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A Review: Performance of geosynthetics

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Abstract: **Locally available material like Laterite, highly compressible clay, black cotton soils cannot be used in roads construction effectively and economically. Reinforcement is required to strengthen such kind of soils. Natural and artificial reinforcements can be used. The study consists of performance of geosynthetics. Various papers on different types of geosynthetics, its performance and life time are studied here. Natural fibres like Jute & coir and geosynthetics can be used effectively to reinforce the soil. It is concluded that research on biodegradable geosynthetics becomes necessary in current era.**

Keywords—Geosynthetics, Biodegadable Geosynthetics, California bearing ratio, Unconfined compressive strength

I. INTRODUCTION

Geosynthetics are synthetic products that are used to reinforce soil, to separate the soil layers, to provide drainage and also for filtration purpose. Geotextiles, geogrids, Geonet, Geomembrane, Geosynthetic clay liner, Geopipe, geofoam, Geocomposite are the different types of geosynthetics. Most geosynthetics are made from synthetic polymers of polypropylene, polyester, or polyethylene, which are all non-degradable polymers and are connected to environmental hazards.

II. REVIEW OF LITERATURE

Geosynthetic's reinforcement function is associated with three mechanisms in helping to attain better performance of unpaved roads. These mechanisms are ----increased bearing capacity, stressed membrane effect, lateral restraint. The reinforcement of natural geotextile with subgrade is an affordable way of constructing the unpaved road in weak subgrades. The environmental destruction will be minimal in the future by using jute and coir in the construction of unpaved roads.[1]

Jute is an effective geotextile material if it is installed properly. It is cost effective and environment friendly. Hill slope stabilization with Jute geotextiles achieved successfully at Sonapur land slide area, at Jorabani to Imphal road , Manipur, at Karimganj - Bangladesh road, Assam. Soil & nutrient loss reduction was found at CSWCRTI, Ooty, Tamil Nadu by using Jute Geotextiles.[2]

The values of unconfined compressive strength and California Bearing Ratio can be improved for highly compressible soils by using Geotextiles. Also it was proved that a single layer of geotextiles at centre will give better results than the geotextiles placed at different depth.[3]

A woven natural geotextile made of fibers of thorny bamboo gave tensile strength 2.38 times than required in case of manila hemp. Sediment flow is effectively reduced for the slopes covered using Bamboo fiber geotextiles.[4]

Waste expanded polystyrene (EPS) beads can reuse to form geofoam granules column (GGC). Swelling pressure in expansive soil is increased by 2.3 times irrespective of geofoam granules column diameter. [5]

Application of Jute Geotextiles over the sub-grade works as an excellent medium for drainage and improves California Bearing Ratio of the sub-grade. Thickness of the subgrade can be reduced by using reinforcement. Thus the design becomes economical as compared to conventional construction.[6]

Performance of Laterite soil and clayey soil can be improved by reinforced it with non-woven geotextile. California Bearing Ratio values is increased in unsoaked condition when compared with their CBR values without reinforcement which indicate that the soil samples reinforced with non-woven geotextile are suitable for subgrade as set by the Federal Ministry of Works General Specification (1997) criteria for subgrade soils. Best increase in strength of soil samples is found at one fourth height from the base surface in case of non woven geotextiles as reinforcement. [7]

Increment in CBR value and decrement in moisture content observed when Clayey, organic and lateritic soils reinforced with geotextiles when tested for CBR, drainage, penetration. Proper separation of layers can be ensured by use of Geotextiles.[8]

Strength properties of all black cotton soil and other poor soil can be increased to many fields by using geotextiles. [9] In this study the type of geotextiles used is not mentioned as well as the depth at which it was placed is not mentioned.

Highly compressible clayey soil can be making it suitable for construction of structures and also as sub grade for pavements by reinforcing it with geosynthetics. The maximum increase in peak stress is observed at a spacing of H/3, for Geotextiles, Geogrids, and Geocomposits reinforcements in clayey soil. The maximum increase in peak stress is obtained when geotextile-geogrid

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geocomposite was used as reinforcement. Use of geocomposites has shown the maximum increase in peak stress at all spacing.[10]

The use of the geosynthetic products can satisfy containment, filtration and reinforcement functions required in irrigation, drainage and agriculture applications, because while they protect and contain fresh water, they also impart a low carbon footprint solution compared to concrete, bitumen, soil admixtures and compacted fine grained soil.[11]

California Bearing Ratio in soaked condition can be improved by using Geogrids and that is influenced by plasticity and percentage fines. The field results obtained is higher than that of lab. However the stress-strain response is similar in laboratory as well as in field. [12]

With the same geosynthetic material and different product geometries, the geocell has a better confinement effect than geogrids, and the triaxial geogrid with a triangular aperture has a better confinement effect than the biaxial geogrid with a rectangular aperture. [13]

Jose Neves et al. demonstrated the implications of subgrade reinforcement with geosynthetics in road pavement design. In this study the materials were used as per Portuguese construction. A reduction in vertical strains and horizontal displacements was achieved due to the reinforcement used in subgrade. [14]

Improvement in rust resistance is found due to use of geosynthetic reinforcement by measuring rut depths at 36 months in both cases Geosynthetic reinforced and un reinforced flexible pavements at highway no.11 at Uttaradit Province, Thailand. [15]

Improvement in the performance of small group of geosynthetic reinforced granular piles (GRGPs) achieved in terms of load carrying capacity, settlement and modulus. The reinforcement at the top portion of the granular pile is found sufficient.[16]

The geosynthetics are non biodegradable material and harmful to environment so for further research and development in the field of biodegradable geotextiles is required. [17]

Here the physical properties of palm mat geotextiles in the laboratory investigated and observed vegetation growth in the Hobq Desert. Mat geotextiles have excellent water retention capacity and scouring resistance. Palm mat geotextiles significantly decreased the soil temperature and increased moisture in summer. The results showed that the palm mat geotextiles had the largest influence on soil temperature in the upper 5 cm of soil and the largest influence on soil moisture in the upper 10 cm of soil. Palm mat geotextiles are auspicious material for sand fixation in the Hobq Desert[18].

Geomembranes such as ALVATECH HDPE 1.5 mm have high chemical resistance, strong mechanical properties, and long-term service lives; also offers a carbon footprint rating that is three times lower than compacted clay. Even if we evaluate good quality clay and a borrow site just 16 km from the project site, HDPE geomembranes coming from 1000 km away still outperform compacted clay on a measure of carbon footprint[19].

Many Geosynthetics manufacturing companies' claims that up to 65% carbon can be saved by using geosynthetics as soil drainage compared to the traditional methods of drainage. 54% carbon savings for permeable pavement, 75% carbon savings in gravity retaining walls, up to 21% carbon savings in highway foundations, 74% carbon savings in highway fin drains, 57% carbon savings in Embankment starter layer can be done by using Geosynthetic materials as compared to the traditional methods [20].

III. METHODOLOGY USED

a) CBR Test:

California bearing ratio tests for different soil samples – laterite soil, organic soil and highly compressible clay performed with and without using any reinforcements according to IS : 2720 (Part 16) - 1987 Tests can be performed by using geotextiles, geogrids, geocomposites at different height and different conditions- soaked or unsoaked conditions.

b) Un Confined Compressive strength(UCC) Test:

Un Confined Compressive strength (UCC) Test are performed referring IS : 2720 (Part 16) – 1987. Soil sample should prepared as in the CBR test and compacted into Proctor mould. Then the test sample should take out by using sampling tube. Soil sample should test initially without reinforcement. Then Geotextiles introduced at various depths as in the CBR test.

IV. CONCLUSION

Carbon production can be reduced much by using geosynthetic materials in installation process or construction process as compared to the conventional methods.

Most of geosynthetics are made from synthetic (non-degradable) polymers of polypropylene, polyester, or polyethylene which involves environmental hazards. In its long term use, because of external environmental factors such as wind, water, friction, and UV radiation it may cause the collapse of synthetic polymers. These further results in the accumulation of micro plastics in the surrounding environment. The natural materials that are used in geotextiles are Jute and Coir. In Rajasthan production of Jute and coir is not common. Hence a new technology or material is required to design that can be usable as Geosynthetics without any harm to the natural land.

V. ABOUT THE AUTHOR

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