MANTECH Publications
Journal of Water Resource Engineering and Pollution Studies
Volume 1, Issue 3, September-December, 2016

Eco-Friendly Treatment and Reuse of Greywater

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Abstract

As global water resources decline, reuse of domestic greywater for the irrigation of home gardens is quickly becoming widespread in many parts of the world. To find an alternative for fresh water resource in the places where drinking water standards are not required, grey water recycling can be adopted. Wastewater is an immense resource which could have significant application in the regions of water scarcity. This paper deals with eco-friendly treatment of grey water by adopting Reed Bed Technology. This is done by using wet land plant, Phragmitesaustralis commonly called reeds that has extensive root system. The characteristics of grey water before and after treatment are analyzed and compared. Results, found that the removal efficiency of reed bed to treat greywater is 85% for BOD, 60% for ammonia nitrogen. These results reinforce the potential of domestic grey water as an alternative irrigation source.

INTRODUCTION

Water resources have become scarce and also the demand for food is increasing. Under this situation, the agricultural productivity has to be increased with minimum water. Therefore the need of an alternate for fresh water source is necessary. Grey water is abundantly available waste water resource. Hence recycling grey water can be used as an alternative irrigation source. The treatment adopted in an eco-friendly manner where special equipments and electricity are not required. This method is done using wetland plants adopting the

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principle of natural wetland and applying reedbed technology. Reeds are rough coarse grasses having extensive root system that grows in wet areas. They can be treated as a natural and inexpensive method for domestic, agricultural, industrial waste water. This is done through phytoremediation which is the direct use of living green plants for in situ, or in place, removal, degradation, or containment of contaminants in soils, sludge, sediments, surface water and groundwater. Using this reed, the domestic sewage is treated and let out for reuse.

OBJECTIVES

- To lower fresh water extraction from rivers and aquifers.
- To reduce wastewater generation
- To optimize reed bed system of domestic waste water through phytoremediation
- To determine the capacity of reed plant in treating grey water.

LITERATURE REVIEWS

Omar hamedjehawi (2014) et al., treated domestic wastewater using reed bed system with Scirpusgrossus plant to remove nutrients and micro pollutants. The main objective is to investigate the ability of the plant to remove pollutants and to optimize a reed bed system through phytoremediation. The author classifies the system as surface and sub-surface flow and merits of sub-surface over surface flow and its classification as horizontal and vertical flow. It is concluded that the use of reed beds for can be used for both secondary and tertiary treatments. This system tends to be more cost effective.

Analysis and design of zero sewage discharge system for Model Township published by Ninad B. Bhalerao and A. R. Kambekar from this journal is referred for framing methodology. The author considers the conventional sewage treatment for study purpose of comparison of quality and overall cost. The quality of treated and untreated wastewater is compared to prove the effectiveness of the project.

From the tabulations and graphs

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1. Wastewater characteristics before and after treatment by reed bed system

2. Environment management cost

Hence by this literature review it is understood that practicing zero waste means moving toward a target in which all materials are used to their utmost potential.

Ramprasad.C (2012), conducted experimental study on the wastewater treatment using reed bed system through the application of Root Zone Treatment.

They clearly explained the arrangement of reed bed system step by step through pictures and the working with its advantages are also explained.

A comparison of treated sewage from STP, RZT is also done by tabulations and charts which clearly showed that there is a remarkable reduction in pH, BOD, COD by reed bed treatment and the treated water is fit to let out directly to water bodies.

From this literature review, it is clear that reed bed system of treating waste water is an economical, efficient and eco friendly method.

There are two types of reed bed viz. **horizontal flow and vertical flow.**

Horizontal flow reduces TSS, TDS, pH and COD whereas by vertical flow treatment where root zone treatment is adopted, in addition to TSS, TDS, pH and COD, Ammonia and BOD can also be reduced.

METHODOLOGY

From the literature reviews and its inference, methodology is framed using horizontal reed bed system as secondary treatment and vertical reed bed system as tertiary treatment.

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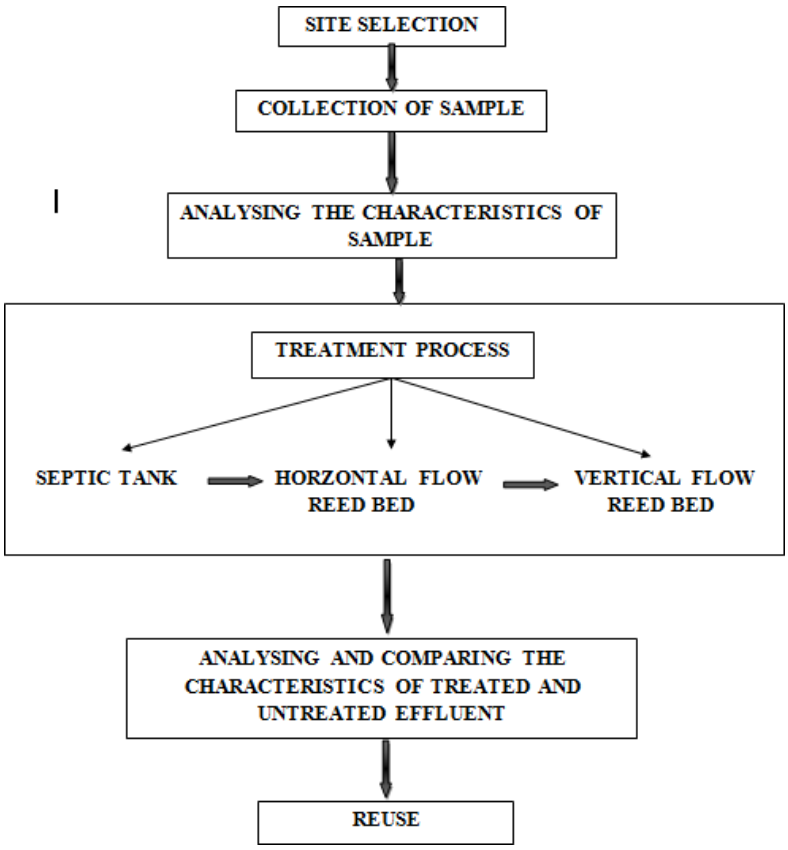


Figure 1

Table 1: Characteristics of untreated sample

TESTS	pH	Ammonia nitrogen (mg/l)	TSS (mg/l)	TDS (mg/l)	BOD (mg/l)	COD (mg/l)
VALUE	7.32	92.9	500	200	70	104

A. Sample and reed plant selection

This project is carried out for the sample of domestic sewage collected from Perungalatur area. Plant used for this eco-friendly treatment is Phragmites australis locally called NANAL that is collected from an agricultural land near Cheiyyar. These plants are easily available in agricultural land, infact, thrown as a waste from crops.

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Especially, this plant has pores in root system hence transports oxygen through it.

B. Analyzing the characteristics of untreated sample

The sample is tested to determine its characteristics like pH, BOD, COD, TSS, TDS and the values are tabulated. **See Table 1.**

C. Description of experiments

The existence of extensive root system creates channels for the water to pass through it. The roots transfers oxygen through the existing pores into the body of the soil and provide an environment where aerobic microbes thrive in. These organisms are necessary for the breakdown of many type of organic compounds particularly ammonia to nitrates. Then the process of nitrification takes place i.e. the plant takes up some amount of nutrients from waste water. The plants are also capable of accumulating heavy metals.

Reed bed can help to achieve a better standard of water quality through

- High level bacterial and viral removal
- Decreased BOD and reduction in suspended solids
- Reduction in nitrogen contents and removal of metals.

The sample is let into the septic tank where heavier particles settle down that prevent clogging of sand gravel filter media. Then the settled sample is sent to horizontal reed bed where it flows horizontally in the sub surface, 10cm below the gravel surface. The oxygen supply plays a major role in contaminant removal process.

In this process BOD and suspended solid levels are reduced. The water from horizontal flow is now sent to vertical flow reed bed where water flows vertically down to the roots. Here due to intermittent batch loading, the oxygen supply is promoted through the media and fill free spaces. This effectively removes BOD, total solids and ammonia, thereby reducing unpleasant odour. **See Fig 2.**

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Fig 2: Experimental Setup of Reedbed Technology



Fig 3: Untreated Wastewater

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Fig 4: Treated Water

D. Determination of characteristics of treated sample

The characteristics of treated water is analysed and results with the efficiency of the treatment are tabulated.

Table 2: Characteristics of Treated Water

TESTS	Ph	Ammonia nitrogen (mg/l)	TSS (mg/l)	BOD (mg/l)	COD (mg/l)
VALUE	7.2	10.4	19.4	20	60
REMOVAL EFFICIENCY	NIL	60%	83%	85%	40%

RESULTS AND CONCLUSION

The greywater sample discharged in the domestic sewage was analysed to determine their characteristics. Reed bed system with root zone treatment was employed on a lab scale to treat wastewater. The characteristics of untreated greywater samples were analysed. After treating with the rootzone treatment using Nanal plant, the characteristics of treated sample includes pH, TSS, TDS, BOD, COD is analysed and compared with untreated sample shows a large temporal variation.

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Table 3: Comparison between untreated, treated samples and permissible irrigation values with the removal efficiency

PARAMETERS	Untreated effluent	Treated effluent	FAO-Permissible Value for irrigation	Efficiency in removal
pH	7.32	7.12	6.5-8.5	-
TURBIDITY (NTU)	16.8	2	-	88.09
HARDNESS (ppm)	480	110	-	77.08
CHLORIDES (mg/l)	439.32	211.15	<250	51.93
DISSOLVED OXYGEN (mg/l)	0	4.66	>4	-
TOTAL DISSOLVED SOLIDS (mg/l)	350	90	<120	74.28
TOTAL SUSPENDED SOLIDS (mg/l)	350	70	<100	80
AMMONIA NITROGEN (mg/l)	92.96	9	10-20	90.30
CHEMICAL OXYGEN DEMAND (mg/l)	104	24	<150	76.92
BIOLOGICAL OXYGEN DEMAND (mg/l)	70	16	<100	77.14

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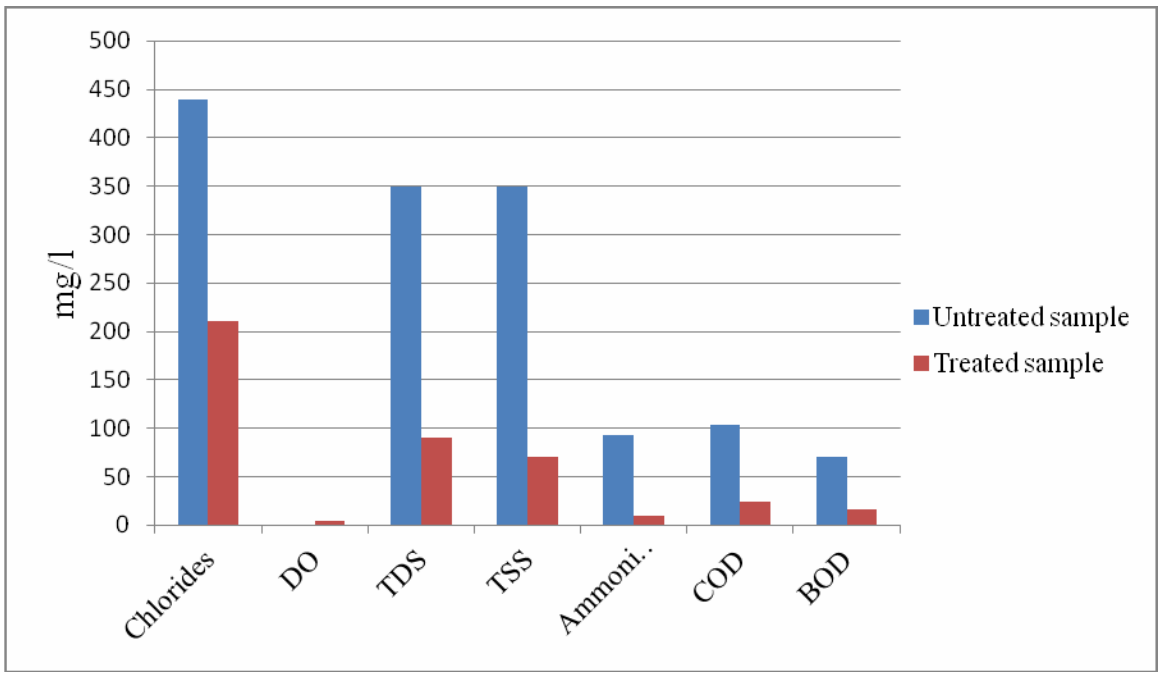


Fig 5: Comparison of characteristics of samples

Results shows that the concentration of BOD before treatment is 70 mg/l whereas after treatment, the removal efficiency is 77.14% which indicates the use of greywater can be put to use in agricultural practices. The use of reed bed to remove nutrients and micro pollutants from domestic sewage is more cost effective than conventional sewage treatment system. It is also more effective in the places where there is a land constraint.

There are, of course, still many instances where farmers either have no other option but to use marginal-quality water resources (such as in regions where reliable water supplies are lacking and discharge of municipal wastewater into the environment pollutes water bodies), or where farmers are unaware that they are directly using wastewater (such as when farmers are located downstream of large cities where wastewater is being dumped into open water).

Planned wastewater use for irrigation, however, is an increasingly important resource in recognition of its potential benefits, especially in urban and peri-urban agriculture. This is driving wastewater use

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in both developing and industrialized countries – especially in water-scarce areas where alternative supplies are lacking. (UNW-DPC August 2013)

This system has proved that "Use of Natural Resources" to treat the onsite wastewater. It is the dynamic option which can directly connect to the masses of general public. Today plants, the only natural resource which has the potential to adapt itself to the human on slot on our environment.

The treated water has a wide range of application in the place of fresh water source where drinking water standards are not to be maintained. It is very helpful for farmers to use this resource since it is economical, no land constraint and simple in construction. It has to be noted that growing reeds do not even require cultivatable land. Hence, waste uncultivatable land can be used for this whole process.

Apart from these, it can be used for terrace gardening, toilet flushing, power plant as a coolant, laundries etc. Hence the process with the obtained removal efficiency can be replaced with conventional sewage treatment plant, is eco-friendly without use of chemicals, special equipments, electricity and also with zero operational and less maintenance cost.

REFERENCES

[1] Omar Hameed Jehawi and Izzati Ismail (2014), 'A reed bed system for the treatment of domestic waste water and micro pollutants', *Australian Journal of Basic and Applied Science,* 8(19), pp.280-283

[2] Ramprasad.C (2012), 'Experimental study on waste water treatment using lab scale reed bed system using Phragmitis australis', *International Journal of Environmental Sciences* , Volume 3, No 1.

[3] Ninand B.Bhalero, A.R. Kambekar, 'Analysis and design of zero sewage discharge system for model township', *International Journal of Research in Engineering and Technology*.

[4] Javier, Mateo- Sagasta (FAO), Kate Medlicott (WHO) (2013), 'Safe use of Wastewater in Agriculture', *UN-Water Project*.

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[5] Rajendran S.M and Dr.Sekaran V.,'Municipal Wastewater Reuse in Arid Regions- Scope for Irrigation in Madurai City', *International Journal of Civil Engineering and Technology.*

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