DESIGN METHODS OF GEOTEXTILE MATERIALS USED IN THE RECOVERY OF WEATHERED SOILS

METODE DE PROIECTARE A MATERIALELOR GEOTEXTILE UTILIZATE ÎN REFACEREA SOLURILOR ERODATE

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Abstract. *The paper emphasizes the functions and design methods of geotextile materials needed for the recovery of weathered soils by erosion from agrarian fields. Also there are presented a few properties of biodegradable textile materials made of natural polymers used in the recovery of soils.*
Key words: *design parameters, geotextile, biodegradability;*

Rezumat. *Lucrarea evidentiaza functiile si metodele de proiectare a materialelor geotextile necesare in refacerea solurilor degradate prin eroziune din terenuri agricole. De asemenea sunt prezentate si anumite proprietati ale materialelor textile biodegradabile din polimeri naturali uitilizate in refacerea solurilor.*
Cuvinte cheie: *parametrii de proiectare, geotextil, biodegradabilitate;*

INTRODUCTION

The water clears away gradually the superior layer of soil from declivous fields that results even into the total removal of fertile soil. This form of manifestation is called surface erosion. The continuous degradation of the fertile soil layer leads gradually to the worsening of soil's chemical properties like the loss of fertile elements from humus soil and K_2O. The erosion made by water affects not only the chemical properties, but also the physical ones like pH and the porosity of soil.(Dumitrescu,1987; Titus, 1996).

MATERIAL AND METHOD

1. The interaction between soil and geotextile material

A lot of textile materials are available for a large scale of geotechnical applications. An understanding of dynamic interactions between the textile structures and the geotechnical environment is essential for the design and selection of textile materials for geotechnical applications for agrarian cultures.

The geotextiles are part of the industrial or technical textiles category. The textile materials from this category can be classified in: composite textile materials made by sheeting, impregnation, lamination or other procedures, industrial textile materials – that are used as components in a fabrication process and industrial textile materials for direct use or embedded in the final products.

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The characteristics of geotextile materials are a result of the interaction between the yarn, the material's geometry and the finishing process, and can be characterized by the geometric and performance criteria.

The geometric parameters are described by: a) the porosity of materials as being the total of free spaces from a volume-unit of materials. Proportional with the growth of the yarn diameter, the structure is prone to become more porous. A porous material is lighter and more permeable. b) the volume of materials that represents the body on area unit. A material is prone to be bulkier if the fiber or yarn diameter and the mobility freedom of the fiber in the repetitive geometric unit is higher. c) the material thickness. Similarly to voluminousness the thickness of the material is related to the fiber or yarn diameter. The higher the diameter of fiber or yarn is, the more the thickness of material grows. (Koerner et al., 2011; Koerner et al., 1995 ; Narejo et al., 1992 ; Weimar, 1983)

The performance parameters are described by: a) the permeability if represented by the flow or pass capacity of the liquid or serum through material. The permeability of a material gets higher if the material porosity grows. The porosity is influenced by the fiber's nature and diameter, geometry of the fiber's cross section and the structure of material and its finishing methods. The permeability is a function of the fiber's or yarn's diameter for a given architecture of fiber (direction of fibers), the size of abruptions in the material's inside is variable depending in a large measure of the fibers' properties. b) the compressibility represents a main mechanical force of textile materials evaluated by: compressibility, hardness and resilience to compression. c)the behavior of materials to the pull evaluated by expansibility and the material's resistance. The expansibility and the material's resistance are correlated to the nature and structure of raw material and also to the technological process of crafting and finishing it. (Koerner et al., 2011; Weimar, 1983).

2. Elements of geotextile materials design for weathered soils by erosion

There are 3 functions of geotextile materials: drainage, filtering and separation. For every function there was established a design procedure using basic concepts of mechanics, hydraulics and geotechnics. For the geotextile materials used in the recovery of agrarian soils, the most important function is the filtering one.

A geotextile filter, as any other filter, must accomplish two criteria:

a) the retention criteria. A geotextile filter must have small enough holes so that it can block the movement of soil particle;

b) The permeability criteria: A geotextile filter must be permeable enough so that it won't slow down the flow of water (for a given porosity). (Koerner et al., 2011; Koerner et al., 1995 ;)

a) Two types of parameters are implied in the retention of soil by a filter:

- the mechanical parameters represented by: hydraulic forces of pull that are prone to move particles; the resistance of soil that depends of the pressure strains between soil and filter and the cohesion of soil that is prone to block the movement of particles and the acceleration of gravity that is prone to provoke or block the movement of particles according to the flow direction;
- the geometric parameters: the sizes of holes from the geotextile material; the size of soil particles and their distribution and the soil consistency.

b) As we have said previously, the permeability criteria is one of the two filters' criteria. The permeability of a geotextile filter must be high enough so that it won't slow down the flow of water. This criterion is emphasized also by the relation between the distribution of blanks (the size of holes and porosity) and the permeability of geotextiles.

The biodegradable textile materials used in agriculture for the recovery of weathered soils are designed according to the following criteria: biodegradability and permeability. The materials are composed of biodegradable polymeric compounds, represented by polymeric mixtures that contain biopolymers type starch, cellulose, chitosan. The organic substance in soil is created because of the plants' activity plus microorganism and natural organisms from different species. The most important constituents of vegetals that have a role in the synthesis of humus are celluloses, proteins and phenolic compounds. Celluloses is transformed by microorganisms into CO_2 ensuring the energy needs and the creation of living matter. (Briassoulis, 2006; Nair et al., 2007; Chandra,. 1998 ; Jakubowicz, 2003).

The biodegradable polymers are used in a very high number of applications and processes such as: fibers, yarns, chemical finishing of textile materials. The lactic acid is a monomer obtained from renewable resources: corn starch, potato starch and other products with high concentration of starch. The polylactic acid is a biodegradable polymer obtained by the direct polycondensation of lactic acid. The applications of biodegradable polymers in agriculture represents an ever-growing domain. (Chandra, 1998; Jakubowicz, 2003).

Biopolymers are defined as substances obtained through biological processes or chemical reactions of natural monomers. Because it is found in high quantities, amidine is the most used raw materials for polymere obtaining on base of alloy. There have been obtained polymere alloys through extrusion with 50% amidine with a synthetic polymere and with a compatibility agent. The hydrophylic copolymere used as compatibility agent encourages the interaction amidine – synthetic polymere. The extrusion of raw material ensures a mixture at molecular level of synthethic polymere and amidine chains. (Nair et al., 2007 ; Okada, 2002).

Biodegradable polymers on base of amidine can be used as fertilizers with controlled release in a slow or controlled lapse. As a result, the loss of fertilizers and environment pollution can be avoided or reduced.

RESULTS AND DISCUSSIONS

The role of the geotextile material in a constructive assembly, is defined as its function. In relation with functions ascribable to these materials in accomplishment of composed structures, these must posses certain physical and mechanical characteristics for which are established, according to case, adequate quality performances.

The main characteristics are represented by their good permeability to liquids and air, a controlled permeability that retains soil particles, and can accomplish simultaneously other functions, not only filter-drain, such as the controlled biodegradation process.

For soils recovery that require works on mid and long term, an important parameter is represented by the physical-chemical durability and dimensional stability of the designed material for a certain structure.

CONCLUSIONS

The geotextile materials are designed according to the physical-chemical properties of soil using the retention and permeability criterion. Also the development of biodegradable textile materials from natural polymers on a celluloses or starch base can solve some of the problems of organic fertilization of soils.

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