CHAPTER 13

SUMMARY AND CONCLUSIONS

13.1 INTRODUCTION

A comprehensive study of the dimensional properties of single-jersey, 1 x 1 rib, pique and interlock fabrics was undertaken, and in view of the large amount of experimental investigations, it will be useful to present a general summary of the research work. There has been much research work on the dimensional properties and handle and low stress mechanical properties of weft knitted fabrics. However, there is a paucity of data on the properties of pique fabrics. The main aim of the research study was to investigate the dimensional properties of knitted fabrics which comprise chiefly single jersey, pique, 1 x 1 rib and interlock fabrics. Besides this, research has been done on the spirality, effect of yarn properties on the low stress mechanical properties, measurement of handle and elastic recovery. Classification of knitted fabrics has been attempted by artificial neural network based cluster analysis. A study on the low stress mechanical properties of treated weft knitted and pique fabrics has been made.

13.2 THE SPIRALITY OF KNITTED FABRICS

A thorough review on the spirality of single jersey fabrics has been undertaken and presented in chapter 2. Methods of spirality measurement, and the factors which affect spirality were described in detail. The results show that fabrics knitted from rotor yarns display less spirality, and wet spun yarns have resulted in low values of spirality. Other treatments such as sizing, scouring and steaming also have led to a reduction in spirality. Lyocell has shown spirality. Lyocell has shown a
greater amount of spirality than in viscose. Fabrics knitted from combed yarns show low spirality compared to those knitted from carded yarns. For the first time, it has been pointed out that wet spinning has resulted in a low spirality, and it is having a permanent effect. It is pointed out that this is a novel approach to reduce the incidence of spirality. Development of ring frames where wet spun yarns can be produced is an important activity in the present century to combat the problem of spirality. It is also pointed out that yarn structure and spirality are synonymous.

13.3 DIMENSIONAL STABILITY OF SINGLE JERSEY AND PIQUE FABRICS

The results show that pique fabrics, in view of the fact they contain tuck stitches, display large changes in their dimensions. Relaxation shrinkage values have been found to be greater in pique in comparison with single jersey. Courses per cm decrease with increase in loop length. From grey to fully-relaxed state, courses per cm show an increase from 35 to 40% for double lacoste, 25 to 45% for Fred Perry, and 19 to 29% for lacoste. The increase in wales per cm is only to the extent of 10 to 18%. It has been found that the increase in wales and courses per cm depends on the relaxation treatments.

Pique fabrics, a derivative of single jersey, display higher weight per square metre in comparison with single jersey. Whilst finishing of pique fabrics, the courses and wales per cm are to be considered for achieving acceptable level of shrinkage of the finished fabric.

13.4 DIMENSIONAL STABILITY OF 1 X 1 RIB FABRICS

In view of the importance of dimensional stability of the knitted fabrics to the consumers, a detailed study on 1 x 1 rib fabrics knitted from
conventional two fold yarns and double rove yarns was undertaken. The experimental study of 1 x 1 rib fabrics shows that the dimensions of the relaxed fabrics are determined by the length of yarn in loop. Plots of observed courses/cm, wales/cm and stitch density against (1/l) and (1/l²) were found to be linear, but showed significant intercepts on the C and W axes. Size of the intercepts varied with the conditions under which the fabrics were relaxed. Stitch density is proportional to 1/l², and does not depend on yarn properties until it has been relaxed enough. Loop shape factor, in the washed state, was found to be independent of stitch length or twist level or tightness factor. However, it was noticed that the tightness factor for the fabric knitted from the double yarn was found to be much higher.

In conclusion, there appeared to be little difference in the dimensional properties of 1 x 1 rib fabrics knitted from double rove yarns and conventional two fold yarns. Thus the study shows that double rove yarns have greater potential in knitted fabrics.

13.5 LOW STRESS MECHANICAL PROPERTIES OF FABRICS

Data for the low stress mechanical properties, as determined by Kawabata Evaluation System (KES) of weft-knitted fabrics subjected to various chemical treatments, have demonstrated that a wide range of the properties may be attained. Compressional resilience has been found to be greater for thinner fabrics. Knitted fabrics, in particular, knitted from 40s yarns have been found to be more compressible when compared to those knitted from 30s. While the above conclusions were reached for untreated knitted fabrics, the trend obtained for treated fabrics is quite different. Resin finish has led to a drastic reduction in tensile resilience and extension. Resin treatment has led to a higher value of bending and shear rigidities. Both compressional energy (WC) and compressional resilience (RC) show a reduction implying that the treated fabrics have become hard.
As regards single jersey fabrics subjected to scouring bleaching, mercerising, resin finishing and enzymatic treatments, it is mercerisation treatment which has led to a significant reduction in tensile resilience and extension. Mercerisation has led to a marked increase in bending and shear rigidities. Coefficient of friction has reduced following mercerisation. The same trend has been noticed in treated rib and interlock fabrics.

13.6 A STUDY OF THE HANDLE OF SINGLE JERSEY AND PIQUE FABRICS

A study of the single jersey and pique fabrics has shown that the former are characterised by higher hand values pique fabrics exhibit higher shear rigidity and friction. The wicking characteristics of single jersey and pique fabrics are affected by loop length and structure.

13.7 ELASTIC RECOVERY OF SINGLE JERSEY AND PIQUE FABRICS

A simple instrument, which involves the principle of hanging weights, was fabricated for measuring extension and recovery of single jersey and pique fabrics. Data for elastic recovery of knitted fabrics subjected to various treatments, such as bleaching, dyeing and enzymatic treatments demonstrated that coursewise recovery was found to be higher
than that of walewise recovery. Pique fabrics are characterised by higher values of elastic recovery. Elastic recovery was found to be dependent primarily on machine tightness factor (K). A significant revelation from the study reported in chapter 10 was that pique fabrics exhibited a higher extension in course wise and wale wise directions, implying that these offer a better comfort to the wearer.

That the simple instrument, which has been developed as part of current research in knitting can be used for a variety of applications such as growth in the fabric, stress strain relations, initial modulus, and measurement of stretch for knitted fabrics containing elastane has been pointed out.

13.8 MEASURING FABRIC HAND

In order to simulate the frictional interaction of fabrics with human fingers, it is necessary to study the interaction of a surface with fabrics. A suitable handle instrument was designed and both the withdrawal force and softness were determined. With the view to normalising the handle force values, they were converted to specific handle force so that comparisons would be possible. It was found that while dyeing had caused harshness to fabrics, enzymatic treatment had made the fabric smoother.

By adopting a novel approach, a measure of softness "S" which is reciprocal of 'K', the slope was obtained. The reciprocal of 'K' which is termed 'S' is a new parameter which characterises the softness of fabrics. It was found that softness of fabrics improved with the enzymatic treatment. Generally, knitted fabrics knitted from coarser yarn were found to be less smooth. It was found that machine tightness factor had a profound effect on softness of pique fabrics. This novel approach can be effectively used to find out the effect of finishes.
13.9 CLASSIFICATION OF KNITTED FABRICS BY ARTIFICIAL NEURAL NETWORK (ANN) BASED CLUSTER ANALYSES

Data set, which consisted of the mechanical properties tested by Kawabata evaluation system, was considered and using the ANN based cluster analysis which is a novel approach, the classification was made. It was found that the 55 fabrics could be classified into five clusters which, on analysis, was found to be logical. Thus, using ANN based cluster analysis, the fabrics, which belong to unknown groups, can be classified.

13.10 RECOMMENDATIONS FOR FUTURE WORK

The study reported in this thesis has concentrated mainly on studying the dimensional and physical properties of single jersey, 1 x 1 rib, pique and interlock fabrics. During the course of the study, several new methods were developed to study the elastic recovery and handle of knitted fabrics. A novel approach was adopted for the first time to control the spirality of having recourse to wet spinning. The research activity has laid foundations for future study with other knitted structures. The research has opened many new avenues which are worth further investigation such as:

1. The effect of yarn twist on the structural and dimensions of pique fabrics is a worth while study.

2. To study the low stress mechanical properties of a series of pique fabrics which are employed in T-shirts with the aid of Kawabata evaluation system.

3. To make the instruments developed for measuring handle and softness more sophisticated by providing suitable load cells and microprocessor. This is an area which will doubtless be of use to
garment manufacturers. The measurement of softness should be carried out with seams.

4. Furthermore, the prediction of stress strain characteristics of pique fabrics by energy methods should be made. All the theoretical models developed by force analysis for predicting the load-elongation characteristics of knitted fabrics are based on the knit loop. Since the type of deformation a tuck loop undergoes is different, new theoretical models are to be developed. The computer can be used to precisely determine the forces and couples acting on the tuck stitch.

5. A study on the dyeing behaviour of single jersey and pique fabrics is required to standardise the recipe etc.

6. Since single jersey derivatives are used to a very large extent in the T-shirts, suitable expert systems should be developed for the benefit of garment manufacturers and consumers. It is important to develop a data base of low stress mechanical properties of pique fabrics of all types which are possible by machinery manufacturers.

7. Air permeability and wicking behaviour which are very important from the point of view of comfort characteristics should be studied for pique fabrics.

8. Shrinkage for weft knitted fabrics including pique should be determined in all possible directions of orientation to have better understanding of their role in garment.