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DEVELOPMENT OF AN ALGORITHM FOR FORECASTING THE CONSUMPTION OF SEWING THREADS AT THE STAGE OF THE SKETCH OF A NEW MODEL

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Abstract:

The article is devoted to forecasting the consumption of sewing threads. The results of a study are presented to establish the relationship between the number of divisions and the consumption of threads, the dependence of the degree of growth in the number of connecting seams.

Keywords: Sewing thread consumption, sewing and knitwear, shuttle stitch, chain stitch, methods of joining parts, stitch design, stitch frequency.

INTRODUCTION.

Currently, the most accurate calculation of sewing thread consumption is the most integral part of modern production planning. Distinctive features of knitwear technology are due to the high elasticity of knitwear. To join parts of garments and knitwear, chain stitch machines up to 70% are mainly used, which has increased elongation and thereby ensures high strength of the seams (Figure 1).

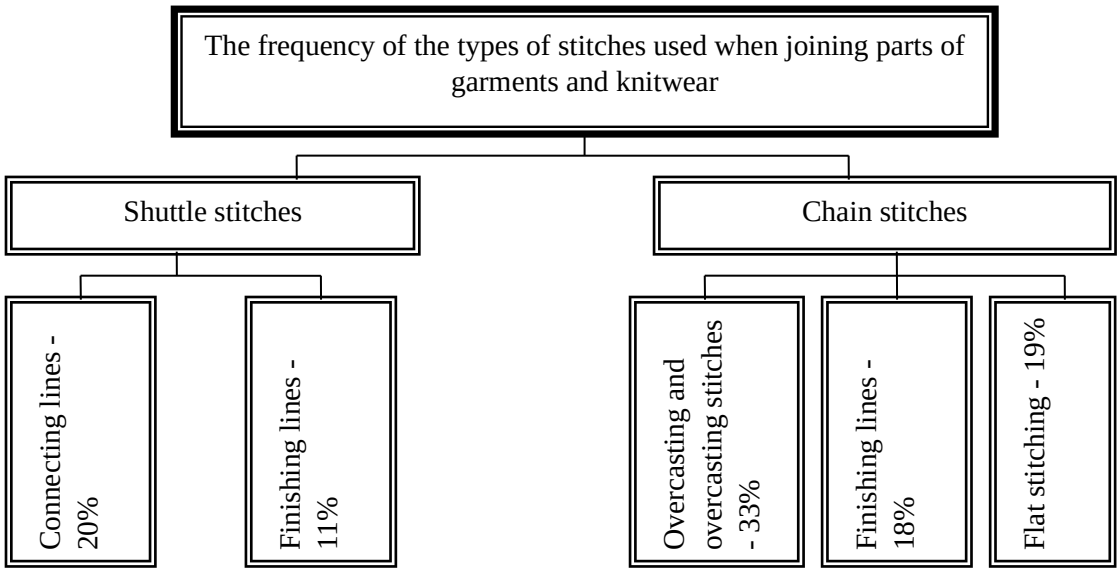


Figure 1. Applied methods of joining parts of garment and knitwear.

For processing individual parts and performing some operations, lockstitch machines are used. This is done in cases where the seams are slightly deformed when the product is worn. Widespread use in sewing knitwear, and especially linen, are machines of a flat chain stitch. Knitted fabrics are finished on buttonhole, button, embroidery and edge-dressing machines. [1,2,3].

RESEARCH METHODS AND ORGANIZATION.

In order to develop a methodology for predicting the consumption of sewing threads, experiments were carried outtodetermine the consumption of threads for the manufacture of garments and knitwear. For this, various types of stitches were made on prototypes with a size of 10x10 cm from two layers of fabric with interlocking interlocking. Thread consumption is determined by unrolling a line and measuring its length [5,6,7].

The thread consumption was determined for sewing lines with shuttle weave, with two-thread chain weave and overcasting with chain weave (Table 1).

Table 1. Influence of stitch parameters on thread consumption (Fragment).

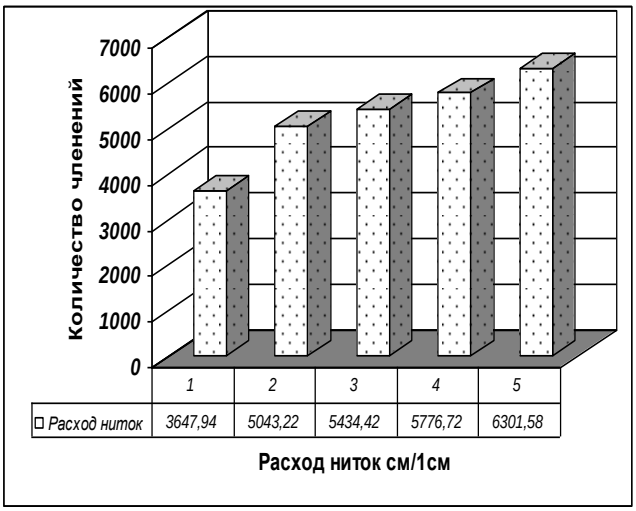
No.	Design stitch	Stitch frequency per 1 cm... (m)	Cutlength 10cm. (Lav.)	Thread consumption		Total consumption, cm, (L)
				Upper thread, see (lv)	Bobbin thread see (lн)	
1	Shuttle double thread single line straight stitch Lav = 10cm	3	ten	12	eleven	23
		3	ten	12	12	24
		3	ten	eleven	eleven	22
		4	ten	12	fourteen	26
		4	ten	fourteen	13	28
		4	ten	13	fourteen	27
2	Shuttle double thread single line straight stitch Lav = 12cm	3	12	fourteen	15	29
		3	12	14.4	15	29.4
		3	12	13	13	26
		4	12	16	16	32
		4	12	17	16	33
		4	12	17	16	33

The results of the experiments showed that the increase in thread consumption is significantly influenced by the stitch design and the length of the processed cuts of the parts in comparison with the number of stitch frequency. It was found that a change in the stitch frequency in two-thread shuttle straight stitches from 3 to 4 leads to an increase in thread consumption by an average of 18.3%. An increase in the length of the processed sections from 10 to 12 cm leads to an increase in the amount of thread consumption by an average of 26.2%.

Research has been carried out to establish the relationship between the number of divisions and the consumption of threads, it is determined by how much the number of connecting seams increases. Determined that, an increase in the number of divisions in the model leads to an increase in the length of the processed sections (the number of seams) in the product from 413.4 cm to 576.2 cm, and accordingly the amount of thread consumption for a 2-thread shuttle line from 626.4 to 1082.48 cm (Table 2). The table shows the dependence of the share of connecting seams in the total length of the seams of the product on the number of articulations. For the model 3803 men's pullover, the share of joining seams in the absence of articulations of the main parts is 54%, and with the number of articulations equal to four, it is 67%.

Table 2. Thread consumption depending on the number of articulations for the model of a man's jumper.

Layoutno.	Number of memberships	Total length of product seams, cm	Length of connecting seams, cm	The share of connecting seams in the total length of the seams of the product,%	Increase in the length of the connecting seams depending on the number of articulations,%	Thread consumption per product, cm						
						Joiningseams			Edge seams			
						2-thread shuttle	3-thread chain	4-thread chain	2-thread chain	3-thread chain	4-thread chain	5-thread chain
						2.8 / 1 cm	13.8 / 1 cm	16.3/ 1 cm	2.8 / 1 cm	13.8 / 1 cm	16.9 / 1 cm	22.5 / 1 cm
1	2	3	4	5	6	7	8	9	10	11	12	13
1	0	413.4	223.8	54	0	626.64	3088.44	3647.94	530.88	2616.48	3204.24	4266
2	1	499	309.4	62	+38	866.32	4269.72	5043.22				
3	2	523	333.4	63	+48	933.2	4600.92	5434.42				
4	3	544	354.4	65	+58	992.32	4890.72	5776.72				
5	4	576.2	386.6	67	+72	1082.48	5335.08	6301.58				



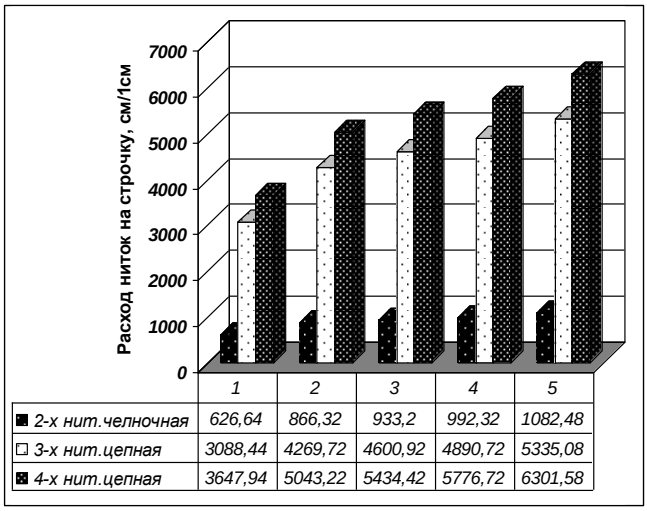


Figure 3a, b. 3a - Dependence of thread consumption on the number of partitions.

3b - Relationship between thread consumption for connecting seams for different types of stitches.

The dependence of the thread consumption for connecting seams (4-thread chain sewing-overlock stitching) on the number of divisions is shown in the histogram (Figure 3). The consumption of threads for products with 4 divisions increased by 1.7 times compared to the consumption for a product in which there are no divisions.

RESULTS AND ITS DISCUSSION.

It can be seen from the diagram that the thread consumption for 3 and 4-thread chain stitches is several times higher than the thread consumption for a shuttle sewing line, namely, for a 3-thread thread consumption is 4.9 times more, for a 4-thread thread - 5.8 times. However, the greater the number of threads in a line, the higher the material consumption of the product.

To establish the relationship between the consumption of sewing threads and the identifiedbased on expert judgment major factors mathematical models have been developed that describe the nature of the change in the amount of thread consumption from the type and frequency of the line, the length of the sections. In this work, as an optimization criterion, the value of thread consumption (Y3) was selected when joining parts of garments and knitwear, where Y3 is a dependent variable. As influencing factors for parameter Y3, the following are selected: stitch type (X1), seam frequency (X2) and seam length (X3). Factor X1 - the type of stitch is assigned a code depending on the type of seam, since this factor has no quantitative indicators; 1-strand 1-strand straight shuttle stitch, 2-strand 1-strand straight chain stitch, 3-strand overlock stitch. (Figure 4).

Table 12. Mathematical models of simple regression, the dependence of the flow rate on the factors.

Factors affecting the amount of thread consumption	Mathematical dependence: y = ƒ (x)	Determinationcoefficient R2,%
Stitch type	y = -22.6 + 37.7X1	91.85
Sewing frequency	y = -77.7 + 31.5X2	71.2
The length of the cuts of the part	y = -488.6 + 53.3X3	85.11

According to the research results, it was found that there is a linear relationship between the thread consumption indicator and the factors under study: Y = -86.24 + 33.68 * X1 + 5.65 * X2 + 4.92 * X3
The squared correlation coefficient (R = SQ) calculated for each of the considered simple and multiple regression models was in the range of 0.75-0.99; Y3-R2 = 92.66%, which confirms the reliability of the dependences obtained.

Based on the research, an algorithm has been developed, the use of which will allow determining the predicted consumption of sewing threads for the manufacture of a unit of a product of a new model (Figure 5). The estimation of the thread consumption in 5 stages is carried out at the stage of the conceptual design of the models. The algorithm assumes a sequence of actions aimed at predicting the consumption of sewing threads:

- Analysis of structural divisions of the sketch, the type of knitted fabric and the price levels of the model;
- Choice of methods for processing slices and connecting parts of the model;
- Determination of the length of the processed cuts of parts in the sketch of the model (Licp);
- Selection of thread consumption indicator (Pi1cm) from the database;
- Prediction of thread consumption (Rn) for the manufacture of a unit of a product of a new model Rn = ƒ (Rst. + Rst.ob + Rob);
- Determination of the forecasted cost of sewing threads (Sn.pr).

At the first stage, a general analysis of the structural divisions of the sketch, canvas properties and price levels of the model is carried out. Specialist visuallyanalyzes in the sketch the presence of structural divisions of the main parts such as a shelf, back, sleeves.

At the next stage, the methods of processing and joining parts of the new model are analyzed and determined. Further, in the sketch of the model, the lengths of the cut lines (Lav) are determined, which are processed with the same connection methods. Measurement results should be reported in centimeters.

At the fourth stage of the forecasting process, the indicator is selected
(Pi1cm) thread consumption per 1 cm from the database, where a reference-accumulator of thread consumption values will be formed depending on the type of stitches.

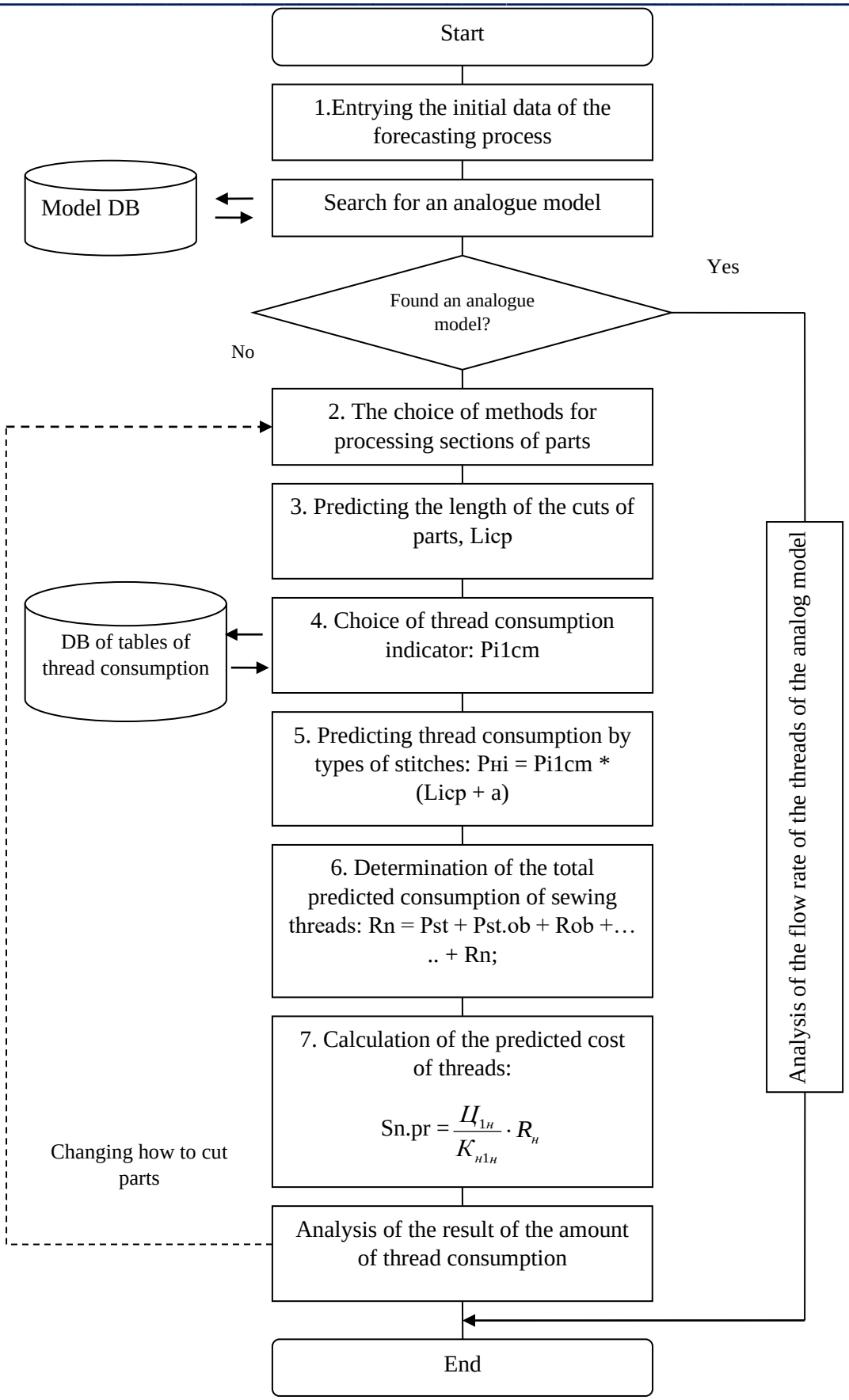


Figure 5. Algorithm of the process of forecasting the consumption of sewing threads at the stage of the model sketch.

Next, forecasting the consumption of sewing threads (Pнi) for each (individual) types of stitches is carried out:

Pнi = Pi1cm * (Licp + a) (1)

where Pi1cm is the amount of thread consumption of the i-th line per 1 cm., Liav is the length of the i-th cuts processed in the same ways, a is the coefficient taking into account the consumption of threads for bartacking the beginning and end of the seam, at the free end of the thread remaining after cutting the seam, a = 10cm ...

The total thread consumption for a product is the sum of the consumption values for certain types of processing;

$$Rn = Pst + Pst.ob + Rob + ... + Rn \quad (2)$$

where Pst is the consumption of threads for sewing stitches, Pst.ob is the consumption of threads for sewing-overlock stitches, Rob is the consumption of threads for overcasting.

At the final stage, the estimated cost of the threads required for the manufacture of a unit of a product of a new model is estimated:

$$Sn.pr = \frac{Ц_{1н}}{К_{н1н}} \cdot R_{н} \quad (3)$$

where Ts1n is the cost of one winding of a sewing thread (in rubles), Kn.1n is the number of threads in one winding (in meters), Rn is the consumption of threads per unit of a new model product (in meters).

CONCLUSIONS.

The application of the developed technique provides for the use of reference books-accumulators of consumption for certain types of stitches to determine the predicted consumption of sewing threads according to the sketch of the model. It is recommended to use the proposed method for predicting the flow rate at the stage of the preliminary design of new models. Assessment of the required number of threads for the manufacture of a product, along with other components, makes it possible to predict the material consumption of a new model and evaluate the effectiveness of implementation in mass production. This technique is implemented using Microsoft Exsel tools, adapted for enterprises that use CAD systems.

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