Root Zone Technology

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***Abstract*- Increasing urbanization and human activities exploits and affect the quality and quantity of water resources. This has resulted in pollution of fresh water bodies due to increased generation of domestic waste, sewage, industrial waste etc. this research re views the Root Zone Treatment System (RZTS) which are planted filter beds consisting of soil. The technology uses a natural way to effectively treat domestic and industrial effluents. RZTS are well known in temperate climates and are easy to operate having less installation, low maintenance and operational costs and incorporates the self-regulating dynamics of an artificial soil eco-system. Use of constructed wetlands can now be recognized as an accepted low cost eco-technology, especially beneficial as compared to costly conventional treatment systems. There is a need to exploit this technology in a developing country like India to its maximum to gain its benefits and for sustainable development.**

Our study investigated the effectiveness and feasibility forb the horizontal flow constructed wetland root zone unit from which samples of wastewater are collected at the inlet and outlet of root zone system dated from March 2017 to June 2017. Some physiochemical parameter namely dissolved oxygen (DO), bio-chemical oxygen demand (BOD) ,chemical oxygen demand (COD), turbidity and pH were analysed using standard methods. the results obtained indicated that the root zone technology works effectively in reducing

100% pollutants to 60% which directly can used to washing clothes, fishing, swimming, irrigation etc. thus the remains of 60% can be moderately cleansed up using modern practices installed which could prevent it from normal functioning duration and operation which could minimize the expenditure prevailing.

Index terms- bio-filter, reed bed, wetland

INTRODUCTION

Environment pollution is one of the serious problems that the world is facing in this era. In India, major problem leading to environment pollution is increasing pollution, industrialization and urbanisation collection, treatment and disposal of industrial and domestic waste water are the serious issues to be handled for preventing damage to the environment. A 2007 study finds that discharge of untreated sewage is single most important cause for pollution of s surface and ground water in India. There is a large gap between generation and treatment of domestic wastewater. There is lack sufficient treatment capacity and also the existing sewage treatment plants are not operated properly and maintained in good running condition. The wastewater generated in these areas normally percolates in the soil or evaporates. The uncollected waste accumulates in the urban areas cause unhygienic conditions and release pollutants that leach to surface and ground water.

The term root zone encompasses the life interactions various species of bacteria, the root of the wetland plans, soil, air, sun and of course e water. Root zone treatment is one of the natural and attractive methods of treating domestic, industrial and agricultural wastes. It is an engineered method of purifying wastewater as it passes through artificially constructed wetland area. It is considered as an effective and reliable secondary and tertiary treatment method.

Root zone system whether natural or constructed, constitutes an interface between the aquifer system and terrestrial system that is the source of the pollutants these are reported to be most suitable for schools, hospitals, hotels and for smaller communities. Constructed wetlands innovation is a built technique for refining wastewater as is goes through a characteristic procedure, which includes soil, s and, miniaturized scale life forms and vegetation. The study on the capacity of marshy plans in the decrease of natural contaminants and

supplements in sea- going frame works begun in the 1950's in Germany.

TYPES OF FLOW SYSYTEM

1) Horizontal surface flow system

In this system, waste water is fed in and moves through the bed media under the surface of the bed until it achieves the outlet zone. The waste water will come into contact with system of high -impact zones will be around the roots and rhizomes of the wetland vegetation that brake oxygen into the substrate and waste water goes through the rhizosphere, the waste water is spotless by microbiological squalor by physical and chemical processes. The longitudinal segment of level subsurface wetland and it can effectively uproot the natural contaminants (TSS, BOD5 and COD) from the waste water.

Horizontal surface flow wetland consists of a shallow basin constructed of soil or other medium to support the roots of vegetation, and water control structure that maintains a shallow depth of water. This kind of wetlands looks and acts much like natural marshes, and they can provide wild life habit and aesthetic benefits as well as water treatment.

2) Vertical subsurface flow system

In vertical subsurface flow systems waste water is fed intermittently and it flows in the direction of vertical through the channel funnels and it is gathered by a seepage system at the base. Vertical flow treatment flow wetlands are composed of gravel topped wihs and, with reeds growing at the same sort of densities as in the horizontal flow systems. The liquid is dosed on the bed in a large batch, flooding the surface. The liquid then gradually drains vertically down through the bed and is collected by drainage network at the base. The bed drains completely free, allowing air to refill the bed.

Advantages and Dis advantages of wetland constructions

Advantages of wetland constructions

1. It achieves standards for tertiary treatment with low cost, such as no electricity, no chemicals for Ph adjustment.
2. Low maintenance cost, since it involves no machinery and its maintenance.
3. It requires negligible attendance for operation and monitoring.
4. It has no sludge handling problem.
5. It enhances the landscape and gives the site a green appeal.
6. It provides natural habitat for birds and after few years gives an appearance of bird sanctuary and also provides recreational and educational areas
7. Though it is a sewage treatment plant it does not have odor problems.
8. It becomes a green zone and it doesn't have

MATERIALS AND METHODOLOGY Study area

The study area geographically lies between 12°45´48" N and 77° 25´36"E. Jain residential school, situated in Ramanagara district was originally constructed by the British in the year 1942 in view of providing the local residents with clean water for irrigation, domestic use, fisheries etc..

The following is the Google location map showing the sample collection points.

MATERIALS AND METHODS Greywater from bathrooms

Water used in hand washing and bathing generates around 50-60% of total greywater and is considered to be the least contaminated type of greywater. Common chemical contaminants include soap, shampoo, hair dye, toothpaste and cleaning products.

Greywater from cloth washing

Water used in cloth washing generates around 25-35% of total greywater. Wastewater from the cloth washing varies in quality from wash water to rinse water to second rinse water.

Greywater from kitchen

Kitchen greywater contributes about 10% of total greywater volume. It is contaminated with food particles, oils, fats and other wastes. kitchen greywater also contains chemical pollutants such as detergents and cleaning agents, which are alkaline in nature and contain various chemicals .

QUALITATIVE COMPOSITION OF GREYWATER

WATERSOURCE	Bacteria	Chlorine	Foam	Foodparticals	Hair	High pH	Nitrate	Odor	Oil & Grease	Organics matter	Oxygen	Phosphate	Salinity	Soaps	Sodium	Suspended solids	Turbidity
Cloth washing			*			*	*		*		*	*	*	*	*	*	*
Washing Of utensils	*		*	*		*		*	*	*	*			*	*	*	*
Bathing	*				*			*	*		*			*		*	*
Kitchen	*			*				*	*	*	*			*		*	*

POTENTIAL OF GREYWATER REUSE:

- Reuse of greywater serves two purposes ,
- Reduces freshwater requirement,
- Reduces sewage generation and load on s ewage treatment plants.
- The amount and quality of greywater will in part determine how it can be resued. Irrigation and toilet flushing are two common uses, but nearly any non-contact use is a possibility.

Possible uses of treated greywater are presented in the table below

Use of treated Greywater	Purpose
Individual household	Toilet flushing
School	Floor cleaning
Government office	Irrigation
Hospital	Gardening
Airport	Car washing
Railway station	Construction
Apartment/colony	Toilet flushing
Theatre	Toilet flushing

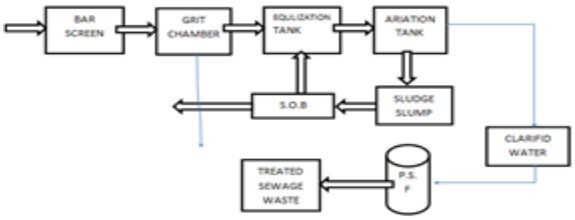
METHODOLOGY

Levels of Greywater Treatment

Wastewater treatment options may be classified into groups of processes according to the function they perform and their complexity:

Preliminary treatment, it is done with simple processes that deal with debris and solid materials. The purpose of preliminary treatment is to remove those easily separable components. This is usually performed by screening and grit removal. Their removal is important in order to increase the effectiveness of the later treatment processes and prevent damages to the pipes, pumps and fittings [2]. Primary treatment is done by mainly the removal of solid by settlement. Simple settlement of the solid material in sewage can reduce the polluting load by significant amounts. It can reduce BOD by up to 40%[2].

Secondary treatment in secondary treatment the organic material that remains in the waste water is reduced biologically. It actually involves harnessing and accelerating natural process of waste disposal whereby bacteria converts into organic stable forms [2].



The greywater treatment plants have been constructed by providing treatment techniques such as screening, equalization, settling, filtration and sludge drying beds. The treated greywater from the treatment plant is used for irrigation of indoor plants ex: for gardening purposes.

COMPONENTS OF EXISTING GREYWATER TREATMENT SYSTEM AT JAIN RESIDENTIAL SCHOOL

1. GRIT CHAMBER

A chamber in which the velocity of waste flow is reduced to a point where the denser sand and other grit will settle out, but the organic solids will remain in suspension. The settled material is buried or used for fill.

2. BAR SCREENS

A grating of steel bars s paced about 2-4 cm on center is placed at angle to the flow of sewage through an open channel. The screen removes coarse and floating solids from the sewage. The screen must be cleaned regularly and the removed solids must be burned, ground and digested, or buried [3].

3. EQUALIZATION TANK

The equalization tanks are provided to balance fluctuating flows or concentrations, to assist self-neutralization, or to even out the effect a periodic dis charge from a batch process.

4. SEDIMENTATION TANK

These are usually large tanks in which solids settle out of water by gravity where the settle able solids are pumped away. It operates by means of velocity of flow is reduced to about 0.005 m/s so that the suspended material will settle out. The usual detention time is 4-8 hours. Longer periods usually result in depletion of dissolved oxygen and subsequent anaerobic conditions.

Figure 5 | Rectangular sedimentation Tank

5. SLUDGE DIGESTER

The sludge which settles in the sedimentation bas in is pumped to the sludge digester where the temperature of 30-35 ◦c is maintained.

6. DRYING BEDS

Digested sludge is placed on drying beds of sand where the liquid may evaporate or drain into the soil. The dried sludge is porous humus like cake which can be used as fertilizer base

The type of filter required for a grey water system depends largely upon the amount of grey water to be filtered, the type of contaminants present and end use. Filtration is one of the most important operations in the grey water purification process. In filtration, water is passed through a filter medium in order to remove the particulate matter not previously removed by sedimentation.

8. STORAGE TANK

The purified water from the filters are pumped to the storage tanks and from there the treated greywater can be supplied for irrigation of indoor plants (for gardening purposes) as the greywater is most suitable for this purpose.

9. STUDY AREA

The study area selected is located at Jain Global Campus, Jakkasandra village, KankapuraTaluk, Ramanagara District. The purposed area study area of Global Campus consists of an area of 38 acre and it consists of green belt area of 60% of overall area. Hence, here this study is carried to purpose sewage treatment plant to treat the sewage generated in college campus and to use the treated water efficiently for gardening purpose within the campus.

The college includes,

1. Day scholar (including students, teaching and non - teaching staff) = 1800 members

Water consumption = 90 lit/day

Therefore,

1800 * 90 lit/day = 1, 62,000 lit/day ----------(1)

2. Hostel students = 600 (including students and staffs)

Water consumption = 225 lit/day

Therefore,

600 * 225 lit/day = 1, 35,000 lit/day ----------(2)

Total water consumption = eq.(1)+eq.(2)

= 1,62,000+1,35,000

= 2,97,000 lit/day

Now it is assumed that 80% diversity of tot al water consumption

= 0.8*2,97,000

= 2,37,600 lit/day

Say 240 KLD

DESIGN OF TREATMENT UNITS

The following design details shows the required dimensions of each individual units of treatment plant that has to be constructed for treatment and reuse of sewage generated by the Jain Engineering college campus.

1. Equalization tank

Q = 240 KLD

Detention tank = 0.4 hr

Pumping hour = 16 hr

Flow rate = 240/16 = 15 KL/hr

Volume of equalization tank = 4*15 =60 KL

Tank Size required = 4.5 m * 4.5 m * 3 m * 1 no.

2. Extended Activated Aeration System (EAAS) Plant

a) Aeration tank

Assumingmes s cone = 4000 mg/L or 4 Kg/m3

F/M = 0.125

BOD cover = 450mg/L

Total BOD load = 240 * 450 = 108 Kg/day

Volume of aeration tank = 108 / (4 * 0.125) = 216m3

Tank size required = 5.5m * 11.5m * 3.5m * 1 no.

b) Diffused Aeration Sys tem

O2 required = 2 times of BOD @ 20 hr working of blowers

= 2 * 216

= 432 Kg/day

= 4,32,000g m/day

c) Air Flow Required

Assuming 18 gm of O2 transfer/m depth

60% of blower consideration

Air flow = 4,32,000 / (24*18*0.6*4) = 416 m3/hr

Air blower equipment capacity = 500m3 /hr @ 2 no.

(1+1) length of diffuser membrane at air dis charge @ 10 m3/m length

= 416 / 15.6 = 27 Running meters

3. Clarifier Tank

Considering sludge recycling to aeration tank from sludge tank @ 100%

= 240 * 2

= 480 KLD

Assuming SLR @ 25m3/m2/hr

Area of tank = 280 / 25 = 19.2 ≈ 20m2

Hence provide 4.5 m * 4.5 m * 3.0 m * 1 no.

4. Clarified Water Tank

To provide continuous filter separation, hence provide the tank of 4 m * 4 m * 3 m * 1 no.

5. Pressure and Filters
Dis charge, Q = 240 m3/day No of hours working =16 hr Flow = 15 m3/hr
SLR= 15 m3/m2/hr
Filter required = 0.8 m Φ * 2 no.

6. Activated Carbon Filter Dis charge, Q = 240 m3/ day No. of hours working = 16 hr Flow = 15 m3/ hr
SLR= 15 m3/m2/hr
Filter required = 1.1 m Φ * 1 no.

7. Chlorinator
Chlorine, Cl2 dis charge <= 1mg/L electronic dosing Pump of 2 LPH= with sodium hydrochloride solution which consists of 5-10% strength

8. Head water holding tank
To provide for continuous separation hence provide a s ump of 100 m3 capacity.

RESULTS AND DISCUSSIONS

The sewage generated will have various physio - chemical parameters which cause various effects on environment as well as human health if it is directly used without any treatment.

Below table shows the raw sewage water quality

Parameter	Unit	Raw sewage
pH	-	5.5-9.5
Suspended solids	mg/l	90-400
BOD	mg/l	150-400
Nitrite	mg/l	1-10
Ammonia	mg/l	10-35
Sulphate	mg/l	12-40
Boron	mg/l	5-10
Chloride	mg/l	800-1000
TDS	mg/l	2500-5000
COD	mg/l	Nil

After providing the conventional treatment for the sewage generated the water quality should be with the limits prescribed in the below table

Parameter	Unit	Raw sewage
pH	-	6.5-8.5
Suspended solids	mg/l	100-200
BOD	mg/l	100
Nitrite	mg/l	>20
Ammonia	mg/l	10
Sulphate	mg/l	>12
Boron	mg/l	2
Chloride	mg/l	800-1000
TDS	mg/l	600
COD	mg/l	Nil

CONCLUSION

The treatment processes that have been established to treat the wastewater can reduce the physio -chemical parameters in to a desirable limit; hence the efficient us e of the treated water can be done. As per the project which is undertaken, 66% of total treated greywater is obtained which is used for irrigation, flushing and gardening etc.

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