CHAPTER 10

SUMMARY AND CONCLUSIONS

10.1 INTRODUCTION

A comprehensive study of the lateral crushing of fibres and precompression studies on sliver and roving was undertaken and in view of the large amount of experimental investigations, it will be useful to present a general summary of research work. There has been much research work on the lateral crushing and compression of fabrics. However, there is a paucity of research on the effect of lateral crushing of some new fibres, pre-compression of roving and sliver on the yarn properties. The main aim of the research study was to investigate the effect of lateral crushing of several fibers such as bamboo, tencel and modal for which no data are available to build up knowledge in the literature and the effect of pre-compression of sliver and roving on the characteristics of rotor, ring and siro spun yarns.

10.2 CHAPTER WISE CONCLUSIONS

Chapter 2: Literature Review

A thorough review of lateral crushing of the fibers, yarns and fabrics has been undertaken and presented in Chapter 2. Compression of fibres, yarns and fabrics has been described in detail. The role of compression in measuring the handle of fabrics and its consequent effect on the properties of needle punched non woven fabrics was discussed. The pioneering study of
Lai and Onions (1973) on the lateral crushing of textile fibres has led to the fundamental understanding of carpet wear and also provided the necessary stimuli for understanding of fibre rupture in rotor spinning. The work done by Audivert (1972) on the evenness of roving was motivating factor in current study. The work of Ozipek (1986) which dealt with the application of lateral crushing apparatus in rotor spinning also provided the necessary motivation.

Chapter 4: Design and development of Fibre Crushing Apparatus, Sliver and Roving Compression apparatus

Custom built devices for pre-compressing sliver and roving were designed and fabricated; these could be retrofitted in ring frames. The lateral crushing apparatus for crushing fibres was developed with many novel features for crushing with many loads. That the pre-compression device could be used for fundamental research was pointed out.

Chapter 5: Influence of Lateral Crushing of fibrous assembly on fibre properties

The uniqueness of the thesis is the fact that for cotton fibres, data are provided for the first time. The effect of lateral crushing on the tensile property of some recent fibres such as lyocell, modal, bamboo, viscose and polyester was investigated to provide some new data. Also, six types of cottons were taken and following lateral crushing their tensile properties were studied. It was found that viscose fibre sustained a higher loss in tensile properties in comparison with acrylic, polyester, modal, bamboo and tencel fibres. In respect of cotton fibres, the loss in tenacity and elongation was found to be greater for finer fibres. The percentage loss of strength and breaking extension varied from one fibre to another depending on fibre type and morphology. This information could be used while spinning the yarns
from these fibres on ring and rotor spinning and also to know the potential of these fibres. It will also enable the manufacturers to consider redesigning of the various parts. Also, lateral crushing of fibres should be carried out at different stages of processing such as card sliver and roving to have an idea of the effect of processing on lateral crushing.

Chapter 6: Finite Element Modelling of Tensile behaviour of filament yarns subjected to lateral crushing

The finite element method demonstrates that it is a powerful technique which will be useful for predicting the properties of filament yarns at 0gf, 800gf, 1000gf and 1200 gf crushing loads.

Chapter 7: Influence of Sliver and Roving compression on the properties of Rotor spun, Ring spun and Siro spun yarns

The effects of roving and pre-compression load on the characteristics of rotor, ring, siro spun cotton and polyester yarns were examined. In respect of rotor spinning, the role of sliver compression was investigated. It was found that there was a substantial improvement in the sliver and roving irregularity with compression. The cohesion of sliver and roving was found to be low following compression implying that considerable changes had occurred in the sliver and roving in particular their porosity. In all the cases, improvement was noticed in yarn characteristics following pre-compression, the optimum load being different. The pre-compression had a beneficial effect of improving the quality of yarns. In view of this, the pre-compression device is recommended to the spinning mills for the purpose of upgrading of cotton and polyester yarn quality. A gist of various results is presented below.
Good improvement in rotor yarn properties is observed with the use of sliver compression apparatus. Yarn U%, Thin, Thick, Neps and Hairiness values are all found to reduce with increase in sliver compression loads. The tenacity and YQI values also improve with increase in sliver compression loads.

Cotton and Polyester yarns obtained from Type I apparatus reveals that yarn parameters improve with roving compression loads. 150 gf was found to be an optimum loading for cotton yarns and similarly, 450 gf for polyester seemed to be good. Contour plots were drawn to highlight the optimal regions. This would enable appropriate selection of parameters while producing yarns utilizing pre-compression device.

Polyester yarns produced from Type II apparatus showed higher values of tenacity with increase in pre-compression loads. However, for cotton yarns, a clear trend was not obtained.

Cotton Siro yarns produced from Type III apparatus revealed marginal improvements in tenacity and uniformity but was not significant.

Chapter 8: Effect of Gauge length on the tensile properties of Cotton Ring yarns using Type I apparatus

One of the unique features reported in this research is the effect of pre-compression load in addition to gauge length and strain rate of Instron tensile tester on yarn strength. This is the first time that the yarn characteristics are reported with the inclusion of pre-compression loads. The results show that there is a gradual decrease in the number of flaws/unit length as the pre-compression loads are increased to 150 and 450gf. After
450gf the trend reverses suggesting deterioration in the yarn structure. Notable difference is seen in the scale parameters of yarns especially at 254mm gauge length produced with and without pre-compression. The shape and scale parameters for short gauge lengths are not the same as that of longer gauge lengths indicating a change in failure mechanism as gauge length changes.

Chapter 9: A Comparative study of the characteristics of weft knitted fabrics produced from conventional and modified ring yarns

A comparative study of the characteristics of weft knitted cotton fabrics made from regular and modified yarns was conducted and the results have been presented. The results show that the weft knitted fabrics made from modified yarns displayed lower spirality and shrinkage was also lower. Dye uptake was found to be minimal for knitted fabric made from modified cotton yarn. Wickability of knitted fabrics produced from modified yarns was found to be poor.

10.3 RECOMMENDATIONS FOR FUTURE WORK

The study reported in this thesis has concentrated mainly on studying the effect of lateral crushing of fibres and the effect of the compression of sliver and roving on the yarn and fabric properties. During the course of the research activity, several custom built devices were designed and fabricated to study their effects on fibres, yarns and fabrics. The research activity has laid foundations for future study with yarns and fabrics. The research has opened many new avenues for researching which are worth further investigations such as:
1. A database on the fibres after they are being crushed is required. The lateral crushing apparatus can also be used for testing plastics, composites and various other blends.

2. To study fibre migration of yarns produced with the compression at different loads.

3. To carry out some treatments such as scouring, mercerizing, bleaching, dyeing and enzymatic treatments on cotton and then to study the effects of lateral crushing on them.

4. To investigate the effects of heat setting, solvent setting and photo degradation on the lateral crushing of synthetic fibres.

5. It will be interesting to study the shear strength of textile fibre following lateral crushing inorder to have a better understanding about deformation of fibres.

6. The structure of crushed fibres may be studied by Raman spectroscopy which is based on light scattering technique.

7. To study the effect of multi-compression on the characteristics of yarns in ring frames instead of a single stage compression. Also, optimization of compression stages should be done by an appropriate statistical design.

A prototype ring frame which incorporates these gadgets should be developed and large scale spinning trials should be conducted on different counts to transfer this innovative technology to the manufacture of textile machinery in India so that this serves as a cutting edge technology. The improved ring frame cannot only be used in organized sector but also in decentralized sector, namely khadi.