Journal of Fiber Bioengineering and Informatics 12:3 (2019) 129–135
doi:10.3993/jfbim00322

Effect of Lubrication on the Changes in Tensile Properties of Cotton Sewing Thread at Different Stages of Sewing

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Abstract

Friction forces play a very important role in performance of sewing thread during the sewing process. Various finishes are applied over sewing threads to reduce the friction forces, which help in masking the basic properties of sewing thread and reduce the yarn to metal friction and yarn to yarn friction. In this paper, the effect of lubrication (%) on tensile properties of sewing thread is measured at four sewing stages: before sewing, after dynamic loading at the tension regulator, after passage through the needle and fabric assembly, and after bobbin thread interaction. It is found that as the lubrication per cent increases friction coefficient decreases, in general. Due to this, the loss in tensile properties of the sewing threads during sewing decrease. Tenacity loss decreases during all sewing stages, as the lubrication percentage increases.

Keywords: Lubrication; Sewing Stages; Tenacity

1 Introduction

During sewing at high speeds, needle thread is subjected to repeated tensile stresses at very high rates. The value of these stresses depends on the sewing speed, machine tension settings, stitch density and sewing thread properties. Due to these stresses, thread shows a negative impact on sewing and its functional characteristics; therefore, significant reduction in the sewing thread strength occurs [1]. A number of researchers observed that there could be 30—40% strength reduction in the cotton thread after sewing, which is due to the structural disintegration, dynamic loading, abrasion and bending deformation [2-4].

The friction coefficient of sewing threads is an important factor for the production process and performance of the garments [5]. Sewing threads develop friction when they pass over various machine parts during the garment manufacturing process. The amount of friction between guiding elements and sewing threads depends on the surface treatment of the thread [5-6]. Various

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Sep. 2019

lubricants are applied over sewing threads to provide a controlled level of friction by masking the thread surface [7-8]. In a recent publication, it is reported that the amount and type of the lubricant applied have a profound effect on frictional properties of the thread. Friction can be 200 times lower for thread with lubrication, as compared to thread without lubrication [9-10]. It is found that most of the researchers have focused on the effect of lubrication on frictional properties of the thread but no study has reported the effect of lubrication on sewing thread strength before sewing and during various stages of sewing. In this paper, the effect of different levels of lubrication has been studied on tensile properties of the threads as the thread progresses through various stages of sewing.

2 Experimental

Cotton sewing thread of 14 Tex is used to produce three different samples by varying lubrication (%) as shown in Table 1. Silicone and wax finish is applied over the threads as a lubricant. The physical properties of the threads are also shown in Table 1.

Table 1: Physical properties of sewing threads

Type of thread	Twist direction	Twist (Turns per cm)	Linear density (Tex)	Lubrication (%)	Tenacity (cN/Tex)	Friction coefficient	
						Yarn to metal	Yarn to yarn
Cotton	Z/S	20	16	3	35.76	0.378	0.366
				4	42.78	0.365	0.354
				5	36.8	0.376	0.332

Tensile testing of threads (before and after sewing) is performed at a gauge length of 250 mm on Universal testing machine as per ASTM standard D2256. Thirty tests are carried out and the error at the 95% confidence interval is found to be less than 4%. Brother industrial lockstitch sewing machine is run at a speed of 4000 stitches/min, to produce a seam on three layers of rib knitted fabric with stitch density of 9 stitches/cm. The same type of thread is used for needle and bobbin thread to prepare the seams. Sewing thread tensile properties are measured at four sewing stages (S1, S2, S3, and S4) as described in literature [11]. The difference in tensile property between any two stages is due to the stresses acting during that stage as shown below;

- stages S1 and S2 - dynamic loading;
- stages S2 and S3 - passage through needle and fabric assembly;
- stages S3 and S4 - bobbin thread interaction

The change (%) and the contribution (%) of the stresses in total change in the tensile property at different stages are calculated from the following expressions:

$$\text{Change } (\%) = \frac{T_n - T_{n-1}}{T_{n-1}} \tag{1}$$

$$\text{Contribution } (\%) = \frac{T_n - T_{n-1}}{T_1 - T_4} \tag{2}$$

where T_n is the tensile property at different sewing stages, with $n = 2$, 3, and 4 corresponding to sewing stage S2, S3, and S4, respectively.