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ASSESSMENT CRITERIA OF FUNCTIONALITY GEOTEXTILES USED IN ROAD CONSTRUCTION

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Abstract: *This work was performed in order to assess the functionality of geotextiles used in road construction. To increase the quality of road works requires the use of geotextiles in their structure. Depending on the role and the benefits they offer, geotextiles have a number of physical properties, hydraulic, endurance and optimal characteristics regarding their degradation. Geotextile properties were identified and divided according to their characteristics area. Thus, there were obtained textile properties oriented towards geotextiles and properties geared to the application field respectively reinforcement, drainage, and filtration. Value engineering works at the level of constructive product conception and production. The instrumentation is done by functional analysis, value functions and design or redesign of geotextile based on the necessary functions. Systematic research method allowed geotextiles dimensioning functions in order to obtain products in terms of quality, reliability and maximum operational performance. Functions obtained from the analysis are appropriate for a single property. After obtaining the set of decisions was possible functions geotextiles hierarchy after the significance of their use. Establishing the importance of the coefficients or characteristics hierarchy after their weight requires the comparison of the features between them and grading them in proportion to their degree of importance. The ranking of these functions is beneficial when designing or redesigning geotextiles.*

Key words: *geotextile, value, hierarchy, functions, road cosnstruction*

1. INTRODUCTION

Geotextiles are technical textiles used in road construction with the aim of reinforcement and stabilize the embankment road, groundwater drainage, separation and control erosion, [1]. Many factors such as road widening, climatic factors, foundation conditions, traffic activity, relocation of utilities led to the search for solutions, one of which is the use of geotextiles.

The use of geotextiles brings a substantial contribution to the mechanical characteristics or increases the stability of the road. Geotextiles, through their characteristics and structure, put into the ground, associated with the earth or with another type of material, constitutes filter elements, draining, separation, reinforcement in works for protection or improvement of foundation soil characteristics.

2. GENERAL INFORMATION

Geotextiles identification derives from the need to know the type of geotextile to be used depending on the physical characteristics, hydraulic, endurance, characteristics relating to the degradation of geotextiles and as the role geotextile fulfils in the constructive assembly, [2]. Also for the optimal choice of geotextile you have to know what function or accumulation of functions, is requested of that material:

- Reinforcement - use of tensile strength of geotextiles to improve the mechanical characteristics of earth or of other construction materials;
- Filtering - retention of land and other particles subjected to hydrodynamic forces that occur as a result of fluid flow;
- Drainage - collection and transport of precipitation groundwater in the plan of geotextiles;
- Separation - prevents interference between adjacent lands and filling materials;
- Protection - prevents the local damage or the damage of a geotechnical system with the help of a geotextile, [3].

There were identified a number of important properties that could be used for objective assessment of geotextile. These properties are arranged according to area traits analyzed in two categories: properties oriented to the type of geotextile (which are important for the quality of material used in road construction) and properties geared to the application of geotextile (which highlights the ability of a geotextile to meet some requirements imposed). The main properties of geotextiles grouped into two categories can be found in Table 1.

Choosing the type of geotextile should be carried out after a criteria of functionality to ensure primarily the properties required in use.

Table 1: *Specific properties of geotextiles*

No.	Properties oriented geotextiles	Properties oriented field of application
1.	Tensile strength	Reinforcement
2.	Breaking elongation	Reinforcement
3.	Mass per unit area	Filtering and separation
4.	Material thickness	Reinforcement, filtering and separation
5.	Stamping resistance	Reinforcement, filtering and separation
6.	Tear resistance	Reinforcement, filtering and separation
7.	Permeability	Filtering
8.	Transmissivity	Drainage
9.	Creep resistance	Reinforcement
10.	Biological damage resistance	Reinforcement, filtering, separation and drainage
11.	Environmental factors resistance	Reinforcement, filtering, separation and drainage
12.	Endurance resistance	Reinforcement
13.	Abrasion resistance	Reinforcement
14.	Porosity	Filtering

Value engineering is a systematic method of research-design according to which the functions of the geotextile material, needs to be dimensioned and made using minimal costs in terms of quality, reliability and maximum performance. Value analysis is based on the examination of the functional parameters of the product realized or his value in use (usefulness) setting each function which leads to the desired parameters using minimal costs. Value analysis acts to maximize operational parameters and minimize costs, both in the design phase of product design and that of production. The way of investigating the techniques of value engineering involves the following steps:

- Functional Analysis - it is a powerful technique of value analysis which shows the specific relationships between all the functions of the material, tests the validity of the studied functions, helps to identify the mission of the functions, widens the knowledge of all project team members of value analysis. Functional analysis is completed with drawing up the list of functions of the analyzed product;
- Functions Value - answer the questions: "How important is the function and how well meets user requirements?" and "What performance does the product meets ". Good performance requires the product to have a predetermined level of quality and reliability.
- Product design and redesign based on the required functions.

The functions of a product are elementary use values, components of global value in use of the product, homogeneous content and having measurable qualities from technical point of view [4], [5]. Drawing up the classification functions of geotextile is based on its definition of the conditions in which they work. Nomenclature of functions represents the totality of the studied functions of the object to meet the requirements.

As noted in Table 2 are found the functions identified as necessary for the geotextile, technical elements of assessment of the functions and their typology according to the standardized classification criteria.

Table2: *Geotextile functions*

Symbol	Function name	Technical dimension	Tipfunction type
F1	Be resistant to breaking	Tensile strength, [6]	Primary, objective, necessary, general
F2	To have breaking elongation	Breaking elongation, [6]	Primary, objective, necessary, general
F3	To have a constant mass	Mass per unit area, [7]	Primary, objective, necessary, general
F4	To have an uniform thickness	Material thickness, [8]	Primary, objective, necessary, general
F5	Be resistant at impact with rigid materials	Stamping resistance (SR EN ISO12236:2007)	Primary, objective, necessary, general
F6	Be resistant to multi-axial stretch	Tear resistance, [9]	Primary, objective, necessary, general
F7	To be permeable to water vapor	Permeability (SR EN ISO 11058:2010)	Primary, objective, necessary, general
F8	To be able to transport and drain liquids	Transmissivity (SR EN ISO12958:2010)	Primary, objective, necessary, general
F9	Be resistant to continue stress	Creep resistance, [10]	Primary, objective, necessary, general
F10	Show resistance to attack of bacteria and fungus	Biological damage resistance, [11]	Secondary, objective, necessary, specific to geotextile
F11	Show resistance to UV and environmental factors	Environmental factors resistance, [12]	Secondary, objective, necessary, specific to geotextile
F12	Be resistant to bending-stress durability without failure	Endurance resistance	Secondary, objective, necessary, specific to geotextile
F13	No mass loss during contact with abrasive element	Abrasion resistance, [13]	Secondary, objective, necessary, specific to geotextile
F14	To separate the phases of a heterogeneous mixture	Porosity (SR EN ISO 12956:2010)	Secondary, objective, necessary, specific to geotextile

Use values of the functions are unequal, so each of them takes part differently in the completion of the value in use of geotextile, fact which enables us to rank them in accordance with

the importance of the need met. For hierarchy the functions is used the technique of imposed decisions. This involves comparing the functions two by two and application of scores by the form (1-0), (0.5-0.5) or (0-1). The score 0 represents a low importance level, 0.5 – medium level of importance and 1 - the maximum level of importance [4], [5].

The total number of decisions resulted from comparing the n functions of the geotextiles is calculated with the equation:

$$D = C_n^2 = \frac{n(n-1)}{2} \quad \textbf{(1)}$$

Establishing the importance of the coefficients or characteristics hierarchy after their weight requires the comparison of the characteristics between them and grading them in proportion to their degree of importance. The coefficient of importance for each function is calculated with the equation (2), in which N represents the sum of the score awarded and D represents the total number of decisions:

$$I = \frac{N}{D} \quad \textbf{(2)}$$

3. MATERIALS AND METHODS

The 14 functions of the geotextiles represented in table 2 are divided in 9 primary functions and 5 secondary functions. According to the equation (1) we get the following:

- Decisions for primary functions

$$D_p = C_9^2 = \frac{9 \cdot (9-1)}{2} = 36 decisions \quad \textbf{(3)}$$

- Decisions for secondary functions:

$$D_s = C_5^2 = \frac{5 \cdot (5-1)}{2} = 10 decisions \quad \textbf{(4)}$$

In tables 3 and 4 are presented the comparative analysis of primary and secondary functions. The values of the coefficients of importance are given by the ranking of the primary and secondary functions. When designing or redesigning the geotextiles, will be taken into account this hierarchy of functions.

Table 3: *Comparative analysis of primary functions*

Function	Decisions																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
F1	1.0	0.5	1.0	1.0	0.5	1.0	1.0	0.5													
F2	0.0								1.0	0.5	1.0	0.5	1.0	1.0	0.5						
F3		0.5							0.0							1.0	1.0	0.5	1.0	1.0	0.5
F4			0.0							0.5						0.0					
F5				0.0							0.0						0.0				
F6					0.5							0.5						0.5			
F7						0.0							0.0						0.0		
F8							0.0							0.0						0.0	
F9								0.5							0.5						0.5

Table 3 (continuation): *Comparative analysis of primary functions*

Functions	Decisions															Sum of the score awarded	Functions coefficient of importance
	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	N	I
F1																6.5	0.81
F2																5.5	0.69
F3																5.5	0.69
F4	1.0	0.5	1.0	1.0	1.0											5.0	0.63
F5	0.0					1.0	0.5	0.0	0.0							1.5	0.19
F6		0.5				0.0				1.0	1.0	0.5				4.5	0.56
F7			0.0				0.5			0.0			1.0	1.0		2.5	0.31
F8				0.0				1.0			0.0		0.0		1.0	2.0	0.25
F9					0.0				1.0			0.5		0.0	0.0	3.0	0.38

Table 4*. Comparative analysis of secondary functions*

Function	Decisions										Sum of the score awarded	Functions coefficient of importance
	1	2	3	4	5	6	7	8	9	10	N	I
F10	1.0	0.5	0.5	0.5							2.5	0.63
F11	0.0				1.0	1.0	1.0				3.0	0.75
F12		0.5			0.0			1.0	1.0		2.5	0.63
F13			0.5			0.0		0.0		1.0	1.5	0.38
F14				0.5			0.0		0.0	0.0	0.5	0.13

Following this analysis we see that the primary functions that must meet the geotextile which will be installed in road geometry are F1 (0.81), F2 (0.69) and F3 (0.69), meaning it must have a very good tensile strength and breaking elongation and have no mass loss during use. As a medium level of importance were obtained functions F4 (0.63) and F6 (0.56). These two functions indicate that a geotextile must maintain its thickness during use and be resistant to tearing. The functions F5 (0.19), F7 (0.31), F8 (0.25) and F9 (0.38), meaning resistance to stamping, permeability, transmissivity and creep resistance does not affect the structure of the road, having a low level of importance.

With regard to secondary functions, the highest level of importance holds F11 function (0.75) and assumes that the geotextile has a very good environmental factors resistance. F10 (0.63) and F12 (0.63) functions are of medium importance level. Functions F13 (0.38) and F14 (0.13) indicates that the porosity and abrasion resistance of the geotextile does not constitute a major importance in the structure of the road.

4. CONCLUSIONS

The use of geotextiles in road construction is a viable solution to increase of their quality.

The properties of geotextiles must relate to the field of application of geotextile in road construction. Designing and redesigning geotextile requires in-depth knowledge of the conditions in which it is used so as to effectively define functions that the geotextile must meet the operational phase of the product.

Assessment of geotextiles functionality requires the application of specific value engineering techniques that allow initially objective hierarchy of its properties and then redesigning by properties priority.

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