CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The aspiration of spinning technologists is focused on higher productivity, combined with adequate quality. For several years, ring spinning was used for the production of yarns, knitted and woven fabrics. The popularity of ring spinning comes from its flexibility with respect to type of material and count range and particularly its optimal yarn structure, which results in outstanding yarn strength. The spinning sector witnessed a number of striking improvements in the machinery design which led to significant improvements in productivity. It was thought that ring spinning had reached a near-saturation point owing to various mechanical and economic limitations. Whatever systems that were developed as alternative spinning systems could not become successful as they had limitations and could not surpass ring spinning system. In view of this, ring spinning still continues to be the predominant system for the manufacture of staple yarns. Most of the new spinning systems have carved a niche for themselves with regard to a particular end product and a particular count range. However, the characteristics and appearance of conventional ring spun yarns have not been completely reproduced by any of the new technologies.

In recent years the major innovation in ring spinning has been the introduction and promotion of “Compact Spinning”. Compact spinning or condensed spinning has gained momentum because it minimizes the width and height of spinning triangle associated with ring spinning. It is a modification to the conventional ring spinning process with the aim of altering the geometry of the spinning triangle so as to improve the structure of the ring-spun yarn by more
effective binding of surface fibers into the body of the yarn. This technology promises yarns with a more consolidated structure and this in turn can offer less hairy yarns, which yield products with lower pilling propensity, stronger yarns, yielding fewer breaks during spinning and subsequent processes, the possibility of utilizing lower twist and hence higher production speeds and softer yarns and fabrics.

The first compact spinning system to be commercialized is by the Rieter Corporation and is called Com4 spinning. However, compact spinning systems is also made by Suessen, Zinser, Toyota, Rotocraft and Rocos. The principle of every compact spinning machine is for the production of compact yarns. In all the compact spinning machines, the width of the spinning triangle has been reduced so as to facilitate the edge fibers to contribute to the strength of the yarn. Another way of compacting the fibers was by using air jet nozzle below the front roller and lappet in the conventional ring frame. Many studies have been done by using the air jet nozzle and in some cases, the performance was equivalent to the conventional yarn. There was, however a reduction in hairiness of yarn in most of the cases.

The number of papers published on compact yarns has been found to increase and new developments have occurred. A most recent paper on compact yarn by Yilmaz and Usal (2010) discusses the compact jet yarn properties which has been produced by the incorporation of air jet nozzle in the ring frame fitted with Rocos compact spinning systems. It has been found that of the conventional, compact jet yarns have shown the greatest improvement in strength and hairiness. The quest for further improvement in compact yarns is still going on and the object is to produce a fabric which will show an all round improvement in appearance.
The compact spinning frames, it is learnt, have been working all over the world. In India a number of well known groups such as Rajapalayam mills, Sri Jayajothi mills, Govindaraja mills, Bannari Amman Spinning mills, Premier mills, GTN Textiles, Thiagarajar mills in the south and Alok industries, Nahar spinning mills, Vardhaman Textiles and Welspun Group in the North have installed compact spinning machines. A further development of compact spinning machine called Eli twist has also been introduced for the production of doubled compact yarn. Theoretical studies on compact yarns have also been done incorporating mathematical concepts.

Velayutham (2010) the managing Director of Sri Gomathi Mills states that twenty–five years ago, it was a luxury to have auto coner in a spinning mills. But today it has become a necessity. Likewise, in the coming years, compact spinning machines will also turn out to be a key line in any spinning unit. His opinion is that the compact yarn improves the efficiency of weaving and knitting processes and also enhances real value of cotton.

Using the compact and conventional yarns, knitted and woven fabrics have been produced and their properties have been published. The surge for investigation still continues and much more work, it is hoped, will be carried out in near future.

1.2 MOTIVATION

The motivation behind this work is that although compact and conventional yarns have been investigated for many properties, still there are many gaps which exist in the scientific literature. For example, Weibull modeling of conventional and compact yarns has not been done and this work addresses this aspect. Also the doubled yarn properties produced from conventional and compact yarns have not been studied so far. The scope of using conventional and compact yarns for the
production of hybrid doubled yarn has to be studied. In addition to these areas, work on the knitted fabric properties such as dimensional stability and spirality is also warranted. Furthermore, comfort of fabrics is often talked about and moisture transportation properties are considered to be very important. Moisture management studies are given lot of priorities as textiles are not only used in apparels but also in protective garments and medical textiles. Wicking constitutes an important element of moisture management area and this aspect has been considered in this study.

Since yarn strength depends on the gauge length there is no single value which can be assigned to a yarn. The strength of the yarn at different gauge lengths should be determined and hence this becomes a statistical aspect. Moreover, in winding, warping and weaving, different lengths of yarn are subjected to stresses and hence determination of yarn strength at different gauge lengths assumes lot of importance. This thesis addresses these aspects for conventional and compact yarns.

Knitted fabrics are used as undergarments as well as outerwear. The appearance of knitted fabrics is marred by spirality and this thesis addresses this aspect in depth.

Doubled yarn are used for the production of suitings’, shirtings’ and dress materials and which are known for their good appearance. The consumption of two fold yarns is on the increase in view of their excellent properties. Since it is thought production of hybrid doubled yarn using conventional and compact yarns will result in cost saving, an investigation has been carried out on this topic for the first time.

Weibull distribution is an important statistical distribution which is applicable to failure of textile materials. Weibull distribution was originally
proposed by Weibull a Swedish Physist in 1939, and he used to represent the distribution of the breaking strength of materials. It has also increasing and decreasing failure rates depending on the shape parameter. Several applications of the Weibull distribution can be found in the literature. It can be applied to various situations such as strength of fibers, yarns and fabrics, height of the waves in the sea, health problems and change in weather conditions. Although Weibull modeling of fibers, yarns and fabrics has been done, this has not been used for conventional and compact yarns. Using the two parameter Weibull model, namely, the shape and scale factors, the performance of conventional and compact yarns can be predicted at any gauge length

1.3 THESIS OBJECTIVES

The specific aims of the present study are as follows:

1. To look at the differences between the properties of regular and compact yarns and to predict the strength of the yarn by Weibull distribution.

2. To study the characteristics of doubled yarn produced by three combinations namely conventional-conventional, compact-compact and conventional-compact.

3. To investigate the dimensional and physical properties of weft-knitted fabrics made from conventional and compact yarns.

4. To study the spirality of weft-knitted fabrics using a new technique.

5. To investigate the moisture management of weft-knitted fabrics produced by conventional and compact yarns by vertical wicking method.
1.4 ORGANISATION OF THE THESIS

The content of this thesis are subdivided as follows:

Chapter 2 presents an extensive review of literature.
Chapter 3 deals with the materials and methods used in the present study.
Chapter 4 discusses the effect of gauge length of conventional and compact yarns
Chapter 5 investigates the effect of doubling twist on the properties of yarns for conventional, compact and hybrid combination.
Chapter 6 explores the dimensional and physical properties of weft-knitted fabrics.
Chapter 7 discusses the determination of spirality using CorelDraw software, a new method.
Chapter 8 deals with the understanding of the moisture management of weft-knitted Fabrics.