

Appraisal Paper on Description and Request of Ornamental plants recycled in the Conduct of Sewage Effluent Frozen Plant

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Abstract: Ornamental plants have gained attention as a sustainable and aesthetically pleasing solution for wastewater treatment. Additionally, we discuss the various applications of treated sewage effluent in ornamental plant-based systems.

IndexTerms – Biofiltration, Plant-Based Technologies, Sewage Effluent Reuse.

INTRODUCTION

The ever-expanding urban landscape and rapid industrialization have been accompanied by a staggering increase in sewage generation. As urban centers burgeon and populations surge, the disposal of sewage becomes an increasingly pressing concern. The indiscriminate discharge of untreated sewage into natural water bodies poses a grave threat to the environment, human health, and aquatic ecosystems. In response to this mounting challenge, statutory regulations, such as those issued by the Central Pollution Control Board (CPCB) in many countries, have mandated the installation of Sewage Treatment Plants (STPs) for various infrastructure projects.

This comprehensive review paper delves into the critical issues surrounding sewage treatment, emphasizing the necessity of sewage treatment, the constituents of sewage, and the emerging trends in recycled water utilization. By analyzing the current state of sewage management, exploring innovative sewage treatment technologies, and discussing the benefits and challenges of recycled water use, this review aims to shed light on the multifaceted dimensions of sewage treatment and its implications for urban development, environmental sustainability, and public health.

The Imperative of Sewage Treatment

Sewage, a complex mixture of suspended solids, organic and inorganic impurities, nutrients, bacteria, and other microorganisms, represents a potent environmental hazard. When left untreated, sewage poses severe threats to aquatic ecosystems, human health, and the quality of natural water bodies. The harmful substances present in sewage can lead to the eutrophication of water bodies, depletion of oxygen levels, and the spread of waterborne diseases. Furthermore, the discharge of untreated sewage into rivers and seas jeopardizes the health of aquatic plants and animals, disrupting the delicate balance of aquatic ecosystems.

In recognition of these environmental concerns, regulatory bodies like the CPCB have mandated the installation of STPs for certain infrastructure projects, including apartments, commercial construction projects, educational institutions, townships, and area development projects that meet specific criteria. This regulatory intervention underscores the importance of treating sewage at its source, preventing the contamination of natural water bodies, and safeguarding public health.

The Composition of Sewage: A Complex Mix of Contaminants

Understanding the composition of sewage is fundamental to appreciating the challenges it poses and the treatment processes required. Sewage is not a uniform substance; rather, it comprises a diverse array of constituents that can vary significantly in their origin and impact. The major components of sewage include

suspended solids, organic matter, inorganic impurities, nutrients, saprotrophic and pathogenic bacteria, and other microorganisms.

Suspended solids consist of particles that are carried along with sewage and can include debris, organic matter, and particulate pollutants. These solids can clog waterways, impair the passage of light into aquatic ecosystems, and serve as a medium for the attachment and transport of contaminants.

The decomposition of organic matter in water bodies consumes oxygen, leading to hypoxia and adversely affecting aquatic life. These impurities can leach into water bodies, posing a risk to human health and the environment. Nutrients, specifically nitrogen and phosphorus compounds, are present in sewage due to the discharge of human waste and detergents. An excess of these nutrients can result in eutrophication, where water bodies become enriched with nutrients, leading to harmful algal blooms and oxygen depletion. The presence of pathogenic bacteria in untreated sewage presents a significant public health risk. Given the diverse and hazardous nature of these constituents, treating sewage becomes imperative to mitigate the adverse effects on the environment and public health.

The Environmental Consequences of Untreated Sewage

When sewage is discharged directly, or indirectly, into rivers, lakes, or seas, it wreaks havoc on aquatic ecosystems, human populations, and the overall health of the environment. **Eutrophication:** One of the most notable consequences of untreated sewage discharge is eutrophication. This process occurs when excess nutrients, primarily nitrogen and phosphorus, enter water bodies, leading to rapid algal growth. The subsequent decay of these algae consumes oxygen, causing hypoxia and harming aquatic organisms. **Waterborne Diseases:** Pathogenic bacteria and viruses present in sewage can contaminate water sources. The ingestion of water contaminated with these microorganisms can result in a wide range of waterborne diseases, including cholera, dysentery, and hepatitis, posing significant health risks to exposed populations. It negatively impacts biodiversity by altering the composition of aquatic ecosystems. Additionally, the presence of suspended solids in sewage can smother aquatic habitats and disrupt the life cycles of many species. **Human Health Risks:** Besides waterborne diseases, untreated sewage can also lead to groundwater contamination. When sewage infiltrates groundwater sources, it can contaminate drinking water supplies, increasing the risk of waterborne illnesses and long-term health problems for communities.

Legal and Ethical Concerns: In light of these adverse effects, there is a growing consensus on the urgency of treating sewage before disposal into water bodies, emphasizing the need for efficient and sustainable sewage treatment technologies.

The Rise of Sewage Treatment Technologies

Efforts to combat the harmful effects of untreated sewage have led to significant advancements in sewage treatment technologies. These innovations have been instrumental in improving the quality of treated effluent, reducing environmental pollution, and minimizing the risk to human health. Some of the key sewage treatment technologies include: **Primary Treatment:** The initial phase of sewage treatment involves the physical removal of larger particles and suspended solids through processes like screening and sedimentation. While this process reduces the organic load in sewage, it does not address dissolved contaminants. Activated sludge, trickling filters, and sequencing batch reactors are commonly used secondary treatment methods. These processes promote the growth of beneficial microorganisms that consume organic pollutants.

Tertiary Treatment: Technologies like sand filtration, chemical coagulation, and advanced oxidation are employed to achieve higher levels of purification. **Advanced Treatment:** In situations where stringent water quality standards are required, advanced treatment technologies such as membrane bioreactors (MBRs), reverse osmosis, and ultraviolet (UV) disinfection are utilized. These technologies can produce water suitable for various non-potable applications.

Decentralized Systems: In recent years, decentralized sewage treatment systems have gained traction, especially in rural and remote areas. **Innovative Approaches:** Researchers and engineers are continually

exploring innovative approaches to sewage treatment, such as using algae for nutrient removal, harnessing the potential of biochar, and integrating green infrastructure into sewage treatment processes.

The selection of the appropriate sewage treatment technology depends on factors such as the volume and composition of sewage, space availability, regulatory requirements, and the desired quality of treated effluent. Advances in technology have not only improved treatment efficiency but also made sewage treatment more energy-efficient and environmentally sustainable.

Recycled Water Utilization: A Sustainable Solution

The increasing awareness of water scarcity and the need for sustainable water management have led to a growing interest in recycled water utilization. Recycled water, also known as reclaimed water or wastewater reuse, refers to the practice of treating and repurposing wastewater for various applications, including irrigation, industrial processes, and even potable water supply.

Urban and Rural Applications

In urban areas, recycled water is being used for landscape irrigation, industrial processes, and non-potable applications in buildings. In rural regions, there is a long-standing tradition of using sewage and solid waste from cities as a source of irrigation water and nutrients for crop cultivation. This practice, known as "night soil" farming, has been practiced for centuries in various parts of the world, particularly in Asia.

Agricultural Reuse

In many agricultural areas, treated wastewater is used to irrigate crops, particularly in arid and semi-arid regions where freshwater resources are scarce.

Industrial Applications

Recycled water is increasingly being employed in industrial processes, where water quality requirements may vary depending on the specific application. Industries such as power generation, textiles, and petrochemicals are adopting recycled water as a sustainable alternative to freshwater sources.

FINDINGS IN LITERATURE REVIEW

The study involved a thorough literature review of scientific articles, research papers, and technical reports published between 1990 and 2017. The collected data were categorized, and key themes emerged through a qualitative content analysis process. In addition, field studies were conducted to investigate the performance of ornamental plants in selected sewage effluent treatment plants. Sewage water, while rich in plant nutrients, poses significant challenges due to the presence of toxic substances, particularly non-degradable metals, which persist in the environment for extended periods. The utilization of such polluted water for irrigating most vegetables and food crops has raised concerns about the accumulation of metals in crops and their potential entry into the food chain. As a sustainable alternative, the identification of non-food crops suitable for sewage-irrigated areas and the dissemination of such knowledge to farmers have become imperative.

Benefits of Reclaimed Wastewater in Ornamental Plant Irrigation

1.1. Nutrient and Water Recycling One of the primary advantages of using reclaimed wastewater for ornamental plant irrigation is the promotion of nutrient and water recycling. Ornamental plants often demand significant quantities of water and nutrients for healthy growth and aesthetic appeal. By reusing treated wastewater for irrigation, the nutrient content of the water can be harnessed, reducing the need for additional fertilizers. This not only conserves resources but also reduces the environmental impact associated with the production and application of synthetic fertilizers.

1.2. Effluent Reduction The use of reclaimed wastewater for ornamental plant cultivation can significantly reduce effluent disposal into natural water bodies. Many sewage treatment plants generate effluents that, if

not properly managed, can pose a threat to aquatic ecosystems and water quality. By diverting treated wastewater to irrigate ornamental plants, the discharge of treated sewage effluent can be effectively controlled, mitigating its potential adverse effects on receiving water bodies.

1.3. High-Value Crop Production Ornamental plant cultivation represents a high-value agricultural activity with substantial economic potential. These plants are in demand for various purposes, including landscaping, decorative purposes, and the floral industry. The growth of the ornamental plant industry offers opportunities for revenue generation and employment, contributing to the agricultural sector's economic sustainability.

1.4. Reduced Pressure on Potable Water Sources The utilization of reclaimed wastewater for ornamental plant irrigation alleviates the pressure on potable water sources. This is particularly relevant in regions facing water scarcity, where the diversion of treated wastewater to non-potable uses reduces the demand for freshwater resources, ensuring a more sustainable.

Challenges and Environmental Considerations

2.1. Potential Plant Damage While reclaimed wastewater offers several advantages, it is crucial to acknowledge that ornamental plants, when exposed to reclaimed wastewater irrigation, may be susceptible to damage. Some studies have reported diffuse damage to ornamental plants and trees under such conditions. The nature and extent of this damage can vary depending on factors such as the quality of the reclaimed wastewater, the specific plant species, and the irrigation method employed. Therefore, careful evaluation and monitoring of plant health and growth are essential to identify potential issues and implement corrective measures.

2.2. Environmental Contamination Risks The reuse of reclaimed wastewater for irrigation necessitates a thorough assessment to minimize the risk of environmental contamination. One significant concern is the potential leaching of nitrates into underground aquifers. Elevated nitrate levels in groundwater can have adverse effects on both the environment and human health. Therefore, stringent controls and monitoring of nitrate concentrations in reclaimed wastewater are essential to prevent groundwater contamination.

2.3. Soil Salinity Issues The high sodium concentrations present in domestic sewage can lead to soil sealing when used for agricultural irrigation, including the cultivation of ornamental plants. Salinity problems have been observed in irrigated systems of greenhouses producing ornamental plants. This issue is compounded when natural rainfall is intercepted by greenhouse covers, and soil and irrigation management practices are inadequate. Addressing soil salinity problems requires careful soil testing, appropriate irrigation techniques, and the selection of salt-tolerant plant varieties. (Lubello et al., 2004) Role of Irrigation Systems (Marina, I. et.al,2006). In the context of reclaimed wastewater irrigation for ornamental plants, the choice of irrigation system plays a pivotal role in optimizing resource use and minimizing environmental risks.

Drip Irrigation

These systems deliver water and nutrients directly to the plant roots, minimizing the risks of contamination and ensuring efficient water use. Drip irrigation not only conserves water but also helps in preventing soil salinity issues by delivering water precisely where it is needed.

Careful Water Management

Adequate control of irrigation timing and duration can prevent over-irrigation, which may exacerbate soil salinity problems. Monitoring soil moisture levels and adjusting irrigation schedules accordingly is crucial to ensure the health and vitality of ornamental plants. Conclusion and Future Directions The utilization of reclaimed wastewater for ornamental plant irrigation presents numerous benefits, including nutrient and water recycling, effluent reduction, and high-value crop production. However, it also poses challenges related to potential plant damage, environmental contamination risks, and soil salinity issues. To maximize the advantages and minimize the drawbacks of reclaimed wastewater irrigation, careful evaluation, monitoring, and adherence to best practices are essential. Future research should focus on the development of improved wastewater treatment technologies to produce reclaimed water of higher quality, reducing the

potential for plant damage. Additionally, studies should explore the selection and cultivation of ornamental plant species that are more resilient to reclaimed wastewater irrigation. Furthermore, innovative approaches to managing soil salinity in greenhouse settings should be investigated to enhance the sustainability of ornamental plant production.

In conclusion, the utilization of reclaimed wastewater in ornamental plant cultivation represents a sustainable and economically viable approach. With proper management and continued research efforts, the integration of reclaimed wastewater into ornamental plant irrigation can contribute to resource conservation, environmental protection, and economic growth in the agricultural sector.

Benefits

Water Resource Conservation: Recycling wastewater reduces the demand on freshwater sources, helping to alleviate water scarcity issues. **Environmental Protection:** By diverting wastewater from natural water bodies, recycled water usage mitigates the environmental impact of untreated sewage discharge. **Sustainable Agriculture:** In agriculture, recycled water contributes to improved soil fertility and crop yields, supporting food security. **Energy Efficiency:** Treating wastewater for reuse consumes less energy compared to desalination or extracting water from distant sources. **Economic Advantages:** Recycled water can be cost-effective, especially for industries and agriculture, where it reduces the need for freshwater procurement.

Challenges

Public Perception: The "yuck" factor associated with recycled water remains a significant challenge, particularly for potable water reuse projects. Public perception and acceptance must be addressed through education and communication. **Treatment Costs:** Advanced treatment processes for recycled water can be expensive, and their implementation may require substantial investments. **Regulatory Hurdles:** Adhering to regulatory standards for recycled water quality can be complex, with variations between regions and applications. **Infrastructure Requirements:** Building and maintaining a separate distribution system for recycled water can be a logistical challenge, especially in densely populated urban areas. **Pathogen Control:** Ensuring the removal of pathogens and emerging contaminants from recycled water is a critical concern for public health.

CONCLUSION:

Throughout this comprehensive review paper, we have explored the fascinating and environmentally significant world of ornamental plants used in the treatment of sewage effluent from Sewage Treatment Plants (STPs). We have delved into the unique characteristics of various ornamental plant species, their applications in phytoremediation, and the potential for transforming wastewater into a valuable resource. In this concluding section, we will synthesize the key findings and emphasize the importance of this innovative approach in wastewater management, environmental conservation, and sustainable urban development.

These plants, renowned for their aesthetic appeal, have proven to possess remarkable capabilities for phytoremediation. They can thrive in a range of conditions, effectively absorb and transform pollutants, and play a vital role in improving water quality. The inherent adaptability and resilience of ornamental plants make them valuable assets in the realm of wastewater treatment. **Diversity in Ornamental Plant Species:** One of the standout aspects of this approach is the sheer diversity of ornamental plant species that can be employed in sewage effluent treatment. From water lilies (*Nymphaea* spp.) to papyrus (*Cyperus papyrus*) to various types of reeds and rushes (e.g., *Phragmites* spp.), the options are plentiful. Different species exhibit distinct mechanisms for pollutant removal, allowing for a tailored approach to wastewater treatment based on specific contaminant profiles and environmental conditions.

Phytoremediation Mechanisms: Ornamental plants engage in a variety of phytoremediation mechanisms, including phytoaccumulation, rhizofiltration, and phytostabilization. Phytoaccumulators, such as water hyacinth (*Eichhornia crassipes*), absorb and accumulate contaminants in their biomass, while rhizofiltrators, like cattails (*Typha* spp.), use their root systems to filter pollutants from the water. Phytostabilizers, such as the canna lily (*Canna indica*), immobilize pollutants in their root zone, preventing their migration. **Nutrient Uptake and Recycling:** Beyond treating pollutants, ornamental plants also excel at nutrient uptake and

recycling. They can assimilate excess nutrients, particularly nitrogen and phosphorus, from sewage effluent. This not only enhances water quality but also offers an eco-friendly means of nutrient management. The harvested biomass of ornamental plants can be repurposed as organic fertilizer or used for various other applications, contributing to the circular economy.

Aesthetic Integration: One of the most compelling aspects of using ornamental plants for sewage effluent treatment is their seamless integration into urban and landscaping environments. These plants not only serve a functional role in water purification but also enhance the aesthetic appeal of treatment facilities and their surroundings. The incorporation of ornamental plants can transform sewage treatment facilities into green spaces that benefit both the environment and the community. **Sustainable Urban Development:** The use of ornamental plants in sewage effluent treatment aligns with the principles of sustainable urban development. As urbanization continues to rise, the need for effective and environmentally friendly wastewater management solutions becomes ever more critical. Ornamental plants offer a sustainable, low-impact approach that can contribute to the creation of greener, healthier, and more livable cities.

Challenges and Considerations: While the potential of ornamental plants in sewage effluent treatment is evident, several challenges and considerations must be acknowledged. These include the need for comprehensive monitoring and management to ensure optimal plant growth and pollutant removal. **Future Directions:** The future of using ornamental plants in sewage effluent treatment is bright and full of possibilities. Continued research and innovation in plant selection, cultivation techniques, and monitoring technologies can further enhance the effectiveness of this approach. Collaboration between environmental scientists, horticulturists, urban planners, and policymakers is essential to harness the full potential of ornamental plants in wastewater management.

Economic Considerations: The economic considerations associated with ornamental plant-based sewage effluent treatment are promising. While initial investments may be required for plant establishment and infrastructure development, the long-term operational and maintenance costs are often lower compared to conventional treatment methods. The potential for revenue generation through the sale of harvested biomass or ornamental plants themselves adds an economic dimension to this sustainable practice. In conclusion, the characterization and application of ornamental plants in the treatment of sewage effluent from STPs represent a dynamic and innovative approach to wastewater management. These plants, with their diverse species and phytoremediation mechanisms, have the capacity to transform wastewater into a valuable resource while contributing to environmental conservation and sustainable urban development.

REFERENCES

- [1] Younis, A., Riaz, A., Mushtaq, N., Tahir, Z., & Siddique, M. I. (2014). Evaluation of the Suitability of Sewage and Recycled Water for Irrigation of Ornamental Plants. *Communications in Soil Science and Plant Analysis*, 46(1), 62–79. [2] Carr, R., Blumenthal, U., & Duncan Mara, D. (2004). Guidelines for the safe use of wastewater in agriculture: revisiting WHO guidelines. *Water Science and Technology*, 50(2), 31–38. <https://doi.org/10.2166/wst.2004.0081> [3] Lubello, C., Gori, R., Nicese, F. P., & Ferrini, F. (2004). Municipal-treated wastewater reuse for plant nurseries irrigation. *Water Research*, 38(12), 2939–2947. <https://doi.org/10.1016/j.watres.2004.03.037> [4] Feigin, A., Ravina, I., & Shalhevet, J. (1991). Effect of Irrigation with Treated Sewage Effluent on Soil, Plant and Environment. *Advanced Series in Agricultural Sciences*, 34–116. https://doi.org/10.1007/978-3-642-74480-8_3 [5] Cichorz, S., Goška, M., & Litwiniec, A. (2014). *Miscanthus*: Genetic Diversity and Genotype Identification Using ISSR and RAPD Markers. *Molecular Biotechnology*, 56(10), 911–924. <https://doi.org/10.1007/s12033-014-9770-0> [6] Arif, I. A., Bakir, M. A., Khan, H. A., al Farhan, A. H., al Homaidan, A. A., Bahkali, A. H., al Sadoon, M., & Shobrak, M. (2010). A Brief Review of Molecular Techniques to Assess Plant Diversity. *International Journal of Molecular Sciences*, 11(5), 2079–2096. <https://doi.org/10.3390/ijms11052079>