A STUDY TO INVESTIGATE THE EFFECT OF SEWING MACHINE SPEED ON THE SEAM STRENGTH

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INTRODUCTION

People wear various types of garments for different purposes. These garments are made by using different fabrics, sewing threads, stitch types, seam types etc. These fabrics, sewing threads, stitches and seams have different properties and characteristics. These different properties and characteristics affect the performance and the appearance of the final garments (Glock and Kunz, 1995). The joining of cut fabric panels could be carried out by using various techniques such as sewing, thermal bonding, using adhesives etc (Perera, 2006). Sewing is the most common method of joining cut fabric panels during the garment manufacture. Different seam constructions are generally used in garment manufacture to achieve the required strength, flexibility, elasticity, appearance etc in garments. These seams should have enough strength to withstand the tensional forces and abrasive forces during the wearing and cleaning. Seam strength is one of the major factors, which affects the durability of garments (Carr and Latham, 1995). The failure of seams in garments may occur due to breaking of sewing thread, tearing of the fabric at the seam, tearing of the fabric at any other place and excessive yarn slippage adjacent to the stitches or due to a combination of them.

Seam strength is generally related to fabric properties, stitch types, tension of the sewing threads, strength of sewing threads, seam types, seam allowances, stitch densities etc. Although seam strength is important, it does not need to be higher than the fabric, from which the seam is constructed (Gribaa èt al`, 2006). For the construction of different seams, different types of sewing machines are used. In order to obtain high quality seams, correct sewing machine parameters should be selected. One of the important sewing machine parameters is the speed of the sewing machine. Even though research has been carried out to investigate most of the other factors related to seams, only relatively fewer research activities have been carried out to find out the effect of sewing machine speed on seam strength. Therefore, the main objective of the research is to investigate the effect of varying sewing machine speeds on the seam strength.

METHODOLOGY

1. A comprehensive literature survey was carried out to identify the factors, which could affect the seam strength.

2. Necessary materials, machines, equipment, and a suitable testing standard were selected and the parameters related to sewing were determined.

3. Fabric samples (five samples each for warp and weft directions for each machine speed) were prepared by using ten (10) different sewing machine speeds. Different sewing machine speeds in rpm (revolution per minute) were selected.

4. The samples were tested for seam strength by using the tensile strength testing machine and the necessary data was collected and analyzed to determine whether the sewing

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machine speed has an impact on seam strength.

DESIGNING THE EXPERIMENT

During the designing phase, the necessary materials, machines, equipment and a suitable testing standard were selected and the parameters related to stitching were determined as given below: The table 1 shows the selected conditions for the experiment.

Table 1: **Selected conditions for the experiment**

Selected conditions for the experiment	
Fabric	Fibre content: 100% Cotton, Fabric structure: Plain weave, Weight: 76.26 g/m2, Warp yarn count: 14.76 tex, Weft yarn count: 15.19 tex, Ends per inch: 80, Picks per inch: 49
Sewing thread	Polyester Cotton core spun sewing thread, Thread count: 36 tex
Sewing machine	Single needle lock stitch machine, Maximum sewing speed 5000 rpm
Needle	Size: 0.030 inch
Tensile testing machine	Tinous Olsun tensile testing machine (with constant rate of extension)
Testing Standard	ASTM D434
Standard conditions	Temperature: 27±2C°, Relative Humidity: 65±2%
Seam type	Plain seam
Stitch type	Single needle lock stitch
Stitch density	14±1/2 stitches per inch

The table 2 shows the selected ten (10) different speeds of the sewing machine for the purpose of preparation of the samples. This is the only variable parameter of the experiment.

Table 2: **Selected machine speeds for the experiment**

Selected machine speeds for the experiment	
Sewing machine speeds (rpm)	1750, 2000, 2250, 2500, 2750, 3000, 3250, 3500, 3750 and 4000

PREPARATION AND TESTING THE SAMPLES

The samples were prepared according to the testing standard ASTM D434. The dimension of a sample was 4”x 14” inches. As the experiment was planned to be carried out in both the warp and the weft directions, samples were cut accordingly. After cutting the samples, they were folded 4” from one side, parallel to the shorter direction. A seam was created by applying a row of stitches, half (½) inch away from the folded line of the sample. For each of the chosen machine speed ten samples were sewn. Of these ten samples, five were sewn with seam parallel to the weft direction and the other five with seam parallel to the warp direction. Thus the total number of samples prepared was 100 for the 10 different sewing machine speeds.

The prepared samples were tested by using the selected tensile strength testing machine. For the testing purposes an extension range of 50 inches, testing speed of 11.81 inches per minute, 100 lbf (pound force) load and 1.0 lbf preload was used. The seam opening was 0.252 inches.

RESULTS AND DISCUSSION

Table 3 and 4 give the seam strength of each sample tested in seam parallel to the weft direction and the warp direction respectively.

Seams parallel to weft direction

Table 3: **Seam strength of samples – Seam parallel to weft direction**

Machine speed (rpm)	Seam strength in lbf					
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average
1750	37.86	32.27	35.88	38.35	37.82	37.44
2000	35.70	34.31	36.24	36.87	36.69	35.96
2250	35.74	37.32	36.10	35.61	36.19	36.19
2500	36.55	38.13	35.97	38.72	36.87	37.25
2750	39.66	37.09	37.43	37.27	37.60	37.81
3000	38.40	34.89	33.33	36.55	37.59	36.15
3250	33.89	32.32	37.72	36.96	32.19	34.62
3500	36.60	39.96	38.67	33.86	37.98	36.81
3750	39.52	35.07	30.03	37.82	37.99	37.89
4000	34.44	37.22	35.74	39.34	35.30	36.43

Seams parallel to warp direction

Table 4: **Seam strength of samples- Seam parallel to warp direction**

Machine speed (rpm)	Seam strength in lbf					
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average
1750	18.01	19.87	21.85	19.31	19.38	19.68
2000	21.99	17.80	17.65	17.76	19.78	19.00
2250	19.47	18.03	19.02	20.05	22.68	19.85
2500	16.46	24.64	19.47	23.10	20.10	20.75
2750	16.01	21.42	19.81	23.04	21.85	20.43
3000	18.50	18.43	16.59	18.37	21.84	18.74
3250	18.88	20.28	18.84	16.10	18.95	18.61
3500	19.74	19.11	15.31	18.07	17.45	17.94
3750	19.02	18.28	18.57	19.33	18.41	18.72
4000	21.67	20.25	19.08	19.16	20.10	20.05

The last columns of Table 3 and 4 show the average value of seam strength for each tested machine speed. The overall average value of seam strength for the selected sewing machine speeds in the weft direction is 36.65 lbf, and in the warp direction is 19.37 lbf. The standard deviation and the percentage of the coefficient variation of the average values for the samples where the seam is in the weft direction are 0.94 and 2.56 respectively. Similarly the standard deviation and the percentage of the coefficient variation of the average values for the samples where the seam is in the warp direction are 0.85 and 4.38 respectively. As per the results, it is could be established that there is no significant change in the seam strength at different sewing machine speeds, both when the seam is parallel to the weft and the warp directions.

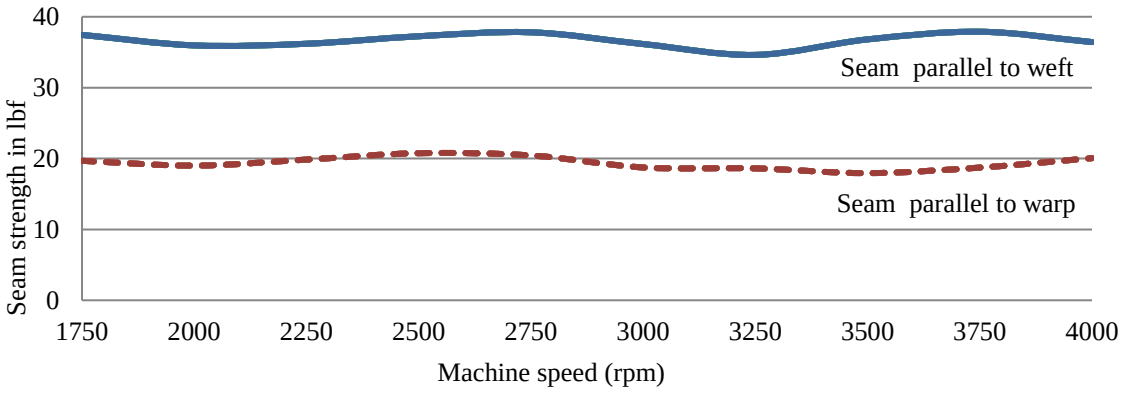

Figure1: **Variation of the seam strength against different sewing machine speeds**

The average strength of the seams parallel to weft direction is higher than the seams parallel to warp direction as the number of ends per inch is higher than the number of picks per inch in the selected fabric. The changes within single direction are not significant.

CONCLUSIONS AND RECOMMENDATIONS

The sewing machine operators use different sewing speeds during sewing of garments. The criteria for using different speeds is dependent on the skill level of the operators, nature of the fabrics, shape of the stitching lines (curved or straight), the length of the seams, limitation of the sewing machine speeds etc. During the sewing process, the needle penetrates the fabric panels at different speeds as sewing machine operators use different sewing speeds. Therefore it is possible to think that with the increase of the sewing machine speeds there is a possibility of reducing the seam strength. As per the results obtained from the samples made parallel to the weft and warp directions, it is difficult to establish a pattern for the seam strength variations against different sewing machine speeds. Low values of standard deviation and percentage of coefficient of variation prove that the changes in the average values of the seam strength at different sewing machine speeds are insignificant.

Therefore, based on the results of this research, it is possible to conclude that the variations of sewing machine speed do not have significant impact on the seam strength. Therefore it is possible to recommend that the higher sewing speeds could be used for sewing purposes to achieve higher sewing efficiencies as there is no significant change in seam strength.

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