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THEORETICAL STUDY OF THE QUALITY INDICATORS OF TWO-LAYER KNITTED FABRICS OF A NEW STRUCTURE BASED ON A MATHEMATICAL MODEL

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A B S T R A C T	K E Y W O R D S
In this article, the quality indicators of two-layer knitted fabrics of a new structure are theoretically studied on the basis of a mathematical model.	Textile, industry, mathematical, modeling, volumetric density, ring pitch, air permeability, isoline, inlet, property.

Introduction

Technological processes in the textile industry consist of a complex set of physical and chemical phenomena, which can only be successfully researched using modern advances in science and technology. In all branches of the textile industry, i.e. in the production of spinning, weaving and knitting, uneven and non-homogeneous textile products (use of fibers, threads, fabrics and gauzes, which are changing properties over time complicates research, which in turn requires large-scale testing with multiple replications. requires [1].

Materials and Methods

Selection of input and output parameters is of great importance when conducting scientific research. As output parameters, technical-technological indicators (physical, mechanical, physicochemical...), technical-economic (performance, durability, long-term operation), economic (machine performance, profit, costs), statistical indicators (dispersion, coefficient of variation, etc.) are obtained.
The incoming parameters are variable factors that represent the qualitative and quantitative indicators of the research object and affect the technological process.

If the experiment is conducted on the basis of one input parameter - a one-factor experiment, if it is conducted on the basis of two or more input parameters - it is called a multi-factor experiment.
In a multifactorial experiment, the factors should be independent and mutually exclusive.
It is also important to correctly determine the range of changes of the input parameters:

$$(Ximin \leq Xi \leq Ximax)$$

It is based on the physical properties of the process and previous scientific research.
In most cases, the models built by theoretical methods can be in the form of mathematical formulas, algebraic equations, systems of algebraic equations, ordinary differential equations, differential equations with special properties and their systems, etc.

Results
It is desirable to effectively use multi-factor mathematical modeling in the research of parameters determining the structure of knitted fabrics.
As influencing factors, the input factors x1- ring step a (mm), x2- ring row height, v (mm), x3- volume density, rg indicators were taken. The selection of the levels and intervals of the researched factors is presented in Table 1.
Selection of levels and ranges of changes of the researched factors.

1-Table

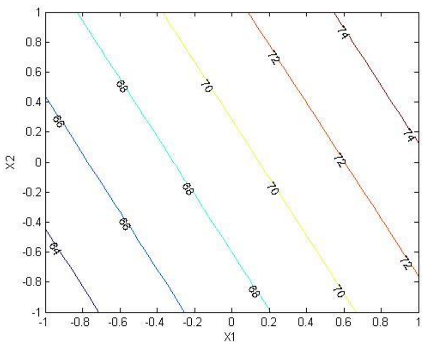
Name and designation of factors		Change levels			Change interval
		-1	0	1	
Ring step, A (mm)	x_1	0,84	1	1,16	0,16
Ring row height, V (mm)	x_2	0,66	0,8	0,94	0,8
Bulk density, R_g	x_3	180	245	310	65

In order to determine the regression coefficients, Student and Fisher's criteria are used to check whether the mathematical model is adequate or not. Y1-air permeability, V (cm3/cm2·sec), was chosen as the output factor.
In order to determine the main problem before mathematical modeling - the air permeability of knitwear, breaking strength and elongation at break using the factors affecting the knitted fabric, the drawing of isoline deviations was obtained based on computational models with the help of programs compiled in the Pascal programming language. Through these isolines, we can determine the parameters of air permeability, tensile strength and elongation at break based on the factors affecting the knitted fabric. [2-3].

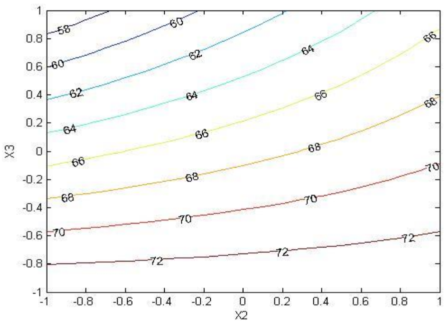
Central non-composite experience matrix 1-table

№	Factors			x_1x_2	x_1x_3	x_2x_3	x_1^2	x_2^2	x_3^2	**Y_1**	**$S_u^2(Y_1)$**
	x_1	x_2	x_3								
1	+	+	0	+	0	0	+	+	0	75,75	2,51
2	+	-	0	-	0	0	+	+	0	67,3	0,82
3	-	+	0	-	0	0	+	+	0	57	1,4
4	-	-	0	+	0	0	+	+	0	60,5	1,5
5	+	0	+	0	+	0	+	0	+	57,7	0,16
6	+	0	-	0	-	0	+	0	+	77,6	1,1
7	-	0	+	0	-	0	+	0	+	55,4	1,5
8	-	0	-	0	+	0	+	0	+	68,9	1,6
9	0	+	+	0	0	+	0	+	+	67,51	0,95
10	0	+	-	0	0	-	0	+	+	71,3	0,74
11	0	-	+	0	0	-	0	+	+	56,9	0,74
12	0	-	-	0	0	+	0	+	+	69,5	1,4
13	0	0	0	0	0	0	0	0	0	68,7	0,28
14	0	0	0	0	0	0	0	0	0	68,67	0,75
15	0	0	0	0	0	0	0	0	0	68,33	0,36
(+), (-) and 0 values should be used in the matrix											

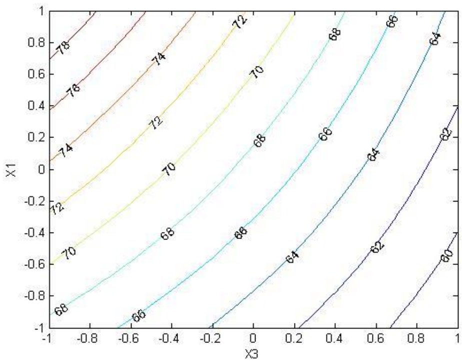
$$Y_{R1} = 67{,}36 + 4{,}36x_1 + 2{,}26x_2 - 6{,}36x_3 + 2{,}81x_1x_2 - 1{,}85x_1x_3 + 2{,}2x_2x_3$$



1.a-figure.



1.b-figure.



1.c-figure.

Figure 1. The graph of the model for the optimization of the air permeability property of knitwear.

Discussion

Figure 1.a above shows the surface deviation of the isolines of loop pitch, loop row height and volume density dependence (analysis) for the air permeability property of knitted fabric. As can be seen from the drawings, the air permeability property of the loop we can see that as the pitch increases, the loop row height increases and the bulk density decreases.

As can be seen from the graphs, the incoming is the first (x_1) and third (x_3) when the factors change from the accepted minimum value (-1) to the maximum value (1) and the second factor x2=0, using the average value (Y_1) air permeability values are described. Knitting fabric using a drawing x_1-ring step A(mm) -1÷-0,7 at an intermediate value, x_2-public row height, V (mm) -1÷ -0,5 in the intervals and (Y_R) to the smallest values of the air permeability indicator, i.e. 64 and x_1-ring step A(mm) -0,5÷1 at an intermediate value, x_2-public row height, V (mm) at intervals of 0.1÷1 and(Y_R) reaching the highest values of the air permeability index, i.e. 74 (Fig. 1.a).

Incoming first (x_1) and third (x_3) when the factors change from the accepted minimum value (-1) to the maximum value (1) and the second factor x_2=0, using the average value (Y_1) air permeability values are described. Knitting fabric using a drawing x_2-ring row height, V(mm) in the range of -1 ÷ -0.7, x_3-bulk density, R_g 0,9 ÷ 1 the smallest value in the range is 56 and x_2-ring row height, V(mm) in the range -1 ÷ 1, x_3-bulk density, R_g -1 ÷ -0,8 the largest value, i.e. 72, is reached in the interval (Fig. 1.b). Air permeability values (Y^1) are described using the average value of the first (x^1) and third (x^3) incoming factors from the accepted minimum (-1) to the maximum (1) value and the second factor x^2=0. Using the drawing, the x^1-loop pitch of the knitted fabric is in the range of A(mm) -1÷-0.6, x^3-volume density, R_g 0,7 ÷ 1 the smallest value in the range, i.e. 60, and x^1-ring pitch A(mm) in the range of 0.7 ÷ 1, x3-volume density, R_g -1 ÷ -0,7 in the interval, the largest value is reached, i.e. 78 (Fig. 1.c).

Conclusion

According to general conclusions, our input factor x^1 reaches the smallest value in the range -1÷ -0.7 and the largest value in the range 0.7 ÷ 1. Our input factor x^2 reaches its smallest value in the interval 1÷ -0.7 and the largest value in the interval -1÷ 1. Our incoming factor x^3 reaches the smallest value of 0.7 ÷ 1 and the largest value -1÷ -0.7.

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