

EXPERIMENTAL STUDY OF HYBRID CONSTRUCTED WETLAND REACTOR FOR THE TREATMENT OF WASTEWATER

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Abstract- This study carried on a series of experiments with a portable vertical subsurface flow constructed wetland reactor for the removal of BOD, COD, Nitrate, turbidity, and pH. To study the treatment mechanism in the soil-plant system, we designed a small scale CW Reactor, planted with typha for Phytoremediation, consist of five filter layers including activated charcoal and synthetic fibre, Hydraulic loading rate of 3.3L/min/m², of three hour rest period, the portable reactor is movable and flexible to install at any location of a wastewater treatment system. Adjustable drovers are provided for easy replacement and washing of materials after clogging of the reactor. The aspect ratio of this reactor has assumed to be 1:1.2 based on two dimensions of reactors and the third dimension of reactor have been finalized after the design of all layers of reactors including the freeboard. A surface flow rate of effluent has been controlled using the control valve at inlet arrangement and it has fixed according to the rate of filtration and retention time of effluent into the various filter layers. A separate disinfection unit has provided for disintegrations of biological impurities, effluents are collected at the outlet of the reactor having removal efficiency of approximately 85 to 90% of mentioned parameters.

Index Terms- Constructed Wetland, Hybrid Constructed reactor, Phyto-remediation, artificial wetland, and sub-surface flow.

I. INTRODUCTION

Waste water generation rate in domestic level is approximately 80% of the supplied water, most of the waste water is drained out through drainage and ultimately it will discharge into the fresh surface water bodies otherwise ground water and it will make fresh water contaminated, to avoid such kind of contamination of fresh water bodies it is essential to treat and reuse waste generated in the varies premises, waste water treatment is very tedious process but if adopt effective technology with certain processed activated material, it will be quite easy to treat generated waste water at the source point, nature have a capacity to treat waste water, hence constructed wetland methods comes out but major disadvantage of this method is requirement of land and retention time.

As we started the investigation of constructed wetland, after executing the initial attempts, we realized that this conventional method and material takes a lot of time to purify water. Hence for the reduction of time of treatment in conventional wetland filter material, we replaced the few materials and come with two different efficient materials like i) Activated charcoal ii) Recron fibre (synthetic cotton). After testing this material in laboratory in different mould, we reached to a conclusion that these two

materials have the capacity to remove almost 85 to 90% of solids present in water and waste water. While executing this experiment, we tested different raw water and waste water sample and we got the desired results with these materials during testing. We utilized college laboratory to test basic parameters like pH and turbidity and remaining parameters were tested in authorized laboratory of irrigation department, the activated charcoal of 800ID which is of very high quality adsorbing material and recron fibres (Synthetic polyester fibres) of 45 micron and 50 micron size is highly effective for removal of suspended and dissolved solids from waste water.

II. DETAIL DESCRIPTION OF THE INVENTION:

The objectives of development of reactor is to give feasible Solution to treat raw and waste water in the premises of dwelling houses, apartments and other places of residence, Different small mould had prepared for Preliminary investigation of efficiency of different materials for filter bed by varying dimension of mould and thickness of layer. While scale-up and reactor design of constructed wetland of vertical flow, Historical problems is to reducing large scale commercial wetland into small scale portable constructed wetland are first reviewed and elements affecting geometrical design of constructed wetland are then examined, the amount of waste water generate in dwelling unit of one family has been considered as a initial discharge for reactor design. Quality of waste water has been tested in an ISO 9001: 2005 certified laboratory, on the basis of reference results obtained during preliminary investigation, finalized some parameters of waste water like BOD, COD, Nitrate..etc for further research work, general approach for design of portable constructed wetland reactor were to provide sustainable solution over treatment of waste water and to restrict the dimensions of conventional wetlands as well as to improve efficiency of treatment.

The aspect ratio of this reactor was assumed to be 1:1.2 based on two dimensions of reactors and third dimension of reactor has been finalized after design of all layers of reactors including free board and inlet for effluent flow into the reactor, surface flow rate of effluent has been control using control valve at inlet arrangement and it has fixed according to rate of filtration and retention time of effluent into the filters.

III. OBJECTIVES OF IDEA:

- To design a portable constructed wetland reactor for waste and raw water treatment.
- To satisfy the waste water parameter up to certain acceptable limit.

- To treat domestic waste water generated in dowering units, hospitals, institute, apartments in their premises only.
- To provide sustainable solution over effluents generated in premises mentioned above.

IV. CONCEPT OF DESIGN:

Following are the points considered for Design

- Organic Loading Rate
- Effluent loading Rate
- Thickness of Individual filtration Layer
- Retention Time
- Plant type for Phytoremediation
- Materials for fabrication of reactor
- Properties of individual materials
- Specific Weight of materials (Saturated)
- Free Board
- Distribution Pipe
- Collection tank
- Pumping Unit
- Disinfection Unit

V. BENEFITS OF NEW APPROACH (OVERCOME THE PROBLEM OF CONVENTIONAL TECHNIQUES):

Following are the benefits of newly designed portable constructed wetland reactor,

Concluded after experimental results:

- Treatment efficiency increased more than 90% of some waste water parameters.
- Portable device or reactor is suitable to treat lower discharge of effluent in any premises.
- Advance processed materials of filter layer are affectively removing most of the contaminants present in waste or raw water.
- Newly design reactor is self sufficient to treat effluent in economical way.
- Effluent discharge can be varying using control valve of reactor.
- Quantity of effluent has to be supplied to the reactor for treatment.
- In brief the proposed invention is useful to treat domestic waste water at the generation point or source point, this will helpful for recycling of waste water generated in the premises of houses, apartments, institutes, hospitals etc.
- This device is portable and highly effective for instant treatment of effluent in affordable prize.

VI. Advantages of new design:

- Retention time of treatment is reduced in new reactor.
- Efficiency of treatment increased by 30%
- New reactor is economically designed hence cost effective.
- Less quantity of water get wastage while treatment in CW reactor.
- Device is portable hence it can be installed at anywhere in system of treatment.

- Less cost of maintenance and most of the materials are easily available in local market.
- Drovers are given to the reactors for easy replacement of materials.
- Reducing the risk of spreading nuisance in surrounding area by providing closed dimensions to the reactor.

VII. APPLICATION OF PROJECT:

- Applicable in area where there is scarcity of water, need to recycle and reuse of waste water generated in the premises.
- Applicable to domestic level, apartments, hospitals, temples, hotels, Institute and forest camps to recycle waste water.
- Applicable in rural area where facilities of water treatment is not available.

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