Geotextile Baffle Wall Contact System (GBCS) For The Treatment Of Wastewater

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Abstract- *The emphasis of this paper is on the filtration performance of Jute geotextiles. As we know treatment of wastewater has become an absolute necessity. An innovative cheap and effective method of purifying and cleaning wastewater before discharging into any other water systems is needed. The aim of this work is to investigate the feasibility of Jute Geotextile as Biofilm attachment media in the treatment of Wastewater for the removal of various pollutants. The removal of Chemical Oxygen Demand (COD), Biological Oxygen Demand, Total Dissolved Solids, and chlorides, sulphates and oil & grease will be monitored for different Hydraulic Retention Time through the performance of aerated GBCS.*

Keywords- Filtration, Geotextile, wastewater.

I. INTRODUCTION

Wastewater is liquid waste discharged by domestic residences, commercial properties, industry, agriculture, which contains contaminants that result from the mixing of wastewater from different sources. Wastewater from various sources need to be treated very effectively in order to create a hygienic environment. Most commonly used traditional methods encompass with various problems like secondary pollution, cost intensiveness etc. The principal objective of wastewater treatment is generally to allow Municipal and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment.

The wastewater must be treated for SS before being disposed of into surface water sources. When untreated wastewater is disposed of into a surface water stream, high concentrations of suspended solids can cause many problems for stream health and aquatic life, and subsequently the water body may lose its ability to support a diversity of aquatic life. SS absorb heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen (DO). Also, due to the high organic character of the suspended solids in wastewater, they consume the DO present in the surface water when it is disposed directly without prior treatment. This results in polluting the fresh surface water sources. The SS can also destroy fish habitat because they settle to the bottom and eventually blanket the riverbed. Hence, an adequate treatment of wastewater for suspended solids is necessary to ensure that their disposal may not affect the health of the surface waters.

The use of geotextiles in suspended solids removal from wastewater could have a far reaching impact on the design of wastewater treatment facilities. It is expected that use of this technology could reduce the cost of overall projects, modifying the wastewater treatment process, and resulting in designing of better and efficient wastewater treatment systems.

This project introduces an innovative technology for treating waste water successfully using jute geotextile material. Use of geotextile baffles as biofilm attachment media for wastewater treatment has been carried out in the present study.

II. MATERIAL

A. Geotextile :

Geotextiles are permeable fabrics made from polypropylene, polyester or coir like fibrous materials.

Geotextile composites have been introduced and products such as geogrids and meshes have been developed. Geotextiles are planar sheets which may be available in structures woven, non-woven or knitted which are relatively thick. They are capable of transmitting fluids across or in-Plane or both but can retain suspended particles. Woven geotextiles are manufactured by interlacing fiber usually at right angles. While the non-woven type by mechanical, heat or chemical bonding of directional or randomly oriented fibers. Benefits of geotextile in geotechnical and environmental engineering design are well pronounced. This study presents applicability of geotextile made of Jute fibers in Environmental Engineering.

Geotextiles can fulfill the following functions when in contact with water, soil and/or stone:

Separation*:* The geotextile, to a great extent, separates layers of different grain sizes.

Filtration*:* The geotextile retains some particles and allows others to pass through.

Reinforcing*:* The geotextile increases the stability of the soil body.

Drainage*:* The geotextile itself functions as a drain because it has a higher water transporting capacity than the surrounding materials.

Jute geotextile

Jute Geotextile is a natural geosynthetics made out of Jute fibres. Jute is a low cost, renewable, biodegradable and eco friendly natural product. Jute was tried long back as field experiments before the concept of geosynthetics was thought of, jute was applied in a road at Dundee in Scotland in 1920, on strand Road at Kolkata, India in 1934 by Bengal PWD and in a road in Myanmar during World War II was reportedly successful.

Jute is a natural lingo-cellulosic bast fibre. Bast refers to a group of strong, woody fibers, such as flax, hemp, or jute, obtained from phloem tissue which are used in the manufacture of woven goods and cordage. Jute is highly hygroscopic and can absorb water up to about 5 times its own dry weight. This property introduces in jute an element of variance in weight under different relative humidity. Jute is a very good insulator of heat and electricity. This property also varies with the change in moisture content. The strand of jute fibre consists of numerous individual filaments, which form a meshy structure. These fibres have varying length, fineness, strength, extensibility, tenacity, stiffness and toughness. The matured jute plant with a height of about three meter is cut and sun dried in the field. The plants with shaded leaves are tied in bundles and immersed in mild flow water for about two weeks for retting. The fibres are extracted from the plant, washed in clean water and sun dried to make it ready for use. The constituents of jute fibre are mainly Cellulose, Hemicellulose and Lignin.

Jute geotextile is having some of the advantages over synthetic geotextiles such as it is much cheaper than synthetic fibre, it is easy to blend with other natural material and synthetic fibres, it is environmental friendly, design biodegradable , hydrophobic , anionic and easily available material. Initially it has got the high strength and non hazardous properties. It is also a renewable source of energy as natural biomass.

Jute Geotextile

Constitients	Percentage
Cellulose	60-62
Hemi Cellulose	22-24
Lignin	12-14
Others (Wax, Ash, Nitrogen etc.)	1-2

Table : Compositions of Jute Fibre

III. METHODOLOGY

Geotextile Baffle Wall Contact System (GBCS)

Geotextile baffle wall contact system utilizes biomass bearing character of geotextile. In this system geotextile material is used as bio filters. Unlike the normal bio filter setup here geotextiles are set as baffles .This baffle arrangement of geotextile made the GBCS system to dominate over normal bio filters especially trickling filter.

The geotextile baffle method may be appropriate for small wastewater treatment plants having difficulty in consistently meeting discharge standards. Such facilities generally have limited surface space, available hydraulic head, operator effort and sludge handling capacity.

The GBCS could be retrofitted in an existing facility as a solution to the following issues:

- To complete treatment at plants not producing effluent meeting discharge standard.
- Seasonal low flow period “polishing” of secondary effluent to reduce BOD ultimate and ammonia and remove nutrients by denitrification.

- Secondary treatment in rural areas after primary clarification in lagoons.

- Pretreatment for a septic system or a rapid infiltration system.

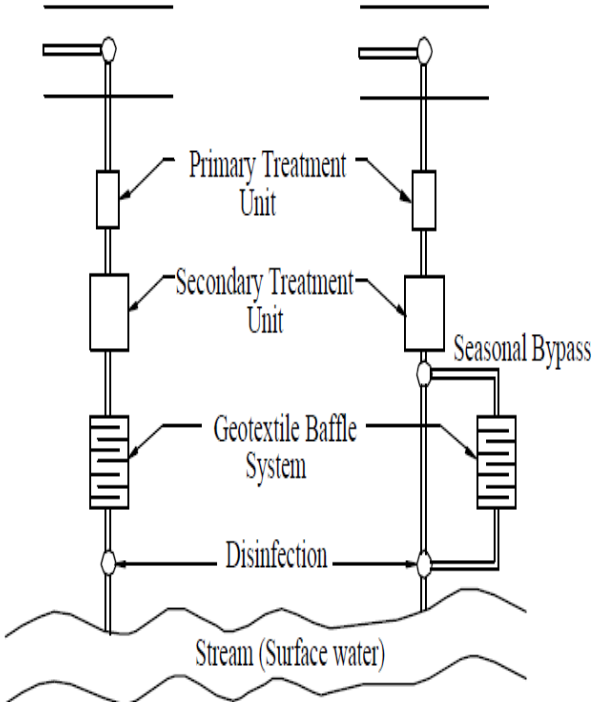

Fig1 Installation

Advantages of GBCS :

- GBCS brings suspended and attached growth treatment mechanisms together.
- Most of the geotextiles have more than 90% porosity. This doubles the gravel porosity used in trickling filters.
- There is no large land requirement for GBCS.
- GBCS sustains constant removal efficiencies.
- GBCS does not cause a high level of odour.
- Baffles help gravity settling

IV. EXPERIMENTAL WORK

- Sample Collection. (Primary effluent from sewage treatment plant, PCMC)

- The characteristics such as BOD, COD, pH, TDS etc of wastewater were analysed according to standard methods. The characteristics are shown in Table I.

- The rectangular reactor was used for the study. Rectangular tank is fitted with U shaped aluminium channels as to hold the baffles.

- Baffles are made and filled in aluminum channels of constant width so centre to centre distance between baffles is maintained.

- Influent was added to the system by means of gravity.

- In each experiment influent was admitted in the tank by gravity then reduction in various parameters COD, BOD.TDS, Ammonia nitrogen and Turbidity was monitored.

V. EXPERIMENTAL SET UP

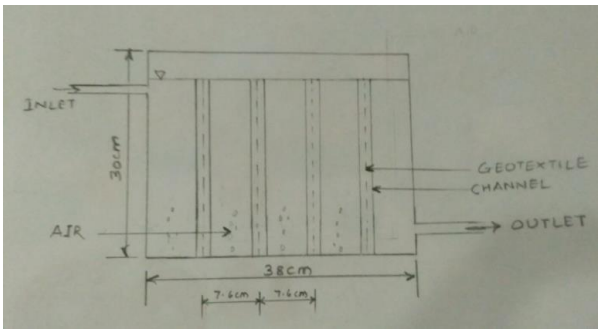

Fig.2 Cross section of GBCS (Spacing 7.6cm)

- Experimental Set Up: As shown in Fig.2 the 25 L rectangular reactor was 38cm wide, 30cm high, and 22cm long. Rectangular tank was fitted with ‘U’ shaped aluminium channels in order to achieve proper fitting of the baffles. Width of each ‘U’ shaped channel is 0.6cm.

- Jute geotextile obtained was in large mats. They were cut into rectangles of dimensions 22cm x 30 cm. The system was aerated with simple fish tank aerators. 2.5W air pump was used to admit in the system supplying 750cc/min air.

- Fig.2 shows the cross-section of GBCS with baffle spacing 7.6cm and also the efficiency of GBCS was tested with baffle spacing 6.5cm as shown in fig.3.

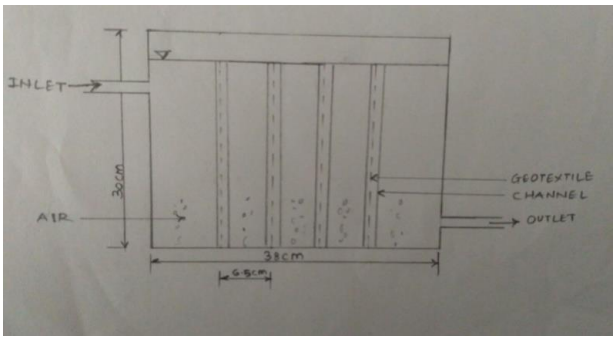

Fig.3 Cross section of GBCS (Spacing 6.5cm)

VI. RESULTS & DISCUSSION

GBCS was tested for following experimental conditions:

- With the use of 2layers of jute in baffles
- With the use of 4layers of jute in baffles
- With the decrease in baffle spacing

Table 1 : Case I – With 2layers of Baffles

Sr.no	Parameters	Unit	Value	After filtration		
				30 min	60 min	90 min
1	pH		6.89	6.89	6.92	7.1
2	TDS	Mg/lit	267	260.2	251.2	242
3	TSS	Mg/lit	492	485.6	430	390
4	Chlorides	Mg/lit	52.2	49	45.1	39
5	Sulphates	Mg/lit	130	124.2	89	81
6	O&G	Mg/lit	15	12	11	9
7	COD	Mg/lit	522	517	451	442
8	BOD @ 3days	Mg/lit	290	286	212	190

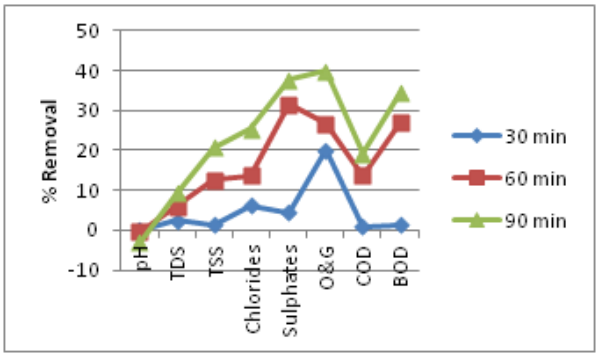

Fig.4 % Removal with change in HRT (for 2layers)

Table 2 : Case II – With 4layers of Baffles

Sr.no	Parameters	Unit	Value	After filtration		
				30 min	60 min	90 min
1	pH		6.98	6.98	7.1	7.1
2	TDS	Mg/lit	172.1	161.2	131	112.5
3	TSS	Mg/lit	151	120	110	45
4	Chlorides	Mg/lit	60	52.3	33.5	22
5	Sulphates	Mg/lit	80.5	70	40.1	30
6	O&G	Mg/lit	10	5	4.2	3
7	COD	Mg/lit	424	350	260	220
8	BOD @ 3days	Mg/lit	120	50	32	25

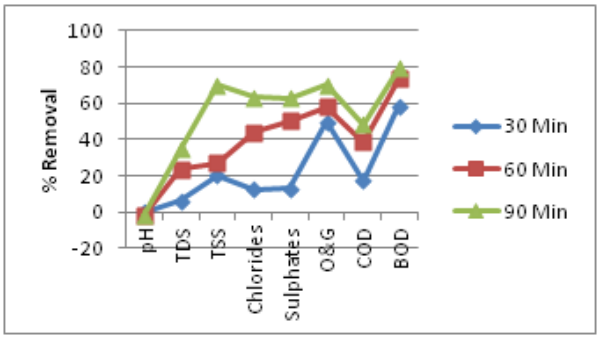

Fig.5 % Removal with change in HRT (for 4layers)

Table 3 : Case III – With change in Baffle spacing

Sr.no	Parameters	Unit	Value	After filtration		
				30 min	60 min	90 min
1	pH		6.89	6.89	6.94	7.1
2	TDS	Mg/lit	320.2	301.1	286	175
3	TSS	Mg/lit	162	145	61	42
4	Chlorides	Mg/lit	36.2	30	24.88	17.2
5	Sulphates	Mg/lit	90.5	72.5	59.27	35.2
6	O&G	Mg/lit	15	12	9	5
7	COD	Mg/lit	488	414	225	205
8	BOD @ 3days	Mg/lit	155	137	28	20

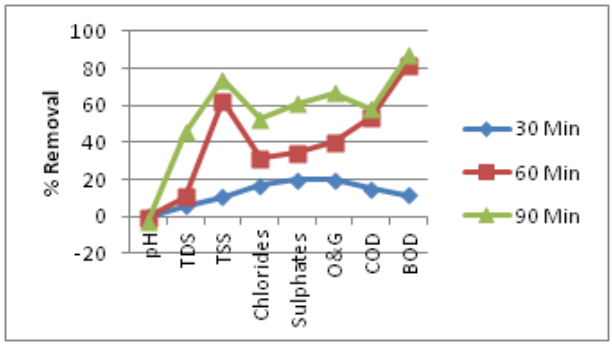

Fig.6 % Removal for change in baffle spacing

Fig.4, 5 and 6 shows the percentage removal of wastewater parameters with respect to change in hydraulic retention time for different experimental conditions. It is observed that as the HRT goes on increasing the efficiency of system increases.

Based on the performance obtained from experiments, the GBCS reactor considered as a feasible reactor for treating waste water.

Filter media used in GBCS is woven jute geotextiles which are cheap, easy to available, biodegradable. So it can be considered as an effective material to use as bio filter media.

GBCS reactor performance is affected with material characters, baffle spacing, aeration availability.

Specific weight of material increases, system performance gets increased.

GBCS needs good aeration system for better performance.

This technique will be suitable for treating low flow wastes and low strength wastes. This technique can be used for treating waste generated from less populated towns. Also, particular industries can embrace this technique in treating their wastes, before they dispose off into surface waters. This method can also be used to treat effluents from natural systems, e.g., aerobic stabilization ponds, which are rich in SS concentrations due to algae growth.

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