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The Impact of Sewing Threads Properties on Seam Pucker

F. Fathy Saied Ebrahim[1,2]

[1]Academy of Specific Studies, Worker University
[2]Home Economic Dept., Faculty of Science &Education, Taif University, KSA

ABSTRACT

This study is aimed to determine the influence of thread properties on seam pucker. The paper provides an overview on the impact of mechanical properties of sewing threads on the seam pucker. The seam pucker of lightweight fabric was evaluated after sewing then after 24h, after 48h and after washing & drying. To determine dimension changes of fabric, the relaxation shrinkage was calculated. The results of thread properties and seam pucker were compared. In respect of seam pucker the best results were established sewing with polyester threads. After washing and drying, the highest pucker was typical of the specimens sewn with cotton sewing threads. It was noticed that increasing the amount of layers in sewing the influence of threads on seam pucker decreases. Washing and drying made considerably greater influence on the occurrence of pucker then time. This study has practical implications in the clothing and other nearly related industries. In the paper recommendations involved with application of sewing thread and evaluation of seam pucker are presented. In most cases the changes of sewn thread mechanical properties after sewing is analysed.

KEYWORDS: Lightweight Fabric, Mechanical Properties, Seam Pucker, Relaxation Shrinkage.

INTRODUCTION

One of the most common problems encountered when making up fine, woven is seam pucker. Most puckering is the result of one or a combination of four major causes: incorrect tension settings, fabric and / or thread instability, structural jamming and poorly controlled fabric feed. Seam pucker problems in lightweight fabrics are serious in garment manufacturing plant, reducing the aesthetic value and degrading quality of garment [1]. Fabric quality is one of the primary requirements for production of high seam quality in apparel. However, fabric quality alone does not fulfill all the criteria for the production of high quality garment. The conversion of a two dimensional fabric into a three dimensional garment involves many other interactions, such as selection of suitable sewing thread, optimization of sewing parameters, ease of conversion of fabric into garment and actual performance of sewn fabric during wear of garment [2].Sewing thread is also a prime contributory factor for satisfactory seam quality. Correct selection of sewing thread requires consideration of its properties in the completed garment under conditions of wear and cleaning [3]. Thus the sewability and seam quality of sewing thread is largely influenced by three factors [2]: (i) the material to be sewn, (ii) The sewing technique and (iii) The end use or the application of the sewn material. Quality of sewing garments is determined by many factors including puckering in the place of a seam. This defect is relevant to garments sewn of light textile materials, especially of lightweight fabrics. Seam pucker is influenced by different factors, as properties of sewing threads and fabrics, processes of needle penetration, stitch formation, sewing thread tension and fabric feeding, seam construction and various technological parameters, and other. Particular great attention is paid to fabric properties and factors of a sewing machine as well as to their compatibility in the process of sewing [4-9].The shrinkage of threads after sewing may have not inconsiderable influence on occurrence of this defect. However, studying properties of threads, the changes of mechanical properties after sewing were analyzed in most cases [10-15]. The limited amount of researches analysing the influence of sewing thread properties on seam pucker have been reported [16-19]. Seam pucker often is evaluated immediately after the sewing process or shortly after it. Thus, there is no possibility to evaluate relaxation processes of sewing garment fabrics manifesting themselves only after longer time passes from the sewing process. Particularly, it is relevant to sewing threads as in the process of sewing they undergo different loads, are stretched, flexed and otherwise deformed. Reversible deformations of threads may assert themselves only after some time, and this fact would also have influence on quality of a sewing garment as due to this deformation threads may crease seams, especially in the sewing garments of light fabrics. One of the factors relevant to seam puckering is the impact of humidity that is often left unconsidered. After sewing, seam quality may be acceptable, but under the impact of humidity seams may crease

***Corresponding Author:** F. Fathy Saied Ebrahim, Academy of Specific Studies, Worker University. Home Economic Dept., Faculty of Science &Education, Taif University, KSA

significantly as macromolecules of fibers in sewing garment fabrics become more mobile and return to their normal status. Thus, in order to asses the reasons of seam puckering in a complex manner it is necessary to consider the compatibility of sewing garment fabrics both in the process of sewing and when some time passes after sewing as well as in the course of operation.

MATERIALS AND METHODS

Polyester and cotton sewing threads having different structural, physical and mechanical properties were selected for the study. The details of these threads are given in **Table 1**.Seam pucker is especially topical for lightweight fabrics of sewing garments. Therefore, in the research fabrics deigned for light garments were used, marked as **S1 (100% cotton**), **S2 (polyester/cotton), S3 (100% polyester**). Mechanical properties of sewing threads was obtained using testing machine "ZWICK/Z005", load of 2 N was suddenly applied to test specimens**. Fig.1** shows the example of seam pucker representation. **Fig.2** shoes a rating system for seam puckering from 1 to 5 with 5 being pucker-free. This AATCC seam smoothness analysis is used by many major manufacturers to rate their seam performance.

Fig.1 The example of seam pucker representation

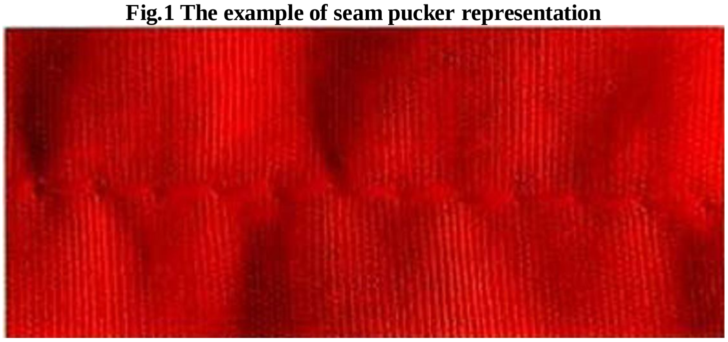


Fig.2 AATCC Photographic seam puckering replicas

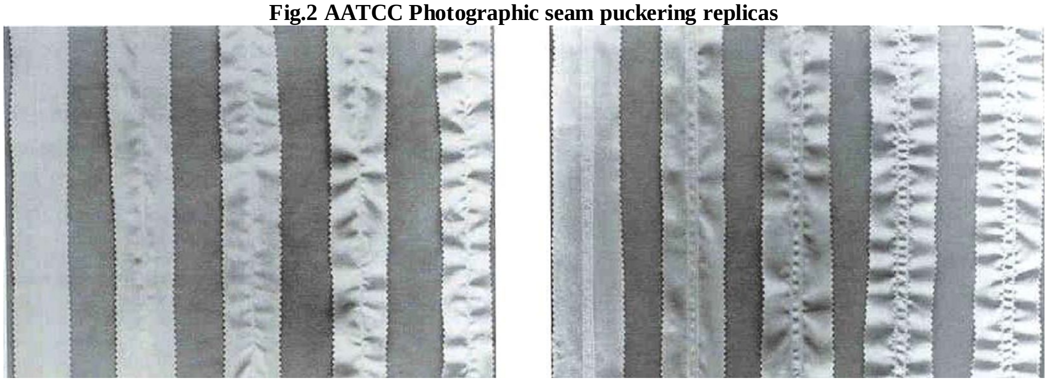


Table 1.
Properties of sewing Threads

Sewing thread code	Composition	Linear density, tex	Elongation at break,%	Breaking tenacity, cN/tex
A	100 % polyester	14.8	18.9	36.3
B	100 % polyester	13.1	19.3	502
C	100 % cotton	14.8	6.0	42.9

(Number of ply = 2; Twist = 18 Twist/inch; Finish = Lubrication finish)

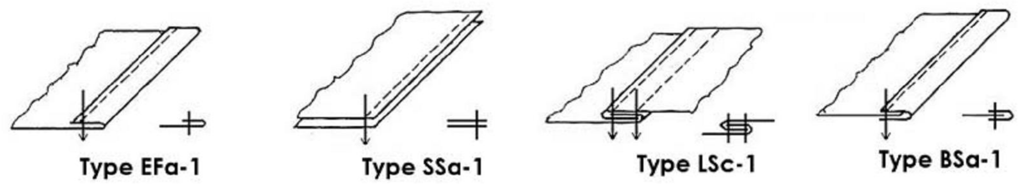
Seam pucker was evaluated by measuring length of test specimens sewn with the sewing threads chosen for research and calculating pucker coefficient W %. [8]:

$$W = \frac{L_S - L_0}{L_0} \times 100$$

where L0 is initial length of specimen, Ls is length of specimen, stretched until puckers disappears.

Length of specimens was measured immediately after sewing, then after 24 h, after 48 h as well as after washing and drying. The seam type was 1.01.01.Another part of test specimens was prepared grouping strips by three. "Juki"DLU 490 one-needle lockstitch sewing machine and "Schmetz" needle No.90 were used with stitch length of 2.5mm. For each group of different sewing thread, optimum tension was selected, respectively. Other sewing conditions were chosen to avoid determining pucker. After washing and drying the specimens may shrink due to the shrinkage of sewing threads as well as the fabric. **Fig.3** shows examples of seams and their representation, classified according to the British Standard 3870 [20].

Fig. 3: The examples of seams and their representation



To determine dimension changes of fabrics, the investigation according FAST-4[21] testing technique was carried out. In order to determine changes of dimensions, the specimen was dried up to humidity of 0 % (T = 105ºC) and lengths (L1) of its sections were measured. Then the specimen was soaked into water, left until saturation and removed. After that, its lengths (L2) were measured at humidity level of 100 %. After measurements, the specimen was dried again and its lengths (L3) were established at repeated humidity level of 0 %. Relaxation shrinkage (RS) was calculated such a way**:-**

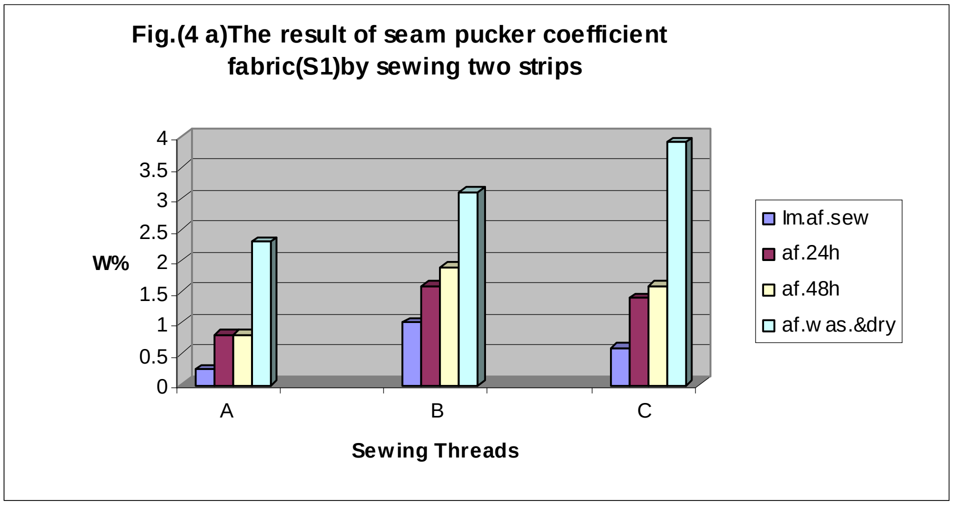
$$\mathbf{RS = \frac{L1 - L3}{L1} \ (\%)}$$

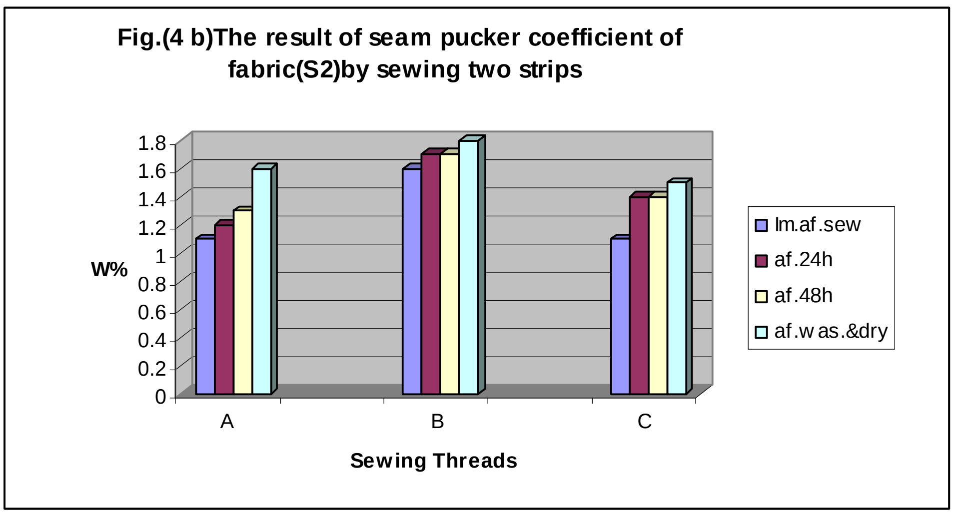
RESULTS AND DISCUSSION

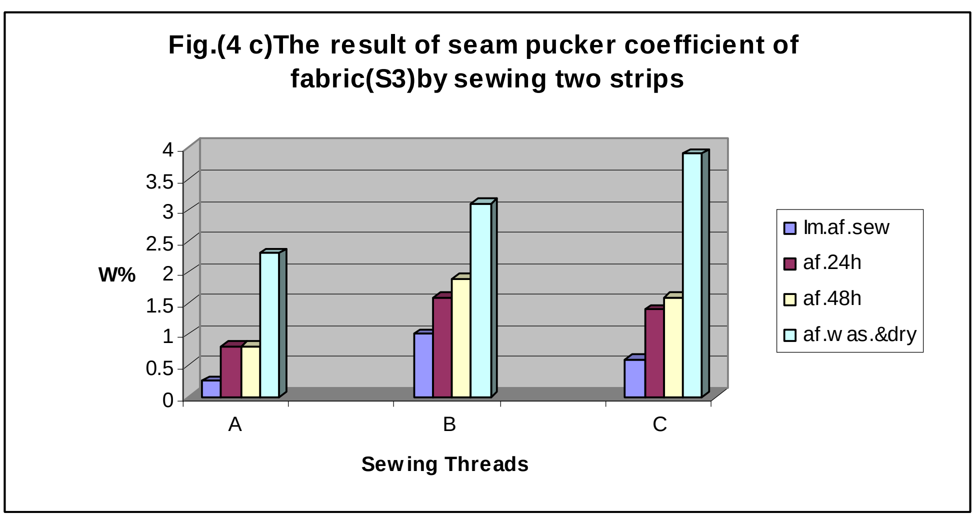
Seam pucker is a result of fabric yarns displacement, when a needle penetrates the fabric and the upper and the lower threads loop insert within fabric. The fabric yarns are bent, stressed, and attempting to return to their original positions, but are prevented by the sewing threads. The fabric structural jamming is the most influenced by the sewing thread diameter alongside with other factors such as fabric properties, seam type, stitch density. The sewing threads chosen for this investigation are fine. The results of pucker coefficients W(%) of the different fabric specimens prepared by sewing two strips are shown in **Fig.4 (a, b, c)**. It was obtained, when the sewing conditions are the same the influence of sewing threads with different composition and mechanical properties on seam pucker is uneven after passing the time as well as washing and drying. Analysing the obtained results it was determined that when sewing by the threads chosen, seam pucker coefficient W is minor, does not exceed 2 % in most cases, and only specimens sewn of fabric **S3** feature higher pucker (W amounted 4 %). It was obtained that after 24 and 48 h from the sewing, the value of seam pucker changes negligibly compared to the results of the measurements carried out immediately after sewing. The processes of washing and drying of specimens was impacted the change of seam pucker considerably greater compared to the influence made by the time factor. Analysis of the results has been shown that greater pucker is typical to the specimen sewn with threads **B**. As research of mechanical parameters of threads showed, these threads attributed the highest reversible strain among the investigated threads. In the process of sewing threads are stretched, flexed and otherwise deformed, and after sewing due to the relaxation processes in progress threads shrink and a seam creases. It is known, as in the process of manufacture sewing garment fabrics receive mechanical impacts, they become deformed. After manufacture processes, slowly vanishing elastic deformations are observed in fabrics and some stresses remains.

Elastic deformation occurs, which due to the new intermolecular interaction may not vanish even over a long time. Under certain conditions (normal wear conditions), material is balanced. After affecting with humidity and warmth, kinetic energy of thermal movement in macromolecular segments increases.

Fig. 4 The results of seam pucker coefficient (W%) of specimens prepared by sewing two strips

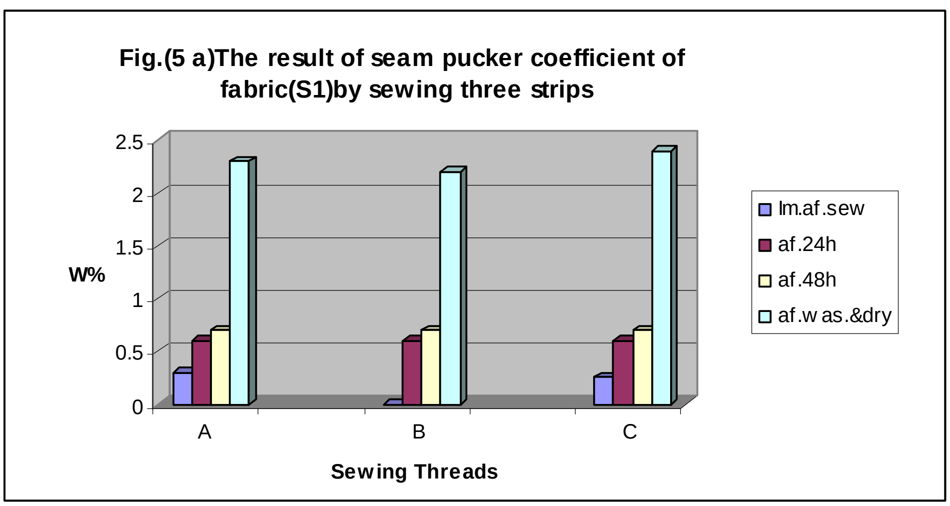


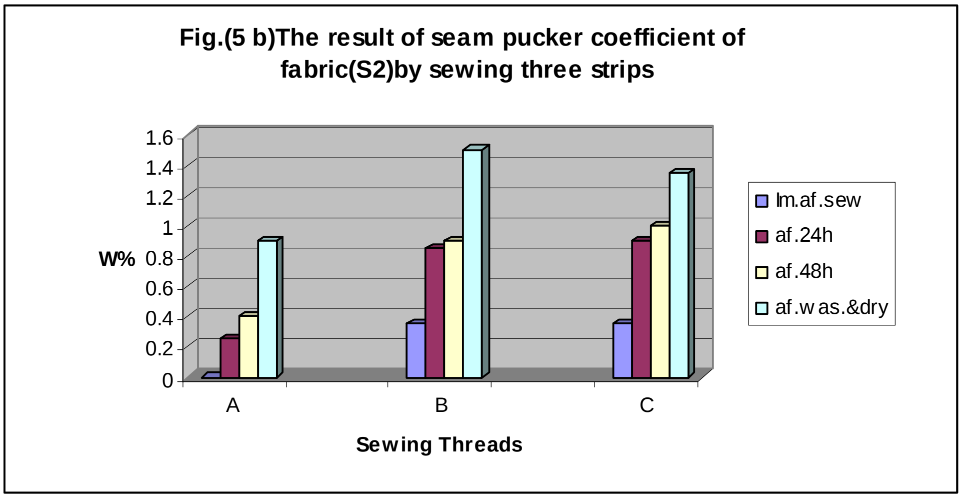


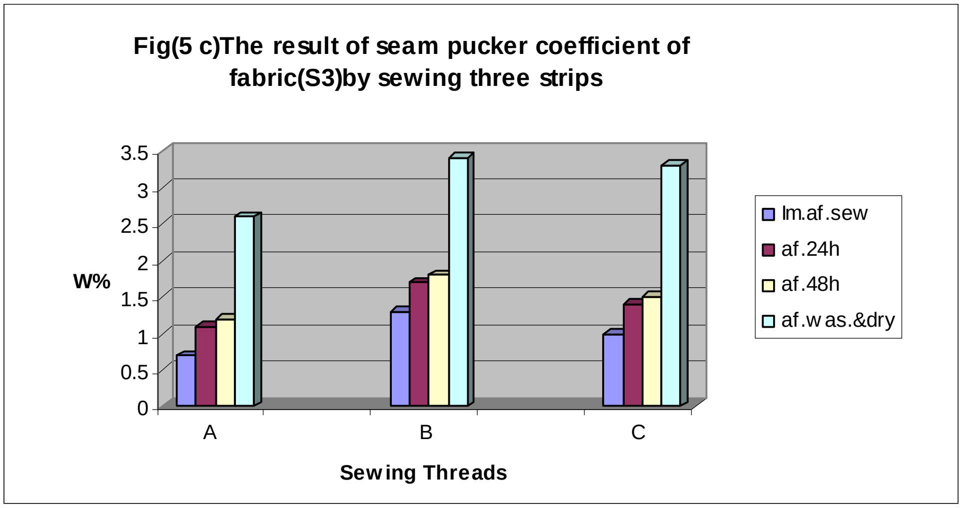


Materials having experienced the impact of humidity and warmth during manufacture processes and in course of wear return to their previous status. Hence, the greater is the deformation of fibers, threads or the material itself, the greater is the shrinkage observed later. Besides, under the impact of humidity and after penetration of water molecules into fiber macromolecules, interaction between macromolecules becomes weaker. Therefore, macromolecules in fibers become more mobile and return to their normal status. It is known that under the impact of warmth, macromolecules and their links assume kinetic energy and become more mobile (mobility of macromolecules increases). Thus, humidity together with warmth stimulates the process of shrinkage. This fact might explain why in all cases the greatest influence on seam creasing is made by the process of washing and drying. The results of seam pucker coefficients W (%) of the specimens prepared by sewing three fabric layers are shown in **Fig. 5 (a, b, c)**. It was noticed that sewing three strips, the seam pucker defect assert itself weaker than sewing two strips: some 1 % in specimens of fabrics S1and S2, and some 2% in specimens of fabric S3.Decrease of the pucker coefficient could be influenced by the increase of thickness and rigidity of sewing: It is known that thicker and more rigid fabrics crease less. In most cases the tendency that threads with highest reversible strain determine greater pucker remain. However, depending on fabric properties the results of investigations can be close. This confirms the influence of fabric properties on seam pucker. Increase of pucker after washing and drying had greater influence in the specimens prepared sewing together three strips of fabric compared to the specimens with two ones. Seam pucker tendencies, however, remain similar as sewing together two layers; a little bit higher pucker coefficient is typical of sewing threads **C**, but this value may be considered nonessential. The value of seam pucker coefficient is moderate, but practically observed puckering is enough to determine downgrade a look of final product sewing from lightweight fabric. Analysis of seam pucker results in all the investigated cases demonstrates that the lowest seam pucker coefficient is characteristic to the specimens sewn with sewing tread **A**. It can be explain that elastic strain of these threads is negligible, whereas remaining strain is the lowest among all the threads investigated. Reversible elongation of cotton sewing thread is also negligible, however, according to the provided results it can be seen that particularly after washing and drying seam pucker is high, in some cases the highest among all the investigated threads. Fibres of cotton threads absorb humidity and swell, therefore, their diameter increases. At the same time, thread diameter increases as well. Length of fibers, however, remains the same. As cotton sewing thread has twist, due to increase of cross-section outer windings are tensioned. However, they do not become longer, therefore thread becomes shorter. The higher is the twist, the greater is the shrinkage of thread. This fact may be used to explain why threads featuring low reversible deformation puckering seams rather strongly after washing and drying.

Fig.5 the results of seam pucker coefficient (W %) of specimens prepared by sewing three strips





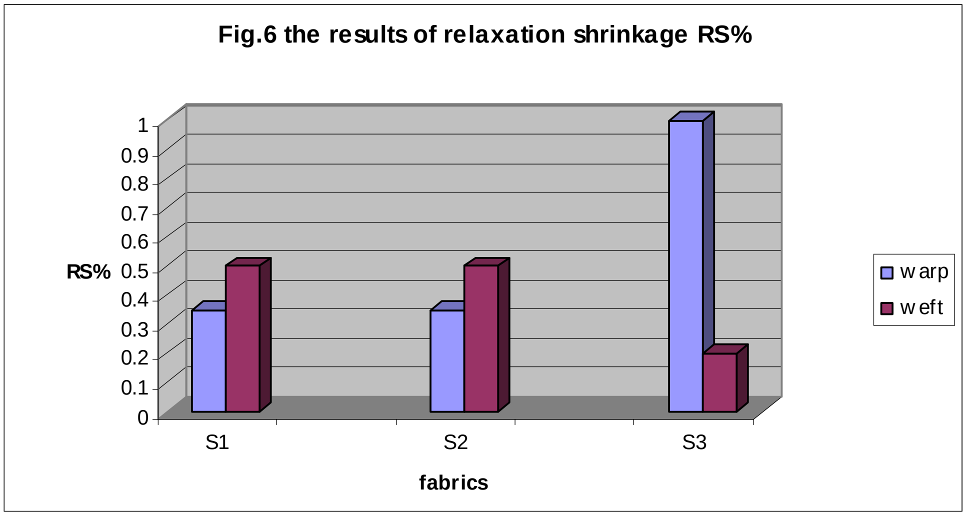


In order to know whether considerable shortening of specimens after washing and drying is observed due to the shrinkage of sewing threads and not of fabrics, testing for determining the shrinkage of the latter was carried out. Results of relaxation shrinkage of warp and weft are shown in Fig.6.

It was established that lengths of the investigated fabrics change neither in the direction of warp nor in the direction of weft while reducing humidity level to 0%, whereas after soaking fabric into water and measuring its lengths (L2) at humidity level of 100%, fabric lengths in the direction of warp become slightly longer, and fabric lengths in the direction of weft remain the same. When fabric is dried to humidity level of 0% again, shrinkage increases and is the highest one.

Changes of specimen dimension take place due to relaxation, when fabric threads are deformed by tensioning or compression. Relaxation takes place due to the impacts of humidity, pressing or water. Problems may arise, when shrinkage exceeds 3%. Relaxation shrinkage of the investigated fabrics both in the direction of warp (RS = 0.35 – 1 %) and in the direction of weft (RS = 0.20 – 0.50 %) is negligible, therefore, it may be stated that after washing and drying sewing specimens become shorter not due to the shrinkage of fabric, but due to the shrinkage of sewing threads.

Fig.6 the results of relaxation shrinkage RS% of warp and weft



Conclusions

The results of the investigation showed that sewing threads used for this research due to theirs structural and mechanical properties caused seam pucker, which pucker coefficient was 2 % in most cases. Principle the value of this coefficient is not high, but for all practical purposes observed puckering determine downgrade a look of final product sewing from lightweight fabric. It was established that when some time passes after sewing the greatest crease to seams is made by polyester sewing threads, the reversible strain where of is the highest. In all investigated cases the highest seam pucker was observed after washing and drying, the time factor made considerably less influence on the occurrence of creases. After washing and drying, the highest pucker was typical of the specimens sewn with cotton sewing threads, due to yarn swelling. The relation between sewing thread mechanical properties and seam pucker is essential for apparel manufacturer for prediction of sewing thread mechanical properties, as related to the required properties of high seam quality. By defining the relation between seam pucker and sewing thread mechanical properties, apparel manufacture can make decision about the optimal sewing thread selection in apparel manufacture.

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