Wetland Wastewater Treatment System for Small City Suburbs – A Review

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Abstract

This paper deals with a conceptual idea of integrating natural wetlands into the infrastructure of a city or community for treatment of wastewaters that are generated. The paper deals with constructed wetlands and their role in treatment of wastewater. Following which the idea of how or rather why not can a natural wetland be integrated into the treatment infrastructure is discussed citing the various challenges that may come up when trying to put into action such a system and certain possible solutions that can be tried. This still being at the concept stage, lots more research into the finer details need to be done before such a concept can actually materialize.

Keywords: Phragmites, Root Zone Treatment, Wetlands

1. Introduction

Water is the most essential commodity in today's world. Population explosion, urbanization and industrialization have increased the demand for quality water. Every activity of man needs water, be it agriculture or domestic activities. Use of water however results in generation of its complimentary viz. wastewater. Waste water collection and treatment has become a necessity due to increasing activities of man. There is a growing interest in natural systems for treatment of waste water and in particular for wetland systems. Natural systems have minimal dependence on mechanical elements; hence cost efficient, low maintenance and hence often suited for small and medium water lows.

2. Root Zone Treatment Systems

Root zone treatment system is a natural wetland system for treatment of wastewater in a soil matrix colonized by selective reed plant. There are two types of treatment systems, horizontal flow treatment beds and vertical flow treatment beds. The horizontal flow treatment beds i.e., low marshes, which have porous fills of coarse sand

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or stone while the vertical flow beds are wetlands i.e., high marshes which have layers of sand over gravel, similar to sand filters with plants. Thereed plants used for treatment include *Phragmites australis*, *Typha latifolia* and *Typha angustifolia* etc. The root zone treatment system requires a pre-treatment system which increases the efficiency of the system and reduces the load on the reed beds¹.

The term root zone encompasses the life interactions of various species of bacteria, plants, soil, sun and water. Root zone treatment system is a natural wetland for treatment of wastewater in a soil matrix colonized by selective reed plant. These are of either horizontal flow or vertical flow type beds. They are also known as constructed wetlands. In this system, these plants conduct oxygen through the stem into their root system for favorable conditions for the growth of bacteria. The wastewater flows through the root zone or vertical way where the organic pollutants are decomposed bio-chemically by the bacteria in the rhizospere of the root plants. The filter media are selected carefully to provide favorable conditions for both plants and bacterial growth and to avoid clogging. Organic pollutants are removed from wastewater and are reduced to their elemental form².

3. Mechanics of Root Zone Treatment System

The purification of wastewater is effected in three steps. First is the metabolism of micro–organisms followed by metabolism of plants and finally immobilization in soil and filler material. The efficiency of the reed bed is due to the physical entrapment of pollutants through adsorption in surface soil and organic litter and utilization and transformation of elements by micro–organisms. The cleaning of the wastewater takes place during its passage through the soil, the cleaning components being filtration, ion exchange, adsorption and biological processes. The plants used for root zone treatment systems act as host for pollution eating microbes that convert the organic pollutants in the waste water into harmless products there by reducing the pollution levels of the wastewater³.

4. Wetland Systems as Infrastructure

1Wetland systems can be natural or constructed. Immaterial of how they are going to be incorporated into the scheme of things for cleansing of wastewaters, they can be developed as the required infrastructure required for providing treatment solutions for small communities without the loss of their functionality as a natural entity that can sustain life forms or eco systems⁴. Challenges do lie in front of achieving such an ambitious target of integrating wetlands into the infrastructure of the human society for the betterment of the society and at the same time protecting the integrity and purity of the wetland and avoiding the degradation of the wetland as a ecosystem.

5. Challenges in Wetlands Integration into Infrastructure

Challenges in incorporating the wetland system into infrastructure are numerous. A few have been discussed in the following sections analyzing their potential challenges and ways and methods to overcome them⁵.

6. Quantity of Wastewater Flow

Constructed wetlands are suitable for only small to medium flows and this is the first and foremost hurdle that a planner can encounter when trying to incorporate natural wetlands into a city suburb's infrastructure. This can be overcome by following certain simple options like limiting the flow coming into the wetlands by segregating the flow coming from various sources and diverting the flow into wetlands in different areas. In case, only a small natural wetland is available in the vicinity, this method of treatment can be adopted in collaboration with other treatment methods with only the allowable flow going into the wetland⁶.

7. Quality of Wastewater Flow

Another major challenge that has to be overcome when considering natural wetlands in treating wastewaters is the quality of flow. Right from the outset, it is one of the objectives that the wetlands ecology is not damaged when trying to incorporate them into the treatment infrastructure. The pristine beauty and habitats in the wetland should not be encroached upon by wastewater flow due to the biological oxygen demand arising due to the release of wastewater into the wetland⁷. The only option for overcoming this is to considerably reduce the biological load of the wastewater before release into the wetlands. This can be achieved by segregating the wastewaters coming from water closets from those coming fromkitchens and bathrooms and ensuring that they go through a stage of pre-treatment and if required a stage of primary treatment before they go into the wetlands for secondary treatment. Constructed or artificial wetlands can also be incorporated into the scheme of things in order to ease into the natural wetland system. The heavy loads like sewage from water closets and industrial effluents can be diverted to other treatment systems thus reducing the load coming on both the treatment plants as well as the wetlands⁸.

8. Regulations and Bye Laws

Local rules and bye–laws ensure that the natural wetlands are protected but most of them are blatantlyflouted when wetlands are used as dumping yards and many of the major cities including Chennai have seen a great reduction in its wetlands in the cities suburbs due to large scale dumping of municipal solid wastes. This not only causes irreversible damage to the wetland ecology but also reduces the extent of the wetlands. Wetlands play a major role in diversion of flood water during monsoons. Dumping of solid wastes clogs the wetlands resulting in flooding in the

surrounding regions. On the other hand, use of wetlands for treatment purposes, if done with proper planning and design will ensure that nature plays a role in alleviating a small portion of our problem and at the same time a program like this will ensure that the wetlands are monitored and maintained properly which will enable a proper breathing space for the wetland itself. In order to the enable such a program, some bye-laws may have to be amended, starting on a pilot scale in a small community and checking whether this program is feasible at all and if so, what are the requirements that have to be fulfilled in order to ensure a successful integration of wetlands into the city's infrastructure. During the entire course of the program all parameters that affect the outcome i.e., the integration of the wetlands into the city's infrastructure and ensuring that the wetland does not degrade due to the effluents are to be monitored.

9. Wetland Vegetation

Wetlands may have all kinds of vegetation and may not be suitable for treatment of wastewaters. In such cases, it may be necessary that the kind of reed plants that are efficient in cleansing waters may have to be artificially cultivated in the wetlands to enhance the suitability of the wetlands in treating wastewaters. At the same time, it should be taken care that the reeds that are introduced in the wetland do not choke other plant forms in the wetland and become a weed, there by defeating the purpose of the integration system. Introduction of the reed plants, if not possible seamlessly into the wetland then it may be possible that a portion of the wetland can be segregated and reed plants may be incorporated for treatment systems and the treated waters can flow from these segregated areas into the wetlands after treatment.

10. Opportunities in Wetland Wastewater Systems

Wetlands form a part of the biosphere and they do have their roles to play. In trying to integrate the wetlands into treatment infrastructure, we are trying to utilize the maximum efficiency of the wetland without affecting its basic ability to function as an ecosystem. The opportunities that arise out of this association are immense. The wetlands enable treatment of wastewaters that have to be otherwise dealt with by using specialized methods. The city's infrastructure gets a boost in terms of treatment efficiency and quantity. The waters that are released into the wetlands form a part of the wetlands and over time play a role in recharging the water resources of the area. When wetlands are incorporated into treatment systems, they get due attention in terms of constant monitoring, which ensures the health and maintenance of the wetland and preservation of habitat. When Wetlands are preserved, then they can also play a major role in dissipation of flood waters as a clog free wetland can ensure easy diversion of flood waters into the water bodies. The flood waters when diverted also act as a kind of flush that can dilute the built up biological load in the wetlands that may have otherwise not come up in the monitoring system or that may have been overlooked.

11. Conclusion

The integration of wetlands into the infrastructure of a city suburb or small community is still in the stages of a conceptual idea and the extent of it materializing into an actual system that can be adopted will depend the challenges discussed being overcome. The use of natural system like wetlands for infrastructural purposes is a delicate matter which involves lots of stakeholders and parameters who will be affected and hence the adoption of such a system has to be taken up, if and only if all challenges are met and proper solutions for each are arrived.

12. References

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