INVESTIGATION OF INFLUENCE OF VORTEX SPINNING PARAMETERS ON YARN PROPERTIES

ABSTRACT

Submitted by

SANKARAKUTHALAM E

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FACULTY OF TECHNOLOGY

ANNA UNIVERSITY

CHENNAI 600 025

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ABSTRACT

The spinning industry has been focusing its attention on higher machine productivity, superior quality and lower production costs. Vortex spinning provides the potential to achieve this target by replacing the major portion of ring spinning, which is dominating the current spinning industry. In current situation, around 8% of every new addition in spinning machinery has been covered by vortex spinning, which provides the "ring like" yarn structure by the development of nozzle and spindle combination.

The aim of this research work is to investigate the influence of spinning parameters on the properties of Polyester/Cotton vortex yarn. Polyester/Cotton vortex yarns with 50/50 blend ratio were produced in two different counts of Ne 20 and Ne 40 counts with four different spinning parameters - delivery speed, spindle size, feed ratio and nozzle pressure. Experiments were designed with the aid of Response Surface Method (RSM). Accordingly different samples were spun in Murata Vortex Spinning (MVS 861) machine with three different level of each parameter with the parameter range level suggested by the machinery manufacturer. The Coefficient of mean mass variation, CVm%, imperfections, tenacity, elongation%, hairiness index H and hairiness by the distribution of hair length were evaluated from the samples produced from these sample design.

From the test results, it is found that the coefficient of variation of yarn mass, CVm% of coarser count vortex yarn is influenced by all the four parameters of the vortex spinning machine. The CVm% of medium count of

Ne 40s vortex yarn is also influenced by all parameters, except the feed ratio. While the spindle size has a significant influence on the thin and thick places of coarser count vortex yarn, it does not have any influence on the thin places of medium counts. The delivery speed does not influence the thin places of coarser counts. The thick places of coarser count and the nep level of medium count vortex yarn are significantly influenced by all the four parameters. The feed ratio also has a significant influence on the nep level of medium count vortex yarn. The interactions of spinning parameters have a significant influence on the CVm%, thin and nep level of medium count vortex yarn, whereas the interactions are having significant influence on the thin and thick places of coarser count vortex yarn.

From the results of tensile properties, it is found that, the tenacity of coarser count vortex yarn is influenced by the feed ratio and that of the medium count vortex yarn is influenced by all the parameters considered in our study. The Elongation at break of coarser count vortex yarn is influenced by the feed ratio and nozzle pressure and that of the medium count vortex yarn is influenced by the spindle size, feed ratio and nozzle pressure. The interactions of spinning parameters have significant influence on the tenacity and elongation at break of medium count vortex yarn. While the interactions have significant influence on elongation at break of the coarser count vortex yarn, they do not have any influence on its tenacity.

From the results of hairiness properties it is found that, the hairiness index, H of both coarser and medium count are influenced by all the four parameters. The interactions of spinning parameters also have significant

influence on the hairiness of both coarser and medium count vortex yarns. The hairiness measurement by its length distribution, which is measured by Zweigle tester also show that, the zweigle 1mm hairs and S3 values are influenced by the all four parameters in both the counts. The results of interactions of spinning parameters also show the same results in measurement of hairiness by its length distribution.

The influence of spindle air pressure and its direction on the properties of Polyester/Cotton vortex yarn has also been studied. The spindle air pressure direction has been changed in both Z and S directions on the Z twist yarn of Ne 40s Polyester/Cotton vortex yarn (50:50 polyester: cotton) and these yarns were then tested for their properties such as tensile, unevenness and hairiness. It is found that unevenness and imperfections are lower with normal spinning condition and increases when the spindle air pressure increases in both directions. The yarn tenacity and elongation at break were found lower at normal spinning condition. When the spindle air pressure increases, yarn tenacity and elongation at break also increases with increase in spindle air pressure. At the same time spindle air pressure in same direction of basic yarn twist gives less increase in tenacity and elongation than spindle air pressure in opposite direction of basic yarn twist. Hairiness index, H and hairiness in different length classes continuously increases as the spindle air pressure increases in opposite direction of basic yarn twist.

This work also investigates the properties of vortex yarn made from 100% Polyester fibre with different fibre fineness and spinning speeds. Four different fineness fibres (0.8, 1.0, 1.2 and 1.4 denier) have been used to

produce yarns of Ne 30 polyester vortex yarn with five different delivery speeds (320, 340, 360, 380 and 400 meters/min) and these yarns are then tested for their unevenness, tensile and hairiness related properties. Linear multiple regression methods were used for the estimation of the yarn quality characteristics. It is found that fibre fineness and spinning speed have not influenced the tenacity of the vortex yarn. The yarn unevenness was found to be maximum for coarser (1.4 denier) fibre and minimum for finer (0.8 denier) fibre. Minimum thin places were noticed for 0.8 denier fibre. The Hairiness index (H) found reduces when the fibre become finer up to 1.0 denier and then increases when the fibre become finer than 1.0 denier. However Zweigle hairiness (1mm) reduces as the fibre become finer. The vortex spinning speed has no influence on the yarn properties except the hairiness values.

Based on this research work, it is concluded that most of the properties of vortex yarn are influenced by the spinning parameters of the vortex spinning machine. The selection of optimum combination of spinning parameters is the most important decision and this research will guide the spinning industry end users to select the optimum spinning parameters for their required quality of the vortex yarn.