ABSTRACT

Spun yarns could be produced from blends of more than one kind of fibres, which are assembled and bound together by means of twist to produce required characteristics such as strength, handle and appearance. Fibre being the structural unit of a yarn, its nature, composition and arrangement could influence structure and properties of yarn. Comfort characteristics of the clothing can be enhanced by changing the fibre structure, yarn structure and fabric structure and also by applying some functional finishes on the surface of the fabrics. Even a spun yarn from a particular spinning process shows altogether different characteristics if the yarn structure is changed. By modifying the structure of the yarn, the thermo physiological comfort characteristics can be controlled by improving the heat and moisture transfer characteristics of a fabric and tactile comfort can be enhanced by proper rearrangements of the fibres in the yarn and fabrics.

One of the simplest method to produce modified yarn structure is to produce hollow yarn in ring spinning, is that, to feed water soluble Poly Vinyl Alcohol (PVA) yarn in the yarn forming zone as a core material, then treat the yarn in the hot water for removal of the core to create hollow in the centre of the yarn structure. The hollow formed in the yarn centre is mainly of closed or blind type, with the surface covered. Covered surface does not allow water easily to get inside the centre of the yarn or hollow space of the yarn structure; hence, to achieve micro-pore throughout the surface of the yarn it is blended with the water soluble PVA fibre along with viscose fibre in the initial process of mixing, like short staple spinning system has been done. The blended yarn is treated with hot water at a temperature of 90ºC for 20-30 minutes for dissolution of PVA fibre from the structure of the yarn; hence, thousands of micro-pores are created throughout the yarn structure, which will enhance the transfer properties of yarn and fabrics. This method helps to

achieve the pores throughout the surface of the final yarn and the fabric made from the yarns are highly voluminous and compressible, wettable, quick absorbing, drying and will have better thermal properties.

The aim of the research work is to investigate the characteristics of micro-pore ring spun viscose yarn produced by blending the viscose fibre with water soluble PVA fibre at eight different blend proportions such as 5/95, 10/90, 15/85, 20/80, 25/75, 30/70, 35/65 and 40/60 in order to optimize the blend proportion of water soluble PVA fibre with viscose and to analyze the spinnability and quality of the micro-pore ring spun viscose yarn characteristics. The yarn properties such as tenacity, packing density, specific volume and wicking of the yarn before and after dissolving of water soluble PVA fibre were determined for micro-pore ring spun viscose yarn and also it was compared with 100% viscose as a reference yarn. From the test results, it is observed that the tenacity of yarn after dissolution of water soluble PVA fibre, drops irrespective of the PVA fibre blend proportion and drops drastically at a maximum of 38.5%, when compared to 100% viscose yarn. The specific volume of micro-pore ring spun viscose yarn reduces and the packing factor increases with increase in PVA percentage. The wickability increases with increase in PVA blend proportion up to certain level and then decreases with higher PVA% due to the larger capillary size and pores in the yarn structure due to dissolution of water soluble PVA fibre.

By considering the effect of water soluble PVA blend proportion on tenacity for the production of micro-pore ring spun viscose yarn, the first three blend proportions such as 5%, 10% and 15% is considered for further optimization in ring spinning system. In ring spinning, the process parameters such as water soluble PVA fibre blend proportion, yarn TM and spindle speed that influences the yarn characteristics are considered for optimization using full factorial design. From the yarn results, the water soluble PVA of

6.7%, spindle speed of 12,652 rpm and TM of 2.7 are considered to be the optimized values and these values are used for further production of micro-pore ring spun viscose yarn. The yarn was spun with the above mentioned optimized parameters and the PVA was dissolved before testing the yarn properties. The comparison of normal twisted viscose yarn (reference yarn) and micro-porous ring spun viscose yarn produced with the optimized process parameters was carried out. From the test results, it is observed that there is a better correlation between predicted and actual values of yarn properties after dissolving PVA. Further, compared to normal twisted viscose yarn, the micro-porous ring spun viscose yarns are having higher specific volume, lower packing factor, better wickability and lower tenacity due to the pores in the yarn structure created by dissolving the PVA fibre from the yarn.

Further, the influence of ring frame process parameters such as, PVA blend proportion, TM and spindle speed on the properties of single jersey knitted fabrics made from micro-pore ring spun viscose yarn such as transfer properties like air permeability, water vapour permeability, wicking height, thermal conductivity, OMMC, compressional energy and compressional resilience were also studied using full factorial design. Finally, the optimum values of PVA of 7%, spindle speed of 13060 rpm, and TM of 2.7 were determined. The yarn was spun with the above mentioned optimized parameters and the single jersey knitted fabric were produced and it is treated with hot water at a temperature of 90ºC for 20-30 minutes for dissolution of PVA fibre from the knitted fabrics and to test the transfer properties of the same. The comparison of knitted fabric produced from normal twisted 100% viscose yarn (as a reference fabric) and microporous ring spun viscose yarn produced with the optimized process parameters, it is observed that there is a better correlation between predicted and actual values of fabric properties. Further, compared to normal twisted 100% viscose yarn fabric(as a reference fabric), the microporous ring spun viscose yarn fabrics are having higher

watervapour permeability, higher wicking height,lower thermal conductivity and lower air permeability values due to the pores in the yarn structure created by dissolving the PVA in the yarn. The single jersey knitted fabrics made from micro-pore ring spun viscose yarn show lower compressional energy as compared to the 100% viscose fabric(as a reference fabric). There is reduction in compressional energy of the fabrics with increase in the level of PVA blend proportion in the yarn ,hence it is easily compressed even at low pressure,resulting in lower compressional energy of the fabrics.In general there is an overall increase in the compressional energy with the increase of twist in the yarn and reduction in the compressional resilency of the fabric.

Finally, the moisture management properties of plated knitted fabrics made from Micro-Pore Ring Spun Viscose Yarn (MPRSVY) and polypropylene (PP) were analyzed. It can be stated that the PP/MPRSVY fabric was rated as a moisture management fabric with large spreading area and excellent one way transport capacity and OMMC values. However, MPRPVY/PP fabric is classified as a fast absorbing and quick dry fabric owing to small spreading area and lower one way liquid transport index and Overall Moisture Management Capacity (OMMC) values.

Based on the research work, it is concluded that most of the properties of micro-pore ring spun viscose yarn are influenced by the spinning process parameters such as PVA blend proportion, yarn TM and spindle speed of ring frame. The selection of optimum combination of spinning process parameters is the most important decision and this research will provide more flexibility and more options for the researchers and textile technologists to change the functionalities of the clothing by structural modification of spun yarn. The developed Micro-pore Ring Spun Viscose yarn (MPRSVY) can be used to produce layered fabric as outer absorbent layer for excess perspiration in activewear fabrics.