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Determination of one Indicators of the Quality of Shoe Sources of the Understanding Materials

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ABSTRACT: The article considers the creation of a model of the quality of sole materials for special shoes. The individual indicators of the quality of the polymer bottom of the shoe as well as the numerical values of these indicators are determined.

KEY WORDS: quality, single indicators of properties, quality models of plantar materials, questionnaire, significance of single indicators, generalized quality indicator.

I. INTRODUCTION

The creation of comfortable, comfortable products that ensure the fulfillment of the requirements with maximum efficiency is associated with the solution of complex materials science and technological problems in the selection of a suitable polymer composition.

In the wardrobe of a modern person there are 8-12 or more pairs of shoes [1-2]. This is not a whim, but a necessity - a characteristic of our time, as each pair of shoes performs its task. Differentiation of shoes led to a differentiation of requirements for shoe materials. Consumer requirements for shoes and, thus, for expanding the range of shoe materials are in clear contradiction with the economic and technological aspects of manufacturers.

To solve this contradiction, it was decided to develop scientifically grounded requirements for sole materials. The first step in solving the issue of improving their quality is to develop a model of the quality of sole materials for casual shoes.

II. LITERATURE SURVEY

Quality is a complex concept uniting a large number of individual indicators of properties. In assessing the quality of industrial products, individual indicators are usually combined into groups. Usually, functional, ergonomic, hygienic, technological, economic and some other groups of indicators are defined [3-4].

Single indicators of properties have a different effect on product quality and therefore have different significance. To identify scientifically based quality requirements for industrial products, qualimetry recommends using the method of questionnaire survey of consumers.

Previous consumer surveys revealed a number of requirements for shoes: beauty, convenience, durability, cost. The vagueness of the requirements for footwear is reflected in the requirements for shoe materials: they are of a general nature. Standards are established only for a small number of properties [5-6].

The basis for solving the issue of creating a model of quality sole materials for everyday shoes put a questionnaire survey. In the survey, both consumers familiar with the problem and shoe manufacturers, who in turn are consumers of shoes and, in addition, who can not only qualitatively but quantitatively evaluate individual quality indicators, were used as respondents. This approach allows you to comprehensively solve the problem. The survey was carried out according to the method described by B.Ya. Krasnov.and others [7-8].

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III.EXPERIMENTAL PART

During the survey, the number of experts for each type of shoes was 25-40 people, dominated by technologists.

The coefficient of expert consistency was more than 0.7, which makes it possible to use the results of the questionnaire to solve the problem. The value of the coefficient of consistency tested by the Pearson criterion.

The summarized experimental results of the survey are presented in the table (table 1).

Table 1.
Result of the expert questionnaire

Groups of requirements and single indicators of quality	The value of quality indicators for different conditions of wear			Averaged factor significance factor, α_i
	Summer footwear	Autumn – Spring Shoes	Winter shoes	
SOCIAL:				
Strength of fastening of the sole	0.088	0.072	0.084	0.081
Abrasion resistance	0.052	0.076	0.066	0.068
Multiple bending resistance	0.048	0.060	0.064	0.057
FUNCTIONAL:				
Hardness	0.056	0.078	0.087	0.074
Slip Resistance	0.073	0.065	0.115	0.084
Thermal conductivity	0.083	0.051	0.074	0.068
Heat resistance	0.102	-	-	0.034
Frost resistance	-	-	0.062	0.021
Permeability	-	0.099	-	0.033
ERGONOMIC:				
Density	0.068	0.067	0.055	0.063
Tensile strength at break	0.132	0.126	0.104	0.120
Elongation at break	0.121	0.098	0.095	0.104
Residual elongation at break	0.118	0.096	0.082	0.099
AESTHETIC:				
Appearance	0.036	0.032	0.036	0.034
ECONOMIC:				
The cost of the finished product	0.023	0.020	0.028	0.024

Thus, the results of the significance of single indicators in the complex operational properties.

As a result of a questionnaire survey on the significance of single quality indicators and groups of quality indicators, it was found that ergonomic indicators have the greatest impact on the quality of shoes. The second place in terms of influence is occupied by functional requirements. In sum, the indicators of the significance of the factors of these two groups have a value of more than 0.7 and are significantly ahead of the social, aesthetic and economic groups of quality requirements (Table 1).

Of great interest are the results of the analysis of the significance of single indicators of quality. In descending order, they are arranged as follows:

- tensile strength at break ($\alpha_1 = 0.120$);
- relative elongation at break ($\alpha_2 = 0.104$);
- residual elongation at break ($\alpha_3 = 0.099$);
- Slip resistance ($\alpha_4 = 0.084$);
- strength of fastening of the sole ($\alpha_5 = 0.081$);
- hardness ($\alpha_6 = 0.074$);
- abrasion resistance ($\alpha_7 = 0.068$);
- thermal conductivity ($\alpha_8 = 0.068$);
- density ($\alpha_9 = 0.063$);
- resistance to multiple bending ($\alpha_{10} = 0.057$);

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- maintainability (α_{11} = 0.036);
- heat resistance (α_{12} = 0.034);
- appearance (α_{13} = 0.034);
- water permeability (α_{14} = 0.033);
- the cost of the product (α_{15} = 0.024).

From this list of individual quality indicators, it can be seen that the social requirements of consumers are of little interest to shoe manufacturers.

IV RESULTS AND ITS DISCUSSION

The values of significance of single quality indicators obtained during the questionnaire survey will be used when calculating the generalized indicator.

Simultaneously with the ranking, the specialists determined the numerical values of the requirements for the sole materials, the results of which are presented in the table (table 2).

The list of individual quality indicators contains both qualitative and quantitative indicators. Evaluating the quality indicators and comparing the quantitative values with the standard, you can achieve the desired result in a scientifically based material of the bottom of the shoe for specific operating conditions.

Table 2.
Expert requirements for shoe sole materials

№	Name of single quality indicators	Value indicator		
		Satisfactory	good	great
1	Tensile strength at break, MPa	3.5	3.7	6.7
2	Relative elongation at break,%	250	340	450
3	Residual elongation at break,%	35	30	20
4	Coefficient of slip resistance, used	0.6	0.8	1
5	Strength of fastening of the sole, kN / m	2.7	3.4	5.2
6	Hardness, us	75	81	85
7	Abrasion resistance, J / mm3	2.5	6.5	10.5
8	Density, kg / m3	1000	900	800
9	Resistance to multiple bending, ths. Cycle	15	50	80
10	Heat resistance, °C	60	90	140
11	Heat conductivity, W / m • K	0,3	0,2	0,1
12	Effective viscosity, Pa • s	40	25	10

For information single indicators of quality to a single integrated generalized indicator used the method proposed by J. Harrington [9]. The method consists in converting individual quality indicators (Yi), expressed on a natural scale, into a dimensionless indicator (Yi '). Recalculation of Yi 'into the values of individual quality indicators (d_i), which can be carried out either by a graphical method, shown in the figure (Figure 1), or by an analytical method based on

$$d_i = exp\left(-exp\left(-Y_i'\right)\right). \qquad (1)$$

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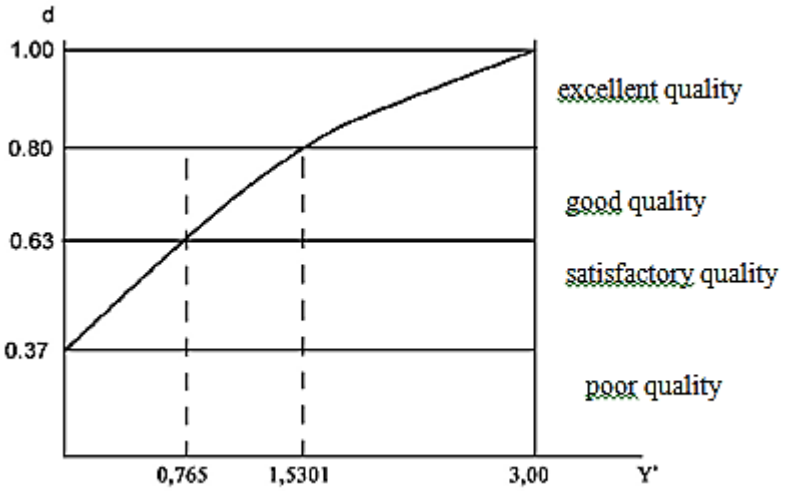

Scale of dimensionless quantities.
Quality indicators in natural quantities

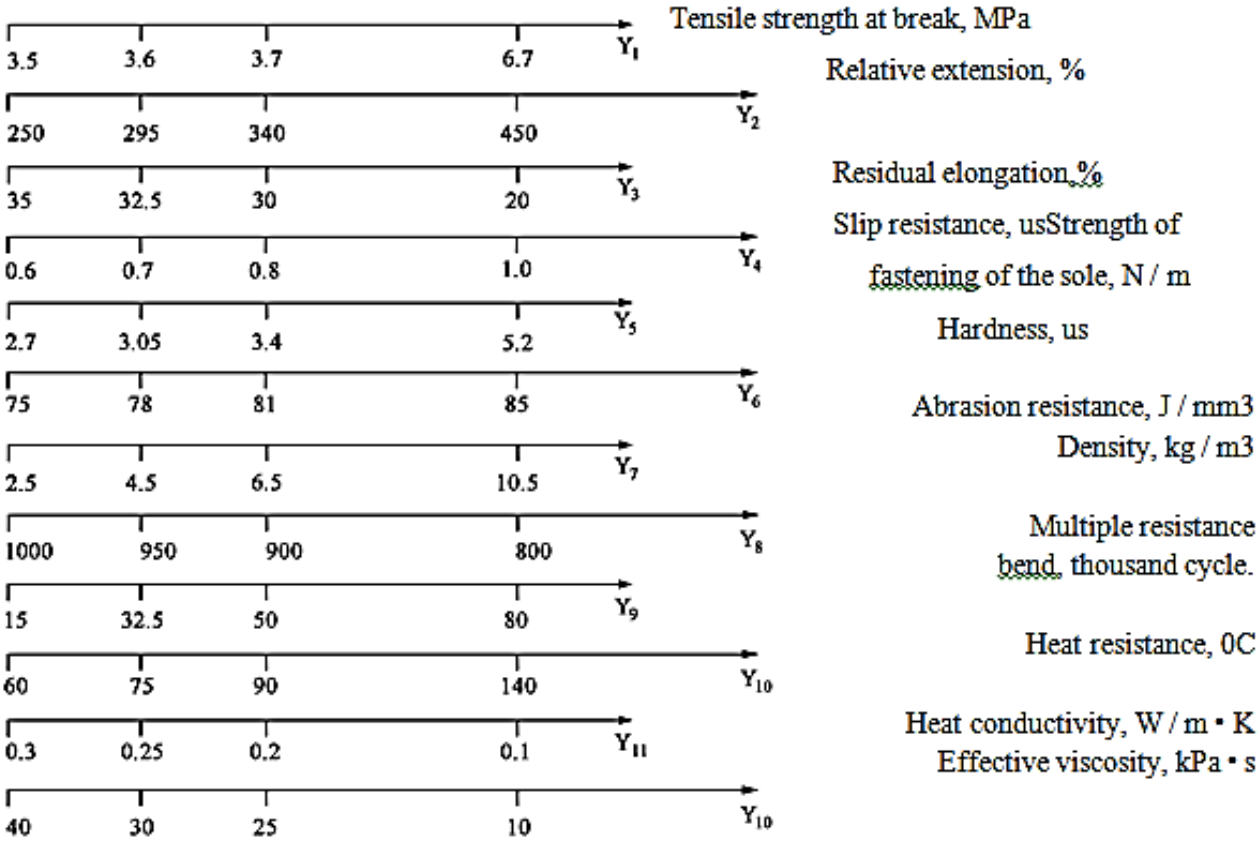

Figure.2. The function of desirability and the scale of assessments of the quality indicators of the polymer composition for the bottom of shoes.

The generalized quality indicator (D), which unites all the single ones into a complex indicator, is determined by the dependence

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$$D_1 = \sqrt[n]{\prod_{i=1}^{n} d_i}$$

or, taking into account the weight of single quality indicators (α_i), according to

$$D_2 = \sqrt[\alpha_1+\alpha_2+\ldots..+\alpha_n]{\prod_{i=1}^{n} (d_i)^{\alpha_i}}$$

where D_1, D_2 are generalized quality indicators calculated using a simplified method or taking into account the weight of individual quality indicators;

d_i is a single indicator of quality on a scale of desirability;

α_i - the significance of a single indicator of quality.

V. CONCLUSION

Thus, based on the calculations of the generalized quality indicator, the best composition is the one with the maximum value of D, i.e. possessing the best set of values of consumer characteristics.

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