Environmental and Civil Prospects of Geotextile: A Review

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Abstract— Rapid progress in industrial textile is leading research and development to cater demand and production for its wide range of applications. Every textile product applied under the soil is a Geotextile. It is any permeable textile material used with foundation, soil, rock, earth, etc. Many applications are related with environment conservation. These are applied in non-textile industries. Continuous challenges posed by limitations of these materials ask for improve and innovate their products and processes. A comprehensive overview is taken in present paper on applications of geotextile for environmental restoration along with few civil aspects as these aspects are many times dependent upon environmental factors.

Keywords: Geotextile, Application, Soil Erosion, Environment, Civil

I. Introduction

Textile industry has many applications in various arenas of modern world leading to emergence of industrial textile. Invention of man-made fibers in 20th century changed industrial textile market worldwide. Every textile product applied under the soil is called as geotextile. Geosynthetic materials are today widely used in geotechnical and civil field. According to ASTM (2005), a geosynthetic is "a planar product manufactured from polymer used with soil, rock, earth or other geotechnical engineering. Thus the term cross references "geo" (earth related) and "synthetic" (man made) (Report of FEMA 2008). These materials are now days used in restoration and prevention of degraded environment and in natural resource management. Depending on the required function, they are used in open-mesh versions, such as a woven or, rarely, warp-knitted structure, or with a closed fabric surface, such as a non-woven (Agrawal 2011).

One of such product of Geotextile is geobag which seems to be preventive for soil erosion. The mode of operation of a geotextile in any application is defined by six discrete functions: separation, filtration, drainage, reinforcement, sealing and protection.

Depending on the application the geotextile performs one or more of these functions simultaneously. Geotextile fabric comes in three main forms such as Non-Woven Geotextiles, Woven Geotextiles, and Coir Geotextiles. Each of these materials has its own unique properties making it perfect for the various applications in which it is used. In addition each geotextile will typically feature a different weight or strength to help meet both light weight requirements and high strength applications. The non-woven geobag is made out of technical fabric that is inhale stitched from three sides and is opened from one side. It is designed to be filled with soil and is installed while in construction of marine and hydraulic structures. The geobags or nonwoven geotextile bags is a geosynthetic product that is made out of polyester, polypropylene or polyethylene is used for the protection of hydraulic structure and in river bank from severe erosion and scouring. Now a days, non-woven needle punched geobags are extensively used in an application of erosion control. Because erosion of soil due to flood is become a crucial problem near the embankment area of river.

Bergado and Soralump (2003) have studied application of geosynthetics in combination with gabions for soil erosion control at bend of Namkading river in Laos suggesting well functioning of geosynthetic application. According to Siddhartha (undated) considerable effort has gone into studying and controlling water erosion. On a problematic slope, geotextiles protect soil and seeds in the initial stages of vegetative growth.

According to Bhattacharya *et al.* (2008) Geotextiles create a stable, non-eroding environment and if constructed using indigenous materials, they could be effective, affordable and compatible with sustainable land management.

II. Environmental Applications

Environmental prevention and remedial applications of geosynthetics are related to erosion and run off control and avoiding seepage on land fill site and filtration in waste water treatment. Loss of surface soil is worldwide problem leading to reduced productivity of natural ecosystems such as agriculture and forests (Lal and Stewart, 1990). Pimental (2006) has reported relationship between soil erosion as food and environmental threat. Prevention of erosion is crucial to cater rising food problem in world. In this view geosynthetic application stands as reliable method along with traditional erosion control methods. Chaudhari (2013) has concluded that geotextile for soil erosion control should have permeability, resistance to abrasion and high resistance to UV rays primarily. He also in his case study in Malda (WB) India has studied application of jute geotextile for erosion control due to frequent floods of river Phulahar in region before it falls in Ganga. According to him based on several fiels trials geogrid technique had developed for landslide erodible slope treatment.

A. Water Resource Management

Bergado *et al* (2003) have demonstrated use of geosynthetics for erosion control and preservation of environment. They found that combination of gabion and mattresses of geotextile is good remedial measure.

B. Soil Erosion Control

Today soil erosion is severe problems worldwide with rate of 1.9 billion hectares per year which is leading risk of land degradation in developing as well as developed countries. 6 billion people depend upon 11% of land for food need (Report of University of Delware, 2009) indicating severity of erosion is unaffordable. Therefore conservation of soil with modern application is imperative. Traditional change in

cropping method and tillage pattern along with trenching and contour formation are seen to be less effective methods for specific time. Geotextile application is emerging now as effective tool to achieve sediment protection. Physical wear of soil by wind and water leads to erosion. Pollution of water is another direct effect of eroding soil. Dense algal growth in water in water bodies is due to sediment deposition.

C. Coastal Protection

Shorelines and harbours are protected with bags filled with locally available material since long back. Costal areas of many cities are under pressure due to various reasons erosion is one of the main of them. Artiers and Lostumbo (2010) have documented results of their project of shore line protection Svalbard near North pole. They found that instrumentation and monitoring was challenging. They used visual and electronic methods to assess stress related to ice impact and found suitable nature of geobadgs for protection of shoreline from ice action. Minimum replacement of geobags can be achieved through careful monitoring. They found that coastal protection requires more flexibility than armored rock. In same study they conclude that geobags can be solution where traditional methods for shoreline protection infrastructure is scarce or no available. Four types of material have been tested by same authors viz needle punched nonwovwn, woven, and composite needle punched nonwoven and found that filaments become loose but still connected to surface.

III. CIVIL APPLICATIONS

Any civil structure can wreck to havoc if soil below is unstable, hence protection is suggested before commencement of erecting structure. Geosynthetic materials can be applied in these structure as integral component of the system. They perform filtration and retention mechanism in roadways dam and canal systems. Geotextile filters are found to be suitable for such applications as alternative to traditional methods.

A. Road and Railway

Textiles were first applied to roadways in the days of the Pharaohs (Egyptian period). They found that natural fibers, fabrics or vegetation improved road quality when mixed with soils, particularly unstable soils. Reinforcement of soil mass with geotextile can serve as tensile strength where shear stress is generated. Road and railway tracks need rapid dewatering to avoid unstability and structural damage. According to Agrawal 2011 geotextile is emerging field in civil applications related to road and railway track construction. Geotextile material facilitate separation of sub base subgrade resulting in strength forming dense mass of fibre at interface of two layers.

B. Canal Lining

Poor construction and in adequate maintenance of channels or surface drainage system leads to erosion of its bank. It undermines these structures and also causes loss of productive land (Wall *et al*., 2003). In situ wash of the soil in drainage is to be avoided with the use of geotextile filters as alternative to traditional methods.

C. Dams Embankment and Reinforcement

Geotextile is applied as deeply burried filters in dam in France, Germany and South Africa. Geotextile filter installed at Valcross dam is found to be performing over 35 years. According to Crum (2008) geotextiles can used in variety of ways in dams and embankments.. Commonly riprap filters are used in upstream or in downstream trench. Tewari (1992) has described about the case study of geotextile in earthen dams. Erosion control of water retaining embankment e.g. earthen dams is one of the many problems faced by the civil engineers. Within the advent of synthetic geotextile, efforts have been put to use geotextiles as a filter layer in place of traditional granular filters.

IV. CONCLUSION

In present paper review of geotextile applications in various environmental and civil arenas in modern world is taken. It is concluded that it hsd wide applications today with rising research in geotextile as emerged branch of technical textile. From present review it is clear that now a day conservation of soil and water resources through civil applications coupled with geosynthetics is gaining immense importance in terms of reliability and economy. However more research is required on long term quality of such applications with permeability of material used to prepare geosynthetic material.

REFERENCES

[1] Agrawal B. J. (2011) Geotextile: it's application to civil engineering – overview proceeding of national conference on recent trends in engineering & technology at BVM Engg college VV Nagar Gujarat India pp 1-4.
[2] Artieres O. and Lostumbo J. (2010) Geosynthetics as ecofriendly defence against erosion in Arctic regions Geo 2010 Calgary Alberta USA
[3] Bergado D.T. and Soralump S. (2003) Geosynthetics for erosion control and preservation of environment International Symposium and Short Course on Soil/Ground Improvement and Geosynthetics in Waste Containment Structures, 2003, AIT, Thailand
[4] Bhattacharya *et al.* (2008) Effects of Palm-mat Geotextiles on the Conservation of Loamy Sand Soils in East Shropshire, UK, *Advances in Geo Ecology*, Catena Verlag, Reiskirchen, Germany ISBN 978-3-923381-56-2 pp 39.
[5] Chaudhari S.K. Geotextiles in Road Construction, Maintenance and Erosion Control, Roads: Geotextiles Road construction division Darbhanga Bihar India. pp. 88-98.
[6] Duglus Crum(2008) Geotextiles in dams: Forging federal guidelines Geosynthetics By: IFAI / Feature, Geotextiles, Specifications, Testing & Codes
[7] FEMA (Federal Emergency Management Agency) (2008) Report on Use of Geotextiles in Embankment Dam Construction and Rehabilitation Association of State Dam Safety Officials, Bureau of Reclamation, Natural Resources Conservation Service, and U.S. Army Corps of Engineers.

[8] Lal R and Stewart B.A. (1990) Soil erosion and land degradation: The global risk, *Soil Degradation*, Springer-Verlag Newyork. pp 129-172.
[9] Pimental D (2006) Soil erosion: A food and Environmental threat, Environment development and sustainability Springer pp 119-133.
[10] Tewari AB (1992) Geotextiles in Earthen Dams: Case Study, P 29-34.
[11] Wall G. *et al.* (2003) Soil erosion causes and effects, Ontario Institute of Pedology Ontario Canada. pp 1-6.

