CHAPTER 10

SUMMARY AND CONCLUSION

10.1 SUMMARY

In this work, we are primarily comparing air jet rotor yarns with conventional rotor yarns. The work reported in this thesis comprises the production of jet rotor spun yarns by fixing an air jet nozzle in rotor spinning machine, their structure and properties, low stress mechanical properties, wicking behaviour and the effect of gauge length on the stress strain characteristics and initial modulus.

Initially, the air jet nozzle was optimized by conducting trials with a series of twenty nozzles with different air pressures. Using this nozzle, three counts of air jet rotor spun yarns were made and their physical properties such as tenacity elongation, evenness and imperfections, hairiness, abrasion resistance, swelling ratio and packing coefficient were determined. The structural parameters namely, packing density and fibre migration were studied using the tracer fibre technique.

The three yarns produced by the combinatorial approach of rotor and jet spinning were studied for flexural rigidity and compression properties. Also they were given various treatments such as scouring, mercerising and bleaching and their wicking behaviour was studied under these states.
The air jet rotor spun and regular rotor yarns were tested at different gauge lengths for tenacity, elongation and initial modulus. Weibull distribution was used for modeling the data.

A comprehensive review of general literatures pertaining to various aspects of yarn properties and their structure has been presented in chapter 2. Yarn structural / geometrical parameters were either determined experimentally following standards or calculated mathematically using equations. These have been presented in chapter 3. Experimental techniques for studying the mechanical behaviour have been described in the same chapter. Results obtained on the various tests have been discussed under different heads in chapters. The major conclusions from these studies are presented in the following section.

Air jet spinning combined with rotor spinning a combinatorial approach is capable of producing acceptable yarns from carded cotton. This can offer a tremendous speed advantage over other staple spinning systems. Information available on this technology is very limited and this thesis addresses the structure property relationships. Yu (1999) has described a system which is designed to produce a novel open end spinning technique. In this system, the opening roller has been replaced by a roller draft system assisted by a high pressure air draft to separate the fibres strand into individual fibres. This was designed to produce minimum fibre damage and to see that fibre straightness and parallelism in the feed material are maintained. The system currently developed retains all the elements of rotor spinning and the air jet nozzle is installed just as in the case of cone winding. Installing the air jet nozzle in rotor spinning is akin to installing it in cone winding machine. Air jet technology has been used in self twist spinning also.

Thus it is quite different from the open end spinning using air jet spinning adopted by Yu (1999). The main purpose of this research was thus to
investigate the possible application of these yarns by systematically investigating the roles played by various processing parameters on jet rotor spun structure and properties. This goal was further broadened by including the wicking tests between air jet rotor and regular rotor spun yarns. This wicking study has addressed the reason behind the phenomenon in terms of possible differences in yarn structure. It was capable of differentiating between regular rotor and jet rotor spun cotton yarns as far as their structures were concerned.

Many studies have concentrated on the effects of gauge length and straining on the yarn tenacity and elongation and very little or no attention was paid to studying initial modulus of yarns. This thesis addresses this aspect in depth for the regular rotor and jet rotor spun cotton yarns. Pan et al (1997) have reported on the size effects on the textile fibres which provided sufficient insight into the various aspects such as initial modulus, which was found to increase with gauge length.

Fibre migration was studied for these yarns by the traditional trace fibre method. Prior to conducting an investigation on the structure and properties of jet rotor yarns, the initial part of this research was devoted to optimise the nozzle parameters.

The work proceeded to assess the properties and structure of these jet air cotton yarns. This investigation showed that the jet rotor spun yarns have a higher rate of migration due to the air jet nozzle and higher amplitude of migration. Yarn diameter values for different counts were found to be smaller for jet rotor yarns in comparison with regular rotor spun yarns.

Wickability was found to be lower for jet rotor spun yarns showing thereby the packing is higher. This investigation also showed that the low stress mechanical properties such as flexural rigidity, compression and tensile
properties were different for jet rotor spun yarns. As regards twist liveliness, the jet rotor spun yarns show a lower value compared to rotor spun yarn.

In terms of tenacity and hairiness, the jet rotor spun yarn show superior performance. That the packing is higher in these air jet rotor yarns is reflected in swelling index also.

Finally, the research on the effect of gauge length on the various tensile properties such as tenacity, elongation and initial modulus has shown that all these show a decrease with increase in gauge length and Weibull distribution is most appropriate to model them. A major finding as that the models which have been developed for predicting initial modulus of twisted yarns should be treated with caution.

10.2 RECOMMENDATION FOR FUTURE WORK

This research attempted to investigate the potential of jet rotor spun cotton yarns. The effect of process parameters such as twist needs to be investigated. Also the effect of rotor diameter, rotor speed and speed of opening roller on the properties of jet rotor spun yarns with the nozzle is an area for further investigation.

The suitability of this yarn in knitting can also be investigated. Also in denim production, the influence of this jet rotor spun yarn needs to be studied. Experiments should also be carried out with air jet nozzles having different coefficient of friction.