A Study on the Treatment of Domestic Wastewater using Geo-textiles as a Filter Media.

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ABSTRACT

The emphasis of this paper is on the filtration efficiency of geotextiles. As we know treatment (operation) of wastewater has become an absolute prerequisite. An inventive, inexpensive and effective method of purifying and cleaning wastewater before discharging into any other water systems is to be compelled. Coagulation-flocculation is a chemical water treatment approach typically applied prior to sedimentation and filtration to intensify the ability of a treatment process to remove particles. Filtration is considered the most important solid-liquid detachment / separation process in water treatment, as well as in wastewater treatment. As a matter of fact, Geotextiles in general are textiles in the traditional sense, but they contain synthetic fibers more of less than natural fibers like silk, cotton or wool hence, biodegradation is not a problem. These synthetic fibers are made into flexible, porous fabrics by standard weaving machinery or are matted together in a random non-woven manner [2]. Proper choice of geotextile filters plays a crucial role in achieving satisfactory filtration performance [2]. In this research non-woven geotextile fabrics of 100,150,200 & 300 GSM were used for the treatment of domestic wastewater. The laboratory portion of the study included a column test with alternating layers of filter media consisting of sand, gravel, pebbles and charcoal. Non-woven geotextile were sandwiched within the filter media. Geotextiles were placed at the upper, middle and bottom layer. The various study parameters include pH, TSS, BOD, Hardness & Turbidity. The porosity of the geotextile material played an important role in filtration process, it was clearly observed that as the pore size decreased the filtration efficiency increased.

Keywords: wastewater, coagulation-flocculation, geotextile, suspended particles, porous.

INTRODUCTION

Wastewater emerges from both industrial and domestic activities and their Treatment, Management and Reuse are one of the key subjects of the day that demands high technical know-how, energy and infrastructure to attain a better treatment goal. [4] Industrially rejected water is specific to the nature of industry and hence the nature of treatment adopted might be idiosyncratic (unique) but domestic wastewater or sewerage is consistent in identity. As known, there are a lot of known and unknown impurities in wastewater that has to be effectively removed to get preferably premium quality treated water. Contaminant removal technologies take up a central role in the primary treatment process of any wastewater treatment [3]. With an efficient & effective contaminant removal system, most of the parameters in the wastewater could be cracked. Effective wastewater treatment is very much essential to protect both human and environmental health, regardless of the size of the community. Potential contaminants in domestic wastewater include disease-causing bacteria, infectious viruses, household chemicals and excess nutrients such as ammonia, along with the more traditional suspended solids and biochemical oxygen demand [1]. Utilization of geotextiles in the treatment of domestic wastewater shall be considered as an inventive, inexpensive and effective method of purifying and cleaning wastewater before discharging into any other water systems. Geotextiles in general are textiles in the traditional sense, but they contain synthetic fibers more of less than natural fibers like silk, cotton or wool hence, biodegradation and subsequent short lifetime is not a problem. These synthetic fibers are made into flexible, porous fabrics by standard weaving machinery or are matted together in a random non-woven manner [1]. Proper choice of geotextile filters plays a crucial role in achieving satisfactory filtration performance.

OBJECTIVES THE STUDY

- The main objective of this project is treatment of domestic waste water by using geotextiles in the filter media.
- To characterize the various Physio-chemical characteristics parameter for the domestic waste to be treated.
- Reducing the pH, Alkalinity, Acidity, Turbidity, Hardness, BOD and TDS of the domestic waste water by using geotextile as a filter media
- Finding out the percentage of effectiveness in the impurity removal using geotextile as a filter media.

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MATERIALS AND METHODOLOGY

Wastewater: domestic waste water is the waste water carrying human wastes including kitchen, bath & other wastes from residences, buildings, industrial establishments or other places. For this experimental programme, waste water samples were collected from a waste water treatment plant close to the college campus through grab sampling technique. The initially collected waste water was tested for its characteristics & the following results were obtained.

Geotextiles: Geotextile is a produced fabric made out of various polymer mixes and it has a permeable or penetrable character that grips or holds the suspended solids. Geotextile has a capacity to extended life time of intermediate sand filter by inability the accumulation of surface of it and also reliability and performance of traditional graded soil filter and easy to construct. These fabrics are broadly defined as sheet or web structure bonded together by entangling fiber or filaments (and by perforating films) mechanically, thermally or chemically. Four non-woven geotextiles (100GSM 120GSM, 200GSM and 300GSM) of varying properties were used in the study. Different combinations of these geotextiles were employed in the research work for filtration analysis to evaluate the efficiency of geotextile filters. They are flat or tufted porous sheets that are made directly from separate fibers, molten plastic or plastic film. [2]

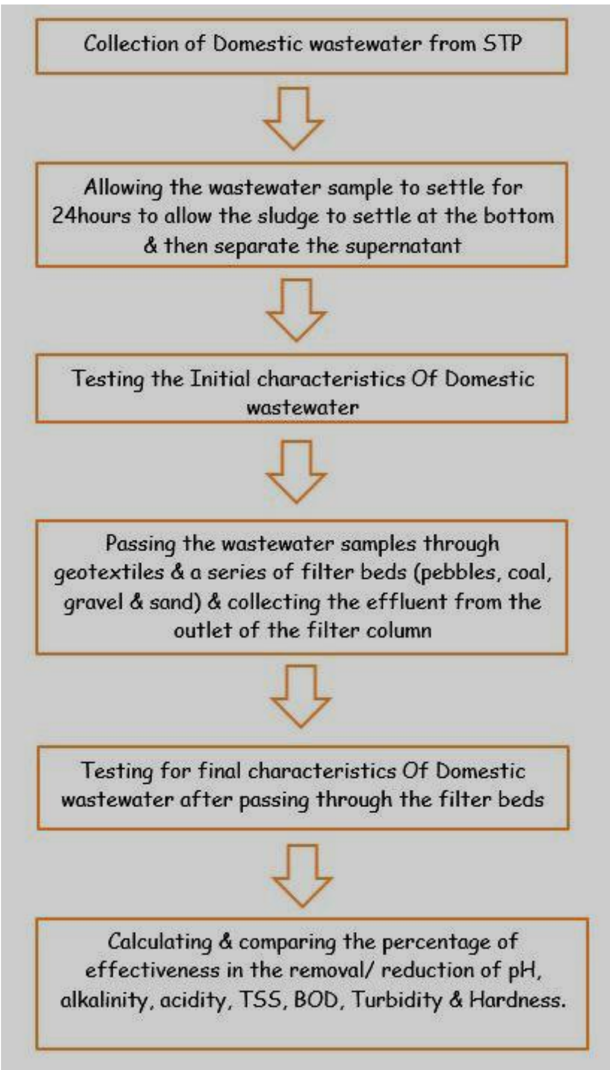
GRAVEL: Gravel is a loose aggregation of rock fragments. Gravel arises naturally throughout the world as a result of sedimentary and erosive geologic approaches; it is also produced in abundant quantities commercially as crushed stone. It should be – hard, durable, free from impurities, properly rounded and have a density of about 1600kg. It grips the sand and permits the filtered water to move freely through the underdrains. It also permits the wash water to move upward uniformly on sand. The gravel is placed in 5 to 6 layers having finest size on top. Surface texture plays a vital role in developing the bond between an aggregate particle and a cementing material.

SAND: Crushed rock is the best type of filtration sand since it has less chance of being contaminated with pathogens or organic material. Grains of sand are rounded and uniform in size. It is a loose granular substance, typically pale yellowish brown, resulting from the erosion silica and other rocks and forming major constituents of beaches riverbeds, seabed, deserts. Obtained from hard rock such as –Quartzite, Basalt, etc it free from –clay and organic matter uniform size and nature hard and resistant. If placed in HCL for 24 hr, it should not lose more than 5%of its weight.

PEBBLES: A pebble is a small, hard and smooth, round stone which is found on beaches and at the bottom of rivers. Pebbles are generally considered larger than granules, less than 20 millimeters diameter. Pebble tools are among the earliest known man-made artifacts, dating from the Paleolithic period of human history.

COAL: coal is agreeable product for carbon filtration because it is readily activated and has inflated availability. There are three different types of coal that can be employed for filtration: anthracite, bituminous or lignite. Of these, bituminous coal is the ideal/best choice due to its higher microporosity, its resistance to impact, its strength and the ease with which it is regenerated. It is commonly referred to as “black coal” and contains the same substance as of asphalt. Adsorption is the most important part for filtration in activated carbon. As water spreads out over the surface area of the rigid block, the dissolved solids within it are captivated to the surface of the carbon and remain while the water continues onward. Additional filtration comes from the size and volume of the pores themselves.

METHODOLOGY



EXPERIMENTAL SETUP OF FILTER BED

A square column was fabricated using flexi glass with an internal diameter of 8cm and 50cm length. The column was provided with 1 outlet port made out of brass at a distance of 3cm from the bottom in order to collect the effluent sample. A glass plate with 6mm perforations was provided at a distance of 8cm from the bottom so that the water trickles down with uniform distribution. Pebbles, Gravel, Coal, River sand & geotextiles (100,120,200 & 300 GSM) were used in the filter media. Each layer of filter media was 8cm thick. The arrangement of the filter media was done based on the size of the particles, (coarser particles on the bottom) the figure below shows the fabrication details of the column setup. The wastewater was allowed to flow through the column by gravity with uniform distribution over the filter bed layers & later the samples were collected & analyzed for various parameters as listed above.

Figure 01- filter column setup

RESULTS & DISCUSSIONS

The water sample immediately was tested for its initial characterization and the following results were obtained

Parameters	Value obtained
pH	7.94
Alkalinity in mg/l	305.63
Acidity in mg/l	100.10
Turbidity in NTU	653
Hardness in mg/l	464
Solids in mg/l	593
BOD in mg/l	89.12

Table 01- initial characteristics of waste water sample

Variation in pH

Fabric size in GSM	pH
120	7.41
150	7.35
200	7.22
300	7.20

Table 02- results for variation in pH

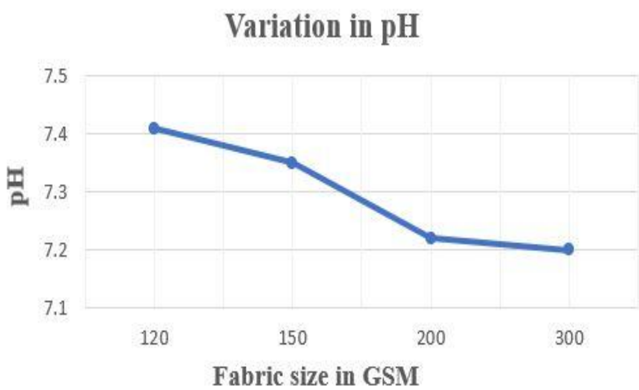


Figure 02- Variation in pH

Variation in Alkalinity

Fabric size in GSM	Alkalinity in mg/L
120	209
150	206.19
200	200.93
300	182

Table 03- results for variation in Alkalinity

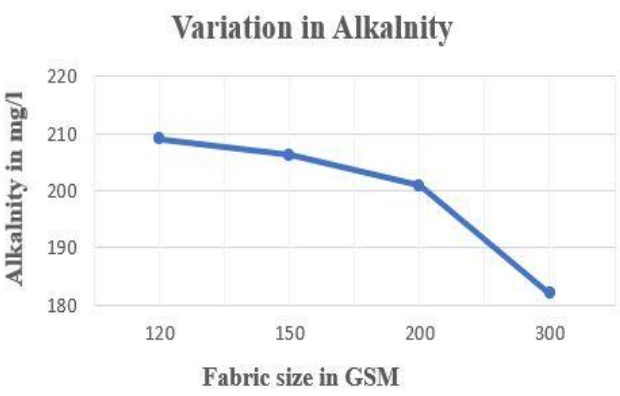


Figure 03- variation in Alkalinity

Variation in Acidity

Fabric size in GSM	Acidity in mg/L
120	98.74
150	94.00
200	91.00
300	83.00

Table 04- results for variation in Acidity

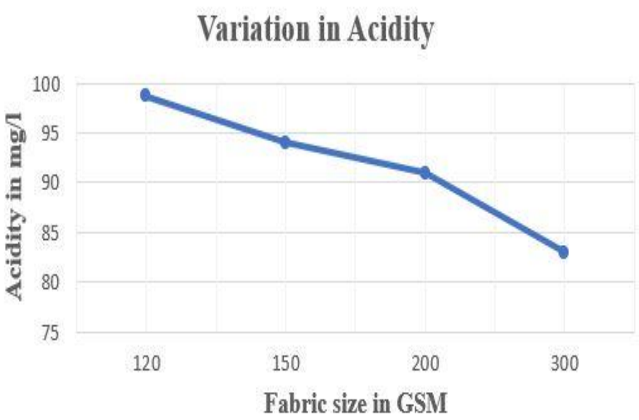


Figure 04- variation in Acidity

Variation in Hardness

Fabric size in GSM	Hardness in mg/L
120	445
150	398
200	364.12
300	317.69

Table 05- results for variation in Hardness

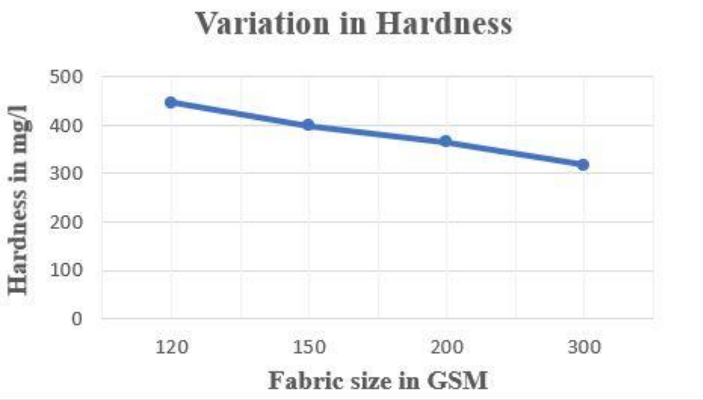


Figure 05 – variation in Hardness

Variation in Turbidity

Fabric size in GSM	Turbidity in NTU
120	641
150	624
200	235
300	175

Table 06- results for variation in Turbidity

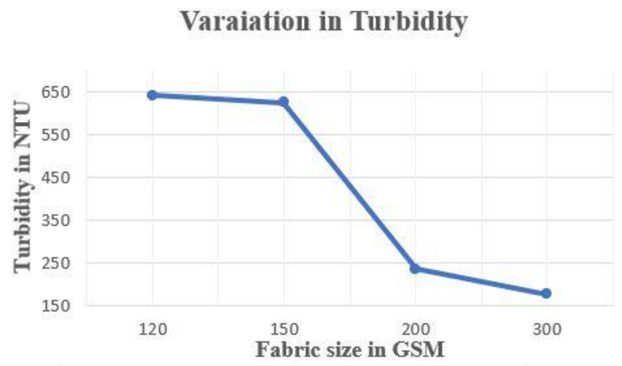


Figure 06 – variation in Turbidity

Variation in BOD

Fabric size in GSM	BOD in mg/L
120	78.4
150	76.7
200	75.4
300	70.16

Table 07- results for variation in BOD

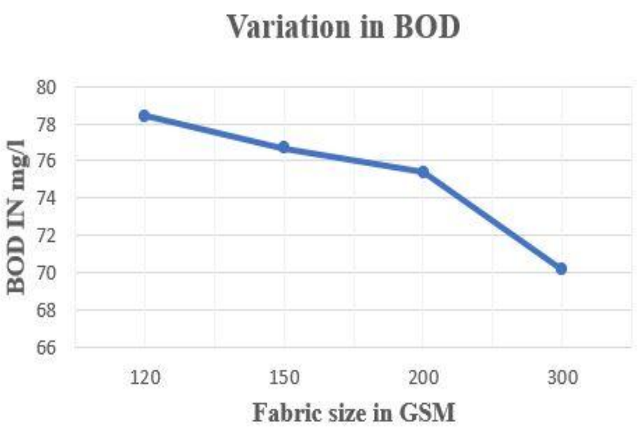


Figure 07 – variation in BOD

Variation in Solids

Fabric size in GSM	Solids in mg/L
120	523
150	220
200	163
300	159

Table 08- results for variation in solids

Figure 08- variation in solids

CONCLUSION

From the literature as discussed above, it is observed that less work is carried out on filtration of domestic wastewater using geotextile filter. Use of geotextiles has been found very effective solution in the treatment of wastewater. Geotextiles provide more strength, flexibility, durability and controlled degradation compared to sand filters. As geotextiles consist of synthetic fibers, bio degradation is not a problem. Geotextile filters improve the reliability and performance of traditional graded soil filters and are easier to construct. The low thickness of geotextile, as compared to their natural soil counterparts, is an advantage in so far as light weight on the subgrade, less airspace used, and avoidance of quarried sand, gravel, and clay soil materials. The ease of geotextiles installation is significant in comparison to thick soil layers (sands, gravels, or clays)

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