LOW-COST SEWAGE TREATMENT BY ROOTZONE TECHNOLOGY FOR RESIDENTIAL BUILDING AT HERLE DIST. KOLHAPUR, MAHARASHTRA

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Abstract: -

Increasing urbanization and human activities deplete and degrade water resources' quality and quantity. As a result of increased output of home waste, sewage, industrial waste, and so on, freshwater bodies have become polluted. Sewage production is high in urban and semi-urban settings. The world is experiencing a sewage treatment and disposal crisis due to a lack of cost-effective treatment solutions. Much progress has been made in treatment technologies, including aerobic and anaerobic approaches. However, substantial capital investments are necessary to provide treatment facilities; additionally, disposal of treated effluents is a big issue. The cost of operation and maintenance for a traditional sewage treatment plant is estimated to be around Rs 12 per 1000 liters. Due to the expensive expense of treatment, sewage is dumped straight into rivers or surrounding water bodies, damaging the society's water sources. For tiny cities and towns, traditional approaches are impractical. As a result, a low-cost approach of sewage treatment is required. Wastewater treatment using Root Zone Technology (RZT) is emerging as a low-cost alternative that incorporates the use of plant species for sewage treatment. Studies were carried out to determine the viability of Root Zone Technology for sewage treatment. The research is being carried out on various plant species using pilot scale reactors. Plants were planted in the reactor and first irrigated using tap water. To reap the benefits of modern technology and ensure long-term prosperity in a growing country like India, it must be fully utilized.

Key word: Phragmite Australis1, Colacasia2, Sewage3, Characteristics4, Rootzone5, etc…

1. INTRODUCTION: -

One of the major issues in the world is now dealing with is environmental contamination. In India, urbanization, industrialization, and population expansion are the key issues that contribute to environmental degradation. To prevent or avoid any environmental harm, there are severe issues with the collection, treatment, and disposal of home or industrial wastewater. According to research, untreated wastewater discharge is India's main source of surface and groundwater contamination. Sewage is a significant source of pollutants from industrial waste and diseases from human waste. Safe wastewater treatment is therefore essential for the wellbeing of every community. In India, there is a significant gap between the production and treatment of domestic wastewater. There aren't many treatment facilities in this area, and the ones that do exist aren't well run or kept in functioning shape. These places, or any other, frequently produce sewage or waste water that seeps into the ground and evaporates. Uncollected garbage builds up in metropolitan settings, resulting in unhealthy conditions, unsanitary situations, and the release of pollutants that seep into surface and underground water. Processes like preliminary sedimentation, aeration, secondary treatment, and chlorination are frequently used in traditional wastewater treatment facilities. This kind of treatment facility requires a substantial upfront expenditure. Additionally, wastewater treatment plants demand an extra-large amount of space and have substantial maintenance costs. Wastewater treatment facilities typically cost a lot of money and produce subpar outcomes. Since traditional wastewater treatment is exceedingly expensive, most public agencies disregard it. In this section, residential wastewater is primarily discussed. The primary objective of wastewater treatment is to keep receiving water sources clean. Investigated is the fundamental viability of root zone technology for the treatment and discharge of wastewater. One naturally occurring and low-cost kind and method for treating and processing industrial, residential, and agricultural liquid waste is phragmites australis. Phragrmites australis, which has a natural home in floodplains and estuaries, is found there. As the reed beds get older, a thick layer of detritus builds up on top of the water and eventually rises above it, providing opportunities for undergrowth or forest encroachment. Grey water contaminants are removed using artificial reed beds. Due to its horizontal rhizome roots, which guarantee a flawless filtration layer for the root zone, Phragmites australis is regarded as the best plant. When land area is not a significant issue or hindrance, reed mats are regarded as an efficient, dependable, and simple secondary and tertiary treatment option. Reed beds are often constructed in small holes, fitted with drainage pipes, laid with a base of crushed limestone, and filled with sized gravel and sand. Reeds frequently have hollow roots in this sandy area, which allows oxygen to enter the filter layer. The crucial interactions of several bacterial species, reed roots, water, soil, and sun are all covered by the term "rhizosphere." They are also referred to as subsurface drainage systems or manmade wetlands. These trees provide oxygen from the trunk to the roots in this manner, which fosters the growth of bacteria. Root zone technology (RZT) usage is surging in acceptance. This is because it seems to provide a more practical and cost-effective answer to management issues in both developed and developing nations. A natural or artificial root zone system that separates the aquifer system from the above-ground system that is the source of contamination is used in water pollution. These work best in small towns, hotels, hospitals, and educational institutions. Through the root zone, sewage effluent runs both horizontally and vertically. In the root portions of plant roots, bacteria included in organic contaminants are biochemically destroyed. Filter medium is carefully chosen to provide conditions that encourage bacterial and plant growth and to avoid clogging. Wastewater is substantially cleaned of organic contaminants and reduced to elemental form. In the root zone, it can potentially accumulate heavy metals. Root sector remedy systems provide a wide range of programs for treating many types of wastewaters, including domestic wastewater and commercial or industrial wastewater that contains biodegradable components, some of which are challenging to treat with other techniques. Root zone technology is a safe, secure, and ecologically friendly solution with a number of benefits, including minimal investment costs low operating and maintenance costs, and no need for technical knowledge. This kind of technique lasts for a very long period and produces no byproducts.

1.2 Objective of study: -

1. To analyze different characteristics of sewage water from study area.

2. To investigate the feasibility of applying the construction wetland system to treat the sewage wastewater

3. Selection analyze the wastewater treatment efficiency of rootzone system with conventional treatment plant.

4. To find optimum cost for constructed wetland based on number of occupants.

1.3 Study area: -

The area selected for this project is A/P Herle, Dist. Kolhapur, Tal. Hathkngale. which is situated 558 meters/1831feet above mean sea level and 74.32 and latitude 16.74.

Figure 1 Location Map

2. Literature Study: -

1. Mr. Rajnikant Prasad, Professor Rangari P. J, Associate Professor. Dilendra Jasutkar published a paper titled "Wetland construction as an effective treatment method for domestic wastewater treatment" in the Proceedings of the International Research Journal of Engineering and technology. They are working on developing a model laboratory for the Munwha region. Artificial wetlands are systems designed to treat wastewater from a variety of sources. The main purpose of this study is to investigate and find an economic method to treat domestic wastewater and compare the effectiveness of naturally aerated wetlands and artificially aerated constructed wetlands. The laboratory model is filled with filter material and an apparatus is artificially ventilated. This study was conducted by building a laboratory model for the Munhwa region. We tested parameters such as color, odor, pH value, COD, oxygen, etc.

2. Mahesh Mane, Bhupen Patil, Mohit Pawar, Yatin Gohil, Akshaya Garimath. International Research Journal of Engineering and Technology (IRJET) Volume: 04 Number: 03 | March 2017 "Introduction to wastewater treatment using

Root Zone technology". This article describes a root zone treatment system, which is a planted clean out mattress with gravel, sand, and adequate material. This method employs herbal strategies to effectively deal with domestic and commercial wastewater. RZTS is well-known, simple to operate in temperate areas, necessitates low installation, maintenance, and operating costs, and incorporates the self-regulating dynamics of altered soil ecosystems. This strategy has been successfully adopted in a few foreign places. The utilization of constructed wetlands is now recognized as a low-cost ecological generation, especially when compared to high-priced standard treatment techniques. There is a desire to fully utilize this generation in developing countries such as India in order to reap its benefits and facilitate sustainable development.

3. B. L. Chavan1, V. P. Dhulap2, (Volume 2012) International Journal of Physical and Social Sciences (IJPSS) Volume: 02 Number:12| December 2012 "Design and Testing of Wastewater in Constructed Wetlands Using Phragmite Kalka". Constructed wetlands provide cost-effective wastewater treatment. Wetland technology is widely applied in Asian countries. Used against many aquatic weeds and macrophytes. Phragmites karaka is an emerging aquatic weed. Due to its rapid growth rate, it is an emerging macrophyte with potential for sustainable use in wastewater treatment. This article describes the use of Phragmites karaka for wastewater treatment using subsurface horizontal flow systems in wetlands. Wastewater is treated with Phragmites karaka using phytorem edition or rhizosphere treatment technique. Physical and chemical parameters before and after treatment are analyzed and evaluated to reduce pollution load. Observe that wastewater before treatment is black, stinky and has a very unpleasant odour. However, after treatment with Phragmites karka in the artificial wetland, the wetland became clear and odourless. After 96 hours, TS concentration increased by 61.64%, TDS increased by 60.37%, TSS increased by 63.19%, hardness increased by 57.15%, nitrate increased by 94.69%, phosphate increased by 92.95%, BOD increased by 61.47% and COD increased by 64.74%. The results indicate that root zone technology is useful for wastewater treatment and can reduce the pollution load on surface and groundwater.

4. Sagar E. Shinde, Suraj Phad, Prashant Mishra, Saurabh Gaikwad, Shubham Bharade – 3rd International Conference on Latest Trends in Technology, Science, Humanities and Management, April 2017, "Treatment Cost-effective wastewater management using root zone technology". Aerobic and anaerobic therapy technology has advanced dramatically. However, constructing processing facilities necessitates a substantial investment. In addition, the disposal of treated wastewater is a big issue. A typical wastewater treatment plant's operating and maintenance costs are estimated to be roughly Rs 12 per 1,000 gallons. Due to expensive treatment costs, wastewater is dumped directly into rivers and adjacent water bodies, degrading society's water resources.In small towns and communities, traditional methods are impractical. As a result, low-cost wastewater treatment solutions are required. Root zone technology (RZT) wastewater treatment employs plants as a cost-effective alternative wastewater treatment approach Research is being conducted to determine the viability of root zone technology in wastewater treatment. This research will be conducted utilizing pilot reactors for various plant species. Plant seeds are planted in the reactor and are initially supplied with regular water. After the reactor had stabilized, varied doses of wastewater were applied at regular intervals for 3-4 days to examine plant development. The discharge owing to hydraulic load is then determined to be nil after reaching steady state. When the reactor was subjected to high hydraulic stress, we assessed the water quality of the treated wastewater.

5. Rajendra B. Waghmode, Sanket N. Research by Dr. Mandale. Purushottam S. Dange Domestic wastewater treatment using innovative root zone technology examined low-cost waste disposal from conventional waste treatment plants and improved root zone technology and concluded that non-mechanized on-site treatment systems are necessary. The maximum amount of suspended matter will stick to the player, and creatures will receive oxygen from tree roots. Here, dissolved solids are converted into suspended biomass which serves as food for microorganisms and helps decompose organic matter. The system requires no external power source and uses minimal chemicals for disinfection, leaving no footprint. This system also brings additional income.

6. Palmer-Jiger et al. (2016) conducted experimental research on dairy wastewater post-treatment using hybrid reed bed technology. This provides information and findings about milk waste, as well as practical treatment methods. He treated dairy waste with hybrid reeds. The system of hybrid seed bed system is very effective in removing up to 14 mg/L BOD and up to 110 mg/L COD with a residence time of 36 hours, BOD removal efficiency is 97%, and COD removal efficiency is verified. It is 92% for dairy wastewater. TDS and TSS are not reduced much. The pH of old milk is quite alkaline, and the method used has brought the pH closer to neutral.

4. Research Methodology: -

4.1 Water sample collection and analysis

The input and discharge of the wetland unit were studied physically, chemically, and biologically.
Step two is to treat sewage effluent with a constructed wetland while keeping an eye on its viability.
Third, contrast the traditional treatment facility with the rootzone system.
Fourth, calculate the best budget for the man-made wetland based on the estimated number of visitors.

4.2 Reed bed construction and operation

After the unit has been built with separate layers of stone chips, sand, and stone dust, plants will be planted within. Plant development will also be monitored.
Third, during the month-long growing period, just regular water will be sprayed.
Following the collection of samples, the sewage water will be released into the root zone.

4.3 Reed action with wastewater To begin, the root zone system creates space for water to circulate. Second, by delivering oxygen deep into the soil, the roots create an environment conducive to the growth of aerobic microorganisms. The first stage in the biological breakdown of nitro compounds is the oxidation of ammonia to nitrate, which needs the presence of these organisms. Third, nitrification happens, which implies that some of the nutrients in the wastewater are absorbed by the plants. The usage of reed beds has the potential to improve water quality. Kills bacteria and viruses quite well. Reduced levels of suspended particulate matter and biological oxygen demand. Metal removal and nitrogen reduction.

5. Results and Discussions: -

5.1 Ph: Below is a comparison of treatment efficiency between wetlands and conventional sewage treatment plants. The table below shows the average pH drop after conventional STP, Cola Cassia RZT, and Phragmites Australis RZT.

Parameter	Raw sewage	Conventional STP	RZT by Colacassia	RZT by Phragmites Australis
pH	6.7	6.9	7.0	7.2

Table 1 pH reduction efficiency

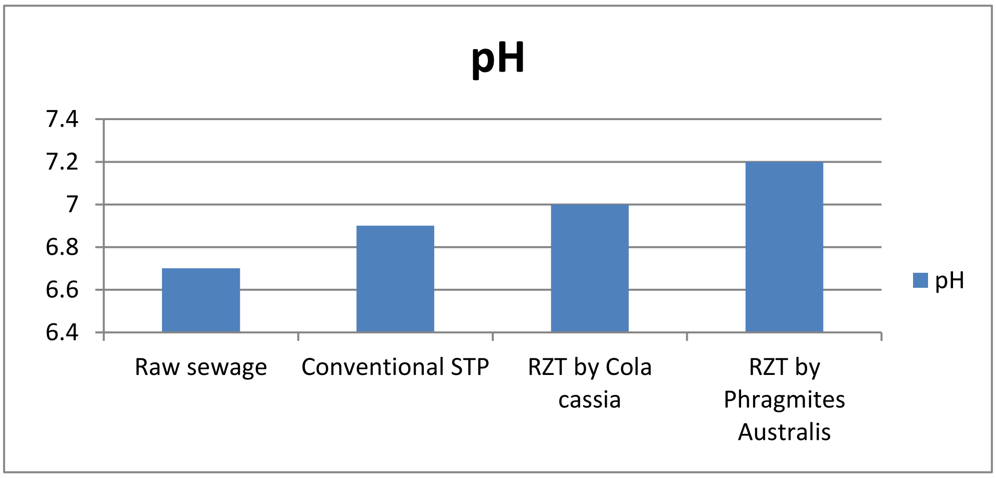

Chart 1 Comparison between treatment efficiencies in pH

5.2 TSS: Below is a comparison of treatment efficiency between wetlands and conventional sewage treatment plants. The table below shows the mean TSS reduction after treatment with conventional STP, RZT with Cola Cassia, and RZT with Phragmites Australis, respectively.

Parameter	Raw sewage	Conventional STP	RZT by Colacassia	RZT by Phragmites Australis
TSS	183	115	95	105

Table 2 TSS reduction efficiency

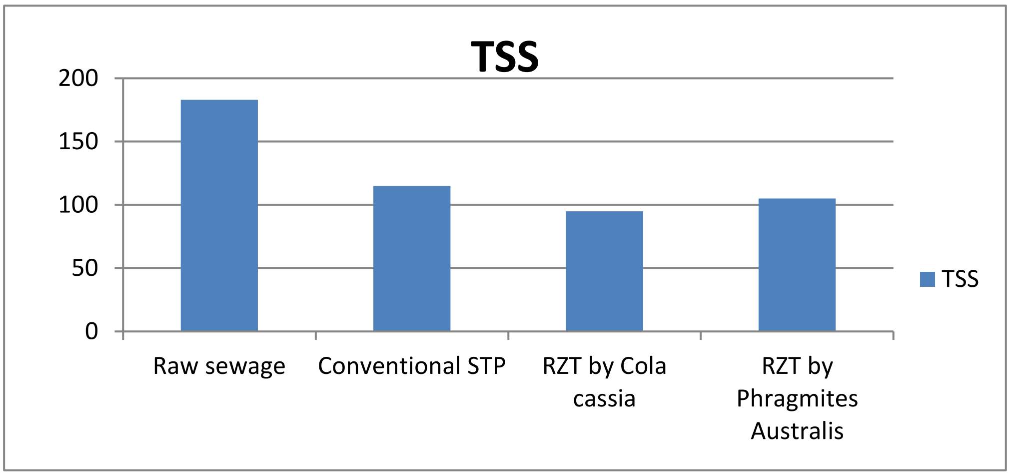

Chart 2 Comparison between treatment efficiencies in TSS reduction

5.3 BOD: Below is a comparison of treatment efficiency between wetlands and conventional sewage treatment plants. The table below shows the average BOD reduction after treatment with conventional STP, Colacassia RZT, and Fragmites australis RZT, respectively.

Parameter	Raw sewage	Conventional STP	RZT by Colacassia	RZT by Phragmites Australis
BOD	280	108	94	101

Table 3 BOD reduction efficiency

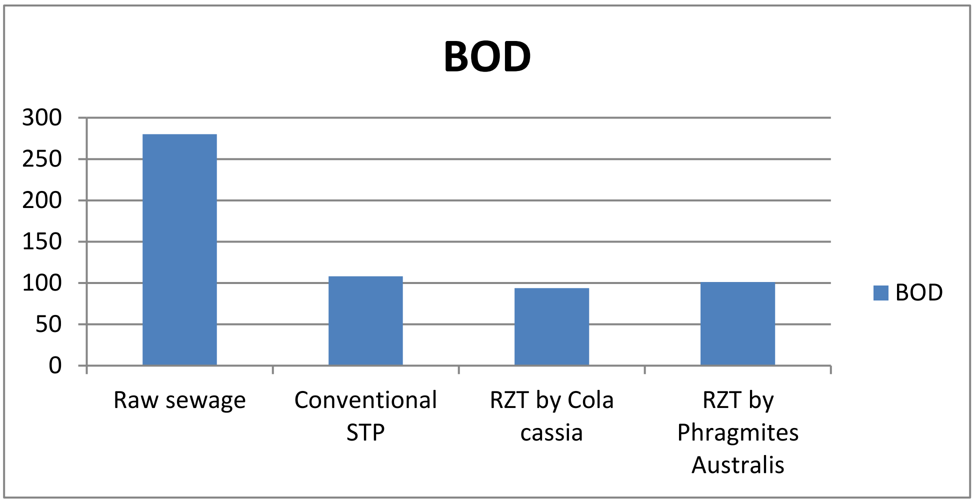

Chart 3 Comparison between treatment efficiencies in BOD reduction

5.4 COD: Below is a comparison of treatment efficiency between wetlands and conventional sewage treatment plants. The table below shows the average COD reduction after treatment with conventional STP, Cola Cassia RZT and Phragmites Australis RZT.

Parameter	**Raw sewage**	**Conventional STP**	**RZT by Colacassia**	**RZT by** Phragmites Australis
COD	442	195	180	210

Table 4 COD reduction efficiency

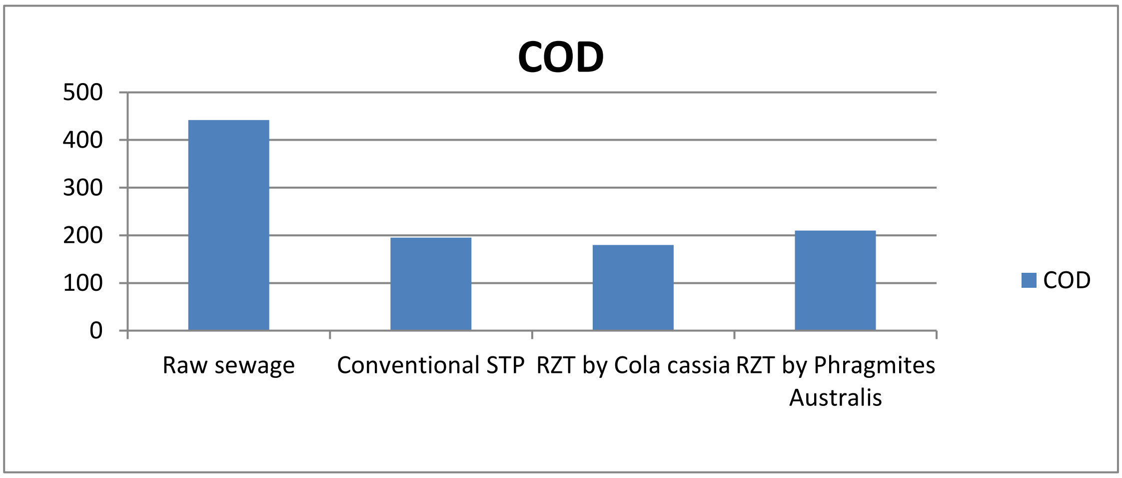

Chart 4 Comparison between treatment efficiencies in COD reduction

5.5 TDS: Below is a comparison of treatment efficiency between wetlands and conventional sewage treatment plants. The table below shows the average TDS reduction after treatment with conventional STP, RZT from Cola Cassia, and RZT from Phragmites Australis, respectively.

Parameter	Raw sewage	Conventional STP	RZT by Colacassia	RZT by Phragmites Australis
TDS	1250	970	940	1020

Table 5 TDS reduction efficiency

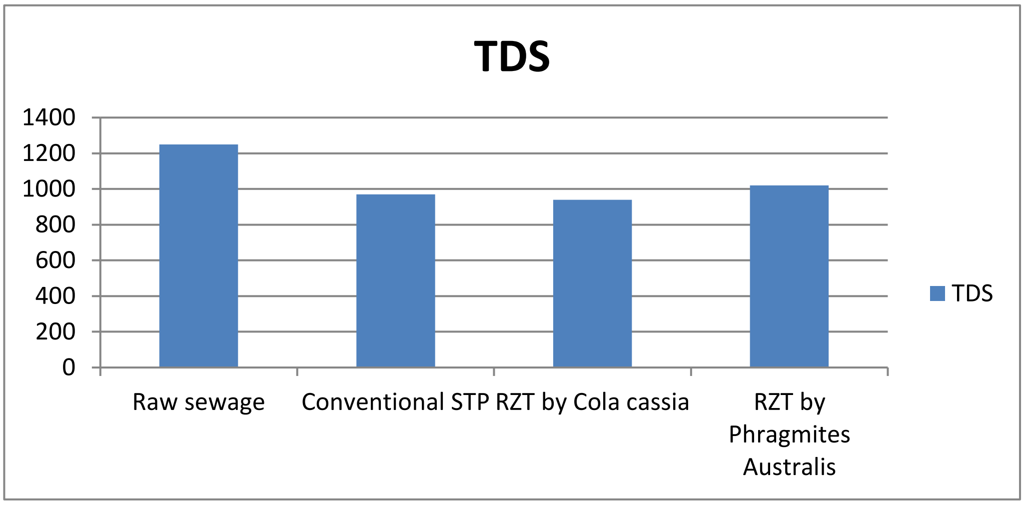

Chart 5 Comparison between treatment efficiencies in TDS reduction

6. Conclusion

Artificial wetlands are widely used in developing countries to treat wastewater from households, laboratories, universities, etc. Building a conventional treatment plant requires a large investment. The operating costs of traditional sewage treatment plants are also very high. For this reason, sewage treatment in our country is seriously neglected. Untreated wastewater leads to poor health in both rural and urban areas. Therefore, according to the above studies, the Green Root Zone technique could be a highly effective treatment method. that's all the results obtained show that Cola-Cassia and Phragmites Australis can be used as alternative solutions for septic tank wastewater treatment. The treatment requires little operation or maintenance. This is a highly effective and economical method of treatment that can be used in small towns, apartments, laboratories, etc. design of 3kld plant which requires minimum 20,000rs. For application but conventional treatment plant cost is almost 5.5lakh. So as compared with conventional treatment plant this plant take less cost of apex but required large area for application of plant. So that, overall cost of this plant is 60-80% is less than conventional treatment plant. If number of occupants increases, it should not affect on this plant. But when we design this plant for more than 3KLD it requires large area. As referred papers cost of expansion for future demand is vary from 20-25% and bit more depending upon various controlling factor.

Based on research results this can be concluded as:

• This study showed that horizontal subterranean wetlands designed with green root zone technology can be used to treat wastewater from campuses, small towns, universities, and so on.

• Based on research, using this technology a reduction in physical and biological parameters can be achieved when using wastewater for horticultural purposes.

• This green root zone technology plays an important role in addition to traditional pre-treatment and pre-polishing processes. Treatment before eating and polishing.

6. References:

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