CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Knitted constructions have grown in popularity for use in leisure wear and in sportswear; however, little is known about engineering these fabric structures particularly with regard to predicting their shrinkage. In textile marketing, sportswear fabrics for comfort and technical textile businesses combine for a greater amount of income in retail and institutional sales of weft knitted fabrics every year. As a case in point, the consumption of pique fabrics is on an increase every year. Various speciality niches including water repellent weft knits, casual wear, weft knits with elastane and application in inner wear both for gents and ladies are also proving to be profitable for scores of producers of weft-knitted fabrics. Considering the large world-wide demand for plain single jersey knitted garments, the necessity to deal with the problem of spirality aiming for a permanent solution assumed considerable importance. It is learnt from the industry circle, that the amount of single jersey knitted fabrics which has been rejected due to spirality is quite high although a great deal of work has been done in this area.

1.2 EXPORT OF KNITS

Export performance, as far as India is concerned, has been remarkable during the past two decades, and accounts for 30% of total export. The knitted garment sector, although a small segment of Indian garment industry, has started emerging as a major value added foreign
exchange earner for the country. Knitted garments are cheaper than those of woven garments. Although the export achievement of knitwear is sizeable, the share in international market is still very low of about 1.5% only. There is a vast scope for Indian knit wears in global market. It is pertinent to add here that export earnings from knitted fabrics and made-ups are also ascending. With liberalisation and inflow of latest technology, new avenues in knitted fabric end uses will be found and newer export markets explored for a better tomorrow.

According to an estimate based on statistics provided by Express Textile, out of the 60,907 garment industries in our country, 7,887 units were engaged in knitwear production. There has been a gradual increase in the production of knitted fabrics in India. The knits accounted for 13.2% of the total fabric produced in 1994-95 whilst this figure rose to 17.3% during 1997-98 reflecting a steady growth.

1.3 KNITTING INDUSTRY IN INDIA

Research on the weft knitted fabrics has been carried out in the past on their many facets, namely, dimensional stability, shape of the loop, spirality, modelling and the application of some high performance fibres such as jute and carbon fibres in knitting. Many testing methods and techniques have been developed for the assessment of the quality of knitted fabrics. Some of these have become outdated and convey nothing to the understanding of the quality of knitted fabrics, and some are very expensive, in that they preclude the customers from using them. A technique, which is very simple, and inexpensive and which is well correlated with the other mechanical properties, is a necessity today, and this thesis addresses these areas.

Pique structures are attractive to garment manufacturers today in view of their open structure, and the ease with which it offers comfort to the
wearers. The consumption of this type of fabric is quite considerable, and garments made out of them have good sales appeal. In view of this, it was felt that an investigation on the dimensional stability of these fabrics is warranted.

The knitting industry in India is concentrated at Maharashtra, Tamil Nadu, Ludhiana, West Bengal and some parts of Karnataka. Tirupur Knitting Industry has undergone ups and downs due to fluctuations in cotton yarn prices. Export of knitted fabrics shows an encouraging trend and a separate industrial estate to house the knitting machines has been created. Whether this has become a successful proposition or not, it is not possible to say now.

The properties of 1x1 rib fabrics from cotton yarns produced from double rove feed system have been studied; this is because a greater proportion of knitted fabrics constitute 1x1 rib, and these are used for vests and outerwear fabrics.

Also, interlock cotton fabrics are used to a very large extent by Railways for their staff who work as gangmen. It has been found that the characteristics of these fabrics differ a lot owing to not following the specifications. So that the factors which affect the characteristics of these fabrics can be identified, a self contained study was thought to be worthy of investigation.

Finally, the effect of various wet processing sequences such as scouring, mercerising, resin finishing and enzymatic treatments on the characteristics of the knitted fabrics have been examined. Holme (1999) feels that fabric finishes will have a very crucial role to play in the effective utilisation of fabrics.
As regards product development, already weft knitted fabrics have replaced some of the woven fabrics. It is extremely likely that the other woven outerwear fabrics may be replaced by the weft knitted fabrics in future, and studies on the characteristics of fabrics will be of considerable assistance.

A basic understanding of the role of the fabric properties both physical and mechanical (low stress) in determining the behaviour of fabrics is vital in solving the problems during their performance. Ever since the first beginnings were made thousands of years ago, an effort is being progressively made for better and faster methods of sewing, leading to an extremely automated and advanced scenario where the speed of the sewing machine is reaching up to 15,000 stitches per minute. Fabrics, being soft materials, are susceptible to deformations due to small stresses in the structure often resulting in very severe problems, both of performance and aesthetics which the discerning customer of today is not willing to compromise with.

The range of fabrics that was available to the designers a few years ago was not only very large, but during the past decade, whilst the development of new generic fibres has not only increased markedly, the technical engineering of the structure of existing fibres has produced an explosion of new fabrics. This obviously leads to different fabric characteristics requiring different handling adjustments and conditions. Whatever properties that are studied for the fabrics should ultimately be helpful in assessing their comfort and handle.

It is pertinent to mention that the properties of fabrics are not static but continue to change with the stresses applied on them during handling, sewing and wearing. The dynamics of fabric properties has drawn the attention of the researchers for developing an understanding of their behaviour under simulated measuring and assessing situations. This has led
to the innovation of very sophisticated testing equipments capable of giving accurate and computerised data for analysis and use in making critical decisions to achieve the goal of quality apparel products. The need for objective measurements techniques cannot be overemphasized.

Changes in the life styles and greater emphasis on comfort have motivated people to use fabrics which are light in weight and volume. Therefore, there is a need to study these universally popular and acceptable knitted fabrics. Some studies are simultaneously being conducted in areas such as handle and comfort, but there is still a long way to go. Even after these are developed, the high cost of robotized equipment would still prohibit their extensive use. Thus the demand for simple, cheap and accurate methods would continue to grow.

1.4 DIMENSIONAL PROPERTIES OF WEFT KNITTED FABRICS


1.5 SPIRALITY IN WEFT KNITTED FABRICS

In spirality, obviously due to its importance, a number of papers have been published (De Araujo and Smith (1989ab), Nutting (1960), Brackenbury (1992), Davis, Edwards and Stanbury (1934), Haigh (1987a),

Wool Science Review was published several times a year by the International Wool Secretariat (1969, 1971, 1972); its authoritative articles were usually about wool science as related to technology. The publications mentioned above deal with the spirality; however, there are several projects and symposia proceedings relating to geometrical and dimensional properties, and spirality of weft-knitted fabrics.

Because of the dimensional instability of knitted loop construction, single jersey knitted fabrics suffer from various forms of dimensional distortion. One such distortion arises from the use of yarn that is twist lively, resulting in wales that are not perpendicular to courses; the phenomenon is called "spirality". Some of the practical problems arising from loop spirality encountered in garments produced by knitted materials are displacement or shifting of seams, mismatched patterns, sewing difficulties, etc. Spirality has an obvious influence on both the aesthetic and functional performance of knitted fabrics, and the garments produced from them. The subject of spirality has therefore been investigated by many researchers from both fundamental and practical view points.

Most of the research work, which has been published on knitted fabric spirality, has clearly demonstrated that the most prominent factor which causes spirality in a single jersey fabric is the relaxation of torsional stresses in the yarn. Unset yarn under low tensile loads has a natural tendency to return to its original untwisted state. When such a twist-lively yarn is knitted into a loop, it will have a tendency to rotate inside the fabric in order to release its torsional strain. In single jersey knitted fabrics, each
loop of a wale behaves in a similar manner, so the whole wale will be inclined.

1.6 OBJECTIVES AND THE OVERVIEW OF THE THESIS

This work described in the thesis is concerned with an investigation of the use of wet spun and treated yarns on fabric spirality. Also, dimensional and geometrical properties of pique, 1 x 1 rib, interlock and single jersey fabrics have been examined. The mechanical properties of series of weft-knitted fabrics produced from a series of cotton yarns using Kawabata Evaluation system have been investigated. Also, the classification of fabrics have been done by cluster analysis. Moreover, the elastic recovery of weft-knitted fabrics has been investigated by using a simple instrument. The handle of single jersey and pique fabrics following full relaxation has been measured by a simple method.

The thesis consists of 13 chapters. Chapter 2 consists of an extensive literature review. Chapter 3 comprises the production of yarns and their various characteristics. Chapter 4 deals with materials and methods used in the investigation. Chapter 5 deals with the spirality of fabrics produced from different yarns made out of cotton.

Included in chapter 6 are the dimensional properties of 1 x 1 rib fabrics produced from conventional two fold and double rove yarns produced from cotton.

Chapter 7 discusses the dimensions of single jersey and pique cotton fabrics. Chapter 8 deals with the low stress mechanical properties of treated weft-knitted fabrics namely, single jersey, rib and interlock. Chapter 9 is concerned with the low stress mechanical properties of pique and single jersey fabrics.
Chapter 10 discusses the elastic recovery of pique and single jersey fabrics.

Chapter 11 contains measurement of handle of fabrics.

In Chapter 12, the classification of 55 fabrics has been done by Artificial Neural Network based cluster analysis.

A general summary of the overall study reported in this thesis is given in Chapter 13 which consolidates the experimental results given in different chapters of the thesis.