TRISTRATIFICAT GEOCOMPOSITE PRODUCING AND UTILIZATION IN CONSTRUCTION WORKS AND PREVENTING ENVIRONMENTAL POLLUTION

Siminea Ioana, Bostenaru Magdalena
Faculty of Land Improvement and Environmental Engineering, Bucharest, Romania
E-mail: siminea_i@yahoo.com

Abstract
This is paper presents technology of production and the utilisation of one geocomposite, which fave been produced in Romania, used in construction works and preventive environmental pollution.
The composites are generally produced in three layers, with different technologies, which depends on the structure of geocomposite fibres.
The three layers of non-woven materials are overlapped and consolidated. From this geocomposite are made drainage wicks, which have been experimented in consolidation works of foundation soil railway and roads fills.
After field measurements are found that:
- *considerable reduced setting of ground at 60 days from execution finish;*
- *physical and mechanical proprieties of foundation soil are improved.*

The biodegradable geocomposite have been produced from offal's organically materials wich are decaying in time. For sowing have been used graminaceae and vegetables seeds. Based on previous reserch practice, biodegradable geocomposite are a most avantageous solution for in waste dump fixing and reinforce the grassed slopes.

Key words: geocomposites for drainage, hydraulic properties, laboratory research, reinforcement, roads, environmental biodegradable geocomposite.

1. INTRODUCTION

The research of works was conducted to obtain tristratific geocomposites from polyester fibres used in construction works.
The composites utilization has the following advantages:
- rapidity at work implementation;
- the permeability to water in compare with classical geotextile;
- transmissivity to water in compare with ordinary geotextiles;
- resistance pressure stamping that reflects resistance at deposition of granular material.

The principal domains for this geocomposites application are roads and motorways. For our country integration in European structures it is necessary to participate to the international transport system.

For view planning of the national roads and for motorways building, through modern technologies are necessary also geocomposites materials.

The coal ashes accumulations are leading to the elimination of large areas from the agricultural circuit and are contributing to landscape degradation. More over the dump heap are easily spreader by the wind leading this way to atmosphere pollution by large quantities of dusts, plant and soil pollution near the dump heaps.

2. GEOCOMPOSITE PRODUCING AND UTILIZATION IN CONSTRUCTION WORKS

2.1. The technological process for fabrication of geocomposite

In this research work were realized 4 types of non-woven materials from polyester fibres of 4 den/60 mm and polyamide of 200 den [1; 5].
The geocomposites are generally produced in three layers, with different technologies, which depends on the structure of fibres.
The technological process for the first and the third layer is made through carding-needle punching and has the following stages (in case of using synthetic offals):
Cutting
Antistatic dressing

Opening
Blending
Making up fibre layer through carding
Mechanical consolidation by pre-needle punching machine
Mechanical consolidation by needle punching machine
If the first and the third layer are made of 100% polyester fibres, the technological process doesn't include stages as: cutting and unweaning.
The second layer is realized from technological polyester fibres from chemical industry, with 200 den fineness, through the process of pneumatic formation of fibre layer and interweaving, with the following:
Cutting with guillotine
Antistatic dressing
Opening on opener with three tambours Blending
Pneumatic formation of fibre layer
Mechanical consolidation by pre-needler punching machine
The three layers of non-woven materials are overlapped and consolidated on the needle punching machine.

2.2. The phisico-mechanical characteristics of the geocomposites

Variants of geotextiles were realized and analyzed in physic-mechanical laboratory [1; 2]. Physic-mechanical results obtained are presented in table 1.

Table1. Physic and mechanical proprieties

Characteristics	UM	Direction	Variant			
			I	II	III	IV
Mass	g/m^2	-	1894	1137	498	410
Thickness	mm	-	25.6	13.9	6.0	4.5
Traction resistance	kgf	L	15.9	32.7	58.6	200
		T	40.7	6.5	45.8	426
Elongation an failure	%	L	123	116	99.5	196
		T	79.1	69.3	104	133

Hydraulic characteristics determined are permeability and holding capacity of sediment discharge (HC).
In table 2 is presented the normal permeability (kn) that was determined by the tests made. Permeability in the plane (kp) of geotextile was determined and has the following values:
Variant I kp = 4.51×10^{-1} cm/s
Variant II kp = 5.20×10^{-1} cm/s
Variant III kp = 5.06×10^{-1} cm/s
Variant IV kp = 5.06×10^{-1} cm/s

Table 2. Normal permeability

Variant of materials	Level 1 0.01 daN/cm^2	Level 2 0.10 daN/cm^2	Level 3 1.00 daN/cm^2	Level 4 4.00 daN/cm^2
V I kn (cm/s)	2.7×10^{-1}	1.66×10^{-1}	5.55×10^{-2}	2.04×10^{-2}
V II kn (cm/s)	2.83×10^{-1}	1.56×10^{-1}	5.04×10^{-2}	2.00×10^{-2}
V III kn (cm/s)	3.06×10^{-1}	1.75×10^{-1}	3.50×10^{-2}	2.53×10^{-2}
V IV kn (cm/s)	1.33×10^{-1}	$9.02 x0^{-1}$	3.0×10^{-2}	2.10×10^{-2}

Holding capacity of sediment discharge (HC) for the variants performed is presented in table 3.

Table 3. Holding capacity of sediment discharge

Variant of materials	Level 1 0.01 daN/cm^2	Level 2 0.10 daN/cm^2	Level 3 1.00 daN/cm^2	Level 4 6.00 daN/cm^2
V I kp (cm/s)	3.68×10^{-1}	2.61×10^{-1}	1.59×10^{-1}	1.17×10^{-2}
V II kp (cm/s)	2.81×10^{-1}	1.76×10^{-1}	6.085×10^{-2}	3.38×10^{-2}
V III kp (cm/s)	1.12×10^{-1}	7.73×10^{-1}	3.45×10^{-2}	1.80×10^{-2}

Due to the table calculations made with coefficients values obtained from determinations made in laboratory on material samples of geocomposite, on different level tests, resulted values of permittivity and transmissivity coefficients for four variants.
Their values are presented in table 4.
Draining wicks were executed, within an experimental reach, on a real scale, in construction works of the foundation soil of a railway back file, in Fetesti-Constanta area.

Table 4. Values of permittivity and transsmisivity coefficients

Variant of material	Coefficient		Level 1	Level 2	Level 3	Level 4
			0.01daN/cm^2	0.10daN/cm^2	1.00daN/cm^2	4.00daN/cm^2
I	Permeattivity	initial	5.42x10^{-1}	4.19x10^{-1}	2.42x10^{-1}	8,60x10^{-1}
		after HC	5.04x10^{-1}	4.16x10^{-1}	3.33x10^{-1}	3.29x10^{-1}
	Transmissivity	initial	2.26x10^{-1}	-	-	-
		afterHC	3.24x10^{-1}	-	-	-
II	Permeattivity	initial	5.58x10^{-1}	3.86x10^{-1}	2.16x10^{-1}	1,34x10^{-1}
		afterHC	4.32x10^{-1}	3.28x10^{-1}	1.93x10^{-1}	1,36x10^{-1}
	Transmissivity	initial	2.63x10^{-1}	-	-	-
		afterHC	3.33x10^{-1}	-	-	-
III	Permeattivity	initial	6.06x10^{-1}	4.57x10^{-1}	1.85x10^{-1}	1,61x10^{-1}
		afterHC	2.22x10^{-1}	1.74x10^{-1}	1.13x10^{-1}	8,45x10^{-1}
	Transmissivity	initial	2.35x10^{-1}	-	-	
		afterHC	3.33x10^{-1}			
IV	Permeattivity	initial	4,26x10^{-1}	3.48x10^{-1}	2.17x10^{-1}	1,34x10^{-1}
		afterHC	-	-	-	-
	Transmissivity	initial	8,16x10^{-1}	-	-	-
		afterHC	-	-	-	-

3. ENVIRONMENT POLLUTION FIGHTING BY FIXING OF ASH DUMPS, USING SEEDED BIODEGRADABLE GEOCOMPOSITE

3.1. Geocomposite description

Geocomposite is a produced by a textile manufacturing technology, namely by carding or winding. The carding technique is applied to produce a fiber mat of variable thickness, with the weight of 150-300g/m^2. Interweaving technique on special equipment, provided with plates, needles, and groves, mechanically reinforces the fiber mat. The grooved needles mechanically generate the fiber felting 15x18x32x31/2 needles are used with nedle puching 50 – 100/m^2 [4; 5].

Table 5. The geotextiles physic-mechanical characteristics

Characteristics	U:M:	Value
Total weight	g/mp	300 ± 10%
Wet weight	g/mp	2000±200
Initial thickness	mm	3,5±1
Wet thickness	mm	3±1
Initial porosity	%	93±5
Water saturation	%	40±5%
capacity	%	200±100
Saturation capacity	l/m^{2}s	1000±10%
Air permeability		medium behavior

After felting, the fibers take random directions, forming relatively large voids in-between. These voids will serve for the insertion of roots and stems of plants germinating on the geocomposite after seeding.

The raw material used for the manufacturing of geocomposite is biodegradable. It is either first-use biodegradable raw material, or recycled cellulose fiber, recycled wool, and other biodegradable fibres.

Due to geocomposite thickness that is 2-5mm, it makes an adequate support for plant growth at the first stage of vegetation.

The geocomposite is to be seeded by using one plant variety, or a mixture of perennial herbs, combining cereal and leguminous crops. The selection of plant variety is subject to the climate conditions of the geographical area, where the geocomposite is used.

3.2. The use of biodegradable geocomposite to stabilize the ash dumps

Fly ashes waste products resulting from fine crushed coal burning in the air. Fly ashes in large amounts are usually disposed of in waste dumps. The fly ash is easily carried away in the air and significantly contaminates the environment. Due to easy spreading of the ash dump, fixing the waste dump is the first step to be taken for environment protection.

According to research carried out in the country and abroad, the following procedures of waste dump fixing are used [1]:

- fixing by spray watering, especially of the new fly ash dumps
- chemical fixing by emulsions
- biological fixing by vegetation: this method is used as a rule on stand-by waste dumps.

This includes using earth cover 10-20cm thick, mud cover, peat, or a mixture of earth and ashes of approx. 10cm.

Based on previous research practice, biodegradable seeded geocomposite are a most advantageous solution to be considered in waste dump fixing.

Under the present circumstances, to provide the covering earth is ever is more difficult. Therefore, using biodegradable geocomposite instead is the most advantageous solution to be applied dump grassing and ash fly scattering prevention.

Research has been initiated in our country for the implementing of the biodegradable geocomposite [4], [5].

In laboratory testing of the biodegradable has been performed, in order to the test the cultivation capability of ashes and to establish the perennial plant varieties used in geocomposite grassing.

4. CONCLUSIONS

Talking into account tests results and measurements executed and exposed above, the following conclusions can be drawn regarding the application of geocomposite:

- the solution can be used in good conditions using materials and equipments found in the country;
- rate execution of a used in good conditions using materials and equipments found in the country;
- rate execution of a wickdrain is about 1,00m/min, in the presence of a gravel sand bed;
- settlements with a decreasing tendency up to 60 days from the end of execution;
- results an improvement of physical and mechanical properties of the foundation soil;
- the geocomposite provides protection against fine particle spreading in the wind, immediately after laying the geocomposite on the ash dump;
- the geocomposite acts like a mechanical support of root anchoring, at the first stage of plant growth;
- wind carried seeds of the spontaneous flora got fixed on the surfage of the geocomposite, and sprouted to grow into fully developed plants;
- after sprinkling, the geocomposite maintains an adequate moisture content underneath and therefore generates favourable conditions for plant root development;
- the decayed geocomposite supplies rich nutrients into ash layer underneath and imp[roves the physical, chemical and biological features of the upper layer of fly ash dumps;
- the geocomposite replaces the topsoil that would have been laid over the waste dump surface for plants to grow on.

5. REFERENCES

1. Boştenaru, M., Dragomir, G., Patru, M., - 1998. Producing of new Romanian geocomposites. In the Bulletin of ARGG, no 3, page 12-14, Bucharest.
2. Kellner L., Gazdaru, A., Feodorov, V., - 1994. Geosynthetics in Construction Works, Bucharest, Romania.
3. Nastea St. T and other authors – Research on valorization of ash dumps in agriculture. ICPA Annals, Vol. LI 1992, pad. 223-236.
4. Siminea Ioana – Research on the use of biodegradable geocomposite for power plant ash dumps stabilization. Scientific works, E, Series, XXXVII, page 101-110, 1994.
5. Siminea Ionana, Bostenaru Magdalena – The first Romanian test concerning utilization of sowed biodegradable geocomosite for fixing the ash dump of coal and preventing environmental pollution. EuroGeo 2000 – Second European Geosynthetics. Conference and exhibition, October 15-18, 2000, Roma Italy.