QUALITY ASSESSMENT OF LEATHER PRODUCTS USING THE METHOD OF ABSOLUTE VALUE PARAMETERS

NICOLETA TRANDAFIR[1], ANDRADA PINTEALĂ[2], MARIAN MOCANU[2], CONSTANTIN – DAN DUMITRESCU[2]

[1] *West University of Timişoara, ntrandafir09@gmail.com*

[2] *"Politehnica" University, Timisoara, Romania, gheorghepinteala@yahoo.com, mmocan@gmail.com, danc.dumitrescu@yahoo.ro*

In the last two decades, the development of leather goods industry, rom the point of view of sustainability, was characterized by emphasizing the two groups of the relevant parameters: (1) Development of production volumes, from the point of view of the assortment, of product quality, the areas of sales, but also in terms of quantities produced; (2) Development of new technologies, capable of providing, in real-time, and in the quantities required by the market, products at a quality level according to customer requirements. As a result of the above, in the quality evaluation of skin products, it is necessary to develop a generally quality index, to consider themselves not only the quality of the finished product, but also aspects of quality product manufacturing process parameters finished. From the set of these parameters, some can be quantified numerically, others do not. This paper aims to develop a methodology for calculating the Synthetic Quality Index (SQI) for leather products, taking into account the effects of manufacturing parameters on the quality of the finished product. All these values will be reported in nominal quality requirements accepted.

Keywords: synthetic quality index, quality characteristics, coefficient of importance.

INTRODUCTION

With the diverse assortment of products, manufacturing processes involve a growing range of components, which by their individual contribution affects the quality of the finished product; furthermore, by combining these components, complex effects result, which, in their turn, have a relevant effect on the final quality of the product. The analysis of product quality is even more important as production volumes become higher. This raises the need to address a method of evaluating the quality of products, taking into account a large number of quality features, which in turn can give a more complete picture of the overall quality of the product. In other words, product quality resulting from the manufacturing process should be as close (or identical) as prescribed in the product documentation, in conjunction with the customer's requirements.

The set of indicators used in assessing the quality of a product contributes to assessing the usefulness of the product on the market. Because by combining selective indicators technical performance of the product are taken into account, the social effects generated by a certain quality of product delivered to the market; all this correlate with the wishes of customers and users of the product choice.

The system of indicators covering quality of a product highlights three distinct levels, namely: level 1 - corresponding to analytical indicators, level 2 - corresponding to synthetic indicators and level 3 - corresponding to complexity indicators.

An embodiment of how you can use the indicator system is the leather industry; this happens because the raw hides production is projected to increase further, especially where export restrictions persist; export deliveries of Romanian leather industry and leather goods exceeded half a milliard euros after the first quarter of 2013, thus prefiguring a new development of the field both in processing raw hides and in related

processes. In this area, the used indicator system takes into account both technological aspects and specific issues related to the leather industry market.

Technological aspects take into account the fact that sustainability was ensured by investments in order to maintain highly skilled jobs in traditional sectors, which allowed increased competitiveness of domestic producers.

Meanwhile, skin and leather products have a high profile in public perception; consumers increasingly want to know where and how to produce the products they buy. Some studies point out that they are among the first products to which there has been recorded a demand for more responsibility from social and environmental point of view. It seems that users are more acutely aware of social and environmental problems due to harmful potential of some chemicals used in leather processing.

The above considerations "forced" the leather industry to find valid answers to a range of issues such as product traceability, transparency and guarantee, performance related to the environment, social common responsibility producer-user.

A possible answer is to develop a system of synthetic indicators, which allows product placement in terms of its intrinsic quality, but also takes into account the influence product use has, in terms of quality, on the social ambient environment.

In the specialized literature, there is presented a variety of methods to evaluate the quality of products that have the above considerations.

Of the many possibilities for evaluating, the paper presents the development of a system of indicators, using the absolute value of the parameter.

ABSOLUTE VALUE METHOD OF PARAMETERS

The general index of the quality has two types of parameters in its structure targeting quality:

- numerically measurable quality parameters and
- quality parameters that can not be numerically quantified

The calculation algorithm is:

1. The selection is made of the quality characteristics of the possible crowd that characterize product quality, involved technologies and the short and medium term effects requirements arising from use of the product. (X, Y, Z, ...)

2. For these features, prescribed values are adopted; they will be the reference values or nominal values (X_N, Y_N, $Z_{N,...}$). They express the values and minimum quality requirements imposed by the designer.

3. The actual characteristics measured or evaluated by tests(for parameters that can not be quantified numerically) are determined using methods and specific equipment; to test a lot of products the medium value of each quality characteristics, X_r , Y_r , Z_r are determined using the formula:

$$X_r = [\Sigma X_i]/m; \quad Y_r = [\Sigma Y_i]/n; \quad Z_r = = [\Sigma Z_i]/p \qquad (1)$$

where m, n, p – number of pieces in the lot; i-values of characteristics obtained from tests or measurements.

4. To operate with average indicators expressed in different units, ***the medium quality index*** (I_X ,I_Y ,I_Z …) is determined for each quality characteristic separately:

$$I_X = X_r / X_N ;\Uparrow \quad I_y = Y_r / Y_N ;\Uparrow \quad I_z = Z_r / Z_N \Uparrow; \qquad (2)$$

Because the values X_N ,Y_N ,Z_N represent normal values, the minimum quality requirements and indices above have above unit values (⇑).

5. Based on these indices the ***synthetic quality index*** (I_C) is determined*:*

$$I_C = (I_X + I_Y + I_Z + \ldots)/ m \qquad (3)$$

where m= number of considered quality characteristics.

6. To highlight the importance of the features in the synthetic's quality index structure, the coefficients of importance of Characteristics of Quality (K_I) are use; the formula is:

$$I^*_C = \frac{K_X .I_X + K_Y .I_Y + K_Z .I_Z + \ldots + K_N .I_N}{K_X + K_Y + K_Z + \ldots + K_N} \quad (4)$$

in which:

I^*_C= ***Synthetic quality index ordering the importance of the quality characteristics***.

K_x, K_y, K_z, K_n= coefficients of importance; if they are expressed by numbers, they may be chosen from 1 to 10, if they are expressed as a percentage, they are represented by the sum of the percentages = 100%($\Sigma K_I = 100$)

Sometimes, the user shares the purchased multitude of the product's characteristics into two groups: the group in which they are grouped i = n base important coefficients(K_B) and another group in which they are grouped j = m aid important or auxiliary coefficients (K_A); in this case ***the synthetic quality index (I^{**}_C)*** may be written as:

$$I^{**}_C = [K_B \Sigma I_{Bi} + K_A \Sigma I_{A\,j}] / (K_B .n + K_A .m) \quad (5)$$

Using quality characteristics degrees of importance (gi), expressed in percentages ***the synthetic quality index IC***** may be written:

$$I^{**}_C = gx.I_X + gy.I_Y + gz .I_Z + \ldots + gn.I_n \quad (6)$$

in which: $1 < gi > 0$ and $\Sigma gi = 1$

Since the weights of importance given to different quality characteristics not only depends on the absolute level of features, but also on their relative level to each other, to provide a correlation of these shares in relation to the calculation of the synthetic quality index for the synthetic quality index can be written:

$$I^{**}_C = (I_X)^{\gamma x} + (I_Y)^{\gamma y} + (I_Z)^{\gamma z} + \ldots + (I_N)^{\gamma n} \quad (7)$$

or the logarithm:

$$\lg.I^{**}_C = \gamma_X .\lg.I_X + \gamma_Y \lg I_Y + \gamma_Z \lg I_Z + \ldots + \gamma_N \lg I_N + \lg a \quad (8)$$

in which: a- the logarithm constant.

To calculate γ_X ....γ_N we use the economical operation function E.

Considering that the economics of exploitation (E) integrate the technical, functional, aesthetic, economic, including social aspects that the product's presence rolls onward, we can write to E:

$$E = \varphi(X, Y, Z, \ldots, W) \quad (9)$$

wherein φ-the envelope function determined by the user.

To highlight the influence of each quality characteristic on the behavior of the E, we proceed to grant a 1% change in values for each quality characteristic in part.

For the position of economy, with one changed feature, we can write:

$$E_X = [x(1 \pm 1/100), y, z, ..w]; \; E_Y = [x, y(1 \pm 1/100)..w]; \; E_Z = [x, y, z(1 \pm 1/100), ..w]; \; E_W = [x, y, z, .., w(1 \pm 100)] \quad (10)$$

The differences are calculated: $\Delta E_X = E - E_X$; $\Delta E_Y = E - E_Y$; $\Delta E_Z = E - E_Z$;…, $\Delta E_W = E - E_W$.

Then the weights of quality characteristics(γ_i) are calculated:

$\gamma_X = \Delta E_X / E$; $\gamma_Y = \Delta E_Y / E$; $\gamma_Z = \Delta E_Z / E$; …; $\gamma_W = \Delta E_W / E$

With the quality indices and weights of each quality characteristic the synthetic quality index (I^{**}_C) can be determined.

A scale for assessing the quality of products of the same class is prepared, with advance set limits: I_{C1}-I_{C2} –satisfying; I_{C2} –I_{C3}-good; I_{C3}-I_{C4}-very good; I_{C4}-I_{C5}-excellent. The calculated value of the synthetic index introduced in the appreciation scale allows relative assessment of the quality of the analyzed product, compared with other similar products.

CASE STUDY – THE LEATHER INDUSTRY

Production processes at a tannery can be grouped into four categories: storage of hides, skins soaking operations, operations that occur after tanning and finishing operations. Transforming the raw hides and skins into tanned ones is achieved through technological process in which chemical, biochemical, mechanical processes alternate. To assess the performed process quality, the following quality features were considered relevant:

- The amount of waste generated per product, expressed in Kg/ m^2 $\rightarrow$[X_N =2,12 kg/ m^2]
- The amount of solvent consumed product, expressed in g/ m^2 $\rightarrow$[Y_N =43,36 g/m^2]
- The incidence of environmental costs in the turnover of the company, expressed in %. [Z_N = 4,2%]

Accepted or standardized values are the ones above.

To assess the quality of manufacturing processes, the trade level, a total of five lots of skins was selected; the synthetic data necessary to determine the quality index (ICS) is shown in Table 1.

The rating scale of the synthetic index has the following values: 0 to 0.550 insufficient; 0.555 to 0.999 sufficient; 1.000 to 1.499 satisfactory; 1.500 to 1.999 fine; <2 very well.

Table 1. Medium quality clues table

No.	Batch size	The medium values of the characteristics			I_X	I_Y	I_Z	
		[X]	[Y]	[Z]				
	pieces/ lot	kg/ m^2	g/ m^2	%	–	–	–	
1	50	2,10	45,00	5,1	0,99	1,03	1,2	
2	70	1,92	49,08	5.8	0,90	1,13	1,3	
3	60	3,20	38,05	4,1	1,50	0,87	0,9	
4	50	2,80	48,5	4,3	1,33	1,11	1,02	
5	40	1,86	43,02	4,25	0,87	0,99	1,01	
The medium value of the quality indexes I^m_i					1,118	1,026	1,086	i= X, Y,Z

I_C^{**}= (1,118+1,026+ 1,086) / 3= 1,04;

If we consider the share of importance of quality characteristics in the leather processing - P_X = 0,42%; P_Y = 0,20%, P_Z = 0,38%, the synthetic quality index value, with the evaluation weight of importance I^{**}_{CP} is:

I^{**}_{CP} = 1,118.0,42+1,026. 0,20+1,086.0,38 =1,08

In both cases it is observed that from the point of view of the quality index the processing loads are situated in the the synthetic acceptable.

CONCLUSIONS

The quality of the finished leathers can be exposed by a number of numeric values on different references: technical (physical, mechanical and other properties), economical (cutting area, physical productivity, chemical, water or energy quantity used) and usability of the product. Besides all these and without the possibility to be measured but fundamentally important, it's added some esthetic and organoleptic properties (dye uniformity, finishing uniformity, conformity with the sample, physical natural defects or provoked during the processing, physical-mechanical tests , etc). One of the specs that can be targeted is the role of the best practices on the sustainability of transformation the raw hides in finished leathers, analyzing especially the impact of these approaches at the technological processes quality's level.

From the economical point of view, leather is a key material, generating welfare and jobs in a large variety of value chains in which is involved as main compound as: shoes industry, garment, leather goods, upholstery, automotive, aircrafts, medicine, etc. That's why to calculate the synthetic indicia of quality for each lot or batch becomes a very important and imminent job to do!

Follow the environment indicators and their inclusion into the quality analyses to the factories in our country (small or big!), can contribute to the sustainability of the specific processes from the leather industry. Their implementation in the vision, mission and strategy of the leather factories can lead to the testing of the possibilities of collaboration with the local communities as well as with the business communities in projects linked on environmental sustainability.

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