Design of Hybrid Constructed Wetlands Reactor for the Treatment of Wastewater: A Review

[1]Prof. Nilesh Pal, [2]Ashish kar, [3]Amitkumar Walde, [4]Sayali Bagade,
[1]Assistant Professor, [1]Academic In charge, [2]Student, [3]Student, [4]Student, [5]Student.
[1]Civil Engineering Department,
[1]J D College of Engineering and Management Nagpur, India.

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ABSTRACT

Constructed wetland method is used to treat Wastewater. It is a low-cost wastewater treatment method which can productively treat wastewater, with the help of biological process. It can be provided a low cost, low maintenance alternative to traditional wastewater treatment. The constructed wetland method is beneficial to treating the institutional wastewater, by this method wastewater can be converted into reusable water and this water can be used for gardening, floor washing, cleaning the utensile & flushing purposes. Constructed wetland provides eco-friendly effective solution over the costlier convention process.

Introduction :-

Today, constructed wetlands are widely used to treat domestic wastewater and agricultural wastewater. Constructed wetland is an environmentally friendly technique for removing pollutants from waste water and has been applied to domestic and institutional wastewater, agriculture drainage, etc. Wetland is one of the effective remediation technologies that now attract environmentalists for the treatment of wastewater contaminants. The constructed wetland system can remove suspended solids, nitrogen, BOD, PH, nitrate, and other pollutants from wastewater by using the biological process. The wastewater is mainly due to the flushing of toilets, kitchens, and cleaning water, which is polluted with bacteria, viruses, washing and cleaning agents, dirt, and leftover food. This can all be filtered by a CW wetland reactor. wastewater, industrial wastewater, and runoff waters. Treated effluent water can be used for irrigation and other water recycling purposes. These pollutants include nitrate, pH imbalances, biological oxygen demand (BOD), nitrogen compounds, suspended sediments, and other hazardous substances.

Wastewater entering wetlands generally comes from many sources, such as defecation, cooking and washing. This wastewater often contains a mixture of microorganism, including bacteria, viruses, detergents, waste products and food. Biological processes found in wetland ecosystem filter, degrade and transform these pollutants in carefully designed reactors.

Additionally, the scope of wetland use extends beyond domestic wastewater treatment. It is also used to treat wastewater and wastewater making it a versatile solution for a variety of wastewater management application. Medical devices produced by wet processes are superior and can be reused in a variety of fields, including agriculture, irrigation and other water supply application.

To achieve this goal, extensive research is being conducted on various materials and their ability to meet removal efficiency criteria. Once these materials are identified, the next step is to establish the correct layer thickness. This process requires the completion of forms for initial testing that allow each processing step to be systematically evaluated. In this form, the treatment process unfolds through a series of layers. Starting with clay, soil, gravel and slit of initial filtration. Subsequent filtration steps involve the use of activated carbon and cotton. Each of these materials makes a unique contribution to the treatment process, working together to effectively removal contaminants from wastewater. The CW reactor itself has a capacity of 15 liters and is made of a durable aluminium housing. The size is 32x32x50cm, providing a compact yet efficient design. The thickness of the individual material is carefully adjusted. The thickness of the soil is approximately 0.051 m, sand is 0.070m, and activated carbon is 0.082 m. therefore, this comprehensive introduction highlights the important role of literature review in the design of continuous reactors for wastewater treatment. He emphasizes the importance of careful selection of material, determining layer thickness, and the actual construction of the reactor itself. This systems approach ensure that CW reactors are well-equipped to address contaminant removal challenges, contribution to more sustainable and environmentally friendly wastewater treatment solution.

Objectives :-

1. To identify best suitable method for the treatment of waste water.
2. To test various wastewater parameter.
3. To identify & analyse material to be used in wetland reactor.
4. To design the hybrid reactor for the treatment of institutional waste.

Methodology :-

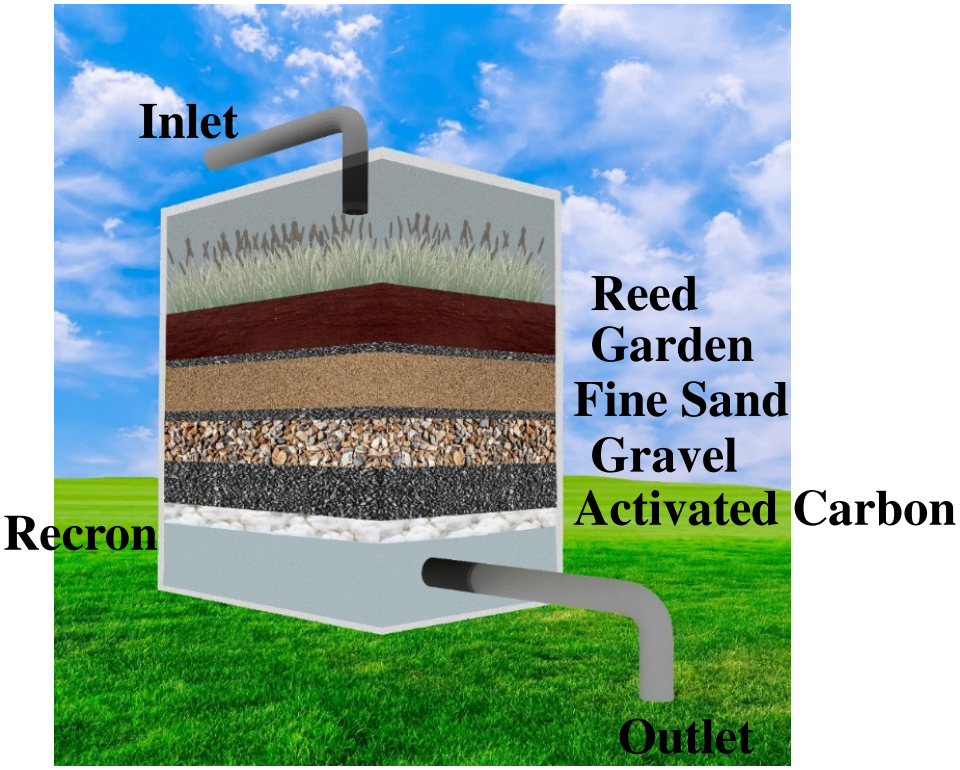
The study of literature reviews understanding and analysing for the use of designing the CW reactor. Various literature were helps to finding the best methods for the treatment of wastewater. In the Initial stage of designing the CW reactor, firstly we have to decide the materials which can be use in treatment process. After that analyse the various parameters for the removal process. The removal process can be done by the multiple layers of the reactor for that we have to check thickness of various layer or filter media for the betterment of the removal efficiency. The pollutants removal can be done by the various materials, that material can be used for the removal of contaminants and then we have to set the thickness, of we have prepare at the moulds for initial testing. In this mould there are so many stages of treatment process, starting from the Clay, Soil, Gravel and Churri for the filtration. In the adsorption process, Activated Carbon and synthetic resin are used.

The CW reactor capacity is a 15-litre, which is prepared with an aluminium frame. The reactor dimension is (32×32×50 cm). The materials thickness of soil is about 0.051meter, sand is 0.070 meter, Activated Charcoal is 0.082 meter.

Materials and their use in filtration process :-

1) Plants:- The aquatic plants are used in the CW reactor for the biological process. The plants are absorb the nutrients from the wastewater, and remove the complex organic material from the selected wastewater.
2) Soil :- It is used for the healthy growth of plants in the CW reactor. It also helps to remove the TDS, colour, and particulate matter from the wastewater.
3) Sand :- Sand is filter media, is maintains the temperature of the water and it also helps to reduce the turbidity, colour and odour.
4) Gravel :- Gravel ability to hold the impurities from the wastewater.
5) Activated Carbon :- Activated carbon is an highly absorbent material because it is highly porous material and provides large amount of surface area to absorbed contaminants.

Design of Reactor :-

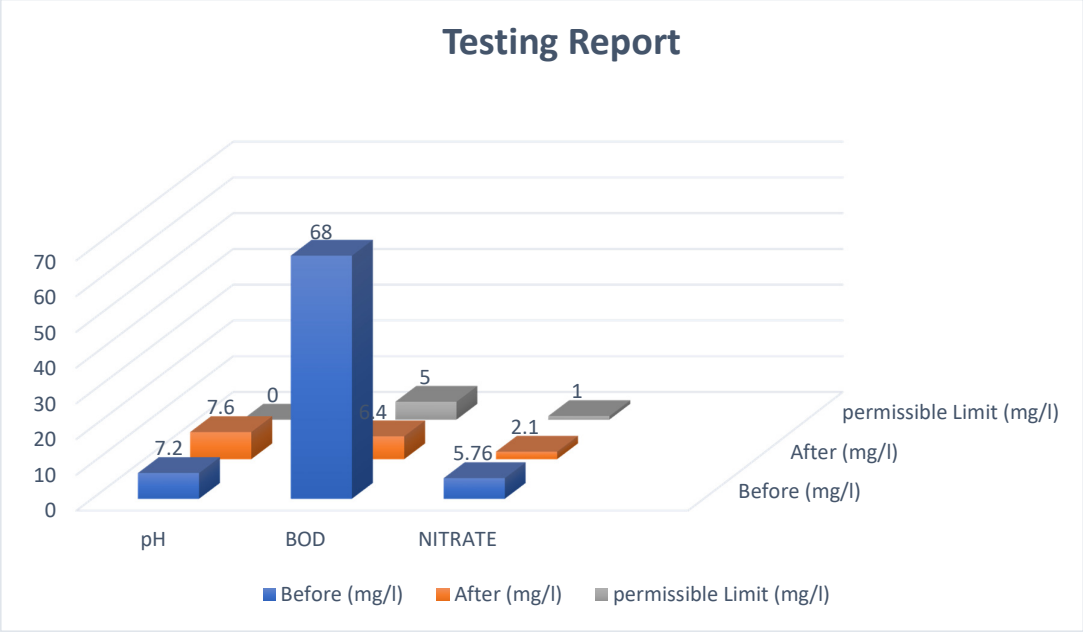


Result :-

Tabular form

Sr. No.	Parameters	Before	After	Permissible Limit
1	pH	7.2	7.6	6.6-8.5
2	BOD	68	6.4	less than 5 mg/l
3	Nitrate	5.76	2.10	1 mg/l

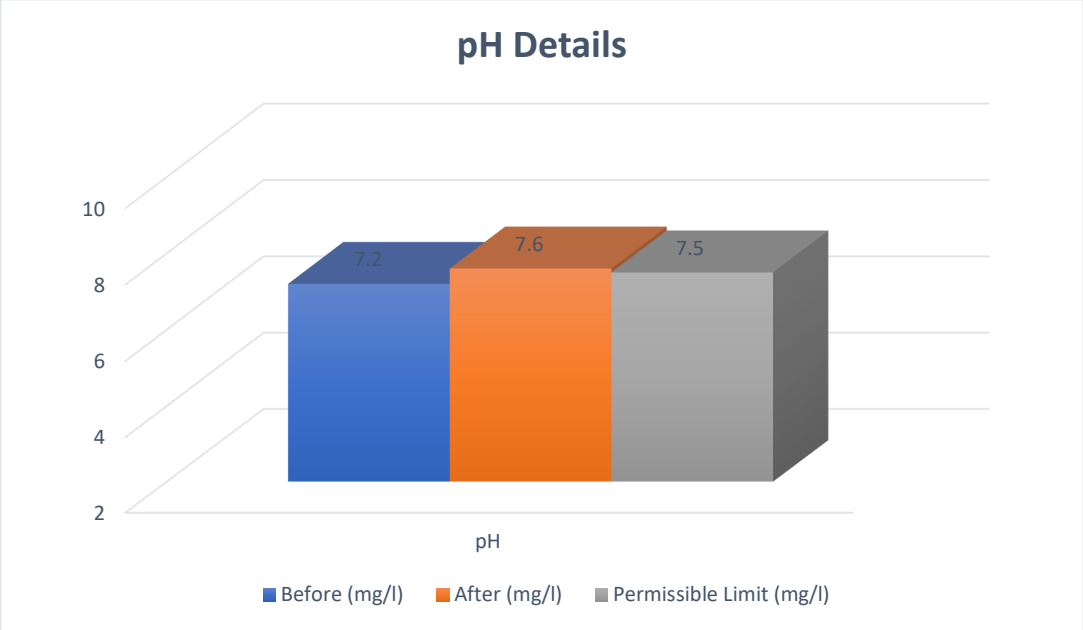
Graphical Form



Combine Graph

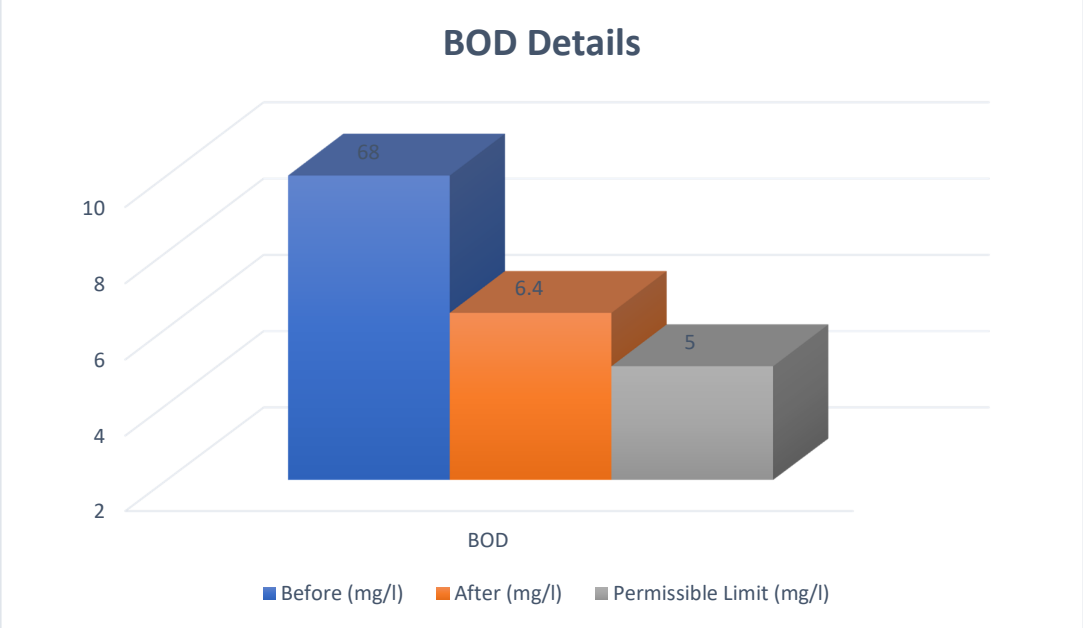
The Testing were done on the various parameters such as pH, BOD, NITRATE, etc. In this testing report we have found that the given parameters are satisfied and under the permissible limit. The removal efficiency of CW reactor is high, nearly 80-85% removal efficiency obtained from CW reactor. The biological, Chemical and physical parameters none satisfied in this CW reactor.

Individual Graphs :-



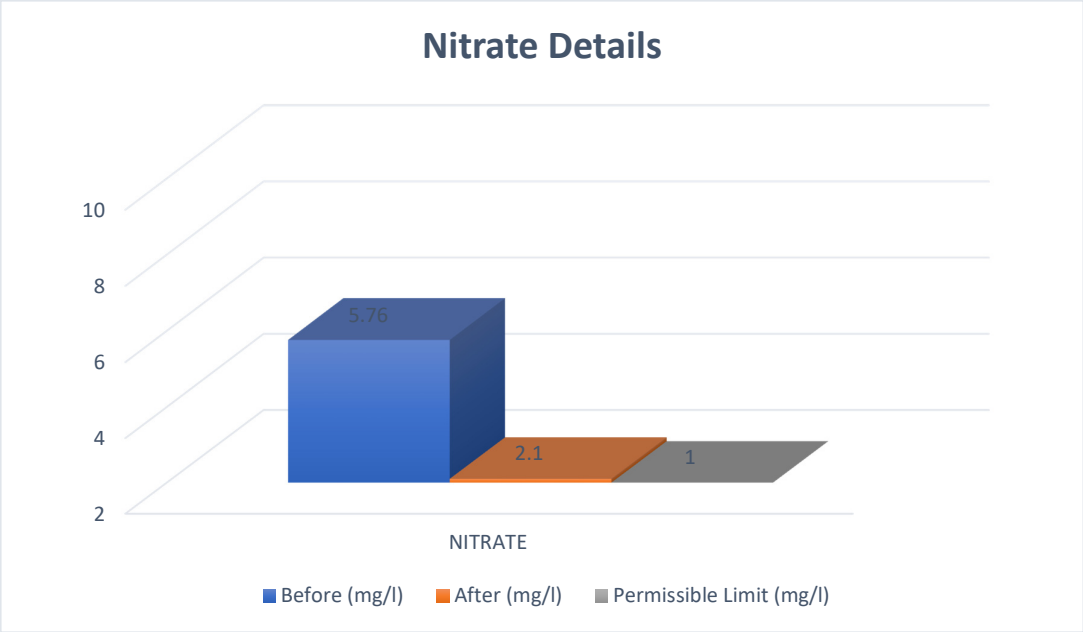
pH :-

The pH of water of pure/drinkable water is 6.5-8.5 in this permissible limit. In this test the pH of water sample is under the permissible limit,



BOD :-

The BOD (Biological oxygen demand). Permissible limit of BOD is less than 5mg/l, in this test we have reduce the BOD in large amount.



Nitrate :-

The nitrate permissible limit is 1mg/l, In this test we have reduce the nitrate amount from the wastewater by the help of CW reactor.

Conclusion :-

The selection of this project gives the societal, economical aspects. The CW reactor is a green technology widely used for treatment of wastewater, in this reactor we have added conventional materials so it can be easily available. The materials we are used in this CW reactor are easily available in the river and nearby markets. The CW reactor gives a high quantity treated water for the reuse like Gardening, Car Washing, Flushing toilets, kitchens and rooms, etc. the removal efficiency of treated water is good for the reuse of water. After the treatment the parameters like, pH, BOD, Nitrate, etc, are under the permissible limit and the removal efficiency of this reactor is very best.

Future Scope :-

Construction of wetland reactors for wastewater treatment appears to have a bright future.

•These technologies have the potential to be very helpful in tackling the problems associated with water contamination. Constructed wetland reactors are expected to become more effective and versatile with continued study and technological development, providing sustainable solutions for treating various types of wastewater.

•Their ability to enhance ecosystem health and water quality while being ecologically benign makes them an important part of future wastewater treatment solutions. Construction of wetland reactors for wastewater treatment appears to have a bright future.

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