

Strengthening the Subgrade Highways Depending on Classified Geotextile Characteristics

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ABSTRACT: Consideration of principle reinforcing subgrade with using Geotextile and completing classification of Geotextile characteristics relative to the reinforcement subgrade highways. Detailing the main directions for using geotextiles for reinforcing the subgrade. Finally, outlining the key criteria for selecting Geotextile separation.

KEYWORDS: Subgrade, Highway, Strengthen, Geotextile, Geomembrane, Geogrid, Synthetic fibre.

I. INTRODUCTION

The emergence of the first textiles. The Geotextile of the 5th millennium BC was a mat of grass and flax, on which, presumably, resting ancient people. In the era of the Pharaohs, Used in road construction as a means of stabilizing the layers below the foundation. The first idea in manufacturing Geotextiles was natural fiber material, Tissue or vegetation mixed with soil to improve the foundation under a layer based on the road. For the modernist highway premises Geotextile was applied relatively recently. Geotextile this is any permeable textile substance used with base soil, stone, ground ...etc. which is an integral part of the project to be a texture, structure or system. It can be made of artificial or natural fibers. Currently, Geotextile is a highly developed product that must meet many standards.[1] Some represent the main components of Geosynthetics, others Geogrids and Geocomposites Geomembrane. Geotextile function as a permeable textile material utilized in contact with the ground, rocks, soil or any other material related to the implementation projects of constructing highways. Depending on the statistics of the Ministry of Public Works and Housing in Jordan[2] the total length of the highway Jordan to 2718 thousand km, secondary routes, 1876 thousand km and rural routes 2607 thousand km (shown in figure 1).



Fig. 1. Highways in Jordan

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The overall condition of the road surface in accordance with a study prepared by the European Investment Bank for road assessment. Their maintenance needs to include other major highways such as: Highway -15 which is known as the Desert highway and it passes Jordan from south to north, Highway -10 is the it links south and north, Highway -25 is a north-south highway. Highway -35 also known as the King's Highway, Highway 40-is an East West Highway, Highway 65-also known as the Dead Sea Highway and Highway 50-also known as Karak Highway which leads to border points. (Sarayanews. 03.11.2016).[3]

The study showed that more than 65% of the main and secondary routes with a total length more than 2,900 km are in good condition, the rest 1,300 km needs periodic or urgent, or the need to be maintained or reconstruction. It also showed that 30% of the main roads and 35% of the secondary roads, need replacement. In addition, 20% of the main roads and 9% of the secondary roads require emergency maintenance and road 15 is the most notable. Along with the provided statistical data, the issue of improving highways clothing becomes important and urgently needs to be studied, including how to classify strengthening materials based on their characteristics. Based on modern technologies of construction of road surface (used in developed countries of the world), the use of textile material as a means of strengthening subgrade foundation are a priority which deserves special attention.

II. RELATED WORK

The scale of modern scientific achievements on the research topic is significant. The issues of strengthening the subgrade of the highways with geotextiles, papers did not draw their attention to the topic. S.I. Sushkov, A.S. Sergeev lead experimental practical studies of two designs of road clothes, in which Geosynthetic gratings were used.[4]Researches developed and proposed a new Geosynthetic lattice with a honeycomb as it contains seven nodes with polymer ribbons emerging from them with the formation of six triangles, which in turn, formed a hexagon with six angular nodes and one central node. A. A. Degtyar, B.S. Yushkov suggest an option double cone hollow piles in road construction.[5] The authors learned information about subgrade construction developed using the double cone of hollow piles, together with spatial Geogrid. A method of strengthening the weakly grounds of highways, with application of soil-cement pile produced by Jet technology is described by L. M. Timofeyeva and E. S. Krasnov.[6] The authors substantiate that the resulting armored pile foundations can significantly increase the load-bearing capacity of substructure, but the effectiveness of it that it used a large extent depending on the thickness and lithological composition of the soil substructure. Many scientists have developed modern designs to strengthen the foundation as W. Hare, Y. Lucet, F. Rahman [7], M. Setinc, M. Gradisar, L. Tomat [8], T. Janssen [9], C. Liyanage, F. Villalba-Romero [10], Kundan Meshram, S. Mittal, P. Jain, P. Agarwal.[11] However, despite the results of scientific developments in accordance with the topic of the study, the issue of strengthening the foundation of the subgrade of highways with Geotextile remains open and requires detailed studies.

III. OBJECTIVE

Considering the principles of strengthening the foundation below of the subgrade to exploit them in the rehabilitation of highways, as well as, classifying characteristics of Geotextile relative to the refreshment of the foundation below subgrade highways. Finally, Itemizing of the main directions of utilization geotextiles to strength the foundation below subgrade highways.

IV. RESULTS AND DISCUSSIONS

Consists of the main material Geotextile is one of the most versatile and cost effective materials for surface modification. It is designed to provide stream fluids, in turn Geomembrane is designed to limit the liquid flow. Materials associated with geotextiles are tissues formed in mats, grids or plastic sheets. Their main function is to separate the subgrade from the subclass, which leads to the strengthening of the highway. Geotextile performs this function by providing a dense mass of fibers at the interface between two layers. It must meet certain requirements, as it must allow the exchange of substances between air and soil and allows rainwater to penetrate into the soil from outside and also remove excess water to drain from earth without soil erosion. To get whole these properties in Geotextiles, the faithfully choice of textile fiber is of overriding importance. Different synthetic fibers used in

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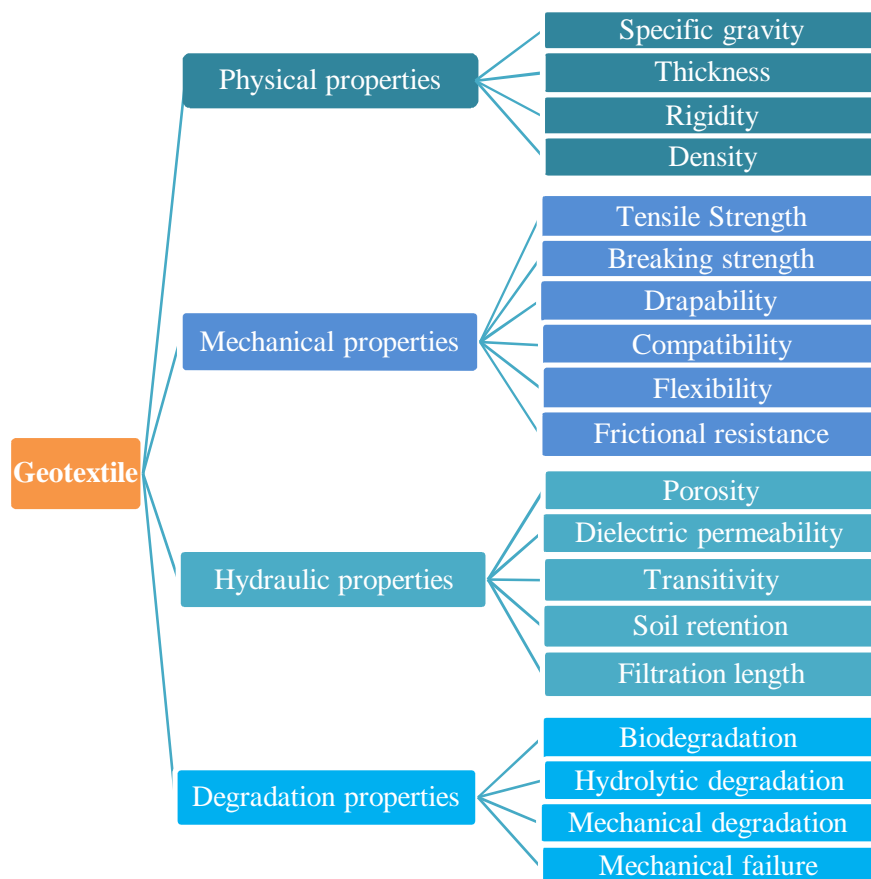
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Geotextiles are nylon, polyester, polypropylene. As well as the possibility to make use of some natural fibers. In most cases, Geotextiles are made of synthetic material polymer substance that do not disintegrate in biological and chemical processes. These include polypropylene, Polyethers, polyethylene and polyamides. This property predetermines geotextiles for highway construction and technical services. At the present time, geotextiles are produced in three basic types:

1. Woven material;
2. Non-woven material;
3. Knitted materials.

In this article, woven and non-woven geotextiles are considered according to their purpose when reinforcing the roadway of highways. In figure 2 shown classification of geotextile characteristics.



* systematized by the author according to the results of the analysis of literature sources [5, 8]

Fig. 2 Classification of geotextile characteristics

In figure 3 shown types of geotextile. Woven geotextile (Fig. 3, a) is a sheet obtained from a set of intersecting filaments, which as a result of the regularity of alternating a thin flat tissue. Different ways of alternating the types of weaving threads that make woven geotextiles determine properties and application woven geotextile. Distinctive properties of woven geotextiles are its insignificant extensibility, as well as the ability to freely not allow water, in

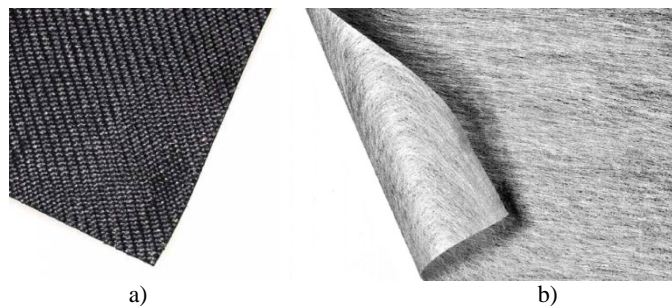
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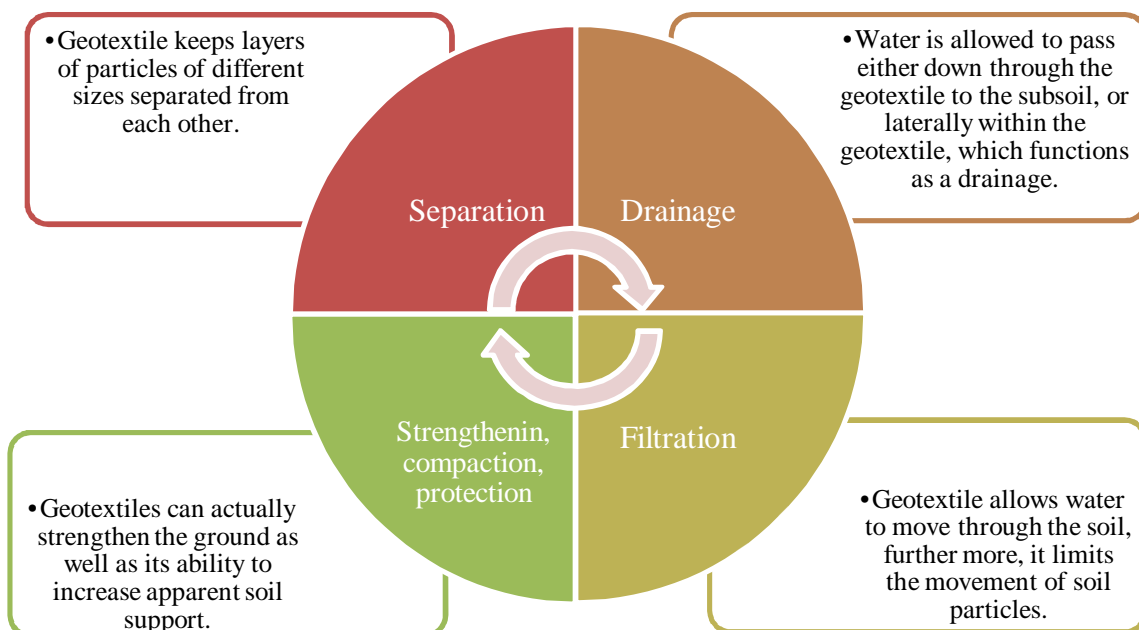
contrast to non-woven material. Non-woven geotextile (Fig. 3, b), which looks like a felt fabric consists of a fiber that either has a direction system or is chaotically structured on a sheet. The process of manufacturing non-woven geotextiles is based on the combination of fibers by means of chemical, thermal or mechanical processes. Methods of manufacturing non-woven geotextiles do not significantly affect the properties of this material and do not change the functional properties of the fabric, in contrast to the woven material. The non-woven geotextile allows water to flow along the plane of the geotextile.



* on the materials of the site <http://geotekstil-spb.ru>

Fig. 3 Types of geotextile: a) woven geotextile; b) non-woven geotextile

The need of the application of geotextiles to reinforce the foundation of the roadway of roads in the road industry and it should be divided into four main areas (Fig. 4).



* systematized by the author according to the results of the analysis of literature sources [6, 9].

Figure 4. Areas of application of geotextiles for reinforcing the base of the roadbed of motor roads

In road construction, the use of geotextiles is most widely spread to stabilize the layers of the road structure by their separation and drainage. Geotextile is used to increase transport loads on soil layers, which have low operating

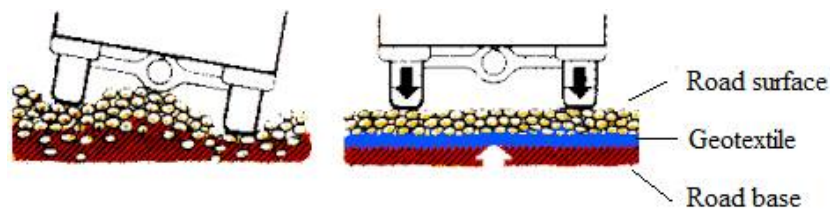
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parameters like high sludge, high humidity, instability and others. Figure 5 shows, the separation of layers with different properties in the design of the road with geotextile increases their integrity and stability as it provides drainage without compromising the integrity of the base layers.



* systematized by the author according to the results of the analysis of literature sources [5, 10].

Figure 5. Example of the use of geotextiles for reinforcing the base of the roadbed of highways

The use of a geotextile as a separation layer is effective for keeping small particles of road structure layers at a basic level, and minimizes the deformation of the layers of the road structure when moving a large number of increasing loads. In the case where large loads cross the surface of the roadway, a pumping action is established that accelerates the movement of water and the migration of soil particles and accelerates the road collapse. In action, the two main criteria for choosing the geotextile for separating layers of the road structure are permeability and strength. Geotextiles used for this purpose should ensure a uniform movement of water through it, while eliminating the washing out of small particles of the layers. In turn, this allows the water to pass through it at the same speed or slightly faster than the neighboring ground. Based on these requirements, it is possible to distinguish such criteria for the choice of separation geotextiles:

- geotextile permeability;
- puncture strength and tensile strength;
- resistance to splash and abrasion.

Filtration is provided by such basic properties of geotextiles as porosity and permeability. The drainage function is achieved by to the ability of a thick non-woven geotextile to provide a free flow of water through the Geotextile plane. Strengthening is achieved by introducing geotextiles into various layers of the road structure, which is achieved by increasing the integrity of the layers, which increases the shear strength.[12] The strength of the geosensitive material for tension allows it to be used as a reinforcement layer, which significantly improves the structural stability of the soil. Geosentetic materials that perform the function of reinforcement in the same way as reinforcing steel in concrete structures, the result is the strength which helps to keep the soil from deformation. In addition, the road structure geotextile or geogrid allows to build roads and embankments on a soft ground and gives the opportunity to increase the slope of embankments.

Geotextile functions in case of road reconstruction with asphalt coating. It is applied to the existing road surface after the application of asphalt concrete. Geotextiles is absorbed by asphalt and in this case it serves as water proof stop and reducing the process of washing away layers of the road structure with a vertical flow of water.

V. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

1. The analysis of the main properties and purpose of the geotextile is performed, which will allow more accurately determine its application in the construction of highways.
2. An algorithm for selecting geotextiles in the form of schemes has been developed.
3. The principles of geotextile work in the design of highways are systematized.
4. The influence of geotextiles on the characteristics of the road structure, depending on the place of its implementation is described.

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REFERENCES

- [1] AASHTO M288-06 "Standart Specifications for Transportation Materials and Methods of Sampling and Testing"
- [2] Ministry of public works and housing – Jordan. Available from Internet: <http://mpwh.gov.jo/English/Pages/Statistics.aspx>
- [3] Sarayanews. 03.11.2016. Khatar ealaa altariq alsahrawii lighiab alealamat al'irshadia (in Arabic). Available from Internet: <http://www.sarayanews.com/index.php?page=article&id=395285>
- [4] Suskov, S. I., Sergeev, A. S., "Eksperimental'noe sravnenie dvuh konstrukcij doroznyh odezd s primeneniem georesetok ustraivaemyh na sklonah lesovoznyh dorog v osnovanii kotoryh vodonasysnyj glinistyj grunt", Lesotekhnicheskij zhurnal, Vol.7, № 1 (25), pp. 126-136, 2017. (In Russian). http://lestehjournal.ru/sites/default/files/journal_pdf/118-126.pdf
- [5] Degtyar, A. A., Yushkov, B. S., "Usileniye slabogo gruntovogo osnovaniya avtomobil'noy dorogi", Transport. Transportnyye sooruzheniya. Ekologiya Vol.1, pp. 28-39, 2014. (In Russian).
- [6] Timofeyeva, L. M., Krasnov, Ye. S., "Sovremennyye metody usileniya slabokh osnovaniy avtomobil'nykh dorog", Mosti ta tuneli: teoriya, dosl'izhennyya, praktika, Vol.3, pp.217–220, 2012. (In Russian). <http://btrp.dit.edu.ua/article/view/26553/23949>
- [7] Hare, W., Lucet, Y., Rahman, F., "A mixed-integer linear programming model to optimize the vertical alignment considering blocks and sideslopes in road construction", European journal of operational research Vol.241, №3, pp.631-641, 2015. <http://www.sciencedirect.com/science/article/pii/S0377221714007127>
- [8] Setinc, M., Gradisar, M., Tomat, L. "Optimization of a highway project planning using a modified genetic algorithm", Optimization, Vol.64, №3, pp. 687-707, 2015.
- [9] Janssen, T., "Design and construction in existing contexts: Replacement of the first High Bridge Levensau", Vol.84, №3, pp.182-194, 2015.
- [10] Liyanage, C., Villalba, F., "Measuring Success of PPP Transport Projects: A Cross-Case Analysis of Toll Roads", Transport reviews, Vol. 35, №2, Special Issue: SI, pp.140-161, 2015.
- [11] Kundan Meshram, Mittal, S., K., Jain, P., K., Agarwal, P., K., "Application of Geotextile in Rural Roads Construction on BC Soil Subgrade", International Journal of Engineering and Innovative Technology (IJEIT), Vol.3, Issue 4, pp. 264-268, 2013.
- [12] Timofeyeva, L. M., Shepeteva, L. S., "O problemakh primeneniya geosinteticheskikh materialov v sovremennom transportnom stroitel'stve", Mosti ta tuneli: teoriya, dosl'izhennyya, praktika, Vol.3, pp. 221-224, 2012. (In Russian).