International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 30-10-2020; Accepted: 15-11-2020; Published: 30-11-2020
Volume 2; Issue 4; 2020; Page No. 484-490

Modeling of vertical and horizontal subsurface flow constructed wetlands: A review

Garima Madhariya[1], Pramod Kumar Mahish[2]
[1] Ph.D. Scholar, Department of Biotechnology. Govt. Digvijay P.G. College Rajnandgaon, Chhattisgarh, India
[2] Assistant Professor, Department of Biotechnology. Govt. Digvijay P.G. College Rajnandgaon, Chhattisgarh, India

Abstract
The current trend is modeling the simple subsurface constructed wetlands for improving the efficiency of the wastewater purification process by increasing the complexity of the constructed wetland system. This paper reviews some published non-mechanistic and mechanistic models for a constructed wetland. Several authors aimed to model the hydraulic behavior of the system including tracer experiments only. There are few published models the biochemical transformation and degradation processes that occur in the complex system subsurface flow constructed wetland. Models describing reactive transport underwater flow saturated conditions can only be used to model horizontal flow constructed wetlands. Some models are reviewed in these categories that use either a series or a network of ideal reactors (continuously stirred tank reactor and /or plug flow reactors) or are only applicable for constant flow rates to model water flow. Transformation and removal processes are described for organic matter and/or nitrogen. Modeling vertical flow constructed wetland with intermittent loading requires transient variably saturated flow models as these systems are highly dynamic, which adds to the complexity of the overall system. Based on this review need to modeling of constructed wetlands from time to time.

Keywords: Wetland, constructed wetland, subsurface vertical flow constructed wetland, horizontal flow constructed wetland, modeling, cstrs, monad kinetics

1. Introduction
1.1 Wetland
Wetland is regions "where water is the essential factor controlling the environment and the related plant and animal life" they are viewed as an asset since they supply helpful items, for example, peat, and perform an esteemed function, such as water cleansing and carbon stockpiling (Zedler & Kercher 2005) [60]. The principal analysis utilizing wetland macrophytes for wastewater treatment was done by Kathe Seidel in Germany in the mid-1950s (Vymazal 2005) [51]. Wetland treatment system are effective in treating organic matter organic matter, nitrogen, phosphorus, and additionally for decreasing the concentrations of heavy metals, organic chemicals and pathogens9(Langergraber 2001) [27].Lakes are the simplest types of wetland to manufacture, anyway wetland biologists warm that a move towards nonexclusive or novel local wetland types won't support biodiversity (Zedler 2000) [59]. The high natural profitability of wetlands and specific selection procedures of an aquatic presence has delivered a rich biota connected uniquely with wetland (Gibbs 2000) [13]. Natural energy mostly uses, requires low construction and operational expanse by the natural wetland system as is energetically sustainable (Gulzar *et al*. 2018) [14].

The term wetland portrays a various range of the environmental system. The specialized significance of the term wetland incorporates a wide scope of a biological system. Regions that are not overflowed can even now be named wetlands in saturated soil conditions, where during part of typical growing season water is at or below the ground surface (IWA 2000) [18]. The nearness or nonattendance of wetland plants is one of the qualities regularly used to characterize the limit of wetland. In what is usually known as the clean water act of the US government, wetlands are characterized as "regions that are immersed or soaked by surface or groundwater at a recurrence and length adequate to help, and that under ordinary conditions do bolster, a pervasiveness of ordinarily adjusted for including developed treatment wetlands-vegetation that they are vegetated by wetland plants (Brix 1997) [5]. Wetland environment has uncommon qualities which make them especially reasonable for wastewater filtration:

- They are semi-aquatic frameworks which typically contain huge amounts of water. The flooding brought about by wastewater expansion is a typical component of the system.
- They have in part oxic, halfway anoxic soils in which organic matter breakdown happens through unique pathways including electron acceptor other than oxygen, for example, nitrate, sulfate, and iron. Therefore, N just as P elements is altogether different from those in the upland biological system.
- They help profoundly gainful, tall emergent vegetation fit for taking up the huge measure of supplements and reacting to advancement with supplements with upgraded growth. The halophytes likewise circulate air through the dirt rhizophere through aerenchyma in the roots (Verhoeven & meuleman 1999) [50].

Wetland structure at the interface of the earthbound and oceanic biological system and have highlights of both. A wetland is an environment that emerges when immersion by water produces soil overwhelmed by anaerobic procedure, which, thus, powers the biota, especially established plants, to adjust to flooding (Keddy 2010) [22].

1.2 Constructed wetlands
Constructed wetlands were at first created around 40 years back in Europe and North America to abuse and improve the biodegradation capacity of plants (Shutes 2001) [44]. Constructed wetlands are a characteristic option in contrast to specialized strategies for wastewater treatment (Stottmeister *et al.* 2003) [45]. Constructed wetland innovation is a novel methodology for on-location wastewater treatment for the most part portrayed by toxin evacuation limit, effortlessness, low development/activity, and upkeep costs, low vitality request, process strength, and reduced sludge production (Verma & suthar, 2018) [49]. Constructed wetlands are ease, are effectively worked and kept up, and have a solid potential for application in developing nations, especially by little country networks (kivaisi 2001) [25].
Constructed wetlands were at first used for supplement expulsion in domestic and municipal sewage, stormwater, and horticultural spillover showing a wide scope of removal ability. The quickening industrialization in creating nations with a gigantic utilization of metals establishes an ecological pollution hazard. The use of wetlands for industrial wastewater treatment is a promising option (Maine *et al*. 2006) [31]. All things considered, the built wetlands are constructed frameworks structured and created to use the natural procedures including vegetation, soil, and their related microbes to help with treating wastewaters (Khandare *et al*. 2013) [24].
Developed use targets in wetland have been utilized in light of various use destinations, for example, utilizing regarded wastewater effluent as a water hotspot for the creation and restoration of wetland domain for greenery, and reuse in framing or environmental improvement (Gulzar *et al*. 2018) [14]. On the off chance that wastewater is to be treated as productively as would be prudent, definite learning, for example, the viability of different plant species, the colonization qualities of specific gatherings of microorganisms, and how biogenic mixes and specific contaminants (wastewater parts) interface with the channel bed material-is basic when structuring developed wetlands.

2. Components of constructed wetlands
2.1 Water
Wetland hydrology is generally perceived as an essential impact on wetland nature, improvement, and diligence (Erwin 1989) [12]. The connection between groundwater and surface water and the discharge-recharge relationship in wetland influence water quality and supplement spending plans just as vegetative arrangement. Hydrologic consideration of wetland nature incorporates nitty-gritty water spending plans, water science, water system, and limitations (Carter 1986) [6]. Groundwater stream has been demonstrated to be a huge determinant of the physical and compound conditions of other aquatic systems. The measure of ions conveyed by groundwater is regular a lot higher than surface water and can impact the pH and supplement status of the wetland (Hunt *et al*. 1999) [17].
Little changes in hydrology can have a genuinely noteworthy impact on wetland and its treatment viability. Because of the huge surface region of the wetland its shallow profundity, a wetland system communicates firmly with the climate through precipitation and evapotranspiration. The thickness of vegetation of a wetland firmly influences its hydrology. A high system hydraulic effectiveness can be accomplished by the legitimate meaning of the shape and depth of the wetland or pond, and the location and type of inflow and outflow structures. Ideal hydrologic viability and hydraulic efficiency give the most suitable conditions for advancing thefundamental biological and chemical procedures of Strom water treatment (Wong *et al*. 1999) [53].

2.2 Substrate, Sediments, and Litter
The choice of reasonable substrates to use in CWs for industrial wastewater treatment is a significant issue. A few examinations were done on choosing wetland substrates particularly for sustainable phosphorus expulsion from wastewater, and the as often as possible utilized substrates, for the most part, incorporate natural material, artificial media, and industrial by-products, for example, gravel, sand, clay, calcite, marble, vermiculite, slag, fly ash, bentonite, dolomite, limestone, shell, zeolite, wollastonite, activated carbon, lightweight aggregate (Albuquerque *et al*. 2009; Saeed & Sun 2012; Chong *et al*. 2013; Yan & Xu 2014) [2, 41, 9, 57]. The determination of substrates is resolved as far as the hydraulic penetrability and the limit of absorbing contaminations. Poor hydraulic conductivity would bring about clogging up of the system, severely decreasing the adequacy of the system, and low adsorption by substrates could likewise influence the long term expulsion execution of CWs. The substrates sediments and litter are significant for a few reasons:

- They support huge numbers of the living organisms in wetlands
- Substrate penetrability influences the movement of water through the wetland, numerous chemical and biological (particularly microbial) changes occur inside the substrates
- Substrate gives storage to numerous contaminants.
- The gathering of litter expands the measure of organic matter in the wetland. The organic matter gives destinations to material trade and microbial connection and is a source of carbon, the vitality source that drives a portion of the significant biological response in the wetland.

2.3 Vegetation
The plant is a significant part of constructed wetlands. Ca is a segment of calcium pectin in the inter-cellular layer of the plant cell wall and place a significant administrative roll in numerous cell reactions (Lamber *et al*. 1998) [26]. K is an activator of more than 40 catalysts and a significant part of cell osmotic potential and charge balance (Kadlec & Wallece 2008) [19]. Mg is a part of chlorophyll and chromosomes and is likewise an activator of numerous compounds in photosynthesis and respiration (Taiz & Zeiger 2006) [47]. As fundamental components for plant growth, Ca, K, and Mg account for0.01~10% of the dry wt. of plant growth, plant uptake of Ca, K, and Mg might be a successful method to evacuate Ca, K, and Mg from wastewater in constructed wetlands (Han *et al*. 2018) [15].
The plant is known to have a complex metabolic system that evacuates, degrades, and sequester the exceptionally poisonous xenobiotic mixes (Khandare *et al*. 2013) [24]. The selection of plants is a significant issue in constructed wetlands, as they should endure the possibly toxic impact of the effluent and its variability (Maine *et al*. 2009) [32].
Common reeds (*Phragmites australis* [cov.] Trin.), Cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and reed canary grass (*Phalaris arundinacea L.*) have been utilized for both domestic

and industrial wastewater treatment. Macrophytes structure the basic segment of wetland which helps to balance out and oxidize dregs. It has been demonstrated that a planted wetland system has higher productivity of contamination evacuation than that without the plant. (Brix 1994) [4]. Diverse plant species are utilized, for this reason, nonetheless, different types of variety *Typha* are now and again utilized for refinement reason in constructed wetlands. The species *Typha* offers focused execution in organic matter maintenance, supplement evacuation, and pathogen reduction (Verma & Suthar, 2018) [49].

The dynamic response zone of CWs is the root zone (or rhizophere) (Stottmeister *et al*. 2003) [45].In the rhizophere, physicochemical and organic procedures are actuated by the collaboration of plants, microorganisms, and soil/silt, to expel substantial metals from wastewater (Khan *et al*. 2009) [23]. Some examinations have archived that macrophytes can improve BOD and bacterial expulsion from wastewaters through sedimentation, mechanical filtration, supplement absorption components, others didn't recognize any huge contrast among planted and unplanted system (Karathanasis *et al*. 2003) [21].

Numerous types of macrophytes are utilized for wastewater treatment. Species choice depends for the most part on the accessibility of the species, their photosynthetic rate, and resistance to the wastewater (Valderrama *et al*. 2002) [48]. The term rhizosphere can be subdivided into the endorhizosphere (the root inside) and the ectorhizosphere (the root's encompassing). The zone wherein the most serious cooperation between the plant and microorganisms is expected. Wetland plants are known to move oxygen into their underlying foundations to help aerobic respiration and to oxidize phytotoxic reduce compound (Fe^{2+}, Mn^{2+}, S^{2-}) in the rhizosphere (Allen *et al*. 2002) [3]. Macrophytes can assimilate pollutants from wastewater straightforwardly into tissues alongside sanitize from catalytic activity by rises the decent variety of the environment in the root zone, in this way they are a key organic factor of wetland (Maine *et al*. 2006) [31]. Macrophytes have a few characteristic properties that make them a basic segment of built wetland. The most significant element of the macrophytes in connection to the treatment of wastewater is the physical impact realized by the presence of plants (Brix 1994) [4].

2.4 Microorganisms

Biofilm (otherwise called periphyton) is a microbial network comprising of bacteria, fungi, and algae, just as other protozoa and metazoan. These microorganisms are joined with the extracellular polymeric substances delivered by the organisms in the biofilm. Microorganisms are significant segments of the wetland system and play a significant role in the organic procedures of supplement evacuation through the nitrification and denitrification process. Hence, biofilms are broadly used to expel supplements from freshwater (Yan *et al*. 2018) [57]. Small groups of bacterial species act incredible impact, and litter and vegetation advance the diversity and abundance of the bacterial community in the constructed wetland (Chen *et al*. 2015) [8]. The presence of coliform bacteria is an indication of the few pathogens that reason ailments, microalgae effectively absorb microbes from the wastewater (Raiz *et al*. 2012) [40].

The biodegradation of industrial wastewater can be improved if the microorganism is recently adjusted to a toxic chemical. Due to the overall increment in water contamination and aquatic ecosystem unevenness, just as the expansion in public awareness, more consideration has been centered on ecological benevolent measures to battle these issues, for example, the utilization of microorganism and their aggregate. In wastewater and water biological treatment system microbial totals all the more regularly comprise of heterotopic microorganisms, for example, bacteria`. Microbial aggregates comprise one of the significant pieces of activated sludge and specific aggregate, which display a better capacity than evacuate pollutants, for example, effectively biodegraded natural issue (Suvilampi *et al*. 2003)[46].

Microbial aggregate plays a huge role in the common aquatic environment and organic wastewater treatment system by influencing essential creation, evolved ways of life, organic matter, and supplement cycling, notwithstanding the gathering of contaminants, for example, pesticides and harmful metals (Wu *et al*. 2012)[54]. Photosynthetic microalgae can uptake nitrogen and phosphorus into their biomass as cell constituents and discharge exogenous oxygen to acknowledge the majority of the high-impact bacterial prerequisites. On the other hand, heterotopic microorganisms can oxidize natural carbon (using O_2 from microalgae as an autotrophic carbon source). In some cases, bacteria can animate algal development by the arrival of nutrients and plant hormones while microalgae can likewise discharge natural intensifies that can be utilized by microbes as a vitality source (Mujtaba *et al*. 2017) [33].

In-plant microscopic organism's affiliation, microbes are fit for contributing toward by and large toxin expulsion by degrading complex natural toxins and absorbing nitrogen and phosphorus. Even though, microorganisms place a significant role in the mineralization of organic toxins and the biogeochemical change of supplements in wetlands (Afzal *et al*. 2015) [1].

3. Types of constructed wetland

The basic classification is usually based on the type of macrophytic growth, further classification is usually based on the water flow regime-

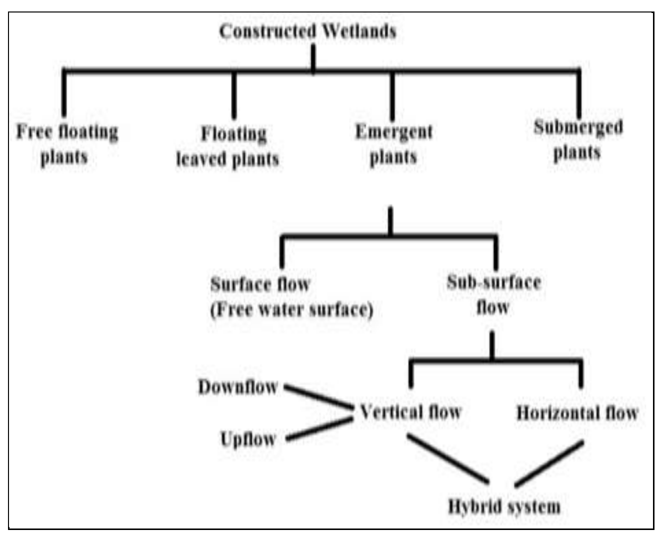

Fig 1: "classification of constructed wetlands for wastewater treatment (Vymazal, 2007) [52]"

Soil-based constructed wetlands are mainly 3 types: they are Horizontal flow system (HF), Horizontal subsurface flow system, and Vertical subsurface flow system (VF) (Stottmeister *et al*. 2003) [45].

HF system is good for- suspended solids removal and bacteria removal because of their ability to filter, BOD removal up to a set oxygen transfer capability, and denitrification (Since it provides oxygen as a part of the nitrate) but poor for nitrification because of limited oxygen transfer capability.

VF system is good for nitrification because of their high oxygen transfer capability which also leads to good removal of BOD and COD. They can also remove some bacteria but less good for suspended solids removal and can become clogged of the sand selection is not correct (Cooper 1999) [10].

4. Modeling

4.1 Modeling of constructed wetland for increasing the surface water quality

Various kinds of models are utilized in various examinations by a mix of various types of macrophytes and stream types for the improvement of water quality. All models are created based on two principle types relying upon the HF system and VF systm (Cooper 1999) [10].

The subsurface stream half breed developed wetland system is constructed by utilizing three rectangular activity units with subsurface vertical and flat stream separately (Sehar *et al*. 2015) [42]. An examination proposed to apply the developed wetland for improving the water nature of the surface run-off, for the most part, the waterway water of Tukad Badung. The developed wetland comprised of four consolidated sorts, for example, 1) the sub-surface model without the vegetation and the surface with the mix of the sweet banner water lily vegetation; 2) the sub-surface model with the sweet banner vegetation and the surface with the water lily vegetation; 3) the sub-surface model without the vegetation and the surface with the water lily vegetation and 4) the surface with the sweet banner vegetation and the surface with the water lily vegetation. The approach utilizes the Water Sensitive Urban Design (WSUD) (Limantara *et al*. 2019) [30].

The trial is set up in a little provincial network named Tidili inside the locale of Marrakech, Morocco. The wastewater treatment plant was made out of three vertical flow constructed wetlands (VFCWs) working in parallel, trailed by two parallel flat subsurface flow developed wetlands (HFCWs), with water-powered stacking paces of 0.5 and 0.75 m3/m2.d, individually. The two units were planted with *Phragmites australis* at a thickness of 4 plants/m2. Wastewater tests were gathered at the channel of the capacity tank and the outlet of the entire framework (VFCWs, HFCWs) stages. The motivation behind this investigation is to assess the efficiency of half and half-constructed wetlands (HCWs) in a rustic rocky zone (Elfanssi *et al*. 2018) [11].

During the most recent two decades, two or three models were created for developed wetlands with contrasting reasons. To excite HF CWs, a few creators have been coupling receptive transport models and ideal reactor models, for example, a progression of CSTR or plug flow reactor reactors, separately (Langergraber 2008) [29]. Mixing cell strategy to display the BOD disposal process. The HF bed is subdivided into various same measured cells that are thought to be blended (Chen *et al*. 1999)[7].water, substrate, plant, litter, and a various types of microorganisms involve in a wetland that provide optimal condition for water quality improvement (Langergraber 2005) [28].

4.2 Modeling based on hydraulic behaviors

A few researchers planned for demonstrating the **hydraulic behaviors** of the system including tracer analyses as it were. There are not many published models that can display the biochemical change and debasement process that happen in the unpredictable system subsurface flow constructed wetland (langergraber 2008)[29]. To decide hydraulic behavior parameters in three parallel inhomogeneous rock beds at an HF CW in Poland. Immediately infused bromide and titanium tracer are utilized to get RTDs. The multi-stream scattering model expected the presence of a few stream ways with various hydraulic properties; it is created utilizing the particular parallel blend of analytical solution from the one-dimensional advection-dispersion equation (Maloszewski *et al* 2006) [34]. Invigorate tracer test and oxygen transport in discontinuous sand channels utilizing in various adaptation. The impact of biomass collection on solute breakthrough is utilized evaluated tentatively by tracer examines (Schwager & Boller 1997) [43].

4.3 Modeling based on monad kinetics

A mechanistic, compartmental reproduction model is created by Wynn and Liehr (2001) [56] to demonstrate and seasonal trend in the evacuation efficiencies of HF CWs. The model comprises six connected sub-models serving to the carbon cycle, the nitrogen cycle, and oxygen balance, autotrophic microscopic organism growth, heterotrophic microbes development, and a water spending plan. Bacterial development rates are model utilizing Monod-type response energy. The carbon cycle deal with few state factors, including plant biomass, dissolved and particulate organic carbon, and refractory carbon. The wetland is accepted to go about as either a single CSTR or a progression of CSTRs. Information from a current CW is utilized to adjust the model. When all is said in done, the model predicts effluent BOD, organic nitrogen, ammonium, and nitrate concentration well. The model additionally imitates regular patterns well. Cooperation's between the carbon, nitrogen, and oxygen cycles were apparent in model yields. Since little was known about the root zone air circulation by wetland plants, oxygen expectations were reasonable. The model is commonly unresponsive toward changes in individual parameters, get together in light of the intricacy of both the biological system and the model, just as the various feedback mechanism. The model is most responsive to changes in parameters that affect microbial development and substrate used straightforwardly. Wynn and Liehr (2001) [56] infer that, with further assessment and refinement, the model could be a valuable structure tool for HF CWs. In any case, no further work has been published since 2001.

Mashauri and Kayombo (2002) [38] build up a coupled model for a waste stabilization pond and HF CW dependent on the growth rate kinetics depicted by Monod dynamic equations. The change of organic carbon considered heterotrophic growth and pass on off of microscopic organisms, and mineralization and settling of organic matter. The fundamental objective of the demonstrating activity was to check the amount of the influent organic carbon is degraded, utilized for biomass growth, and settled. No portrayal of the hydraulic model was given, however, it tends to be expected that the model is just fit for managing consistent flow rates.

Mashauri and Kayombo (2002) [38] infer that the procedures in the pond and CW system likely could be defined by the Monod approach to substrate usage and growth. The conversion of organic carbon was observed to be controlled by mineralization, which contributes to the high growth of heterotrophic microscopic organisms in the systems. This was additionally appeared by the measure of natural carbon collected in the framework. The model additionally uncovered and quantified the measure of algae growing on the usage of carbon dioxide delivered by oxidation forms in the pond.

The model introduced by Mayo and Bigambo (2005) [36] is created to anticipate nitrogen conversion in HF CWs. The scientific model considers the exercises of biomass suspended in the water body and biofilm on totals and plant roots. The state factors demonstrated incorporate organic ammonia, and nitrate nitrogen, which was sectored in water, plants, and aggregates. The nitrogen transformation procedures considered are mineralization, nitrification, denitrification, plant uptake, discharge after plant decay, and sedimentation. Natural conditions considered are temperature, pH, and dissolved oxygen. The trial was utilized for alignment and approval of the model worked with constant water flow, as the model was planned distinctly for steady flow rates. Total nitrogen expulsion of 48.9% was accomplished, with denitrification (29.9%), plant uptake (10.2%), and net sedimentation (8.2%) as the significant pathways. In a further report, Bigambo and Mayo (2005) [36] research the significance of the biofilm biomass in nitrogen evacuation. The measure of biomass present had no influence on the expulsion of organic nitrogen; notwithstanding, it significantly influenced ammonia and nitrate nitrogen change. The developed CW model was additionally combined with a high rate pond (Mayo & Mutamba 2005) [37].

Marsili-Libelli and Checchi (2005) [35] propose the blend of a set of ideal reactors with a strong identification technique to surmise the scattered flow and contamination decrease elements in HF CWs. The models depend on mixes of series and parallel CSTRs of inconsistent volumes in series with plug flow reactor. In every reactor, carbon expulsion is demonstrated utilizing either first-order or Monod kinetics. The inspiration for such a straightforward model was to keep away from the difficulties in assessing the huge number of input parameters required by different models. The estimation procedure registers the parameter's confidence areas based on two differing approximations delivering incidental locales just on account of a predictable identification and in this way permits structured segregation based on the understanding of these regions. This test has been demonstrated to be very responsive to basic and parametric annoyances and can recognize model criticality not uncovered by other execution records. Different model structures have been aligned with informational collections from a few CWs with generally differing hydraulic and contamination evacuation attributes, drawn either from the literature or from field trials performed by the writers. The identification strategy can aid the choice of the best blend of hydraulic through pressure and kinetic to acquire robust but then basic models for HF CWs. It was recommended that the volumes assessed by the identification technique can be utilized for wetland structure.

4.4 CSTR approach based modelling

Rousseau (2005) [39] develops a reaction model that is combined with a system of CSTRs for depicting water flow. The CSTR approach accepts a vertical uniform circulation of substrates, intermediates, items, and microorganisms, which may not be the situation for HF CWs. Vertical blending between the CSTRs was there-fore acquainted with the model vertical gradient in the filter bed. The Activated Sludge Model (Henze *et al*. 2000) [16] is utilized to demonstrate microbial transformations. Particulate substances are joined into the model, to research clogging up and long term evaluation of hydraulic qualities. Moreover, long term simulation joins meteorological information. The created model considers microbiological and plant-related procedures affecting COD and nitrogen in HF CWs. Phosphorus evacuation isn't considered, and it is along these lines accepted that P concentration is non-constraining for microbial and plant growth. Oxygen consuming and anoxic microbial carbon and nitrogen change procedures depend on ASM forms. As oxygen move in HF CWs is constrained, anaerobic microbial processes are considered. The challenge between sulfate-reducing and methanogenic microscopic organisms is displayed as portrayed by Kalyuzhnyi and Fedorovich (1998) [20].

To maintain a strategic distance from microbial restraint due to sulfide amassing, an opposite pathway is predicted by adding sulfide-oxidizing bacteria to the model. Under typical working conditions, it is expected that suspended solids are expelled close to the inlet. Wash-out of solids corresponding to the flow rate is anticipated distinctly at higher flow rates. It is accepted that isolates portions of the biofilm are held inside the pores and used until washed out by a peak flow. The plant growth and decay model was purposely kept basic, portraying plant growth utilizing growth rates that rely upon ammonium and nitrate accessibility. Plant material is expressed as COD, which permits smooth incorporation with the COD-based model depiction of the microbial procedures. Other plant-related procedures incorporate decay, senescence, and physical degradation, and root oxygen loss. A pilot-scale HF CW could be effectively demonstrated utilizing this methodology, even though vulnerabilities have been noted in regards to wastewater fractionation and low estimation frequencies at the experimental plant.

Rousseau (2005) [39] referenced that, at the current state, the model can't be utilized for configuration purposes, yet it may furnish wetland researchers with a system to examine experimental outcomes. The demonstrating activity helped demonstrate the significance of sulfate forms in HF CWs. Research needs referencing by Rousseau (2005) [39] are (i) the physical emphasis process, in connection to parameters, for example, water velocity, porosity, water depth, and water temperature; and (ii) the conduct of particulate substances in the rock gravel (i.e., filtration and settling procedures, and suspension).

5. Conclusion

In this study, try to review different types of wetland models that work better after a few modifications. As compared to the simple form of wetland, combination of two different models gives a better result for wastewater treatment.

6. References

1. Afzal M, Ijaz A, Shabir G, Khan QM. Enhanced remediation of sewage effluent by endophyte assisted floating treatment wetlands. Ecological Engineering. 2015; 84:58-66.
2. Albuquerque A, Oliveira J, Semitela S, Amaral L. Influence of bed media characteristics on ammonia and nitrate removal in shallow horizontal subsurface flow constructed wetlands. Bioresource Technology. 2009; 100:6269-6277.
3. Allen WC, Hook PB, Biederman JA, Stein OR. Temperature and wetland plant species effects on wastewater treatment on root zone Oxidation. Environ. Qual. 2002; 31:1010-1016.
4. Brix H. The function of macrophytes in constructed wetlands. Water Science. Technology. 1994; 29(4):71-78.
5. Brix H. Do macrophytes play a role in constructed treatment wetlands? Water Science Technology. 1997; 35(5):11-17.
6. Carter V. An overview of the hydrologic concerns related to wetlands in the United States. Canadian Journal of Botany. 1997; 64(2):364-374.
7. Chen S, Wang GT, Xue SK. Modeling BOD removal in constructed wetlands with mixing cell methods. J. Environ, Eng. 1999; 125:64-71.
8. Chen Y, Wen Y, Tang Z, Huang J, Zhow, Vymazal J, *et al*. Effects of plant biomass on bacterial community structure in constructed wetlands used for tertiary wastewater treatment. Ecol. Eng. 2015; 84:34-45.
9. Chong HLH, Chia PS, Ahmad MN. The adsorption of heavy metal by Bornean oil palm shell and its potential application as constructed wetland media. Biores. technol. 2013; 130:181-186.
10. Cooper PF. A review of the design and performance of vertical flow and hybrid reed bed treatment systems. Water Sci. Technol. 1999; 40(3):1-9.
11. Elfanssi S, Ouazzani N, Latrach L, Hejjaj A, Mandi L. Phytoremediation of domestic wastewater using a hybrid constructed wetland in the mountainous rural area. Intern. J. of Phytore. 2018; 20(1):75-87.
12. Erwin KL. Freshwater marsh creation and restoration in the southeast. The Status of the Science. Island Press, Washington, D.C, 1989; 239-272.
13. Gibbs JP. Wetland Loss and Biodiversity Conservation. Conser. Biol. 2000; 14(1):314-317.
14. Gulzar F, Mahmood Q, Bhatti ZA, Zeb BS, Shaheen S, Hayat, *et al*. Industrial wastewater treatment in internal circulation bioreactor followed by wetland containing emergent plants and algae: a review. World J. Microbiol. Biotech. 2018; 34(119):1-8.
15. Han W, Ge Y, Ren Y, Luo B, Du Y, Chang J, *et al*. Removal of metals and their pools in a plant in response to plant diversity in microcosms of floating constructed wetland. Ecol. Eng. 2018; 113:65-73.
16. Henze M, Gujer W, Mino T, Van Loosdrecht MCM. Activated sludge models ASM1, ASM2, ASM2D, and ASM3. IWA Scientific and Technical Rep. 9. Int. Water Assn., London, 2000; 121.
17. Hunt RJ, Walker JF, Krabbenhoft DP. Characterizing hydrology and the importance of ground-water discharge in natural and constructed wetlands. Wetlands. 1999; 19(2):458-472.
18. IWA Specialist Group on the use of macrophytes in water pollution control. Constructed wetland for pollution control, 2000.
19. Kadlec RH, Wallace SD. Treatment Wetlands 2nd edn. CRC Press, Boca Raton, FI, 2008.
20. Kalyuzhnyi SV, Fedorovich VV. Mathematical modeling of co- petition between sulfate reduction and methanogenesis in anaerobic reactors. Bioresour. Technol. 1998; 65:227–242.
21. Karathanasis AD, Potter CL, Coyne MS. Vegetation effects on fecal bacteria, BOD, and suspended solid removal in constructed wetlands treating domestic wastewater. Ecol. Eng. 2003; 20:157-169.
22. Keddy PA.Wetland ecology 2nd edn. Published in the United States of America by Cambridge University Press, New York, 2010.
23. Khan S, Ahmad I, Shah MT, Rehman S, Khalia A. Use of constructed wetland for the removal of heavy metals from industrial wetland. J Environ. Manag. 2009; 90:3451-3457.
24. Khandare RV, Kabra AN, Kadam AA, Govindwar SP. Treatment of dye containing wastewaters by a developed lab scale phytoreactor and enhancement of its efficacy by bacterial augmentation. Intern. Biodete. Biodeg. 2013; 78:89-97.
25. Kivaisi AK. The potential for constructed wetland for wastewater treatment and reuse in, developing countries: a review. Ecol. Eng. 2001; 16(4):545-560.
26. Lambers H, Chapin III FS, Pons TL. Plant Physiological Ecology. Springer Verlag, New York, 1998.
27. Langergraber G. Development of a simulation tool for subsurface flow constructed wetlands. Wiener Mitteilungen 169, Vienna, Austria, 2001, 207.
28. Langergraber G. The role of plant uptake on the removal of organic matter and nutrients in subsurface flow constructed wetlands: A simulation study. Water Sci. Technol. 2005; 51(9):213–223.
29. Langergraber G. Modelling of processes in subsurface flow constructed wetlands: A Review. Vadose Zone J. 2008; 7(2):830-842.
30. Limantara LM, Darmawan IG, Solichin M, Dermawan V. Modelling of constructed wetland for increasing the surface water quality by using water sensitive urban design (WSUD). Inter. J. 2019; 16(53):62-69.
31. Maine MA, Sune N, Hadad H, Sanchez G, Bonetto C. Nutrient and metal removal in a constructed wetland for wastewater treatment from a metallurgic industry. Ecol. Eng. 2006; 26:341-347.
32. Maine MA, Sune N, Hadad H, Sanchez G, Bonetto C. Influence of vegetation on the removal of heavy metals and nutrients in a constructed wetland. J. of Environ. Manag. 2009; 90(1):355-363.
33. Mujtab G, Lee K. Treatment of real wastewater using co culture of immobilized *Chlorella vulgaris* and suspended activated sludge. Wat. Res. 2017; 120:174-184.
34. Małoszewski P, Wachniew P, Czupryński P. Study of hydraulic parameters in heterogeneous gravel beds: Constructed wetland in Nowa Słupia (Poland). J. Hydrol. 2006; 331:630–642.
35. Marsili-Libelli S, Checchi N. Identification of dynamic models for horizontal subsurface constructed wetlands. Ecol. Modell. 2005; 187:201–218.

36. Mayo AW, Bigambo T. Nitrogen transformation in horizontal sub-surface flow constructed wetlands: I. Model development. Phys. Chem. Earth. 2005; 30:658–667.
37. Mayo AW, Mutanba J. Modelling nitrogen removal in a coupled HRP and unplanted horizontal flow subsurface gravel bed constructed wetland. Phys. Chem. Earth Parts A/B/C. 2005; 30(11-16):673–679.
38. Mashauri DA, Kayombo S. Application of the two coupled models for water quality management: Facultative pond cum constructed wetland models. Phys. Chem. Earth. 2002; 27:773-781.
39. Rousseau DPL. Performance of constructed treatment wetlands: Model- based evaluation and impact of operation and maintenance. Ph.D. diss., Ghent Univ., Belgium, 2005.
40. Riaz MA, Ijaz B, Riaz A, Amjad M. Improvement of wastewater quality by application of mixed algal inocula. Bangladesh J. Sci. Indus. Res. 2018; 53(1):77- 82.
41. Saeed T, Afrin R, Muyeed AA, Sun G. Treatment of tannery wastewater in a pilo-scale hybrid constructed wetland system in Bangladesh. Chemosphere. 2012; 88:1065-1073.
42. Sehar S, Sumera, Nameem S, Perveen I, Ali N, Ahmad S, *et al*. A comparative study of macrophytes influence on wastewater treatment through subsurface flow hybrid constructed wetland. Ecol. Engin. 2015; 81:62-69.
43. Schwager A, Boller M. Transport phenomena in intermittent filters. Water Sci. Technol. 1997; 35(6):13–20.
44. Shutes RBE. Artificial wetlands and water quality improvement. Environ. Intern. 1997; 26:441-447.
45. Stottmeister U, Wiebner A, Kuschk P, Kappelmeyer U, Kastner M, Beterski O, Muller RA, Moormann H. Effect of plant and microorganism in constructed wetland for wastewater treatment. Biotech. Adv. 2003; 22:93-117.
46. Suvilampi EJ. Microbial diversity in a thermophilic aerobic biofilm process: analysis by length heterogeneity PCR (LH-PCR).Water Res. 2003; 37(10):2259-2268.
47. Taiz L, Zeigar E. Plant Physiology 4th edn. Sinauer Associates Inc., Sunderland, 2006.
48. Valderrama LT, Compo CMD, Rodriguez CM, De bashan LE, Bashan Y. Treatment of recalcitrant wastewater from ethanol and citric acid production using the microalgae *Chlorella vulgaris* and the macrophyte *Lemna minuscula*. Wat. Res. 2002; 36:4185-4192.
49. Verma R, Suthar S. Performance assessment of horizontal and vertical surface flow constructed wetland system in wastewater treatment using multivariate principal component analysis. Ecol. Eng. 2018; 116:121-126.
50. Verhoeven JTA, Meuleman AFM. Wetland for Wastewater Treatment: Opportunities and Limitation. Ecol. Eng. 1992; 12:5-12.
51. Vymazal J. Horizontal subsurface flow and hybrid constructed wetlands system for wastewater treatment. Ecol. Eng. 2005; 25:478-490.
52. Vymazal J. Removal of nutrients in various types of constructed wetlands. Science of the total environment. 2007; 380(1-3):48-65.
53. Wong THF, Persson J, Somes NLG. Hydraulics efficiency of constructed wetlands and ponds. Wat. Sci. Tech. 1999; 40(3):291-300.
54. Wu Y, Li T, Yang L. Mechanisms of removing pollutants from aqueous solutions by microorganisms and their aggregates: A review. Biores. Technol. 2012; 107:10-18.
55. Wu H, Zhang J, Ngo HH, Guo W, Hu Z, Liang S, *et al*. A review on the sustainability of constructed wetlands for wastewater treatment: design and operation. Biores. Technol. 2015; 175:594-601.
56. Wynn MT, Liehr SK. Development of a constructed subsurface flow wetland simulation model. Ecol. Eng. 2001; 16:519-536.
57. Yan Y, Xu J. Improving winter performance of constructed wetlands for wastewater treatment in northern China: a review. Wetlands. 2014; 34(2):243-253.
58. Yan L, Zhang S, Lin D, Gua C, Yan L, Wang S, *et al*. Nitrogen loading affects microbes, nirifiers and denitrifiers attached to submerged macrophyte in constructed wetland. Sci. Total Environ. 2018; 622:121-126.
59. Zedler JB. Progress in wetland restoration ecology. Elsevier Science Ltd. 2000; 15(10):402-407.
60. Zedler JB, Kercher S. Wetland Resources: Status, Trends, Ecosystem Services, and Restorability. Annu. Rev. Environ. Resour. 2005; 30:39-74