CHAPTER 13

SUMMARY AND CONCLUSION

13.1 INTRODUCTION

Measurements of low stress mechanical properties have been developed over the past 65 years, and analysis of stress-strain relationship is well documented. Mathematical models have been developed for predicting tensile, bending, and shear of the woven fabrics. The use of these measurements, and knowledge of low stress mechanical properties of fabrics have been well appreciated in recent years. In addition to the handle of fabrics, recently these properties have been used to compute tailorability, and attachments have been provided to have an idea about the comfort properties. In other words, it is possible to have a complete characterisation of a fabric with these commercial instruments. These are very helpful for product design, process control and objective evaluation. As time passed, the method of computing hand values was simplified, simpler systems were introduced, and a large number of parameters was not required to describe the basic mechanical and surface properties. Fortunately, the lesser the number of parameters which are measured, the more accurate is the handle but a large quantity of fabrics is required for evaluation. It is not known as to what will be the future of these systems which were developed as simpler systems have provided increased scope for the measurement and application of fabric mechanical properties. It is possible to characterise a fabric with the aid of these commercial instruments and to have a better understanding of its potential in garment manufacture. An idea of the total appearance value (TAV) can be had from the data on the mechanical properties.
Although a considerable amount of work on fabric mechanical properties has been reported, it is for the first time new data on silk fabrics are provided. It is well known that the physical properties of woven fabrics depend on the properties of the constituent yarns. The silk fabrics have an unique handle. The handle of fabrics has been studied from 1930 onwards from Peirce (1930). The main purpose of this thesis was to investigate the low stress mechanical properties of the silk fabrics, and to relate them to the fabric handle. The objective evaluation of the silk fabrics has been carried out by the various systems such as KESF (Kawabata Evaluation System for fabrics) and FAST (Fabric Assurance by Simple Testing) principles. There is a good correlation between the mechanical properties obtained by two systems.

An extensive review of work is presented in chapter 2. An experimental investigation of the bending rigidity of the yarns with various twist levels was carried out. There is a good correlation between the values obtained by KESF bending tester and cyclic hysteresis bending tester. An increase in the amount of twist in the weft yarn has led to a drop in tensile and bending modulus of the silk yarns.

There is a good correlation between the bending rigidity values obtained by the cyclic hysteresis bending tester, KESF system and cantilever bending tester.

There is a good correlation between the ratio $C_0/G_0$ and total hand value (THV) obtained by the cyclic hysteresis bending tester and KESF system respectively.

Objective evaluation of the silk fabrics by the KESF system shows distinctly the mechanical properties of the various groups of silk fabrics. The changes in the mechanical properties of the grey and finished fabrics have been studied which help engineering of the fabric to obtain desirable surface
texture. Based on this study, an optimum level of twist so as to obtain a best crepe effect has been found out for the two groups of fabrics.

The objective evaluation of the fabric has helped classifying the silk fabrics into different groups which have distinct characteristic features that are explained in terms of primary hand values. Each class of fabrics could be easily discriminated by the use of prediction equations. These equations would help maintaining the quality of the fabric.

A simple instrument to measure the handle force is described, and it is shown that the specific handle force is a very convenient measure to represent the handle. Relationships have been established between the specific handle force and the low stress mechanical properties for a range of different group of laboratory and commercially developed samples. Thus, measurement of the specific handle force can do away with the measurement of the low stress mechanical properties. An examination of this device lead to the conclusion that this system has definite advantages over other available testing equipment. The extraction force has been predicted theoretically with the aid of a model, which takes into account the various nozzles used.

The bending rigidity of the fabric has been predicted by the use of the theoretical models developed by Abbott (1968) and Leaf et al (1993). These models could be profitably used in predicting the bending rigidity of the fabrics. This helps engineering silk fabrics to the desired fabric handle.

By the objective evaluation of silk fabrics, polar charts have been prepared to set the acceptability limits for the mechanical properties measured by the various systems such as FAST, KESF and handle force tester. Such polar charts will help the routine quality control testing to maintain the fabric quality. This could be used by the garment industry
where the mass scale production of the garments needs specific mechanical properties to give the improved efficiency in the production.

KESF system gives a comprehensive idea of the fabric handle as well as the comfort properties of the silk fabrics measured in terms of $q_{\text{max}}$ and thermal conductivity.

13.2 RECOMMENDATIONS FOR FUTURE WORK

There are a number of areas for future work on the areas of measurement and application of low stress mechanical and surface properties of silk fabrics; these are set out below:

1. Extending the use of fabric extraction force in studying the effect of temperature and relative humidity on it.
2. Development of further testing and analysis of fabrics as shell materials to simulate the fabrics used in garment making.
3. Evaluation of silk fabrics made from other types of silk such as spun silk, tasar silk, and blends containing silk and other natural and synthetic fibres.
4. Testing of various sizes and shapes of fabrics in the fabric extraction method, and understanding of these variables on the extraction force. The instrument can be linked to the measurement of drape so that this serves as a multi-purpose tester. The use of this method to study the handle of silk yarns before and after degumming can be explored.
5. A correlation between subjective assessment of silk fabrics and the extraction force is required.
6. The effects of photo degradation, weathering and wear on the fabric extraction force can be examined for silk fabrics.
7. Based on the extraction force, some attempt can be made to derive tailorability of the fabrics.