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# Horizontal Subsurface Flow Constructed Wet Land Treating Domestic Waste Water

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**ABSTRACT** - In AITS Tirupati , horizontal subsurface flow (HSSF) wastewater treatment in built-up wetlands (CWs) was studied using three different treatment media (gravel, coir for purification and ceramic pebbles). The study focused on the establishment phase of the wetland during the first months of its operation (establishment phase). At this stage, media porosity, bacterial biofilm and plant root growth were underway and it was prior to the steady state operational stage. The different of different experimental procedures were performed in terms of biological oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids treatment (TSS). Also, the performance of plastic beds in terms of pollutant reduction was better than gravel and rubber beds, and gravel beds were more advanced than rubber beds

**KEYWORDS:** Natural Wetlands, Horizontal Constructed Wetlands, Domestic Wastewater, Experimental Investigations , BOD , COD , Wastewater Treatment .

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## I. INTRODUCTION

**General :**

Rapid population growth of India affects pollution rate of natural resources as well as unavailability of good water and air. Water also plays an important role in the water cycle and in human survival. Controlling pollution and using water properly is everyone's responsibility. Globally, the lack of clean water is a growing problem and natural water resources are insufficient to meet their needs as cities become more populous and industrialized and important to improve sanitation and the environment. The number of countries that have been affected by water scarcity over the past forty years are mostly developing countries. With global water scarcity issues, it is important to consider non-standard water sources to meet the growing demand for fresh water.

There are two basic reasons for treating wastewater: to prevent pollution and thereby protect the environment, and to protect public health by securing water supplies and preventing the spread of waterborne diseases. Throughout history, wastewater management has presented people and governments with wide-ranging technical, economic, and political challenges that have necessitated the development of wastewater management strategies in different eras and cultures. In the 21st century, it can be said that technologies for treating wastewater are now well established and can achieve almost any degree of purification. The Horizontal flow constructed wetland is established as most economical.

**Horizontal Flow Constructed Wetland :**

Among the wetlands covered, HSSF-CWs are a widely used concept (Vymazal, 2005). Pre-treated (to avoid clogging) wastewater flows horizontally (i.e. inlet and outlet horizontally opposite) through the artificial filter bed of porous media, usually composed of a matrix of sand or gravel and the macrophyte roots and rhizomes. This matrix is populated by a layer of attached microorganisms that form a so-called biofilm. Cleaning occurs through a variety of physical, chemical and (micro)biological processes such as sedimentation, filtration, precipitation, sorption, plant uptake and microbial decomposition. The subsurface flow regime has a major impact on the physico-chemical conditions that develop in the HSSF-CW treatment reactor and on the types of vegetation that can be grown in this type of wetland (Fonder, 2010). The HSSF-CW have the advantage of a smaller footprint or land requirement (because the contact area of water, microorganisms and substrate is large), a lower risk of the spread of vector diseases and odors compared to surface flow type wetlands where the majority of the atmosphere lies exposed wastewater streams.

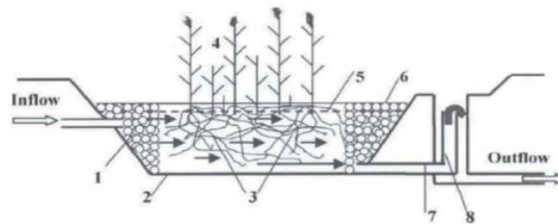


Fig. 1 : Schematic representation of a constructed wetland with horizontal sub-surface flow.

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| <p>1, distribution zone filled with large stones; 2, impermeable liner; 3, filtration medium (coir, crushed rock); 4, vegetation; 5, water level in the bed; 6, collection zone filled with large stones; 7, collection drainage pipe; 8, outlet structure for maintaining of water level in the bed.</p> |
|---|

### Constructed Wet Land :

Engineered wetland systems for wastewater treatment technologies have proven to be effective, inexpensive, and sustainable. The removal of contaminants from these systems is based on a combination of physical, chemical and biological processes. Wetlands have been developed and built that utilize natural processes to treat wastewater. Plants, soil and small microorganisms were used to remove pollutants from the wastewater. Developed wetlands have been used worldwide and have achieved good results. Wetlands were built using engineering technologies for the following reasons:

- To compensate for the conversion of natural wetlands by agriculture and urban development.
- To serve as a flood control center and to produce food and fiber.
- Mainly used to treat wastewater to improve water quality.

### Objectives Of Wetlands :

The main goal of wetlands is to continuously and effectively treat the wastewater coming from different sources.

- The quality of the waste water is identified.
- Improves water filtration and does not harm the water table.
- Treated water Used for plantations.

## II. NEED OF STUDY

From screening the researcher's previous work on various parameters, methods, analysis, case studies and processes, we can arrive at the following objectives.

- Characterization of domestic wastewater.
- Design and manufacture of the engineered wetland unit.
- The optimization variables such as flow rate filter media and duration.
- To check the removal efficiency of various



Fig 2 : Horizontal Flow Wet land

### Advantages :

- Does not have the mosquito problems of the Free-Water Surface Constructed Wetland
- No electrical energy is required
- Low operating costs

**Disadvantages :**

- Requires a large land area
- Little nutrient removal
- Risk of clogging, depending on pre- and primary treatment
- Requires expert design and construction supervision.

**III. TYPES OF WETLANDS**

**Surface Flow Wetland :**

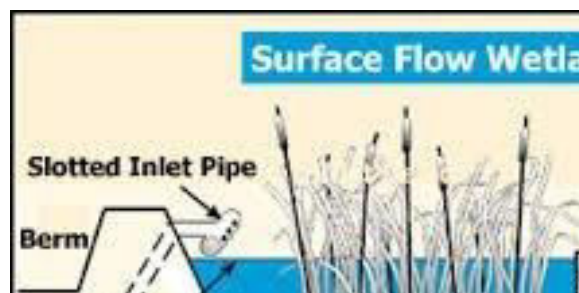


Fig 3.1: Surface Flow Wetland

Surface-flow engineered wetlands Subsurface-flow engineered wetlands A subsurface-flow (SSF) wetland consists of a sealed basin with a porous substrate of rock, gravel, and soil, or a combination of these. The water level is designed to stay below the top of the substrate. The wastewater is pushed vertically into the sediments by gravity. SSF wetlands have been most commonly used to reduce biochemical oxygen demand, chemical oxygen demand, suspended solids, metals, nitrogen, phosphorus, and pathogens from domestic and industrial effluents.

**Subsurface Flow Wetland :**

Vertical Flow Constructed Wetlands is the first book to present the state of the art in the theory and applications of vertical flow wetlands. This

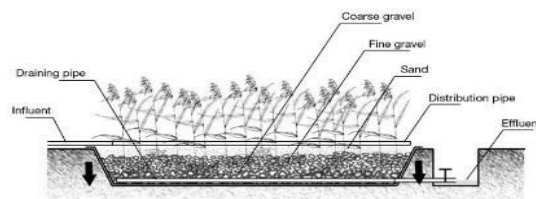


Fig 3.2 : Sub surface Flow Wetland

book will introduce you to vertical flow systems with application and performance information.

A focus on water conservation through reuse of treated water shows the advantage of vertical flow design, which has greatly increased the attractiveness of the technology in recent years. which has greatly increased the attractiveness of the technology in recent years.

**Hybrid Flow Wetland :**

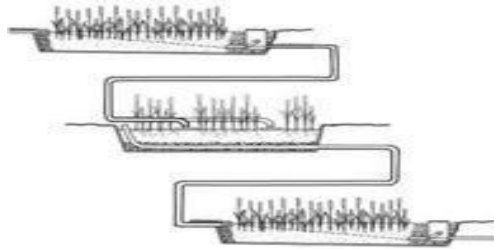


Fig 3.3 : Hybrid Flow Wetland

An integrated constructed wetland is an unbounded constructed wetland with free surface current with emerging vegetation areas and local soil material. Its goals are not only to treat effluent from farms and other wastewater sources, but also to integrate wetland infrastructure into the landscape and enhance its biodiversity.

**IV. MATERIALS USED**

**Coarse Aggregate:**

Coarse aggregate refers to irregular and granular materials such as sand, gravel or crushed stone and is used to make concrete. In most cases, Coarse occurs naturally and can be obtained by blasting quarries or by hand crushing or crushers.



Fig 4.1 : Coarse Aggregate

**Ceremic Pebbles :**

Pebbles are generally considered larger than granular (24 mm (0.0790.157 in) in diameter) and smaller than cobblestone (64256 mm (2.510.1 in) in diameter). A rock that consists mainly of pebbles is called a conglomerate. Flint tools are among the earliest known man-made artifacts from the Paleolithic period of human history.



Fig 4.2 : Ceramic Pebbles

**Coir :**

COIR is a versatile natural fiber derived from mesocarpic tissue, or the husk of the coconut fruit. The shell contains 20% to 30% fiber of varying lengths. After the shell has been ground, the long fibers are removed and used for various industrial purposes, such as: B. for the production of ropes and mats.

canals, dams, bank protection, coastal engineering, and mud fences or geotubes at construction sites.



Fig 4.4 Geotextiles

**Electrical Mortar :**

Most electric motors work through the interaction of the motor's magnetic field and the electric current in a coiled wire to create a force in the form of torque that is applied to the motor shaft.



Fig 4.5 : Electrical Mortar

With a reverse flow of energy, converting mechanical energy into electrical energy the mortar works .



Sewer Pipes :

4.4 Geotextiles :



Fig 4.3 : Husk

A sewer pipe is a conduit for the disposal of waste materials. Sewer pipes come in a variety of sizes and are made of different materials. Over time, these Geotextile composites were introduced and products such as geogrids and meshes were developed. Geotextiles are durable and can cushion a fall. Geotextiles and related products have many uses and currently support many civil engineering applications including roads, airfields, railroads, embankments, support structures, reservoirs, sewers can deteriorate or become damaged and need to be repaired or replaced.



Fig 4.6 : Sewer Pipe

V. METHODOLOGY

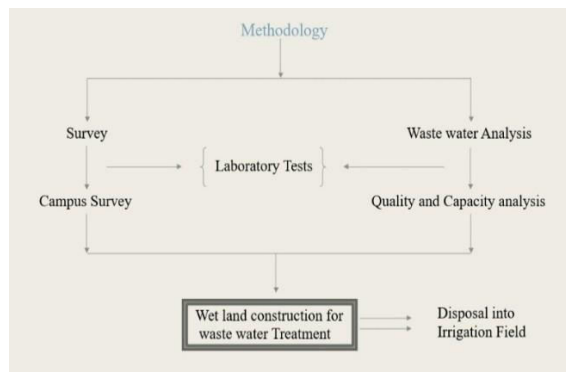


Fig 5 : The fig represents the flow chart showing the methodology of the horizontal wetland on several stages .



### **Construction Process:**

#### **Selection of Suitable Site :**

Choosing a suitable location depends on several factors, such as: B.: Availability of land, people and material, close to the source of sewage, slope of the ground, no damage to the environment, easy access, good transport and pumping system.

#### **Excavation of Wetland :**

Excavation of wet land For the suitable dimensions of 200cm (length) 300cm (width) on the earth's surface. And a depth of 2.7 m at the level upstream and 2.9 m at the level downstream follows the maintenance of a slope of .

#### **Laying of Non Percolation Layer :**

The non-percolating layer helps resist water intrusion into the water table. This reduces the damage caused by sewage seepage.

#### **Spreading Of Gravel :**

The coarse aggregates are used with a size of 8 mm to 40 mm. Before coarse aggregates are spread, the aggregates are cleaned and dried. After drying, the aggregates are distributed on top of the non-seeping layer.

**Laying of Geotextile :** Placement of geotextile on the surface of pre-placed coarse aggregate. The geotextile acts as a separator and resists mixing of one layer with the other layer.

#### **Spreading Of Coir :**

The well sized and shaped char product is placed over the geotextile layer. This charcoal has the ability to absorb the toxins and pollutants present in the wastewater, resulting in purification of the water.

#### **Laying Of Geotextile :**

Placement of geotextile on surface of upstream coir . The geotextile acts as a separator and resists mixing of one layer with the other layer.

#### **Spreading Of Ceramic Pebbles :**

The ceramic pebbles are used with a size of 2 mm to 4.75 mm. Before spreading Ceramic pebbles, the Pebbles are cleaned and dried. After drying, the pebbles are spread on top of the geotextile layer.

#### **Laying of Final Layer of Geotextile :**

Placement of geotextile on surface of upstream Ceramic Pebbles. The geotextile acts as a separator and resists mixing of one layer with the other layer.

#### **Piping System:**

The 1.5 inch diameter polyvinyl chloride pipe is used at the wetland outlet and an L-bend is used to run the pipe up and a similar pipe is connected at the other end.



**VI. RESULTS AND DISCUSSIONS**

The constructed wetland for domestic sewage treatment was performed with different operating variables by monitoring various parameters such as COD, BOD, turbidity, etc. with vertical flow systems and horizontal flow systems, and the results were tabulated as follows.

S.No	Name of Experiment	Results	
		Waste water	Treated water
1.	pH	9.20	7.4
2.	Conductivity	2	1
3.	Acidity	175mg/l	98mg/l
4.	Alkalinity	84mg/l	115mg/l
5.	Chloride	365mg/l	280mg/l
6.	Total Dissolved Solids	0.012mg/l	0.0015mg/l
7.	Turbidity	54NTU	12NTU
8.	Biological Oxygen Demand(BOD)	7.5mg/l	2.5mg/l
9.	Chemical Oxygen Demand (COD)	350mg/l	75mg/l

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