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Review paper

THE IMPORTANCE OF GEOGRIDS FOR LANDFILL SECURITY AND ENVIROMENTAL PROTECTION

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Abstract

The area intended for the disposal of (mining...) waste is represented by earthen surfaces. Soil is a natural universal water purifier in which rainwater is filtered and thus protects the quality and correctness of underground drinking water. The soil has a great absorption capacity, both physical and chemical. The cleanliness of the earth's surface is greatly impaired (worsened) by the disposal of (mining) waste on the surface of the soil, which is (eventually) permitted (by the project) for that purpose. In order to protect the soil (the wider surroundings of the site) from the harmful effects of waste (erosion, pollution, etc.), we must first protect it, whereby we widely use, as one of the solutions, different types of geosynthetics and accompanying geomaterials.

The waste disposal site is a complex geotechnical building, the main purpose of which is the safe (without active risks to the living environment) and environmentally friendly disposal of waste, which cannot or is not cost-effectively recycled, or otherwise usefully used.

At landfills of various types of waste (materials), geogrids are used as reinforcement as an independent element or as an integral part of a geocomposite. Of course, this refers to geomembranes, geotextiles and other types of geosynthetics as part of one of the covered - protected or drainage layers of the landfill. The geogrid must meet the requirements (resistance) of mechanical strength, as well as resistance to chemical agents and elevated temperature.

Keywords: *(mining) waste disposal sites, geosynthetics, geogrids, mining waste, pollution*

1. INTRODUCTION

Geogrids are relatively easy to manage, large quantities of this material can be installed quickly with minimal labor and lower installation costs. The geogrid can be installed in all weather conditions without demanding equipment or special construction techniques. Geogrids provide tensioning for: various types of landfills, foundations, foundations of railway lines and roads, earthen reinforcement of earthen embankments, transfer of loads on terrain of extreme mass, etc. With their tensile strength, geogrids are suitable for various types of demanding projects.

Engineering solutions that include the use of geogrids can preserve natural mineral resources by reducing the thickness of the roadbed and the need for large amounts of soil to stabilize steep slopes. Geogrids are relatively easy to manage, large quantities of this material can be installed quickly with minimal labor and lower installation costs. The geogrid can be installed in all weather

conditions without demanding equipment or special construction techniques. Geogrids provide tensioning for: various types of landfills, foundations, foundations of railway lines and roads,

By crossing (combining) types (materials) of geogrids (geotextiles) in the form of a certain hybrid technology of manufacturing these products, we obtain usable parameters suitable in the field of environmental protection and the necessary mechanical and temporal usability (longevity).

The basic division according to the type of material from which geogrids are made is synthetic and natural (organic). Organic geogrids have unique characteristics consisting of biologically and chemically degradable natural fibers. They are designed to hold the soil in place until natural vegetation is established. On the other hand, geogrids and geotextiles made of synthetic materials have much greater strength, elasticity and durability. [1,2,3,4]

Geogrids are most often used in the cover protective structure of the landfill so that the cover structure can take over the tension that may occur due to differential settlement of the deposited waste. And since landfills are sometimes located in abandoned quarries, it is often necessary to arrange steep rock slopes in order to make the best use of the space for waste disposal.

At waste disposal sites, geogrids are most often used to strengthen the sides - the edges under the waste, as well as to strengthen the cover in the zones above the geomembrane (if necessary) (Fig. 1). In geotechnical engineering, they are most often used to strengthen and stabilize weakly load-bearing soil. In this case, the material whose fraction size is larger than the opening of the mesh is piled on the geogrid and the material is trapped in the openings of the geogrid and a system resistant to external forces is created (1,2,3,10).

Figure 1. Presentation of covering (covering) the slope of the landfill with a geogrid

2. EXPERIMENTAL

2.1 Geogrids for the purpose of slope stabilization

The greatest role of vegetation in protecting the slope from erosion and its stabilization is ensured when its surface enables the establishment of a given vegetation and allows water to flow at a certain speed and intensity on the surface, thereby preventing the degradation of the vegetative cover.

In difficult conditions (such as slopes with a critical angle, channels with high flow, etc.) the vegetative cover, even when well established, will not be able to survive under the erosive force of the water.

Figure 2. Reinforcement of supporting slopes with a geogrid, with the additional help of natural vegetation

Synthetic geogrids are made of UV-stabilized polyethylene that ensures long-term soil retention. The flexibility of the product allows it to follow the contours of the ground and prevents the formation of voids. If the soil is not anchored, it will become subject to the influence of underground water flows and erosion. The use of these nets works by lining the working surface when creating steeper slopes.

Organic geogrids have unique characteristics, they consist of biologically and chemically photo-degradable natural fibers. They are designed to hold the soil in place until vegetation is established.

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 the soil and allow the bond between them to develop allows soil loss to be reduced by 90% or more.

In addition to the above, organic geogrids act as "mulch" and thereby improve the establishment of vegetation. After degradation, they do not leave any toxic material.

Hydroseeding enables easier greening immediately after the installation of the geogrid (Fig. 2). (8,9,12)

3. CONCLUSION

Geosynthetics are mainly polymer products that are used to stabilize and isolate terrain (materials) and have a wide range of applications.

Geotextiles, geomembranes and geodrains are most commonly used in the rehabilitation of geosynthetic landslides. The primary function of geomembranes and geodrains on landslides is

drainage, while geotextile performs multiple functions: filtering, draining, reinforcement and separation.

Geogrids have a reinforcing function, while with geocomposites it is variable, depending on the combination of constituent materials.

The characteristics of geotextile materials can be determined using mechanical models. Thus, every type of deformation of real materials is imitated by a simple model or this imitation is represented by complex models that are formed by a combination of simple models. Simple models used to describe elastic, viscoelastic and plastic deformation are models that define the properties of materials that do not exist in nature, but whose properties, under certain load conditions and other external influences, approximately reflect the behavior of real materials (5,9).

A special type, geogrids (and geotextiles) made of natural (organic) material (coconut, jute...) represent a 100% biodegradable solution for erosion control (geoggrids or geotextile mats made of coconut or jute fibers). Organic geogrids have unique characteristics, they consist of biologically and chemically photo-degradable natural fibers. They are designed to hold the soil in place until vegetation is established. A geogrid or permeable geotextile provides a natural support system (improvement of characteristics) to soil and vegetation. In addition to the above, organic geogrids act as "mulch" and thereby improve the establishment of vegetation. After degradation, they do not leave any toxic material.

As a possible solution in many cases, where an effective result is sought both in terms of ecology and construction, safety, and terrain security, there is a hybrid approach to the use of building materials. Namely, by using (hybrid) different types of materials when making geogrids or geotextiles, we can solve seemingly contradictory requirements in their application.

Such hybrid (combined) materials, which would contain crossed bundles of organic and synthetic origin, can, depending on the need (purpose) and their mutual relationship, be an "ideal compromise", that is, a saving solution. Material of organic origin would have a positive effect on the development and preservation of vegetation and the entire eco system, while geosynthetic materials would have a primary application of a mechanically stabilizing nature, as many times stronger and more weather-stable materials. In addition to the above, organic geogrids act as "mulch" and thereby improve the establishment of vegetation. After degradation, they do not leave any toxic (harmful) material.

Because geogrids are relatively easy to manage, large quantities of this material can be installed quickly with minimal labor and lower installation costs. The geogrid can be installed in all weather conditions without demanding equipment or special (in)construction techniques.

Special attention in further development should be paid to the use of new (natural) materials and hybrid technology for the production of geomaterials, as products of the future (4,10,11,12).

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