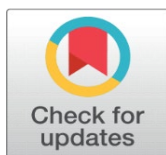


# CLEAN DEVELOPMENT MECHANISM AND CARBON CYCLING OF SEWAGE WASTE BY CONSTRUCTED WETLANDS

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## ABSTRACT

Wetlands, which can be artificial or natural, which provide a low-cost method of wastewater treatment in both rural and urban regions. The term "Constructed Wetland Treatment System" refers to a system that is specifically designed to improve water quality as a major goal and is termed as CWTS. Many of these systems were built in the past to treat small quantities of wastewater contaminated with easily degradable organic debris from outlying sections of cities and towns. However, the desire for better water quality has increased in recent years, and water reclamation and reuse is now the primary driving force for the implementation of CWTS around the world. Natural wetland losses have prompted the establishment of constructed or manmade wetlands, also known as engineered wetlands, which offer the same roles and values as natural wetlands around the world. Planting emergent macrophytes, which go through the physical, chemical, and biological processes of natural wetland systems, gives CWTS its natural qualities. In the last 50 years, the number of CWTS in use has skyrocketed. Constructed wetlands are becoming increasingly popular and important. These systems are typically utilized in towns and cities for tertiary wastewater treatment. Surface-flow systems are typically used to remove suspended particulates as well as low concentrations of nutrients such as nitrogen and phosphorus. These developed wetland treatment systems are also employed to provide village residents with secondary sewage treatment. These engineered wetland systems have proven to be a cost-effective and energy-efficient approach to achieve high wastewater treatment efficiency. Wetlands are typically built for one of four basic purposes: to create habitat to compensate for natural wetlands that have been converted for agricultural and urban development, to improve water quality, to manage flooding, and to produce food and fiber (constructed aquaculture wetlands). In this study, sewage wastewater is treated by constructing a horizontal sub-surface flow created wetland with reed grass as vegetation to treat waste and clean sewage wastewater.

**Keywords:** CWTS, Reed Grass, Horizontal Subsurface Flow, Sewage Waste, CWTS, Department, Government



## 1. INTRODUCTION

The clean development mechanism allows a country to reduce or limit waste emissions as part of a Kyoto Protocol commitment to conduct a waste emission-reduction initiative in developing countries. As a result, the CW can do carbon reductions by accomplishing them in nations, as reducing greenhouse gas emissions is less expensive by this technology, while also funding clean technology projects in underdeveloped countries. CDM's main goal is to reduce greenhouse gas emissions in a more cost-effective way. Wetlands are designed to reduce greenhouse gas emissions through carbon cycling. Constructed wetlands are sinks for Greenhouse gases. To reduce greenhouse gas emissions from the environment, multiple solutions are available, one of the most cost-effective methods is the construction of wetlands. Water samples are collected, and water flows are used to determine carbon inputs and outputs. Surface and ground water, precipitation, and the concentration of carbon (dissolved and particulate, organic and inorganic) in these flows are all factors in determining the volume of the flows. Wetlands, both natural and man-made, are important carbon sinks.

Wetland vegetation traps air pollutants especially atmospheric carbon dioxide. The sink of carbon cycling is the ecosystems growing in the wetlands. Wetlands increase carbon reserves by reducing greenhouse gas (GHG) emissions from the wetlands and so restoring their carbon storage, which is important in the context of climate change, which is harmful to humanity. Construction of wetlands is a cost-effective means of preserving current carbon stocks and minimizing Carbon dioxide and GHG emissions. Constructed wetlands are man-made wetlands that are designed to filter a variety of contaminants from the water that flows through them. They operate as "environmental filters" or "Nature's Kidneys." Many mechanisms are used in specially planned constructed wetlands, mostly phytoremediation (i.e., through plants, particularly Macrophytes). In order to achieve better treatment performance various types of constructed wetlands could be combined into Hybrid systems as per our requirement.

**Figure 1**



**Figure 1** construction of wetland

**Source:** Author

**Figure 2**



**Figure 2** Plantation of reed grass in wetland

**Source:** Author

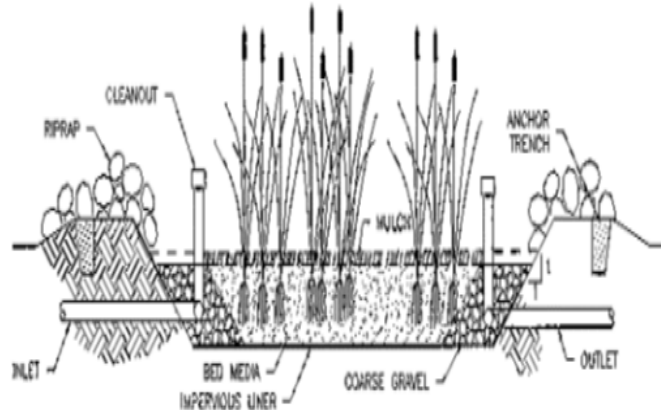
## **2. METHOD AND METHODOLOGY**

The characteristics of constructed wetlands vary. While constructing a wetland, the design, characteristics, and techniques involved may alter, depending on the necessity, which is based on the pollutants to be removed. Municipal wastewater of the city is selected, and pre-treatment is done. The domestic sewage carried out through the sewage network from residential area contains grit, heavy solids, and floatable materials, such untreated wastewater is passed through a zone called pre-treatment chamber with some open head space. After retention and setting for about 3 hours, the wastewater enters into half fitted round rocks boulders to filter prior to entering into the inlet, then to the main treatment chamber.

The main treatment is done in Gravel bed which is a one called rectangular earthen wetland with the daily wastewater treatment capacity of 40 – 50  $m^3$ . The bottom was graded for gravity flow from inflow to outflow and sealed by 8 cm thick local clay having impervious property. In the surface area of gravel bed Reed grass was planted which was collected from naturally occurring population. The common reed grass (*Phragmites karka*) is a fixed element of wet ecosystems; it may expansively grow under favourable conditions. Rhizomes are most important part of the plant. Rhizome may grow up to 4-10 m of length per year.

The treatment includes three steps: -

- 1) Pre-treatment zone
- 2) Inlet zone
- 3) Outlet zone

**Figure 3****Figure 3:** Construction method of a sub-surface flow Constructed wetland**Source:** Author

Sample was analysed before and after entering the treatment zone for the following parameters: -

- 1) Temperature
- 2) pH
- 3) D.O.
- 4) BOD
- 5) COD

The Constructed Wetlands of Horizontal Subsurface Flow type consist of gravel or rock beds which are sealed by an impermeable layer and then planted with most common wetland vegetation i.e., reed grass. The wastewater from municipal nalas is fed at the inlet zone, which flows through the porous medium filled under the surface of the bed in a horizontal path having gradient so that the water reaches the outlet zone, where it is collected and then discharged or collected for further use. In the filtration beds, the pollutants present in municipal wastewater are removed by microbial degradation and chemical and physical processes of aerobic and anaerobic types. The areas around the roots, where oxygen is released to the substrate, removes the pollutants present in water more efficiently.

Käthe Seidel, who created the Horizontal Flow Constructed Wetlands using coarse materials as the rooting medium, invented this type of constructed wetland in Germany in the 1950s. Reinhold Kickuth in 1960 proposed that soil media with high clay concentration can also be a better option for treating wastewater and coined the term "Root Zone Method." High treatment effects for organics and suspended particles were observed using these soil-based systems. Later, soil was replaced by coarse material, and washed gravel or rock with a grain size of 10–20 mm is now often used.

**Figure 4****Figure 4** Reed grass (Phragmites karka)

Source: Author

Because the quantity of dissolved oxygen in the filtration beds is relatively low, organic compounds are successfully converted into simple compounds mostly by microbial degradation under oxygen-deficient or anaerobic conditions. Filtration and sedimentation are the primary methods for removing suspended particles, and the removal efficiency is usually extremely high. Denitrification is the primary nitrogen removal mechanism in HF CWs. Because there is constant soggy conditions in the filtration bed, ammonia removal is reduced. In HF CWs, phosphorus reduction is often low. The most essential functions of reed grass in HF CWs are - the provision of substrate (roots and rhizomes) for the growth of associated bacteria, radial oxygen loss from roots to the rhizosphere, nutrient uptake, and bed surface insulation from heat.

### 3. RESULTS AND DISCUSSIONS

The physicochemical analysis of the water sample before and after entering the treatment plant was done and the following results were obtained. Temperature of the water is seen to change from 17 to 25°C. The pH of the water sample which was slightly alkaline i.e., 8.5 at the inlet was found to be neutralized by the system to 7.1. The removal efficiency of Total Solids by constructed wetlands was 44.4 %. The efficiency of the C.W. to remove Total dissolved Solids is 55.6 % and Total Suspended Solid is 24.2 %. The dissolved oxygen is found to be remarkably increased by 1.30mg/l to 3.45mg/l and the Chemical oxygen demand is found to be remarkably decreased by 105.5mg/l to 31.6 mg/l.

**Table 1**

Table 1 Observation Table			
DESCRIPTION	INLET SAMPLE	OUTLET SAMPLE	% EFFICIENCY
Temp in (Dec – Feb)	17	16	5.88
pH	8.5	7.1	16.4
Total solids	900mg/l	500mg/l	44.4
Total Dissolved Solids	800mg/l	355mg/l	55.6
Total Suspended Solids	95mg/l	72mg/l	24.2

D.O.	1.30mg/	3.45mg/l	165.3
B.O.D.	105.50 mg/l	31.60 mg/l	70

#### Cost of establishing Horizontal Subsurface flow Constructed Wetland

Land, site assessment, system design, earthwork, liners, filtration or rooting media, vegetation, hydraulic control structures, and miscellaneous charges like-fencing, labour for monitoring, etc.) are the primary investment costs for constructed wetlands. Individual costs, on the other hand, vary greatly depending on overall capital cost, gravel type, liner, plants, plumbing cost, control structures, etc.

Pumping energy (if necessary), compliance monitoring, wetland maintenance, pre-treatment maintenance (including regular cleaning of screens and emptying septic or Imhoff tank and grit chambers), vegetation harvesting (if required), and equipment replacement and repairs are all low-cost operations and maintenance options for constructed wetlands. The initial costs are significantly lower than competing concrete and steel technologies. Furthermore, because wetlands have a higher rate of biological activity than other ecosystems, they may convert many of the contaminants found in conventional wastewaters into harmless by-products or vital nutrients that can be used to boost biological productivity. Because the water is treated naturally by the sun, wind, soil, plants, and animals, only a little amount of fossil fuel energy and chemicals are required so it is a cost-effective way to treat wastewater.

## 4. CONCLUSIONS

It has thus been established through the results of present study that the Constructed Wetlands serve as potential of Carbon sinks. The wise use of C.W. for the treatment of wastewater can serve as brilliant technology for the purpose of Carbon sequestration from the waste and soil.

During the last 50 years, constructed treatment wetlands have evolved into a reliable wastewater treatment technique that may be used to treat sewage, industrial and agricultural wastewaters, and storm water runoff. Pollutants are eliminated by mechanisms that are typical in natural wetlands, but some processes take place under more regulated settings in manmade wetlands. Organics and suspended particles are effectively removed by all forms of constructed wetlands, although nitrogen removal is less successful but might be improved by combining different types of CWs which are named as Hybrid type constructed wetland. Unless specific media with high sorption capacity are utilised, phosphorus removal is usually low. Because constructed wetlands use very little or no energy, their operating and maintenance expenses are substantially lower. In addition to wastewater treatment, manmade wetlands are frequently planned as dual- or multipurpose ecosystems that can provide additional ecosystem services including flood control, carbon sequestration, and wildlife habitat.

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## CONFLICT OF INTERESTS

None.

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