INVESTIGATIONS ON CERTAIN ASPECTS OF ROTOR SPINNING AND MECHANISM OF FORMATION OF ROTOR SPUN COTTON YARNS INTO LOOP AS WELL AS GEOMETRY AND DIMENSIONAL PROPERTIES OF THE RESULTANT PLAIN WEFT KNITTED STRUCTURE

by

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A thesis submitted
in fulfilment of the requirements
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CERTIFICATE

This is to certify that the thesis entitled "Investigations on Certain Aspects of Rotor Spinning and Mechanism of Formation of Rotor Spun Cotton Yarns Into Loop as well as Geometry and Dimensional Properties of the Resultant Plain Weft Knitted Structure", being submitted by Mr. Talal Saloom Alaiban to the Indian Institute of Technology, Delhi, for the award of the degree of DOCTOR OF PHILOSOPHY in Textile Technology, is a record of bona fide research work carried out by him. Mr. Talal Saloom Alaiban has worked under our guidance and supervision and has fulfilled all the requirements for the submission of this thesis, which to our knowledge has reached the requisite standard.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.

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DEDICATED TO

MY WIFE SAFAA AND SON TARAQ

FOR THEIR

AFFECTION, PATIENCE AND UNDERSTANDING

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ABSTRACT

In view of the growth potential of rotor spinning technology in India, as well as commercial availability of Sankar-4 (a long staple Indian cotton) fibres, rotor yarns spun from the mentioned cotton fibres were considered for experimental investigations.

First phase of the present study (Chapters 2 and 3) was directed towards optimising the process parameters to obtain best possible yarn quality. Thus, influence of certain factors, such as fibre length, rotor diameter and twist on yarn quality was studied. It was observed that there is an optimum fibre length for achieving the best quality in rotor yarns. This length seems to be around 30 mm. A plausible explanation for this observation has been offered. The most regular yarn is seen to be produced by a rotor having its diameter equal to fibre length multiplied by 1.44.

It is interesting to observe that the twist loss in rotor yarns increases with twist level and could be considered as an additional factor responsible for their observed flatter curves of twist vs. yarn strength. The increase in twist loss and in yarn unevenness with increasing twist factor appears to be associated phenomena.

Chapter 4 of the present investigation deals with mechanism of loop formation of rotor spun cotton yarns at extreme cam settings. It was observed that the mechanism of loop formation at the two extreme settings are different. Tools were generated to predict (1) the highest yarn tex value which a certain machine gauge would accept and (2) the range of TF resulting out of a certain combination of machine gauge and compatible yarn linear density. Data on loop length from the subsequent chapter also revealed dependency of robbing back on cam setting and sinker spacing.

Geometry and dimensional properties of single jersey structure made from the experimental yarns were investigated in Chapter 5. It was observed that the classical expression of loop shape factor displays significant dependency on tightness factor and machine gauge. Spirality of wale line affects loop shape considerably and grows with twist liveliness of yarn, slackness of construction and coarseness of machine gauge and hence all these factors must be influencing the loop shape.

An attempt to incorporate degree of bending of loop into third dimension in expression of shape factor, led to a modified form of shape factor expressed by the product of ratios of wale to course spacing and thickness of fabric to diameter of yarn. This modified factor is

dependent on loop asymmetry as well as tightness of construction and is related to yarn properties.

The conventional dimensional parameters such as K_c, K_w and K_s were observed to be dependent on factors like tightness of construction, machine gauge etc. and hence their tenability, at least in so far as rotor spun cotton yarns are concerned, is questionable. Method of production of dimensionally staple loop with minimum asymmetry has also been suggested.

The investigations have also underlined the necessity of exploring the fundamental problem of quantifying process of full relaxation of loop of cotton yarn.

General introduction to the problem-complex and general conclusions are given in Chapters 1 and 6 respectively.

CONTENTS

CHAPTER 3 : EFFECT OF YARN LINEAR DENSITY AND TWIST FACTOR ON YARN CHARACTERISTICS