Environmentally-Sustainable Single End Slashing

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Introduction

The process of weaving fabrics with high levels of tension and abrasion can cause damage to the yarn threads. To protect threadlines during the process, a protective polymer is coated on the surface of the yarns prior to weaving. This application process is known as slashing. The current slashing system is incompatible with today's demand activated manufacturing strategies. Methods of improving the uniformity of polymer coating application were studied, and several applicators were designed and evaluated. Prewetting of the threadlines before coating application was shown to greatly improve coating uniformity. The objective of the research is to design a single-end slashing process that is environmentally friendly and will improve productivity and flexibility. . The parameters mainly studied were slot dimensions (height, length, and width of the slot applicator), coating speeds, coating formulation, coating concentrations and viscosities. Coating coverage, tensile properties, and hairiness, SEM pictures were used to evaluate coated yarn.

Experimental

Material. Tests were conducted to evaluate the performance of seven coating solutions at various concentrations of solids. Aqueous-based polyacrylamide size produced by Vulcan Performance Chemicals was used.

Two types of cotton yarns are used for this research, which are a 10's cotton count, air-jet-spun yarn made by Springs Industries, Inc, and a 30's cotton count, ring-spun yarn, supplied by Richer Yarns, Ltd.

Polyoxyethylene (Ethox Chemical, LLC) as a surfactant was used to reduce the surface tension of the liquid so that the liquid would more easily spread over the yarn.

Procedure. The setup used for a single-end slashing is shown schematically in Figure 1. The apparatus can be divided into three sections: prewetting, sizing, and drying. Yarn from a bobbin mounted at one end of the apparatus, is pulled through a tensioning device, through the prewetting and application device, and the microwave drying system, and then is wound up using a take-up machine.

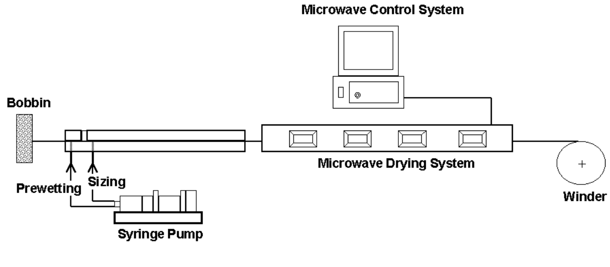

Figure 1. Schematic of single-end sizing apparatus.

Results and discussion

The effects of several parameters on single-end-sized yarn characteristics were slot geometry, yarn count, yarn speed, and size concentration and viscosity. The single-end-sized yarn characteristics measured and/or observed were tensile properties, hairiness, size coverage on yarn surface, and morphology of the yarn.

Yarn Speed. The polyamide solution was also applied at a yarn speed of 200m/min and 500m/min. The tests were conducted using the 24-inch-long and 0.25-inch-high slots with four different widths.

The coverage versus slot width as a function of yarn speed is shown in Figure IV-3. With the narrowest slot width (0.02"), the coverage was 95% for all speeds. For yarn speeds of 100 and 200m/min, the coverage did not vary much. For the yarn speed of 500m/min, however, as the slot width was increased, the coverage decreased gradually.

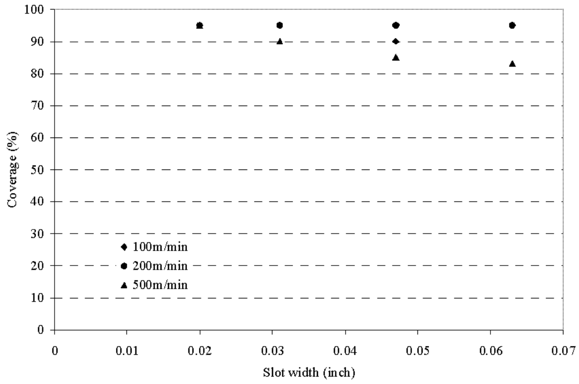

Figure 2. Slot width versus coverage as a function of yarn speed.

Size Formulation. The coverage and tensile properties of yarn sized at 100m/min with 20wt% polyacrylamide-PVA aqueous solution (Callaway 1867) are compared with those for yarn sized with 20wt% polyacrylamide aqueous solution (673-65-B). The 20wt% Callaway 1867 has a viscosity of 640cP, which is much higher than the 23cP of the 20wt% 673-65-B. The comparison is made for 24-inch-long and 0.25-inch-high slots with four different widths. Coverage of sized yarn using 20wt.% Callaway 1867 was lower (range of 60 to 70%) due to higher viscosity.

Size Concentration. The effect of size concentration on coverage and tensile properties were studied using the commercially available 24 wt.% polyacrylamide-PVA aqueous solution (Callaway 1867). As supplied, the concentration was 24wt.%, and the viscosity was 2000cP. Water was added to the size to make a 20wt.% solution having a viscosity of 640cP and a 15wt.% solution having a viscosity of 150cP. The coverage was very poor for the 24wt.% and 20wt.% size solutions, but was increased to 100% for the 15wt.% size solution. At the higher concentrations, elongation was higher and tenacity was lower.

Conclusions

The Effects of several parameters on single-end sized yarn characteristics were studied. It was found that a slot height of 0.25" was sufficient to retain size in the slot at all speeds (up to 500m/min). For speeds up to 800m/min, a slot length of 24 inches was sufficient. The effect of slot dimensions on coverage and tensile properties were studied. Slot length affects coverage more than tensile properties. As slot length was increased, coverage was increased. As width was decreased, coverage was increased. Yarn speed did not affect coverage or tensile properties. The elongations of single-end sized yarn were lower than those of unsized and commercially sized yarn. The tenacities of single-end sized yarn had similar values with commercially sized yarn. Tensile properties depended on the size formulations, and did not depend on the size coverage on yarn surfaces. When size concentration was decreased, coverage and elongation were increased, and tenacity were decreased.

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