuration of loops, loop frequency, average loop height and length, and core diameter. The various methods of assessing the instability of air-jet textured yarns are evaluated as regards their suitability. It is found that the instability values measured by all the methods have a good correlation with texturability. However, the measure of instability based on the extension values of the yarns is dependent on parent yarn extension properties and hence cannot be used for comparing the stability of textured yarns made using parent yarns of different filament extensibilities. The instability test method, based on percentage decay in the

work done after a fixed number of repeated loading cycles, which is not influenced by the extension properties of parent yarns and also simulates the deformation pattern of the yarns during processing and while in fabric form, is, therefore, recommended. To evaluate the bulkiness of air-jet textured yarns, the methods reported in the literature to assess the bulk, and also the relationship between the physical bulk measured by the package density method and structural parameters such as core diameter and loop frequency are studied. The static and dynamic wicking behaviour of air-jet textured yarns are examined in terms of the structure and filament properties.

Water plays an important role in air-jet texturing. Wetting of the supply yarns before entering the texturing jet, is known to improve texturability. Changes in the fluid properties inside the jet and a reduction in the friction of filaments during texturing are the explanations put forward by various research workers. To study the influence of water, polyester yarns of different friction levels and nylon yarns conditioned in environments of different relative humidities have been textured in both dry and wet conditions.

A test rig was fabricated to measure the interfilament friction. The tensions generated at the nozzle exit and in stabilizing the structure, the instability, bulk, mass uniformity and tensile properties of air-jet textured yarns have also been studied in relation to the frictional levels of the filaments. Friction influences the structure and properties of air-jet textured yarns. A deterioration in air-jet textured yarn quality has been observed at higher levels of interfilament friction. It has been found that the role of interfilament friction is same within dry and wet textured yarns. Discrepancies between the structures of dry and wet textured yarns and yarn properties are observed when they are analysed in terms of friction levels of feeder yarns during texturing. The results suggest that the role of water is not related to frictional aspects alone.

The analysis of the influence of filament parameters on the structure and properties of air-jet textured yarn is important in understanding the interaction between the filaments and fluid forces during the process. Filament parameters such as filament fineness, cross-sectional shape and the number of filaments in the yarn have been studied in relation to their influence on structure and properties. A high level of dependence has been observed.

Texturability of yarns with heavier filaments is poor in terms of loop frequency, loop height and length, loop shape and yarn bulk. Yarns with trilobal filaments perform better in air-jet texturing compared to yarns with circular filaments of similar fineness. There is an optimum number of ends for good stability of textured yarns using a particular jet. Mass uniformity, tensile strength realisation and bulk levels of air-jet textured yarns tend to improve with an increasing number of ends.

The air-jet texturing process provides an effective means of blending yarns with filaments of different chemical natures and properties. As the appearance of fabrics is influenced by the blend uniformity of the constituent threads, an understanding of the role of the various parameters of air-jet texturing in influencing blend uniformity is important, so that the required degree of blend intimacy in the air-jet textured yarns may be engineered. Blend inhomogeneity is quantitatively assessed in relation to raw material and nozzle parameters etc. Blend uniformity is poor in the case of blends of components of dissimilar properties. Blend homogeneity improves with the degree of texturing as assessed by the delivery zone tension. In the case of components of similar properties, finer filaments are found to produce better blend homogeneity.

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