

STUDIES ON THE TUFT BREAKAGE
PROCESS IN THE BLOWROOM

by

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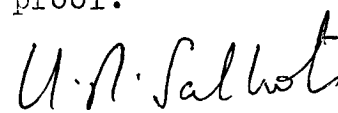
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ABSTRACT

It has long been recognised that the production of quality yarn depends upon how well the processes in the blowroom and cardroom have been performed. The opening and cleaning of fibrous material in the blowroom, being the first process, may considerably influence the yarn properties and process performance at subsequent stages of spinning. The recent technological and engineering advances in the design of blowroom machinery speaks for its importance. In the latest phase of development, the blowroom machines have been designed to achieve intensive opening right from the bale stage thereby, improving the process and reducing the number of subsequent machines in the blowroom.

The present work relates to the opening action of the blowroom and aims to investigate three aspects of this process, viz., degree of openness of the fibrous material, distribution patterns of tuft size and suitable mathematical model to describe the breakage process. There exists in the literature some investigations into the above mentioned aspects, but these have never been dealt adequately. Hence, there are a number of points of disagreement between different research workers besides certain unsubstantiated statements. In view of this, it was considered worthwhile to investigate these aspects more thoroughly.

The thesis has been divided into three parts, each concerning one aspect of the problem. All the studies have been made on cotton only.

The first part concerns the estimation of the degree of openness which so far had remained a subject of controversy. This is mainly because of the fact, that various methods, which have been used so far, gave indirect estimation of the degree of openness. The direct estimates like mean specific weight and specific volume of individual tufts could not be obtained because of the absence of a method for the measurement of apparent volume of single tufts. Therefore, perhaps for the first time, an attempt has been made to measure the apparent volume of individual tufts produced in the blowroom. This quantity was then used to calculate the specific weight of individual tufts. The technique of measurement of apparent volume is based on the principle of displacement of light-weight expanded polystyrene beads. The method has been shown to be quite accurate and reliable. It has been shown that there is a very good correlation between weight and volume of individual tufts as also between mean tuft weight and mean specific weight. Therefore, the mean tuft weight can be taken to be a very good estimate for the degree of openness, and the individual tuft weight, which is easier to measure than

the tuft volume should, preferably, be used for any study of the breakage process.

The second part relates to the distribution pattern of individual tuft weights. Different research workers arrived at different frequency distributions like gamma, log normal, Poisson and negative binomial. It appears that part of this disagreement may be due to the absence of a standard and reliable technique for the separation of individual tufts. In this part of the work, therefore, a simple technique has been described for an efficient individualisation of blowroom tufts. This new technique, which has been called the "tracer-tuft technique" is based on the principle of mixing 2-5% of grey tufts in a mass of dyed cotton. These grey tufts, after passing through an opening machine are broken and seen scattered in the coloured cotton. The colour contrast enables the grey tufts to be easily separated with the help of tweezers. For greater accuracy, these tufts are further examined for any further division by holding them against a light source. A simple distribution, the exponential distribution, has been shown to fit the data for all the 12 samples studied. A mathematical justification has also been offered for fitting the exponential distribution.

The third and the last part of the work analyses various elements of the breakage process. It has been shown that the breakage function of a blowroom opening machine can be described by a truncated exponential distribution. This function has not been previously studied in detail; and in fact, some research workers simply assumed it to be a Poisson function. Two models have been given for a mathematical treatment of the breakage process. The first model is a modified form of the one used by some workers for coal breakage studies. This model is based on the concept that the breakage process can be considered as a process in which one function describes the size distribution resulting from broken particles of each size, termed the breakage function, and another function describes the probability of breakage of tufts of each size, termed the selection function. The other model is based on the concept of number of tufts into which each tuft of a given size breaks. This number has been taken to be a function of the tuft weight involving two parameters. These parameters can be used to describe the whole breaking process of an opening machine. A method has been described for the iterative estimation of these parameters from the input and output tuft weight distributions for a given machine. Experimental data has also been given to show the validity of this model.

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