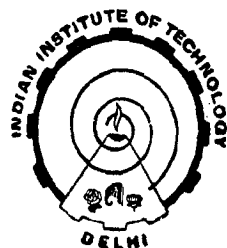


**STUDIES ON STRUCTURE AND PROPERTIES
OF
ROTOR AND RING SPUN YARNS**

By
H.V. SREENIVASA MURTHY

A thesis submitted to the
Indian Institute of Technology, New Delhi
for the award of the degree of
DOCTOR OF PHILOSOPHY



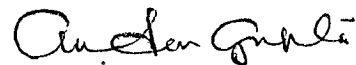
DEPARTMENT OF TEXTILE TECHNOLOGY
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
FEBRUARY, 1986

DEDICATED
TO
MY BELOVED PARENTS

CERTIFICATE

This is to certify that the thesis entitled 'STUDIES ON STRUCTURE AND PROPERTIES OF ROTOR AND RING SPUN YARNS', being submitted by Mr. H.V. SREENIVASA MURTHY, 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. H.V. Sreenivasa Murthy has worked under my guidance and supervision and has fulfilled all the requirements for the submission of the thesis, which to my knowledge has reached the requisite standard.

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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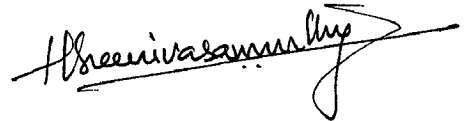
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ABSTRACT

Yarn production by rotor spinning technique which was an emerging technology a decade or two ago is now firmly established in the textile industry as a major route for spinning short staple fibres.

Even before the advent of the rotor spinning system the subject of 'twist' was one of the factors much debated by the technologists. It is well known that 'twist' is the spiral disposition of the components of a thread which is usually the result of relative rotation of two ends, and twist is an essential element to give a yarn coherence and strength.

The topic of twist in yarn structure assumed complex dimension when rotor spinning was introduced because the relative rotation of the ends are done in a different manner as compared to ring spun yarn

Transmission of twist during rotor spinning is studied using a simple plucking technique to investigate the structure of fibre assembly during yarn formation in rotor spinning. Physical state of fibre mass, twist distribution, incidence of wrapper fibres measured in a striped yarn are discussed.

Systematic classification of belts according to structural configuration is attempted, and the influence of twist on percentages of belts belonging to each category is reported. Twist loss during spinning for rotor and ring spun yarns are investigated. It is established that the untwist method of estimating twist in yarn gives a reliable estimate of the actual twist in yarn.

Twist to break and detwist to break studies were carried out to highlight the influence of twist densities on structural characteristic differences in the yarn structures.

Porosity of rotor and ring spun yarns as determined through wicking behaviour show that wicking in rotor spun yarns is less sensitive to twist than the corresponding ring spun yarns.

Comparison of the results of migration parameters of rotor and ring spun yarns show that ring spun yarn possesses higher migration values than rotor spun yarns. Migration of ring spun yarn is found to increase with increasing twist whereas in case of rotor spun yarns the migration decreases initially and increases after a certain level of twist.

The influence of twist on tensile behaviour of rotor and ring spun yarns are reported. The influence of the structural differences on tensile properties, breaking energy behaviour, initial modulus etc. are highlighted.

The influence exerted by mode of twisting on tensile properties of rotor and ring spun yarns are compared. Two modes of twisting, namely, static twisting and dynamic twisting (ring traveller twisting) are used in two stage twisting method. One important finding emerging out from this study is that when low twisted yarn is dynamically twisted, addition of twist upto a certain level markedly improves the strength of rotor spun yarns

The breaking energy of dynamically twisted rotor yarns is also observed to be generally higher than the corresponding ring spun yarns. This is particularly true when high twist levels are employed. This behaviour shows that in certain applications where high level of twist densities are required rotor spun yarn may be superior to the ring spun yarn.

Some important parameters influencing the tensile behaviour of rotor and ring spun yarns are examined through estimation of fibre rupture during tensile failure, translation efficiency of fibres in rotor and ring spun yarns and influence of interfibre frictional interactions. It is found that the percentage fibre rupture in rotor spun yarn is thirtytwo to thirtyfive percent lower than ring spun yarns. The translation efficiency in rotor yarn is found to be twentyfive to thirty seven percent lower with polyester and fourteen to thirtytwo percent lower with viscose yarn as compared to ring spun yarns. Irrespective of the fibre type, shorter length fibre give better

translation efficiency as compared to longer length fibre in rotor spun yarns. An opposite trend is seen with ring spun yarns.

By altering interfibre friction during tensile testing through the use of a special jig for 'in-situ' testing of polyester yarn under different medium it is observed that the interfibre frictional interaction has a greater influence on tensile behaviour of ring spun yarns than rotor yarns.

The influence of fibre characteristics, namely, fibre type, fibre denier and fibre length on the mechanical properties of rotor and ring spun yarns are studied. It is found that shorter length and finer denier fibre is more suitable for rotor spinning.

Finally the structural reinforcement through belts and its influence on tensile properties of rotor yarns are examined. Belts are intentionally generated by the use of fifteen percent shrinkable coarser denier, longer length acrylic fibre component in blend with viscose staples. Belts are then allowed to shrink, through application of heat, to increase belt compression on yarn. A high increase in modulus, tenacity and breaking energy can be achieved through radial compression of belts.

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