THE STUDIES ON CORRELATIONS BETWEEN THE PROPERTIES OF STRENGTH AND FREQUENCY ASSEMBLIES SEW PROTECTIVE CLOTHING

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1. INTRODUCTION

Now, in accordance with the requirements of applicable standards on protective clothing, exposed to SR EN 340:2004, the demanding requirements of users and the security and protection of workers during the course of harmful factors all work environments with different degrees of risk shows a series of requirements imposed by the resistance properties of clothing assemblies, structure and way of finishing materials. Garments are subject to special measures tension, compression, bending, etc. work action activity. This leads to the appearance of dress of the tasks that ultimately contributes to the breakdown product of complex totality to ensure the protection and operating requirements of special clothing in the manufacturing process requirements, a major significance to the strength, durability sewing assemblies, the basic structure of materials and the materials for assembly, use on clothing due to compliance within a reasonable exploitation of the products. Thus, one can mention that the protective clothing of technology have an important significance for ensuring the multifunctionality of special purpose products, which must cope with the requirements of multi-user situations.

2. EXPERIMENT DETAILS

Due to the fact that universal protective clothing consisting of overalls and coats, their destination is the safety and protection of workers, providing protective and hygienic properties, study the properties of resistance to the assembly by sewing materials were selected with the bicomponent fiber composition of 53% cotton, 47% polyester; 35% cotton, 65% polyester; 33% cotton, 67% polyester worked with various types of finishes as waterproofing. On the outer protective clothing (short), which serves as insulation and protection from harmful environmental factors at work, study samples were used with membrane performance waterproof Gore - Tex polytetrafluoroethylene, waterproof material composition 100% polyester fiber and waterproof finish. The purpose of this study was to determine the behaviour of assembly lines and the structure of materials investigated in the operation of protective clothing, carrying out the experimental research in this regard.

As mentioned in the literature, the uncorrelation between technological parameters of the particular materials used for making protective clothing, may cause changes in products irreversible. The study of correlation between parameters applied in the work load at break, elongation at break, the frequency steps in the seam , the fineness of thread assembly allows to address the broad dependence between variable factors investigated, as the result following the development of recommendations on the optimal correlation between the strength properties of the sews 301 and sews' frequency and the structure of materials. The experimental investigations were conducted under conditions laboratory performing the request of the assembly 301–SSa-1 tensile direction perpendicular to the direction seam stitching and a considerable number of samples of various types of material mentioned above, adopting various stitch densities of steps, such as 3; 3,5; 4 steps 1 - cm. For items of clothing applications most frequently encountered are placed perpendicular to the assembly line, following the direction located on the stitching. Proposed to carry out experimental research the thread was selected proceeding from the requirements of users, the frequency of use in protective clothing, having the fineness of N_m 40/2 and 100% polyester fiber composition, being one of the most resistant. The work on the application of experimental samples was done to the car breaking traction PT-250M-2 (car image is represented in figure 1), which were taken the following data:

1) the maximum tensile direction perpendicular to the direction of the sews, the cut sews produced when measured in kg,

2) absolute elongation at break, measured in millimetres and relative elongation at break, measured in % for application in traction stitch direction.

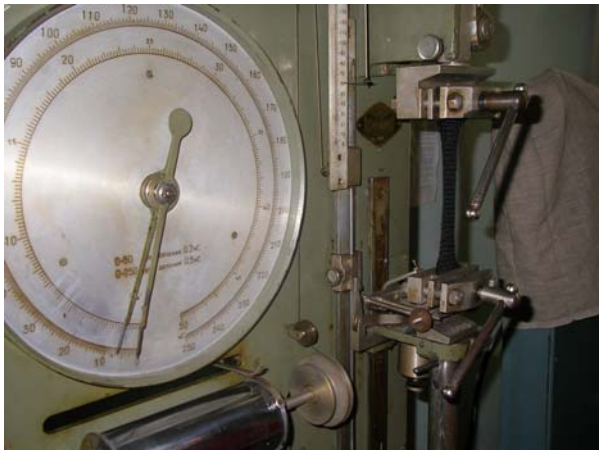

Figure1. Traction machine PT-250M-2.

Before the test, samples are conditioned in standard atmosphere. The experiments performed static type are characterized by short (1 to 1,5 min).

The processing experimental results obtained by the correlation between parameters are characterizing through the properties of strength and frequency of seam 2 D system that was achieved using Excel.

The experimental data presented in Table 1 of the primary data. To calculate the correlation between the factors of interest in the paper, use the average values corresponding to five different kinds of materials research. The results focus in the form of diagrams, such as variation in the frequency chart of the sew and breaking load, stitch diagram and frequency variation of elongation at break; diagram of variation of breaking load and elongation at break, graphically representing the correlation of the factors investigated.

3. RESULTS AND DISCUTIONS

The correlation analysis, which is part of the important fields of statistics, and research, is concerned with the description of dependence of two or more variables, determining their dependence. That correlation analysis shows the extent to which Maths' function has success to describe the behaviour described by the model. The correlation of two quantities X and Y, means that both are determined in the same phenomena and laws, most often known and not directly depending on the quantities of one another.

The role of correlation analysis is to select the significant factors (statistical variables) with an interaction (statistical connection) between these factors. [1]

The intensity of the relationship between two variables: the correlation coefficient r is a dimensionless value and the values in the range $-1 \leq r \leq 1$ ($-1 \leq r \leq 1$).

The equality $r = 0$ (or $r \cong 0$), indicating no correlation between those variables, or the existence of nonlinear dependencies. The higher the absolute value of r, the correlation is stronger relationship: $r = \pm 1$ the value corresponds to a strict functional dependence between variables.

Meaning link: sign of correlation coefficient indicates the direction of the correlation: if $r > 0$, the link is direct (due to higher X, Y growth occurs and vice versa), and if $r<0$, the correlation is inverted (with the increase of X, Y occurs decreases and vice versa) [1].

As a first step in data processing establish an experimental database.

In this case the correlation between frequency steps to determine the seam strength characteristics and their variables, determining the correlation coefficient r, the variable X is the significant factor (frequency stitch), and Y - the criteria of optimization (Y_1 - breaking load stitch direction, Y_2 - stitch direction elongation at break, Y_3 - breaking load direction perpendicular to the stitching). The results are placed in table 2.

The interpretation of the results is presented as diagrams in figures 2-5.

Table 1. Type of primary experimental data

Nr. crt.	The type of the sew, finishing	The fineness of thread, Nm	The frequency steps in the sew, steps / 1 cm	The tear in the direction of the stitching task, N	Elongation at break relative to the direction of stitching, %	Tensile load perpendicular to the direction of stitching, N
1	1. Cotton 35 %, 65% PES, waterproof finish, antioily	40/2	3,0	110,96	31,8	40,14
2			3,5	113,9	32,1	40,2
3			4,0	117,2	34,2	42,36
4	2. Cotton 53 %, 47% PES, finish antioily	40/2	3,0	161,16	37,8	40,5
5			3,5	162,18	39,0	44,4
6			4,0	170,34	39,4	48,4
7	3. Cotton 35 %, 65% PES, finish antioily	40/2	3,0	66,4	18,4	42,1
8			3,5	70,4	20,0	43,7
9			4,0	70,7	20,6	50,04
10	4. Cotton 33 %, PES 67 %, waterproof finish, antioily	40/2	3,0	71,6	20,4	41,86
11			3,5	72,74	22	43,66
12			4,0	75,16	22,8	52,96
13	5. Gore – Tex, polytetrafluoroethylene	40/2	3,0	58,32	32,8	42,0
14			3,5	62,1	35,4	42,12
15			4,0	62,5	38,4	42,7
16	6. Gore – Tex, polytetrafluoroethylene	40/2	3,0	64,46	13,0	42,8
17			3,5	67,2	14,0	43,6
18			4,0	67,16	14,8	48,08
19	7. PES 100%, waterproof finish	40/2	3,0	112,26	39,2	40,46
20			3,5	82,87	30,2	47,7
21			4,0	82,0	30,6	51,5

Table 2. The coefficients of correlation between variables X and Y

Nr. crt.	The type of the sew	The correlation coefficient between X and Y_1	The correlation coefficient between X and Y_2	The correlation coefficient between X and Y_3
1	1.Cotton 35 %, 65% PES	0,9994	0,9176	0,8777
2	2. Cotton 53 %, 47% PES	0,9122	0,9607	0,9999
3	3. Cotton 35 %, 65% PES	0,8955	0,9672	0,9454
4	4. Cotton 33 %, PES 67 %	0,9791	0,9819	0,9316
5	5. Gore – Tex	0,9061	0,9991	0,9349
6	6. Gore – Tex	0,8595	0,9979	0,9277
7	7. PES 100%	-0,8783	-0,8456	0,9842

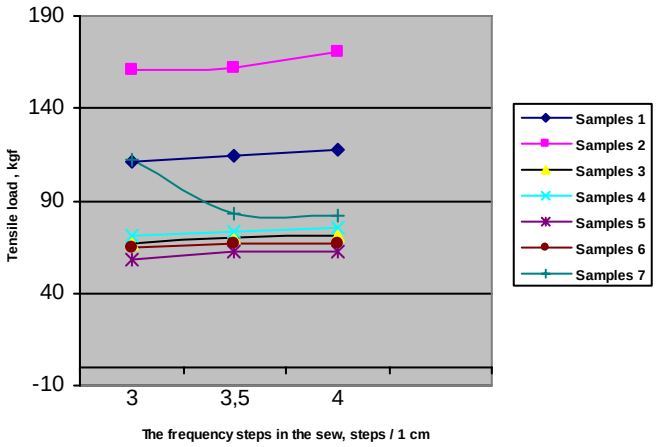

Figure 2. Diagram of variation of frequency rate and tear seam in the direction required.

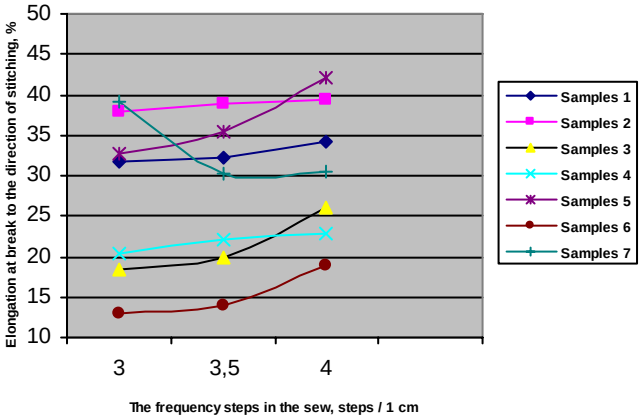

Figure 3. Stitch diagram and frequency variation of breaking load applied perpendicular to the direction of the stitch.

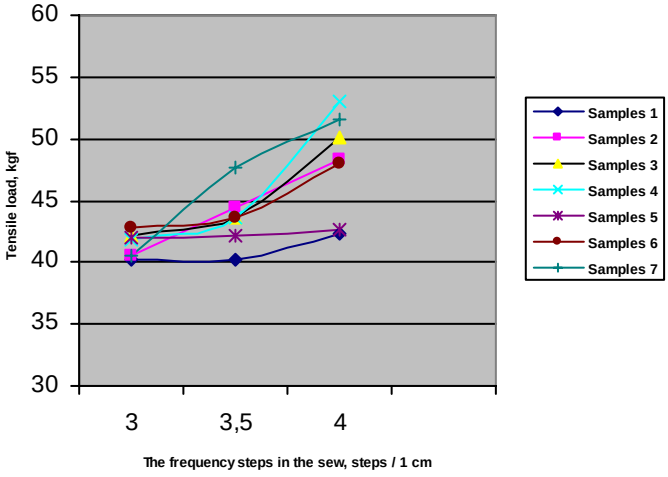

Figure 4. Diagram of change of frequency and elongation at break stitching required stitching direction.

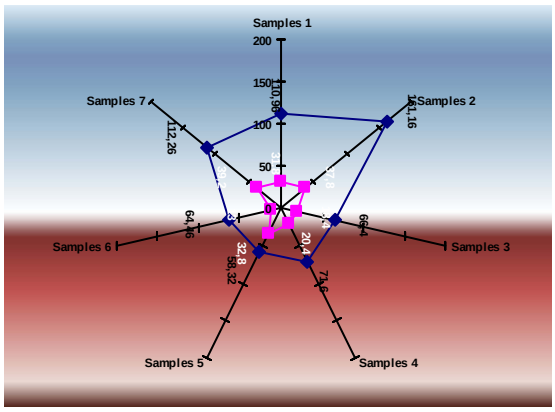

Figure 5. The histogram relations applied to the load and elongation at break in the stitching direction.

4. CONCLUSION

As a result of the work carried out the experimental investigations of correlation respect to variable *X* (the density steps in the seam) and *Y* (resistant properties of materials for protective clothing) can be adopted the following conclusions and practical recommendations:

1) For all samples of bicomponent fabrics and membrane performance, waterproof material outside the fiber composition of 100% PES were obtained coefficients of correlation between variables *X* and Y $_r$*>0* (table 2), the link is direct - that is, with increasing frequency steps in place seam strength parameters increase the joints (breaking load and elongation at stitch direction and load direction perpendicular to the seam tear). Thus, at the protective clothing, for joints made with finesse thread N_m 40/2 (100% PES) in order to obtain parameters of the seam is resistant recommended frequency of 3.5 and 3 steps/1 cm. With the decreasing frequency parameter value and parameter values of lower seam strength joints;

2) The waterproof material 100% polyester fiber composition observed an indirect correlation between frequency and task steps in the seam and-seam direction elongation at break (*r<0*) and frequency steps in the seam between the direct and pregnancy - Breaking perpendicular stitch direction (*r> 0*), this is by demonstrating the results (table 2). That is, with increasing frequency steps decrease occurs in the seam strength of the assembly parameters (breaking load and elongation direction perpendicular to the seam), and with increasing

frequency steps in the seam occurs increase the resistance of the assembly parameters (load and elongation at break stitching direction). This phenomenon is due to increased compression of the assembly of synthetic materials with high frequency of steps in the seam, breaking the material being produced with breaking assembly. This recommendation may be proposed that use a number of steps are increased to 1 cm from synthetic materials seam and resistance seam is reasonable to increase the use of unconventional methods of assembly, such as welding and sewing methods to cover the special equipment with adhesive tape;

3) The direction breaking load values exceed the amounts seam tensile load applied perpendicular to the direction of the stitch;

4) The seam strength properties for different types of materials depend largely on the structure of the assembled material, the fineness of thread, the fineness of those used density steps in the seam;

5) As analysis of the performance properties are aware that resistance is lower in fiber composition material, the share exceeds the share of cotton yarn, synthetic fibers of PES fibers increased with increasing weight of PES;

6) Using the methods of statistical processing of experimental data in Excel help to obtain optimal results in an effective time, contributing to the optimization of complex processes in the clothing industry.

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