

EFFECT OF SOME CARDING PARAMETERS ON
CARDING FORCE AND PERFORMANCE
IN A FLAT CARD.

A THESIS

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ABSTRACT

The research on carding during the last decade has been concentrated on the three aspects of carding namely, the methods of increasing the card productivity without deteriorating the quality, fibre arrangement in the sliver, and the fibre movement inside the card. While conducting such studies, the investigators emphasised the importance of the transfer coefficient and related it to the recycling of fibres on the cylinder. They have shown a general awareness about the importance of the movement of fibres through the card which is influenced by the loading conditions of the wired surfaces. The important role of doffer has been truly emphasised, but the role of flats in carding has been neglected due to the complex nature of their action on fibres. In fact the principal work of individualization of an entangled mass of fibres takes place by the interaction of the relatively moving surfaces clothed with sharp points. When the fibre flocks on the cylinder clothing enter the actual carding zone, they are pulled and opened by the moving card wire surfaces. In this process, they produce resistance and the forces required to overcome this resistance are termed as carding forces. It is often important to have information on the magnitude of these forces, while analysing the problem of fibre breakage during carding, the effect of various pre-treatments on

web quality etc. The fibre and clothing stresses that occur in this zone can be well determined from a knowledge of these opening and carding forces. The problem of carding forces in flat card has hardly drawn any attention and requires adequate analysis for better understanding. The main object of the present study is to analyse these carding forces in terms of fibre properties, machine variables and process conditions and their impact on the quality of the product.

The forces which occur in the carding zone of a revolving flat card are interesting. The high peripheral speed of the cylinder, the space between the cylinder and flats through which the air currents pass and the properties and conditions of the materials processed will result in different kinds of forces such as centrifugal, air shear and frictional. The action of the thousands of wire points of cylinder and flats on the fibre tufts create opening and carding forces. A separation of these various forces and quantitative determination of the components of these forces are not possible except in the case of opening and carding forces. Yet a critical analysis of these forces will lead to a thorough understanding of the process of carding. The first part of the thesis covers a brief review of literature on the technology of carding and an intensive analysis of the different kinds of forces that occur in the carding zone.

The second part of the programme deals with the design and fabrication of a suitable transducer to determine the carding forces quantitatively. Development of a technique to measure the carding force is difficult, as, many limitations arise because of the card construction. The close interval between the two clothings and the high peripheral speed of the cylinder clothing as well as the complete enclosure of space in which the process occurs do not permit installation of a transducer in the carding space. Further the force on a single card wire point will obviously be very small. Hence a method of force measurement was developed with an active test transducer which could be fixed outside the carding zone so as to overcome the limitations mentioned. The carding force on a certain number of flat wire points was sensed by a mechanical set up, a cantilever beam, and was then transformed into an electrical signal potential with the help of strain gauges and a Wheatstone's bridge. The principles and methods of measurement, fabrication and the calibration procedures have been explained elaborately in the second phase of the programme.

The third part of the thesis includes the observations made from the planned experiments. Carding forces and performance, and the quality of the sliver were determined with various experimental set ups. The

following variables were considered while performing the experiments :

A. Machine Variables

(a) Speeds of i) Cylinder

ii) Doffer

iii) Lickerin

(b) Setting between

i) Flats and cylinder

ii) Doffer and cylinder

(c) Density and specifications of the wires on the flat fillet.

B. Process Variables

(a) Weight per yard of lap fed,

(b) Weight per yard of sliver delivered,

(c) Relative humidity of the shed,

(d) Different kinds of fibres with varying properties,

(e) Fibre treatments before processing

C. Double Carding (or Pre-Opening)

This part of the thesis describes clearly the setting up of experiments and the methods of measurements used. It consists of all the observations obtained during the course of the investigation.

The last part of the thesis consists of the discussions of the results obtained and the final conclusions. The observed results clarified that carding forces were influenced by the setting between flats and cylinder, the speed of the cylinder, the fibre load in the operational layer, the preliminary opening of the fibre stock, the specifications of the moving wire points and the fibre properties such as friction and flexural rigidity. The increase in carding force with an increase in operational layer generally deteriorated the quality of the sliver. An increase in cylinder speed reduced minor hooks and nep content, but increased major hooks with improved fibre parallelization. Two important factors affecting hooking pattern were doffer speed and sliver weight per yard. Higher doffer speeds and heavier slivers decreased major hooks, increased minor hooks and affected fibre parallelization in the sliver. The fibre parallelization was also influenced by the fibre treatments before carding. An increase in interfibre friction improved fibre parallelization. The regularity of the sliver was influenced by production rates, cylinder speed and doffer-cylinder setting. Changes in lap weight per yard and in lickerin speed did not affect the quality of the sliver, eventhough lickerin speed influenced the carding forces in the intake zone. In this final part of the thesis the observed results have been analysed for their significance and scope for further work has also been discussed.

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