MINING AND METALLURGY INSTITUTE BOR
and
TEHNICAL FACULTY BOR, UNIVERSITY OF BELGRADE

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53rd International October Conference on Mining and Metallurgy

PROCEEDINGS

Editors:
Ana Kostov
Milenko Ljubojev

3 – 5 October 2022. Hotel "Albo" Bor, Serbia

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APPLICATION OF GEOGRIDS IN RECULTIVATION MEASURES OF DEGRADED LAND

Milenko Jovanović[1], Daniel Kržanović[1], Radmilo Rajković[1], Miomir Mikić[1], Emina Požega[1]

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Abstract

Geogrids are the most often used to strengthen and stabilize a weak-bearing soil. In some cases, the material, the fraction of which is larger than the opening of a mesh, is piled on the geogrid and material is trapped in the openings of geogrid and a system resistant to the external forces is created. Now, there are the geogrids made of natural (organic), synthetic and composite type of materials. Geogrids and organic geotextiles are the natural and 100% biodegradable solution to the erosion control using the geogrids or geotextile mats made of coconut (or jute) fibers. They are designed to hold the soil in place until vegetation is established. A geogrid or permeable geotextile provides a natural support system to the soil and vegetation.

***Keywords**: geogrids, recultivation, organic geomaterials, degraded land*

1 INTRODUCTION

1.1 Geogrids - types

Geogrids are most often used to strengthen and stabilize a weak-bearing soil. In some cases, the material, fraction of which is larger than the opening of mesh, is piled on a geogrid and material is trapped in the openings of the geogrid and a system resistant to the external forces is created. In addition to stabilize and strengthen the weak-bearing soil, the geogrids are also used to reinforce asphalt in such a way that a geogrid is installed between layers of asphalt. In this case, it is important to mention the use of geogrids in the road rehabilitation for the purpose of preventing the reflection of existing cracks on a new layer of asphalt. The third important purpose of geogrids is to protect against the soil erosion. For this purpose, there are two-dimensional geogrids that have small mesh openings and three-dimensional geogrids. Depending on the manufacturer, the geogrids may differ, but their primary function and mode of operation is the same. [1-3]

The main difference between geogrids is reflected in the type of material they are made of. There are geogrids made of artificial or natural fibers (materials), as well as geogrids that use geocomposites.

A particularly suitable type of geogrid for recultivation the land degraded by the mining operations is the one made of natural materials - an organic type of geogrid.

1.2 Organic geogrids

Geogrids and geotextiles made of organic (natural) materials such as coconut or jute (Figure 1, [4]) represent a natural and 100% biodegradable solution for erosion control using geogrids or geotextile mats made of coconut fibers. Organic geogrids have the unique characteristics. They consist of biologically and chemically photo-degradable natural fibers. They are designed to hold soil in place until vegetation is established. A geogrid or permeable

geotextile provides a natural support system (improvement of characteristics) to the soil (soil, landfill) and vegetation.

Organic geogrids are more flexible than most types of synthetic geogrids. This allows them to easily follow the contour of the soil surface. The ability to make direct contact between the fibers and soil and allow a bond between them to develop for reduction in soil loss by 90% or more. After degradation, they do not leave any toxic material in soil. [2,3]

Figure 1 *Geogrid of jute, produced Huesker [4]*

2 EXPERIMENTAL

2.1 Application of geogrids in measures of recultivation of degraded land

Natural recultivation of certain, inactive mining facilities (dumps, mines, quarries, etc.) is a very slow process, measured in time intervals of more years, while in some locations it is not possible. An adequate approach to recultivation implies that a Project (plan) is based on a database.

In general, the technical, bio-technical and biological measures should be applied within the reclamation of degraded areas.

The substrate, the land on which the landfill is formed, may have the unfavorable geomechanical characteristics. Geotextiles or geogrids can be used to reinforce the substrate. Geogrids have a lower coefficient of stretch than geotextiles, they do not adapt to the terrain and loads to the same extent.

Bio-technical measures, together with technical measures, contribute to faster achievement and maintenance of permanent landfill stability.

Bio-technical measures imply the proper selection and application of vegetation which, together with technical measures, will lead to the permanent stability, both in horizontal and vertical direction. On almost horizontal locations, after the completion of technical measures, the biological measures of landfill reclamation can be applied.

Before the formation of landfill, the first phase of technical measures is the stabilization of substrate for the future landfill and its planning, drainage or installation a drainage system. After this phase, tailings are filled and a landfill is formed in phases.

As a suitable solution in many cases, where an efficient result is sought, and on the ecological, field security plan, there is an organic (coconut, jute, hemp, etc.) approach of usable materials.

In particular, it should be emphasized that many of the presented materials have a very wide application in the field of environmental protection, especially in the prevention of groundwater and surface water pollution through infiltration control, and also in the treatment and immobilization of various types of waste, especially hazardous waste. [1,5,6,7]

3 RESULTS AND DISCUSSION

3.1 Erosion processes and their control

The occurrence of erosion processes depends on a degree of implementation the technical measures and possibility of occurrence the unexpected excessive natural or anthropogenic processes. In terms of erosion stability, the landfill formed with the application of technical measures is a heterogeneous, conditionally consolidated environment sensitive to the origin and development of both internal and surface forms of erosion.

Figure 2 *Achieving the erosion stability using geosynthetics [2]*

Analysis of erosion stability should be performed taking into account: physical and mechanical characteristics of natural soil and landfill, indicators of filtration current flow, probability of high-water occurrence, landfill geometry, as well as the other specific indicators that can affect the erosion stability.

The formation of surface forms of erosion on slopes is caused by water, which arrives on the slope: as the atmospheric sediment, by discharge the underground water on the slope, from irrigation, or their simultaneous action. Water on slopes can cause washing of soil particles, plastic flow, sliding, landslides or gully formation, which depends on the amount and energy of surface water and the physical and mechanical properties of soil that makes up the surface of the slope.

The landfill is an environment, suitable for creation the filtration current flows, due to the acceptance of underground water around the perimeter of landfill from the natural soil and surface water infiltration. In the conditions of formation the filtration current flows in different porous environments, there are changes in the speed and filtration forces, that is, the intensity of internal erosion processes.

In the conditions of the appearance and development of intense filtration flows, a technical measure that can be applied is the injection of bentonite clays or geosynthetics into the horizontal surfaces of the landfill, as well as slopes, which leads to mitigation and reduction of the intensity of internal erosion processes.

Prevention of surface erosion is done by reducing the water reaching the slope, using a system of drainage channels with a mandatory perimeter channel and drainage or geosynthetics (Fig. 2). Using the geogrids, the surface layer of soil can be protected from erosion. They are placed and secured with wedges, and then covered with a substrate mixed with grass seed or weeding is done by hydroseeding.

Another way to control erosion processes is the installation of geomembranes. Geomembranes produced of natural fibers of jute or hemp, consist of natural cellulose veils as a supporting layer, grass seeds and additives for accelerated growth. In order to prevent erosion, a vegetation geomaterial is also used, which consists of a thin layer of non-woven geotextile that is sewn to a natural canvas composed of a mixture of grass seeds. [1,3,5,6,7]

4 CONCLUSION

Geogrids and organic geotextiles are a natural and 100% biodegradable solution to the erosion control using geogrids or geotextile mats made of coconut (or jute) fibers. They are designed to hold the soil in place until vegetation is established. A geogrid or permeable geotextile provides a natural support system to the soil (land, landfill) and vegetation.

The installation of these efficient systems (geogrids, geotextiles, geomembranes) in various branches of ecology and industry and their usefulness directly depends on the materials from which they are made. The application and selection of types and materials refers to the protection and stabilization (stiffening) of the surfaces (slopes) of landfills and other mining facilities, where the choice of the covering layer type depends on the deposited material, size and shape of a landfill itself. [6,7,8]

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As a possible solution for savings in many cases, where an efficient result is needed, both in terms of ecology, as well as in terms of construction, safety, and security of the terrain, it represents a hybrid approach to the use of construction materials. Namely, using (cross-hybrid) different types of materials in the production of geogrids or geotextiles, seemingly contradictory requirements in their application can be solved

Special attention in further development should be paid to the use of the new natural materials and hybrid technology of geomaterials, as products of the future. [6,7]

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