CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Characteristics of spun yarn are mainly influenced by several factors such as fibre properties, type of fibres, spinning method, arrangement of fibres in the yarn and the process parameters of yarn manufacturing activities. Among all spinning technologies, the ring-spinning is still widely used for spun yarn production. Ring spinning provides true twisting of fibres by virtue of the tension control applied on the fibres from the moment they exit the drafting system to the moment they enter the twisting zone. It is indeed the only spinning system that is capable of inserting entirely true twist. Ring spinning represents the best option in connection with utilizing yarn structure to contribute effectively to fabric structure and fabric performance. It is the most effective system in meeting structural changes in view of today’s product range complexity. It is also the most expensive system as indicated by its substantially lower production rate compared to other spinning systems, and the need for more costly preparation before and after spinning (Roving and Winding Processes).

The development in the ring spinning is focused towards the modifications in the ring spinning system like minimization of spinning triangle to improve the quality and production. This modification is known as compact or condensed spinning. Many developments are under progress in this field by various machinery manufacturers, applying any one of the
principles like pneumatic compacting or magnetic compacting. Generally in the spinning industries the above compacting principles were adopted only for the manufacturing of “Combed Compact Yarn”. There is a scope to focus the Research and Development activities on the manufacturing of “Carded Compact Yarn”.

Between the 1950s and 1980s, innovative spinning methods like rotor spinning and friction spinning were introduced into the field. These technologies were mainly suitable for coarse yarns up to 30s Ne count. Rotofil single jet spinning system came into the field in the early 70s. The main limitation of this system was poor yarn strength when compared to ring spinning system. Hence the commercial viability of this method was limited. Murata Jet spinning entered the market in the mid eighties as a new technology to produce yarns ranging from Ne 40s to 80s, particularly for polyester staple fibres.

The functions of the twin nozzles in Murata Jet spinning are to twist the fibres by the first air jet nozzle and then the fibres are untwisted by the subsequent second nozzle. Ultimately, it produces core and wrapped structured yarn. When compared to regular ring spinning system, it claims high productivity at lesser labour cost and power cost by the elimination of roving and winding process. The only limitation in this system was reduction in yarn strength of 10 to 15% when compared to regular ring spun yarns.

The special feature of the Murata vortex spinning system was to produce medium count yarns that have 20 times higher production than the regular ring spinning system. The basic principle of this Murata air vortex spinning is that the drafted fibres are sucked by the nozzle with the help of air current and wrapped around the core fibre on the top portion of hollow stationary spindle. This Murata vortex spinning is more suitable for viscose
and polyester / viscose blends than cotton yarn. It is mainly due to more cotton fibre loss and lower yarn strength.

An attempt has been made through this research work by developing single air jet nozzle and fabricating a single head jet spinning unit for producing air jet yarns with minimum fibre loss and improved yarn characteristics. For the performance analysis of the developed jet nozzle, this work was carried out using three materials such as cotton, viscose and polyester. All these three types of yarns were produced using the above developed nozzle with sliver fed and roving fed. Influence of different air feed angle, different wrapper fibre chambers and air pressure on yarn quality characteristics and yarn structure were critically analyzed. After the above analysis, all the nozzle design parameters were optimized.

In addition to the production of single jet cotton, viscose and polyester yarns, comparison of their characteristics with the other spinning systems was also carried out through this work. 40s Ne cotton carded regular ring yarns, Suessen regular carded compact yarns and Suessen D-slot carded compact yarns were compared with single jet yarns produced from the above developed nozzle. 50s Ne viscose regular ring yarns, Murata air vortex yarns were compared with single jet yarns produced from the above developed nozzle. 60s Ne polyester regular ring yarns, Murata air jet yarns were compared with single jet yarns produced from the above developed nozzle. For all samples, similar raw materials and the ideal spinning conditions were maintained to get accurate data of yarn characteristics, fibre migration and yarn structure.
1.2 SCOPE AND OBJECTIVES OF THE PRESENT INVESTIGATION

The following are the objectives of this research work

- To design and develop the single jet nozzles with various design parameters such as different wrapper fibre chambers and different air fed angle.

- To fabricate a ‘Single head single jet spinning unit’.

- To analyze the fibre loss in percentage, end breakage in percentage and optimize the design parameters of single jet nozzle using sliver fed and roving fed jet yarns of cotton, viscose and polyester.

- To compare the characteristics and structure of the sliver fed jet yarns of different materials like cotton, viscose and polyester with regular ring yarn, compact yarn, D-slot compact yarn, Murata air jet yarn and Murata air vortex yarns.

- To analyze the test data using statistical tools.

1.3 ARRANGEMENT OF THESIS

The thesis is organized in such way that the general introduction is given in the Chapter 1. Chapter 2 has literature review which consists of air jet nozzle designing, air jet spinning system, air vortex spinning system and compact spinning system. Materials and methods are discussed in Chapter 3. Chapter 4 consists of design and fabrication of single jet nozzle. Chapter 5 is dealt with the design and development of ‘Single head single jet spinning unit.’
Chapter 6 is dealt with the analysis of fiber losses, end breakage and structure of single jet yarn. Chapter 7 consists of optimization of nozzle design parameter for single jet Cotton, Viscose and Polyester jet yarns. In this chapter, analyses using the sliver feed, roving feed and their effect of nozzle design parameters on yarn quality characteristics were discussed. Chapter 8 dealt with the comparison of single jet cotton yarn with ring, regular compact and d-slot compact yarns. This chapter also deals about the comparison of single jet viscose yarn with ring, Murata air vortex yarns and also covers the comparison of single jet polyester yarn with ring, Murata air jet yarns. Summary and Conclusion are given in Chapter 9.