



# **iJRASET**

International Journal For Research in  
Applied Science and Engineering Technology



---

# **INTERNATIONAL JOURNAL FOR RESEARCH**

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

---

**Volume: 7      Issue: 1      Month of publication: January 2019**

**DOI: <http://doi.org/10.22214/ijraset.2019.1138>**

**[www.ijraset.com](http://www.ijraset.com)**

**Call:  08813907089**

**E-mail ID: [ijraset@gmail.com](mailto:ijraset@gmail.com)**

# Study of SHEFROL - An Eco friendly Bioreactor used for Wastewater Treatment of Udgaon Village: A Review

Pooja Avinash Bhokare<sup>1</sup>, S.M. Bhosale<sup>2</sup>, J.S. Lambe<sup>3</sup>

<sup>1</sup>M-Tech Scholar, Environmental Science and Technology, Department of Technology, Shivaji university, Kolhaur, Maharashtra, 416004, India

<sup>2</sup>Assistant Professor, Environmental Science and Technology, Department of Technology, Shivaji university, Kolhaur, Maharashtra, 416004, India

<sup>3</sup>Professor, Department of civil engineering, Dr. J.J. Magdum college of engineering, Jaysingpur, Maharashtra, 416101, India

**Abstract:** Today in lots of villages and towns the wastewater is at once discharged into natural water sources such as river, lake and many others. Due to this, many troubles asrised like spreading of diseases, pollution of water resources, reduction of aesthetics of water sources, deterioration of water exceptional, contamination of water resources with polluted rely and it adversely affect on irrigation and fish production. Also, the wastewater is used for irrigation purpose which reasons reduction in fertility of land, reduction in first-rate of soil and many others. To lessen this trouble there's need of proper remedy on wastewater before discharging it into water assets and also to irrigation motive.

**Keywords:** Water resource pollution, wastewater impact on irrigation, wastewater treatment. Aquatic plants, SHEFROL system

## I. INTRODUCTION

Primarily, natural treatments together with soil filter, built remedy wetlands and waste stabilization pond had been the best approach recognized. Initially, importance isn't always given to remedy on wastewater. Wastewater turned into absolutely disposed of within the nearest river, lake, etc. As the groups grew, the sporting ability of the receiving water became subsequently exceeded and troubles began to get up in phrases of aesthetics, public fitness, environmental effects, or, extra commonly, a mixture of the 3. The need for remedy previous to discharge changed into diagnosed at this point and primary treatment became developed to get rid of most of the larger solids and natural be counted. Natural systems were more or less forgotten due to the fact they'd now not accomplished properly below the required masses. As information of the environment, ailment inflicting marketers, and treatment processes accelerated the complexity of the treatment strategies additionally extended to eliminate higher and better percentages of the pathogens and contaminants of concern. The price of treatment regrettably increased as nicely and maintains to accomplish that even within the absence of further boom in remedy complexity. The Clean Water Act further aggravated the trouble with the aid of requiring secondary remedy at many sites that had not formerly used that stage of remedy. Natural remedy structures got here back into attention on the whole as an try to discover a greater fee effective method of achieving the mandated treatment tiers than become available with the prevailing mechanical or chemical techniques. Natural remedy structures aren't disposal practices. Nor are they random applications of waste and wastewater in numerous habitats. Natural remedy systems are engineered facilities which make use of the talents of flowers, soils, and the associated microbial populations to degrade and immobilize wastewater contaminants. The predominant classes of herbal remedy system are land treatment and aquatic treatment structures. Each of those categories may be similarly subdivided primarily based upon the kind of software and the forms of plants used. Land treatment is the utility of wastewater or wastewater sludge's to the soil, and allowing the flowers and soil matrix to dispose of contaminants. Land treatment is split into land farming slow rate irrigation, speedy infiltration, and overland waft remedy structures. These remedy schemes are not in the of this record and as such will not be stated any in addition herein. Aquatic treatment involves passing wastewater via both wetlands or different aquatic plant ecosystems, whether or not natural or man-made. Removal of contaminants takes area by plant uptake, microbial degradation, filtration, chemical precipitation and sedimentation. Wetlands systems are designed around emergent aquatic vegetation (macrophytes) and may be divided into subsurface flow systems and unfastened water floor structures. Observations of the behaviour of floating and submerged plants within the latter structures have been in part chargeable for the of these plant species for use in separate treatment structures. These structures are usually known as aquatic plant structures and are differentiated from wetlands through the understanding that the former carries no massive emergent species. The

principal classes of aquatic plant systems are floating aquatic plant and submerged aquatic plant systems. Aquatic plant systems take on an expansion of paperwork and use many one-of-a-kind species of flowers. Several glide schemes have been tried as well as many variations on the kinds of flowers used and the quantity of plant harvest performed. Conflicting reviews at the contribution of the flowers themselves to the treatment have resulted in widely varied design tactics. Udgaon is one of the oldest village in Kolhapur district having populace about 14513 in 12 months 2007. Udgaon is situated on the bank of Krishna river. In my challenge I am going to use SHEFROL (Sheet Flow Root Level) system to deal with wastewater in udgaon village which is the use of aquatic plants that act as natural retailers of phytoremediation Used for in-situ removal of contaminants within the environment, the time period 'phytoremediation' comes from the Greek phrase for flora ('phyto'). In this progressive system, the wastewater flows as a thin sheet thru the roots of pick aquatic plants in especially designed trenches crafted from plastic sheets. As the flowers develop, thriving on the waste, they constantly detoxify the water. As an end result of the extensive 'water-root-microorganism' contact made in these units, over eighty % of wastewater remedy is finished speedy (in about 2 hours) (Prof. Abbasi ,March 2, 2017) as compared to two days or extra needed in different structures like certainly cardio lagoons, oxidation pond, facultative pond, aerated pond (S.C. Reed, et al., Natural Systems for Waste Management and Treatment, New York, Mc Graw-Hill, 1988). The handled, turbidity-loose water can then be used for irrigation in farms and gardens. No foul scent emanates from the water treatment plant, which doesn't use any type of chemical. A simple system, it could be installation or dismantled effortlessly in addition to scaled up or scaled down as in step with want. It additionally makes use of gravity and the topography, as a result putting off the requirement of pumping water.

## II. LITERATURE REVIEW

S.T. Garba, M. Gundusu and Albina conducted laboratory pot test on native grass species, *Cyperus rotundus* for assessing the absorption and accumulation ability of it Seeds are seeded into soils (?2Kg). The soils have exclusive concentration of metals Zn, Pb, Cd, Ni. Experimental soil is altered by means of adding a hundred and fifty, one thousand and 3000 pp[m Zn as  $Zn(SO_4)_{three}.6h_2O$ ; a hundred and fifty, 500 and 1000 ppm Cd as  $Cd(NO_3)_2$ ; one hundred fifty, 500 and a thousand ppm Ni as  $Ni(NO_3)_2.6h_2O$ . Plants are allowed to grow for 8 weeks below cautious supervision and good enough watering. Soil, shoots and roots of grass had been analyzed the usage of atomic absorption spectrophotometer(AAS). The values indicates that absorption, excessive retention and concentrating of metals in roots with less translocation of shoots. Therefore, it conclude that grass *Cyperus rotundus* is first-class for metals excluder or stabilizer for Zn and Ni having more price of BCF(Biconcentration component) and EF(Enrichmen thing) than TF(Translocation aspect).

Adane Sirage Ali, Piet Lens PN and Hans Van Bruggen JJA investigated the performance of numerous FTWs for home wastewater. Secondary and number one municipal wastewater effluents were used in 5 pairs of FTWs and 2 manipulate. Temperature, pH, electric conductivity, dissolved oxygen,  $NO_3^- -N$ ,  $NH_4^+ -N$ , TDN,  $PO_4^{three-} -P$ , total phosphorus, DOM fractions, DOC, TOC, COD and BOD were measured each week for four months. The presence of plant life created premier pH stage and stimulated oxygen demanding activities within the FTWs. Mean elimination efficiencies of the FTWs for  $NH_4^+ -N$ , overall dissolved nitrogen,  $PO_4^{three-} -P$ , and overall phosphorus become seventy six%, 61%, 53% and sixty three% respectively. Mean  $NO_3^- -N$  reduction inside the secondary influent turned into sixty nine% while for the duration of number one influent remedy phase,  $NO_3^- -N$  awareness turned into elevated in the effluent due to extensive nitrification in the gadget. Among the DOM fractions, fulvic acid changed into the most eliminated (eighty four%) by way of all of the FTWs. All FTWs perform better than the manipulate and; amongst FTWs emergent macrophytes carry out higher than loose-floating hydrophytes mainly under high pollutant loads and with admire to overall performance stability.

Rajendra. B. Magar, Afroz. N. Khan, Abdulrazzak Honnutagi evaluated the impact of Water hyacinth in two specific styles of sewer or drainage line, one from water closet and some other from bathtub or bathe room. Further, the reading of diverse parameters like ability og hydrogen(pH), Turbidity, Chemical oxygen demand(COD), Chloride and shade has been periodically taken every 24 hours fir 5 days. The effect of water hyacinth has ended in importance decrease in turbidity and due to which the removal of flocs and discount in organic count number in wastewater has been discovered. Bruce Alan Hastie has delivered kinds of aquatic flowers used in treatment and basic requirements for their layout and operation. He concluded that aquatic macrophyte device carry out nicely for suspended solids, organic oxygen call for, nitrogen elimination but they do not do as nicely putting off phosphorus. Metals and hint organics removal were investigated however there are troubles with each that need to be resolved before aquatic macrophytes can be used for this sort of remedy on big scale. He concluded that Aquatic flowers are nicely appropriate to regions with an abundance of land and warm weather. The lacks of mechanical parts, opportunity availability make aquatic plant exact applicants for use in underdeveloped countries and lead them to noticeably easy to get running.

J.Vymazal has studied the forms of constructed wetlands for wastewater treatment. Free water surface structures with various styles of vegetation as loose floating, floating stage, submerged and emergent are utilized in many countries. Subsurface flow devices are generally constructed with horizontal flow, but the accelerated need for ammonia elimination initiated a quick development and unfold of vertical flow machines which are intermittently fed. This allows better oxygenation of the bed and consequently higher nitrification. Also, various types on built wetlands can be mixed in an effort to attain better remedy efficiency. Most built wetlands round the sector are still mostly used to deal with municipal and home wastewaters but treatment of many sorts of industrial and agricultural wastewaters, storm water runoff and landfill leachate has lately grown to be additionally not unusual.

Greenway and Simpson (1996) also undertook a have a look at of the Townsville Wetland, which was a U-shaped channel of  $60 \text{ m} \times 4 \text{ m} \times 400\text{-mm}$  dimensions and a detention time of five days with six species of macrophytes (floating, two submerged, and three emergent ones). Their results confirmed that the Townsville Wetland produced superb effluent with 67, forty four, 74, 65, ninety one, and six% discount for BOD, suspended solids, total nitrogen, ammonia-nitrogen, nitrate-nitrogen, and overall phosphorous, respectively.

Greenway and Simpson (1996) studied some other mission inclusive of four linear channels ( $120 \text{ m} \times 7 \text{ m} \times$  six hundred mm) that were planted with 3 macrophyte species of 4-day detention time. The findings confirmed average BOD discounts of forty six% and suspended strong discounts of sixty eight%. However, best three% of overall phosphorus have been eliminated. The researchers (Greenway and Simpson 1996) indicated that the wetland projects confirmed that a superb popular of remedy changed into being performed, making them distinctly powerful in attaining their reuse goal.

Mustafa (2013). Used A horizontal surface-drift constructed wetland treatment system situated in Karachi (NED University of Engineering and Technology) for treating wastewater containing domestic sewage and occasional flows from laboratories of diverse university departments aiming to assess the application of constructed wetlands for reuse. The layout of this pilot-scale built wetland consisted of a mattress this is rectangular in form with dimensions of 6-m top, 1.5-m length, and zero.6-m width; a surface location of nine  $\text{m}^3$ ; a hydraulic detention time of four days; and a drift charge of 1  $\text{m}^3$  in line with day planted with the not unusual wetland plant *Phragmites karka* (Retz.) Trin. Ex Steud. The machine was monitored for eight months for the duration from September 2010 to April 2011. Results confirmed that the common reductions in BOD and COD were 50 and forty four%, respectively. About 48% of effluent BOD concentrations were under the edge of 30 mg/l. The suspended solid elimination performance ranged from 73 to 86% with a mean discount of 78%. Roughly 38% of effluent SS concentrations were underneath the edge of 30 mg/l. The common discount in ammonia-nitrogen concentration for this examine was forty nine%, while the common discount in ortho phosphate phosphate concentration over the monitoring length turned into 52%. Moreover, the wetland decreased both total and fecal coliforms. The common removals of the analyzed indicator bacteria (overall coliforms and fecal coliforms) were within the variety from 93 to ninety nine%, displaying a high efficiency of the constructed wetland gadget in removing pathogens.

Almukhtar et al. (2017) assessed the possibility of recycling home wastewater dealt with through vertical-go with the flow constructed wetlands for crop irrigation. The authors indicated that the studied wetlands confirmed high efficiencies within the elimination of maximum contaminants assembly not unusual requirements of wastewater reused for irrigation. In addition, wetlands had been suggested with the elimination within the variety of fifty five% for chromium (Cr) (Arroyo et al. 2010), between 25 and 35% for nickel (Ni), among 25 and 87% for zinc (Zn), about 9% for copper (Cu) (Galletti et al. 2010), 33% for cadmium (Cd), 75% for cobalt (Co) (Pedrero et al. 2010), and bacterial removal between 1 and 6 log gadgets (Feigin et al. 2012) as shown in Online Resource 1, resulting in the consideration of wetland generation as the most attractive one for wastewater remedy and subsequent reuse (particularly for irrigation functions). These studies indicated that if constructed wetlands are accurately designed and operated, they can be used correctly for secondary and tertiary wastewater treatment underneath local conditions. Hence, built wetlands can be used in the remedy train to upgrade the prevailing malfunctioning wastewater remedy vegetation, specifically in developing countries.

Vymazal et al. (1998, Vymazal et al. 2006) and Wu et al. (2014) studied that Free water floor float built wetlands are comprised of an uncovered aquatic location included with diverse plant kinds inclusive of submersed, floating leaved, free floating, backside rooted, or emergent macrophytes. The operation of loose water surface built wetlands is similar to that of natural ones. This system includes a sealed shallow pool to prevent wastewater leakage to the aquifer with a substrate of 40-cm-thick soil for establishing the macrophytes, as mentioned with the aid of Stefanakis et al. (2014). In loose water floor flow, the wastewater is loaded from the pinnacle; it then horizontally flows thru the machine media generating a water intensity usually starting from 20 to forty cm, but a depth of up to 80 cm. Moreover, remedy techniques such as sedimentation, filtration, oxidation, adsorption, and precipitation will occur as wastewater passes thru this wetland gadget. Since free water surface go with the flow built wetlands carefully simulate herbal wetlands a high flora and fauna range is expected (bugs, mollusks, birds, mammals, and so forth.). Moreover, these styles of

wetlands require a large land place, which lead them to unattractive for agricultural dealt with wastewater reuse and have a excessive capability for exposure of pathogens to people (International Water Association (IWA) Specialist Group 2000). Because of the latter, free water surface glide built wetlands are occasionally used for wastewater remedy because of the high possibility of human publicity to pathogens (USEPA 2000). As a result, this type of wetland is normally carried out for superior effluent treatment from tertiary techniques including trickling filters, activated sludge systems, and lagoons.

Vymazal 2007; Kadlec and Wallace 2008; Tsihrintzis and Gikas 2010 studied that Free water floor waft built wetlands are appropriate treatment technologies for the removal of suspended solids, nitrogen, heavy metals, biochemical oxygen demand, and pathogens. On the other hand, a subsurface go with the flow constructed wetland systems consist of macrophytes planted on substrates of sand or gravel, permitting flooding of the machine with wastewater, to be able to skip thru the media by gravity, enhancing remedy methods .The substrate arrangement on this device will provide a powerful route that enhances the position of microorganisms in the gadget to treat various styles of pollution and permitting mechanisms which include adsorption and filtration to arise.

Suhad A.A.A.N.Almuktar, Suhail.N.Abed, Miklas Scholz (2018) highlighted that Constructed wetlands may be classified consistent with water degree, macrophyte, and water movement management. Wastewater characteristics determine upon the wetland elegance (layout) for use for treatment. Wetland conduct and performance concerning wastewater remedy is especially connected to macrophytes, substrate, hydrology, surface loading charge, influent feeding mode, microorganism availability, and temperature. Having reviewed wastewater reclamation the usage of wetland technology, the following has been concluded: & Pollution is removed through the technique, that's commonplace in herbal wetlands, even as in built wetlands, those tactics are undertaken underneath greater managed circumstances. & All sorts of built wetlands are very effective in eliminating organics and suspended solids, whereas elimination of nitrogen is lower, but will be progressed via the use of a combination of various sorts of constructed wetlands. & Removal of phosphorus is commonly low, until unique media with high sorption potential are used. & Successful pathogen elimination from constructed wetland effluent turned into difficult. & Storage of the wetland effluent in lagoons proved useful for pathogen removal. & Using hybrid wetland systems enhances pathogen removal from the effluent as unmarried-degree wetlands can not meet the standards for irrigation reuse. & Constructed wetlands require very low or 0 electricity input, and therefore, operation and upkeep costs are a lot decrease as compared to conventional treatment structures. & In addition to treatment, constructed wetlands are frequently designed as dual- or multi-motive ecosystems, which may also provide different environment services along with flood manage, carbon sequestration, or wildlife habitat.

Prof. Abbasi (March 2, 2017) used SHEFROL an eco friendly inexpensive, and simple era bio reactor that is Low-Cost Technology Is Helping a Pondicherry Village Treat Its Wastewater, and It Uses Plants. A SHEFROL plant treats wastewater using aquatic plant life – four leaf clover, and water hyacinth – that act as natural dealers of phytoremediation. Used for in-situ removal of contaminants within the surroundings, the term 'phytoremediation' comes from the Greek word for plants ('phyto'). In this innovative system, the wastewater flows as a thin sheet through the roots of choose aquatic flora in in particular designed trenches crafted from plastic sheets. As the vegetation grow, thriving on the waste, they continuously detoxify the water. As a result of the in depth 'water-root-microorganism' touch made in these units, over 80 % of wastewater treatment is finished speedy (in approximately 2 hours) as compared to two days or more wanted in different systems.

### III. CONCLUSION

After surveying all of the above studies articles, it is able to be concluded that, the usage of aquatic plants for treating wastewater treatment could be very efficient in all components. The SHEFROL technology can be used anywhere. It uses the topography and gravity, hence removing the requirement of pumping water. The handled, turbidity-free water can then be used for irrigation in farms and gardens. No foul odor emanates from the water treatment plant, which doesn't use any kind of chemical. A easy device, it may be installation or dismantled without problems in addition to scaled up or scaled down as consistent with need. The SHEFROL is a Low fee era as compared to different sewage treatment plants.

### REFERENCES

- [1] S.T.Garba, M.Gundusu and L.B.Inuwa Accumulation ability of the native grass species *Cyperus rotundus* for the heavy metals; zinc(Zn), Cadmium(Cd), Nickel(Ni), and lead(Pb) International research journal of pure and applied chemistry 17(1):1-15,2018
- [2] Tasneem Abbasi, M.Ashraf Bhatt S. A. Abbasi. Feasibility of using *Salvinia* (*Salvinia Molesta*) as a bio agent for continuous treatment of sewage in SHEFROL bioreactor . Jan 2015.
- [3] Adane Sirage Ali<sup>1</sup>\*, Piet Lens PN2 and Hans Van Bruggen JJA2 Purifying Municipal Wastewater Using Floating Treatment Wetlands: Free Floating and Emergent Macrophytes Department of Environmental Science, Advances in Recycling and Waste Management 2017, 2:3 DOI: 10.4172/2475-7675.1000138



- [4] Rajendra.B.Magar, Afroz.N.Khan, Abdulrazzak Honnutagi Wastewater treatment using water hyacinth civil engineering department,kalsekar technical campus,school of engineering and technology,new panvel,indiadec 2017
- [5] Hastie, Bruce Alan .The use of aquatic plants in wastewater treatment .Dec 1992 . The university of Texas at Austin
- [6] Rahi, R, Gunaseelan ,S. A .Abbasi and Abbasi S. A. (2013). Assessment of role of aquatic macrophytes Eichhornia Crassipe (water hyacinth ) as a bio agent for rapid wastewater treatment in embankment of SHEFROL bioreactor. National conference on hydrology with special emphasis on Rain water harvesting (P 207)
- [7] Suhad A. A. A. N. Almuktar, Suhail N. Abed & Miklas Scholz Wetlands for wastewater treatment and subsequent recycling of treatedeffluent: a review Environmental Science and Pollution Research (2018) 25:23595–23623
- [8] Jan Vymazal Constructed Wetlands for Wastewater Treatment Department of Landscape Ecology, Faculty of Environmental Sciences,Water2010, 2, 530-549; doi:10.3390/w2030530
- [9] S.A.Abbasi , G.Ponni, S.M. Tauseef. Treatemnt of sewage by weed Ipomoea Aquatica. A feasibility study on Bench scale SHEFROL Bioreactor. Advances in Health and Environment safety . PP 353-359, 29 Dec 2017. Springer Transactions in civil and Environment Engineering springer, Singapore.Chapter 30 , volume I.
- [10] Prof S.A /Abbasi. The low cost technology is helping a Pondicherry village to treat its wastewater using plants. March 2, 2017.Innovation , Pondicherry, waste management, water management.



10.22214/IJRASET



45.98



IMPACT FACTOR:  
7.129



IMPACT FACTOR:  
7.429



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24\*7 Support on Whatsapp)