CHAPTER 1

INTRODUCTION

The knitting industry in India completed 100 years of its existence in 1993. A cotton hosiery unit was first established at Kidderpore in Calcutta in 1893 and the first woollen unit incepted in 1902. The knitting industry plays a dominant role in Indian economy, and this can be gauged from the fact that one-sixth of yarn production is consumed in this industry alone. Being a labour intensive industry, it is confined to cottage and small scale sector, and is highly decentralised in its operation. The industry provides direct employment to 2.7 lakhs workers, and indirect to around 2 lakhs. The textile industry contributes around 28% of the country's exports - 50% of which is contributed by apparel and knitwear sector alone. Since 1960's, the industry launched a massive export thrust and made a dent by exporting to Russia, East Europe, UK, France, Italy and Germany.

It has been estimated that India's share of the World market of all textiles amounts to 2.9%. Exports have phenomenally grown in the last decade or so. In 1966, exports touched just Rs. 66 lakhs. The growth has been slow, until the beginning of this decade. In the last few years, exports have escalated. In 1991, it was $ 542.4 million in 1992, $ 751 millions and in 1993, $ 1052 million. In 1994, bulk of these exports was from Tirupur, and this industry was earning over Rs.2500 crores including direct export of Rs.1300 crores, indirect export of Rs.900 crores, and Rs.250 crores of knitted fabric exports. Total exports are predicted to be around Rs.3538 crores in 1997, the corresponding figure for 1995 was Rs.2034 crores. This clearly demonstrates the growth of the industry.
Weft-knitted fabrics made out of cotton are very popular in South particularly in Tirupur, and are being exported to a number of countries in the world. With the advent of new types of fibres and new types of yarns such as rotor, increasing quantities of weft-knitted fabrics are currently being produced. The knitting machine has transformed into a new high speed one, and many structures are possible. Advances in the design of weft-knitted fabrics have taken place, and the demands of these for T-shirts are also on the increase. Besides single jersey fabrics, Lacoste fabrics are also becoming very popular. In addition, considerable advancements in wet processing of knitted fabrics have taken place. In bleaching and dyeing of knitted fabrics it becomes imperative to know the permissible chemicals and dyes; there is also an awareness of natural dyes which can be employed for dyeing cotton fabrics. There exists control system for the quality of the products.

Whilst all these developments are welcome in that they all aim at producing quality fabric, managing these technologies is becoming very difficult. There are many knitting units in India which have been started very recently with new types of machines. But what is observed is that most of these are difficult to manage owing to a multiplicity of factors such as lack of trained operatives, trained personnel and lack of management concepts. So it is apparent that getting sophisticated equipment is one aspect, and managing the unit is another aspect.

The most important factor in an organisation today is to produce goods required by the seller or supplier of goods, and failure to do so will lead to closure of the units. No doubt, management today spend money for acquiring information technology, data base systems, CAD systems and for organising training programmes. TQM (Total Quality Management) has become the watchword in the industry.
With all the above inputs, the knitting industry can only survive with the updating of technical knowledge and skills. It is a well known fact that any new technology has a life span of 2-3 years, and thereafter a new technology will take over its place. Adoption of new technology leads to a multitude of problems, and stringent quality control measures are prerequisites for making it a successful one. For example, mills which export yarns for knitting, will have to ensure that there is no contamination in them besides following the quality norms.

Another problem that is facing the knitting mills is the fact that there is no consistency in the products produced. Knitting industry is affected by the increase in yarn prices, and these are dictated by cotton prices. Coupled with the yarn prices, the political trouble in some of the countries to which yarns are exported has led to erosion of profits. Fluctuations in cotton prices and the demand of the yarns are the principal factors which affect the profitability of a knitting mill.

This work addresses some aspects of weft-knitted fabrics such as spirality, physical properties, mechanical properties, handle and deformation mechanisms. An attempt has been made to predict the mechanical properties by neural networks. Finally, an attempt has been made to dye the knitted fabrics by pad batch method with the object of achieving considerable savings in chemicals and costs. Between 1991 and 1994, the prices of 40s count have more than doubled from Rs.174 to Rs.491 per bundle, the price has further gone up to Rs.530 now. It is unfortunate that the promise of the textile policy in 1985 to make adequate supply of yarn at reasonable rates has turned a distant dream.

For end use of fabrics, the mechanical properties are of special interest as they are helpful in the prediction of fabric handle. The end uses of textiles decide the way they should be selected and constructed, suggesting that some properties should act in a certain way, while others remain of less relative importance. For example, outerwear fabrics need to
satisfy some aesthetic physical and thermal properties as well as being required to be durable.

Objective evaluation of fabrics has become very common now in view of its repeatability and reliability. Some of the systems such as KES-F and FAST, which were originally used for woven apparel fabrics, are currently being applied to knitting and non-wovens sectors. This thesis deals with the data obtained from KES-F system with suitable modification to weft-knitted fabrics.

It has been found that the interlock fabrics differ widely in their properties due to variation in the construction parameters. This plays a very crucial role as purchasing decision has to be taken based on their various specification. Some of the specifications are not satisfactory, and some thought has to be given to make them more purposeful.

Many research workers such as Bühler, Davis, de Araujo and Smith, Alaiban, Haigh, Primentas have made useful contributions to the spirality of weft-knitted fabrics, and factors affecting spirality have been investigated in depth.

Adoption of scientific knowledge concerning evaluation of knitted fabrics, and introduction of novel methods in dyeing are of paramount importance if the knitting mills are to work at high level of efficiency. The credibility of a knitted garments manufacturing organisation depends on the way the scientific principles are followed for day to day performance.

A survey of literature presented in Chapter II shows that there has been a great deal of research done on weft-knitted fabrics particularly with reference to spirality, physical and mechanical properties and handle. These have tended to concentrate on mechanics of weft-knitted fabrics, dimensional stability and prediction of loop shape. What appears to be less emphasized in the literature is the relationship between the mechanical
properties of knitted fabrics and the handle force which gives a sum total of the mechanical properties. Also, WD values which have a better utility than that of THV have been computed.

Although the subject of spirality has been investigated in depth, there are some gaps in understanding its occurrence and use of several combinations of 'S' and 'Z' twisted yarns has been tried. Also, measurement of strain of knitted fabrics has been accomplished by a new radial strain tester. In this, the properties namely, flexural rigidity, extension and recovery and bagginess can be obtained. The correlation between the values obtained from this instrument with those obtained from conventional testing instruments has been attempted.

The variation existing between the commercial samples of interlock fabrics, and a system by which the characteristics can be assessed for the benefit of consumers has been proposed. Finally, an attempt has been made to investigate the possibility of dyeing knitted fabrics by pad-batch method in view of its potential; the attendant problems associated with this technique have also been adumbrated.

The thesis is divided into 13 chapters. Chapter 1 contains general introduction. Chapter 2 is an extensive survey of the literature on spirality in weft-knitted fabrics, their mechanical properties and handle, theoretical studies and dyeing methods. In developing this survey, care was taken to create a coherent organization of the literature.

Chapter 3 is concerned with the research objectives.

Chapter 4 deals with the characteristics of various types of yarns used for knitting.

Chapter 5 is concerned with the materials and methods used in the study. In this, details of fabrics produced or obtained commercially, testing
of knitted fabrics by conventional and KES-F system, measurement of air permeability are described.

Chapter 6 is a discussion of the results obtained on the spirality. The major role played by direction of twist in yarn, and the various combinations used is stressed.

Chapter 7 discusses the physical and mechanical properties of commercial weft-knitted fabrics determined by KES-F system.

Chapter 8 discusses the handle force, and details of the instrument fabricated for measuring it.

Chapter 9 discusses the bagginess of knitted fabrics, and instrument developed for measuring it.

Chapter 10 is concerned with the engineering of interlock fabrics following the frame work provided by research workers.

Included in chapter 11, are WD values, a new concept introduced for representing handle of knitted fabrics.

Chapter 12 contains the prediction of the mechanical properties by neural networks.

Chapter 13 contains the results of an investigative study of the pad batch method of dyeing knitted fabrics. The advantages of pad batch method vis-a-vis exhaust method, and the problems encountered are discussed in depth.

Finally, the industrial implications of the study have been discussed with a view to offering some recommendations concerning the weft-knitted fabrics.