Geotextile As Filter Media for Artificial Groundwater Recharge- A Review

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Abstract— Groundwater is the water which is found beneath the ground surface at a certain depth which moves slowly through geologic formations of soil, sand and rocks known as aquifers. Due to its quality, indiscriminate exploitation of groundwater has taken place which has resulted in depletion of groundwater sources. Currently, conventional artificial filters including aggregates (coarse and fine) with coarser one at the bottom and fines at the top which are properly arranged in layers are mostly used in recharge wells for filtration of groundwater. Clogging of these filters takes place after certain amount of time depending on quality of runoff. Due to this, discharge rate is decreased and it is finally choked down. As a result, timely maintenance is required which is not very easy. To overcome this, geotextiles can be used as a filter for recharge of groundwater. Geotextiles are the porous textiles which are used as drainage and filtration applications. These can be used as a filter media for groundwater recharge to increase the discharge rate and for filtration of water due to its features like controlled properties, rapid installation and easy maintenance.

Keywords: *Groundwater, Artificial recharge, Filtration, Geotextile.*

I. INTRODUCTION

Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It moves slowly through geologic formations of soil, sand and rocks which are called aquifers and is stored within it. Groundwater as a source of water supply has great advantages over surface water sources such as streams, rivers, or lakes. Due to the long retention time under the ground surface, groundwater is generally hygienically safe for drinking, domestic use and storage purpose.It has become the major source of providing water to different sectors in India on account of its occurrence, availability and reliability. These quality parameters have led to its indiscriminate exploitation in some parts with due regard to its recharge. This has resulted in the considerable amount of depletion of groundwater in some areas causing long term sustainability. Artificial recharge of groundwater through experimentally designed structures has been proven as a workable option for augmentation of groundwater resources. It also helps in proper utilization of surplus runoff which otherwise is wasted. Related to drinking water supply, the principal reason is usually to enhance the groundwater quality through filtration and treatment. Other reasons for recharge of water artificially include the control of ingress of saltwater, the augmentation of low river flows, reducing surface runoff and soil erosion, absorption of floodwaters to reduce their destructive capacity and the control of subsidence.

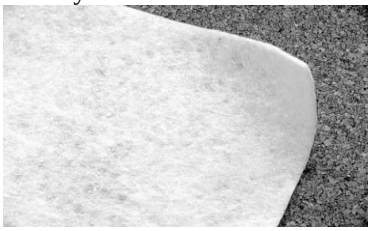
II. NEED

- To meet our water demands by enhancing its quantity and quality.
- To enhance the augmentation of natural moving surface water into ground water reservoir through advanced construction techniques.
- To hold decline in levels of ground water.
- To increase the ground water availability at particular place and time and simultaneously utilize it for sustainable development.
- To enhance the infiltration rate of rain water in the subsoil this has decreased in a drastic manner in urban areas due to paving of open area.
- To improve quality of ground water by dilution.
- To increase the production of agriculture.
- To improve ecology of the area by increase in vegetation cover and green area.

III. GEOTEXTILES AS FILTERS

Geotextiles are poros textiles, a class of geosynthetics, polymeric materials used in various infrastructure projects due to features such as self-restrained properties, rapid installation, and volumetric compactness (Koerner and Soong, 1995). These synthetic fibers are composed of: (polypropylene, polyethylene or polyester), thickness (denier) and length (filaments or short staples). The main charaterstic that controls engineering behavior is the composition of fibers from the manufacturing process.

Geotextiles are commonly used in erosion control and drainage applications. Some of the applications include slopes, dam embankments, shorelines shielded with rip rap, flexible block mats and concrete filled fabric formed systems. In all these applications, geotextiles are used for retention of soil particles while allowing fluid to pass freely. But the fact is that, primary purpose of using geotextiles is filtration for which they are widely used.



IV. GEOTEXTILE FILTER REQUIREMENTS

- Retention: It is to be ensured that geotextile openings or pores are small enough to prevent excessive movement of soil particles.
- Permeability: It is to be ensured that geotextile is permeable enough to allow liquids to pass through it without causing much pressure buildup at the upstream.
- Anti-clogging: It is to be ensured that geotextile has adequate openings, preventing trapped soil from causing clogging of the openings and thus affecting permeability.
- Survivability: It is to be ensures that geotextile is strong enough to resist the damage during installation and filtration process.
- Durability: It is to be ensured that geotextile is resistant to chemical, biological and ultraviolet (UV) light exposure throughout the design life of the project.

V. ADVANTAGES OF GEOTEXTILES

- These are flexible in nature.
- They have good filtration characteristics.
- Water permeability is high.
- Good durability
- Highly resistive to different climatic conditions.
- Highly resistive to chemical and biological attack.
- Time saving and cost effective construction.
- Environment friendly material.

VI. MECHANISM OF FILTRATION

A filter should prevent excessive movement of soil particles, and at the same time allowing fluid to flow freely through the filter layer. Therefore, it is summarized by following requirements:

- The filter should retain soil, considering that the size of filter pores or openings should be less than a stated maximum value.
- The filter should be permeable enough to maintain a relatively free flow through it, considering that the size of filter pores and number of openings should be larger than a stated minimum value.
- To keep a stable soil structure by building up a natural filter.
- To maintain adequate permeability in the geotextile throughout the lifetime of its application.

VII. CONCEPT OF NATURAL FILTER/BRIDGING

The opening/pores size of an efficient geotextile should be small enough to retain bigger soil particles to prevent soil erosion. It is generally acceptable that a certain percentage of the soil particles is smaller than the biggest size of openings in the geotextile, and that loss of the smallest soil particles will occur. However, after a period of time due to the formation of a natural filter, this will stop. A natural filter is a granular layer from which the finer fraction of particles are washed out and then the remaining coarser fraction will operate as a filter medium for the subsoil. This is also known as a bridging network of particles. The geotextile functions as a catalyst: It encourages equilibrium between particles after the restricted washout of finer particles by generating a self-filtration zone (bridging) at the interface.

VIII. EXPECTED OUTCOME

One of the major causes of choking of filter media is clogging for which regular cleaning and maintenance is required. Alternate methods of artificial recharge should be inducted for replenishment of groundwater sources. Geotextile as filter media can be used to enhance the rate of discharge and water quality parameters and resistance time of clogging shall be increased. It is also expected that maintenance of this filter media is comparatively easy than currently induced filter media.

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