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Treatment of Domestic Wastewater by Reed Bed System: A Review

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ABSTRACT: Human activities exploits the quality of waste water, this has resulted in pollution of surface and subsurface water bodies. A large amount of potable water is being wasted regularly from various sources including households in the form of waste water. Recycling and reuse of waste water helps to conserve the energy, resources and protects the environment. This paper reviews the reed bed technology which is one of the cost effective methods to treat the waste water generated from smaller communities, colleges, hostels. It explains the importance of reed bed technology over conventional treatment methods of waste water, and gives information about the types of reed bed system, some efforts are reported on this aspect of investigation, there is a need to adopt this innovative method for the treatment.

KEYWORDS: Root zone technology, reed bed system, waste water, removal efficiency, reed plants

I. INTRODUCTION

Due to expeditious increasing population, urbanization leads to the increasing the usage of water for several activities which in turn leads to the formation of large quantity of sewage, due to improper treatment it will damages the status and quantity of water resources[4]. A study shows that release of untreated sewage directly into nearby streams causes pollution of ground water and surface water. Sewage contains numerous disease causing microorganisms and bacterias. Water scarcity also another major problem, reuse of treated water is one of the solutions to down the rate of water scarcity hence proper treating method should be analyzed [2]. Traditional waste water treatment plant involves processes like primary sedimentation, aeration, secondary sedimentation etc., but it requires very large area and also large amount to install for smaller communities hence it is not economical.

Reed bed technology is most efficient and economical method should be carried out in rural areas and colleges[1]. This will reduce the concentration of overall sewage entering the water sources. It mainly depends on soil, sun, plant, air. The first reed bed system was constructed by NEERI at sainik school, Bhubaneswar, Orissa[1]. It was reported that reed bed system is most suitable for treating waste water generated from schools, colleges, hostels, and smaller communities.

1.1 MACROPHYTES AND ITS TYPES:

Plants which are adopted to living in aquatic environment are referred as hydrophytes or macrophytes.[6]

Based on the growth, macrophytes are classified as:

1. Free floating macrophytes: these are the plants found suspended on water surface with their root are not attached to substrate or bottom of water body. Ex. water lettuce, pistia.[6]
2. Floating leaved macrophytes: type of macrophytes where leaves that float on water surfaces. Ex. Water lilies, pond weeds [6]
3. Emergent macrophytes: the plants which grows in water but pierces the surface hence it is partially in air. Ex, **reed (phragmites)**, cyperus papyrus, flowering rush,[6]
4. Submergent macrophytes: A plant grows under water with roots are attached to substrate or without any root system. Ex, sagittaria, sparganium, acorus, carex.[6]

1.2 REED BED SYSTEM:

The method of treating domestic waste water using different sized gravels, sand , soil, and reed plants(emergent macrophytes).[8]

Based on construction;

1. Horizontal flow system
2. Vertical flow system
3. Hybrid flow system

• horizontal flow •

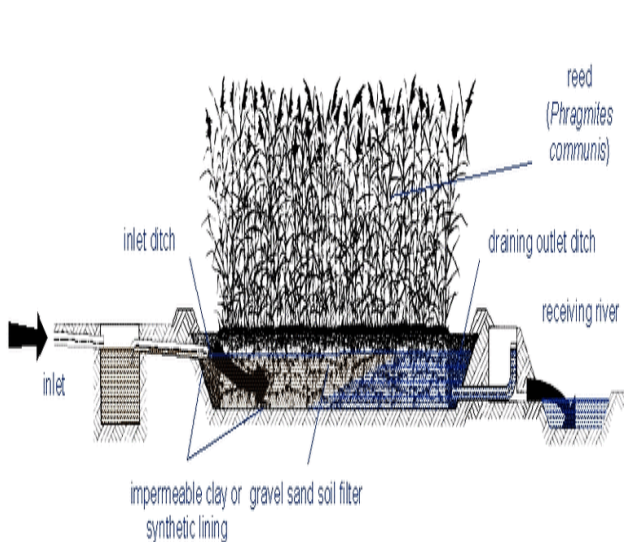


Fig 1. Horizontal flow reed bed system

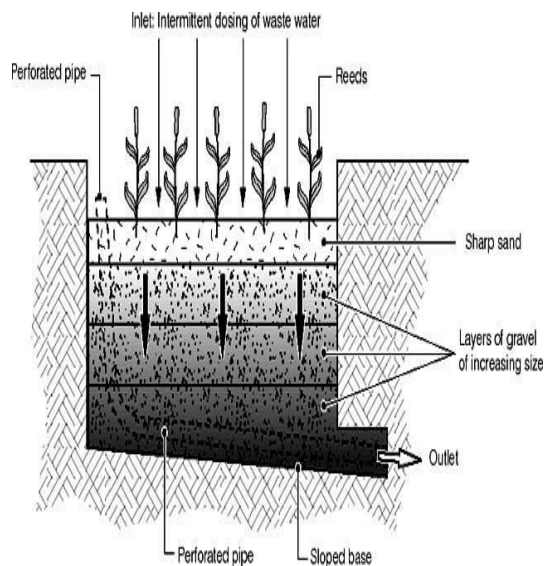


Fig 2. vertical flow reed bed system

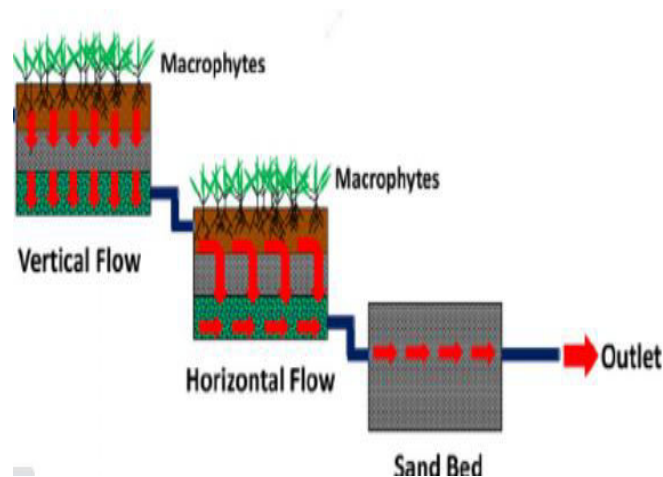


Fig 3. Hybrid flow reed bed system

Hybrid flow reed bed system: Depending on the purpose, hybrid wetlands could be either Horizontal Flow wetland followed by Vertical Flow wetland or Vertical Flow wetland followed by Horizontal Flow wetland [8]

II. LITERATURE REVIEW ON POLLUTANT REMOVAL FROM WASTE WATER BY REED BED TECHNOLOGY

The review concerned to contemplative of reed bed system and literature connected to good examination aspect of treating waste water with particular reed bed method are dispensed below.

Sreenikethan, P.M Maheesa et.al., (2009): in this work waste water collected from different units like hospitals, canteen, milk processing unit, conducted experiment on lab scale model of area 1m*6m and used different gravels of particle size like 1.0-2.5cm, 0.4-0.6cm, 0.25-0.4cm and laid up to 3cm, 10cm, 10cm respectively. They analyzed the parameters

such as COD, NH₄-N, PO₄-P. 97% to 99% of NH₄-N, 50% to 60% of COD, 60% to 73% of phosphate removal efficiency was achieved.

Mahesh mane, Bhupenpatil, et.al, (2017): This paper explains the feasibility of using root zone technology to treat sewage waste water. Samples were collected and analyzed various parameters like pH, TDS, DO, COD, BOD and explains the application of this technology for future.

Omar hameedjehawi, et.al (2014): constructed and worked on pilot scale system and collect domestic sewage from bukitputri, universiti kebangsaan Malaysia (UKM). Fiber glass tank with PVC pipe, gravels of different sizes, river sand were used. *Scripus grossus* locally known as rumpu menderong plant was used for experiment.

Bista and N R Khatiwada: the study was conducted on 2 full scale domestic waste water treatment units of Kathmandu university and dhulikhel hospital. They carried out both horizontal flow reed and vertical flow type used *Phragmites karka* was local reed in Nepal. Parameters like COD, faecal coliform were analysed, removal efficiency reached 20-38 mg/l of COD and 98.3% of faecal coliform.

R. Gersberg, and B. V Elkins: this report emphasis, assess the role of 3 aquatic plants like *Scirpus validus* (bulrush), *Phragmites communis* (common reed), *Typhalatiflora* (cattail). The main aim is to removal of nitrogen, BOD, TSS, high ammonia removal efficiency was found by bulrush and reed beds, BOD removal efficiency was greater in bulrush and reed beds i.e, 5.3 and 22.2 mg/l respectively.

Jan felix kobbing, Stefan zerbe et.al., (2013): the author explains importance of reed (*Phragmites australis*), qualitative and quantitative properties of reed, usage of reed in waste water treatment process and global extent of reed beds and potential yields.

Jurgen kern and Christine idler (1999): study was conducted on 2 reed bed systems, one system treats domestic waste water with reed *Phragmites australis*, removal efficiency reached up to 80% to 90% of COD, total N, total P. second system treats mixture of domestic and agricultural wastewater produced by cheese dairy, efficiency ranged between 13% to 99% David Raphael et.al (2020): analyse the campus grey water by constructing the pilot scale batch flow wetland system. *Rhynchospora corymbosa* type of macrophyte used for the treatment. Removal efficiency was reached 81% of COD, 81% of TSS, 0.2% of pH 10% of TP.

O. Raphael et.al., (2019): study was conducted to compare the performance of vertical and horizontal wetlands, *R. corymbosa* reed plant was used for the study. Here they carried out the treatment for highly polluted greywater. they analyzed the various parameters separately for horizontal and vertical flow system, the efficiency for HF and VF was BOD – 35%, 35.4%, COD – 61.9%, 56.7%, pH – 8.8%, 12.8% respectively. The removal efficiency was found to be high in horizontal constructed flow system.

F. Masi et.al (2017): performance study was conducted for vertical flow treatment wetlands system for Orhei town in Moldova. Around 5 hectare of total area was occupied by the treatment system, daily treated flow was measured 1000 – 2000 m³/d. the removal efficiency of the plant was observed that 89% of TSS, 73.1% COD, 73% of BOD.

M. Manderiasushil (2012): analysis was conducted on various parameters to treat the domestic sludge through reed bed system by setting up reed bed system of 3.5ft * 2ft * 3ft, gravels of different sizes used as filter media, *Phragmites karka* was locally available grass used for the treatment, they planted 6 to 8 plants in rectangular tank and carried out the experiments and analyzed the parameters before and after of 15 days of intervals, parameters such as total phosphorus, total kjeldahl nitrogen, nitrate nitrogen. the removal efficiency was found that, 61% of total kjeldahl nitrogen, 50% of ammonium nitrogen, 65% of total phosphorus. The overall efficiency was 50%.

III. CONCLUSION

Based on the several investigations was carried out by the authors was studied and following conclusions can be drawn Reed bed system can be carried out by using different kinds of reed plants, efficiency of the treatment depends on the type of flow system we adopt. it is concluded that reed bed system is one of the cost effective process and treated water may be reused for other activities like flushing, gardening, washing cloths etc.

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