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Treatment Method for Sewage Water Used in Horticulture

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Abstract: *The purpose of a sewage treatment plant is to take wastewater, filter it for any contaminants, and then discharge it back into the environment in a way that is safe for humans and other living things. Because improper wastewater management contributes to environmental pollution and infectious diseases can easily spread due to the presence of a variety of pathogenic organisms in wastewater, the primary goal of wastewater treatment is to enable the proper disposal of wastewater from industrial, domestic, and commercial uses without endangering human health or the environment. To treat wastewater in the conventional sense, a number of physical, chemical, and biological procedures are used to filter out nutrients, organic materials, and solid particles. When we talk about the physical, chemical, and biological properties of water, we're talking about its quality. This metric assesses the state of water in relation to the requirements of various living organisms, whether they be humans or other non-human creatures. When referring to a collection of criteria that can be used to evaluate compliance, it is most commonly used in this context. The most popular criteria for evaluating water quality are its impact on ecosystem health, human contact safety, and potability.*

Keywords: *Sewage Water, Treatment for Horticulture, Safety of Human Contact, Drinking Water, Management of Wastewater, Physical, Chemical, and Biological Processes.*

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Introduction

Irrigation using sewage and wastewater is commonplace in both rural and urban parts of the majority of developing nations. The sole source of water for irrigation in these regions is frequently contaminated water [7]. Although there are other water sources available, small farmers generally choose wastewater due to its high nitrogen content. This helps them save money on artificial fertilisers. In many dry and semi-arid parts of the world, people have been using wastewater to cultivate crops for hundreds of years [8–12]. Due to a lack of wastewater collection and treatment facilities and prohibitive prices or shortages of freshwater, farmers frequently resort to using untreated wastewater since they have no other choice. Chemical and microbiological pollutants pose serious threats to public health when wastewater is used for agricultural purposes. Soil and groundwater contamination are additional ecological problems that might result from wastewater utilisation. With proper planning, execution, and management, wastewater irrigation can offer numerous advantages and practical uses for the environment [13–25]. Most wastewater irrigators do not own any land of their own; instead, they rent out tiny pieces of ground and use the nutrient-rich sewage to grow vegetables and other cash crops [26].

Many people living on low incomes rely on sewage water microeconomies in Latin America, Africa, and Asia. Countless people without land would lose their sole source of income if these practises were to be stopped or overregulated. But these nations don't treat their sewage before using it for irrigation [27]. Developed nations are the most common users of wastewater treatment systems, thanks to the substantial investments made in this area over the last 40 to 50 years. In North America, tertiary treatment is often used for sewage water, while secondary treatment is more common [28]. The United States has made progress thanks to a federal initiative that provided 56 billion USD to state and municipal governments between 1972 and 1989 for the purpose of building secondary management amenities. They did, however, swap out state revolving funding for local loans for these grants. In developed nations, treating sewage is essential for protecting human health and preventing water pollution [29]. However, the majority of underdeveloped nations cannot afford this option. Consequently, rather than allowing industrial and municipal effluents to flow freely into lakes and streams, developing nations would be better off applying wastewater to farmland [30]. The people living in the streams and other water sources are endangered because the sewage goes to a dangerous downstream site. Wastewater treatment can reduce or eliminate these dangers through physical, chemical, and biological processes in a wastewater treatment plant [31]. Because it is a dirty by-product that needs secure management and removal, sludge is a potentially harmful by-product of wastewater treatment. Crop irrigation, aquaculture, landscape irrigation, and artificial groundwater replenishment are just a few of the numerous uses for sewage water for irrigation. In many regions of the globe, this is among the most storied and famous customs [32–37].

An estimated 20 million hectares of land across the globe are irrigated by wastewater. The highest number of crop plants that can be grown is [38]. A significant amount of the sewage water used to irrigate lettuce, mangoes, tomatoes, and coconuts remains untreated. Water farming areas in Pakistan and other underdeveloped nations sometimes use sewage and industrial effluent. Countries that have limited water supplies have found that sewage irrigation improves soil quality and plant health [39–41].

Types of Treatment

Bacteria utilise oxygen to decompose waste materials in the traditional aerobic wastewater treatment method. The bacteria involved in this treatment use a lot of energy to carry out their job, and there's also the possibility that it will create a lot of sludge. This process will become more costly and difficult to control as a result [42–45]. Because the bacteria involved in anaerobic treatment do not utilise oxygen, it differs significantly from aerobic treatment. Less energy is used and less sludge is created during anaerobic treatment, making it far easier than aerobic treatment. As a result, this process will become easier and less expensive. Furthermore, it is possible to regulate the temperature at which the anaerobic process bacteria prefer to work, which is particularly beneficial in hot regions [46-51]. On the other hand, there are drawbacks to the anaerobic process, such as the fact that it isn't as fast as the aerobic process and can only remove basic organic waste—not nutrients or infections. Any facility that treats wastewater requires substantial funding and oversight, according to this study [52]. Hence, it is important to think long and hard before deciding to build such a facility. Localized treatment and disposal system's effect on water quality assessment of the effects of improperly located and maintained on-site sewage treatment and disposal systems (OSTDSs) on urban coastal waterways in terms of water quality [53-19]. Damage to the receiving body of water and possible threats to public health could result from OSTDS that are not adequately maintained, according to this study's authors [60].

From 2006 through 2007, a water treatment facility and bore wells in Delhi city were employed in a water quality monitoring project that utilised the water quality index (WQI) approach. Using the Water Quality Index (WQI), water standards are ranked from excellent to extremely bad [61]. The index can take on values between zero and one hundred, with one hundred indicating the highest possible quality. Nitrate, pH, total dissolved solids, turbidity, and water temperature were the five parameters that were examined in monthly water samples obtained at three separate locations in Delhi. The water quality was determined to be adequate for the water supply, falling between the "good" and "medium" categories, according to the three samples [62-73]. Among the established criteria for surface water categorization, the Water Quality Index (WQI) stands out. The numerical phrase known as this index simplifies a mountain of data on water characteristics into a single metric for water quality [74].

Sewage water, including sludge and effluent, was defined in their study, as were efficient methods for treating sludge. The physical, chemical, and biological features of sewage water were also catalogued in several places [75–81]. The researchers set out to assess the degree of sewage contamination along the entire length of the Gomti River as well as its present physico-chemical status. The river's upstream and downstream areas were both sampled. The current state of water's physicochemical properties can be ascertained by analysing eight water samples [82-89]. Temperature, conductivity, total solids, total dissolved solids, total suspended solids, pH, chemical oxygen demand, biological oxygen demand, and dissolved oxygen were all factors taken into account in the study. The characteristics of interest for the bacteriological samples included Total Coli (TC), Faecal Coli (FC), and Faecal Streptocoli (FS) (FS). The results showed that the Gomti River's water quality was extremely low, dangerous, and unsuitable for any use, and they also found high levels of sewage pollution indicator bacteria [90–95].

Literature Review

Researchers Drechsel et al. [1] combed through a plethora of resources, including databases and search engines, to compile their findings. These resources included: the University of Washington Library, Science Direct, JStor, PubMed, PLoS, Google Scholar, Google, and the websites of several UN agencies and organisations, including UNICEF, UNEP, UNFPA, World Bank, WHO, UNICEF, and the Water Supply and Sanitation Coalition. Agriculture, anaerobic digestion, evaluation, application, aquaculture, behaviour modification, bed, benefits, biogas, biosolids, California, challenge, city, cities, and composting were all phrases that were utilised in searches.

Engineering consultants created and published Tzanakakis et al., [2] as "grey" literature. Despite not having been peer-reviewed, these studies provide valuable insight into the difficulties and successes of passive wastewater treatment system design in Northern Canada. This data has not been combined as of yet. Passive wastewater treatment systems in non-arctic locations have also been the subject of a large amount of research into their design and performance. Since most of these research have focused on systems in "cold" climates, the design approaches and performance evaluations developed for these systems should be applicable to arctic system design.

Given the growing human population and the depletion of key nutrients for crop development, Anjum et al., [3] assume critical importance for the long-term viability of agriculture. Sewage sludge contains numerous contaminants of emerging concern (CECs), such as microplastics (MPs), engineered nanomaterials (ENMs), per- and polyfluoroalkyl substances (PFASs), flame retardants, plasticizers, metals, antibiotic resistance bacteria (ARBs), and resistance genes. Nevertheless, this practise does raise some concerns (ARGs). It is these CECS.

In order to set up and keep going a wide variety of human activities, Feyzbakhsh et al., [4] are crucial. Thanks to aquatic life and irrigation, water resources provide a valuable source of food for humans. Nevertheless, the majority of the world's water supplies are contaminated by human settlements' and industries' liquid and solid waste. One of the most limited resources in the twenty-first century will be water, as the human population continues to rise at an unprecedented rate around the globe. With more than 5 billion people on Earth, most of them will call cities home in 2015. There will be a total of 23 megacities by 2015, with populations exceeding 10 million. Interestingly, 18 of these megacities will be located in developing nations. At the heart of the urbanisation phenomena are the challenges that come with supplying water sector infrastructure, including sanitation services, freshwater supplies, and municipal services. Obtaining essential human requirements infrastructure, including safe drinking water and proper sewage disposal, as well as housing, healthcare, and social services, is currently a huge task for politicians, planners, and engineers.

The prevalence of Mallik et al., [5] is on the rise across the globe. A water issue is also affecting India, a developing nation. As a result, researchers are looking into wastewater reuse as a potential new area to focus on in order to find solutions to the ever-increasing water crisis. Reducing water consumption and overall sewage production, wastewater reuse leads to sustainable development. Institutional infrastructures, together with the availability of relevant policies and technologies, are crucial to the success of water reuse initiatives. Safe distribution and monitoring of the treated water is also of the utmost importance. There is a need for a system that can function well in varied settings because most reuse systems are designed for specific wastewater or environmental and economic factors. In this article, we have reviewed the literature extensively and determined the efficacy of two crucial chemical and biological processes utilised in wastewater reuse systems. After identifying the gaps and limitations in the current literature, this paper discusses the future scope of research in this area and analyses the effectiveness of reuse systems through the lens of environmental and economic variables.

Statement of The Problem

To handle the campus-wide effluent, this IPTA constructed a state-of-the-art sewage treatment plant. Because it is still in the early stages of development, this campus cannot yet accommodate all of the people who have expressed interest in living here. During the whole development phase, it was operational for the sewage treatment facility [96-99]. Additionally, the project's problem statement is that this facility produces water of a better grade after treatment: In order to learn how this campus handles wastewater management, this study is being carried out [100]. This plant's water treatment energy usage is set to be processed for complete development to accommodate students, according to the information acquired. Excessive energy consumption during wastewater treatment operations is a result [101–105]. Furthermore, this plant's highest water grade necessitated numerous wastewater treatment procedures. As a result, our research will centre on a processing approach that improves water quality from A to B while simultaneously meeting the minimum standard [106-111].

The primary goal of this capstone project is to examine the water treatment process used by the Sewerage Treatment Plant at one of the IPTAs in Selangor.

- In order to see how the Sequencing Batch Reactor (SBR) works and make any necessary adjustments, we will shorten its runtime.

- In order to evaluate the effect of optimising plant operation on energy consumption, we will compare the existing process with the one that follows. The energy required to treat sewage water to an acceptable grade for effluent is directly proportional to the complexity of the procedures involved.
- The purpose of this analysis is to assess and contrast the water quality before and after the adjustment operation. The following critical parameters will be examined: pH, Biochemical Oxygen Demand, and many more (BOD)

Biological, chemical, and mechanical sewage systems all contribute to the formation of sewage sludge. Micro- and microelements abound in sludge, but it also contains harmful substances and potentially infectious microbes [112-117]. On a regular basis, the amount of sludge in the effluent sewage volume is kept below 2%. As a by-product, sewage sludge retains the chemical makeup of the treated sewage. According to their findings, non-industrial ways of neutralising sewage sludge have received disproportionate focus in their study of sewage sludge treatment methods [118–121]. Although composting and environmental utilisation are distinct from one another from an economic perspective, it demonstrates that they are the best options for sludge management [122–129]. Although composting is the most cost-effective way to neutralise sewage sludge, it is more costly than finding an environmentally friendly use for it (Fig.1).

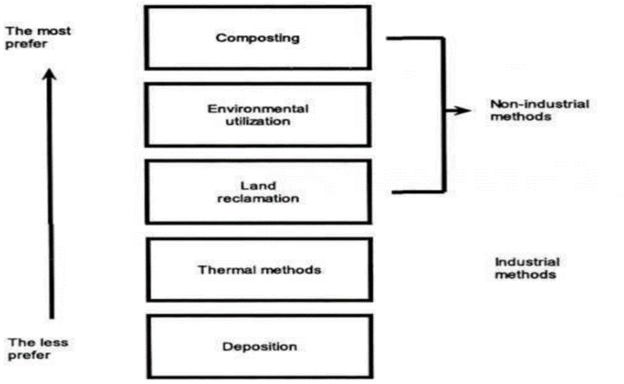

Figure 1: SBR For One Complete Cycle

Containing human waste (mostly faeces and urine), water used for washing, food scraps, dirty clothes, and other common household items, domestic sewage is a type of industrial effluent [130-135]. Sewage or residential effluent is the proper term for this. Although "wastewater," "domestic," and "municipal wastewater" have mostly supplanted the earlier term "sewage" in current usage, it is helpful to distinguish between the two. Restaurants, laundromats, hospitals, schools, offices, retailers, and other commercial facilities that serve the surrounding region of bigger communities produce commercial wastewater [136-141].

Blackwater, which contains faeces, urine, blood, and vomit from flush toilets, and greywater, which is used for washing clothes and dishes, are both components of domestic sewage. The possibility that blackwater contains pathogenic organisms that can spread disease to both humans and animals makes it a distinct environmental danger [142–143]. There are four class of pathogens found in sewage: When you wash dirty diapers, clothes, and bedding in greywater, the concentration of certain pathogens may be lower. These include bacteria like Salmonella, Shigella, Campylobacter, or Vibrio cholerae; viruses like hepatitis A, rotavirus, coronavirus, and enteroviruses; protozoa like Entamoeba histolytica, Giardia lamblia, and Cryptosporidium parvum; and helminths and their eggs, such as Ascaris, Ancylostoma, and Trichuris, which feed on human blood. One way to help the environment is to treat sewage. Large solids can be removed from sewage using bar screens, whereas floating and settleable waste can be removed by basic treatment. Concentrated sewage can have its biochemical oxygen demand reduced through secondary treatment, however diluted sewage or sewage with harmful substances are less effectively treated. To give you an idea of its density, sewage sludge weighs 721 kg/m³, which is equivalent to 0.721 g/cu cm³. The density, in either the Imperial or US customary measuring system, is 45.011 lb/ft³ or 0.4168 oz/inch³. (Fig.2).

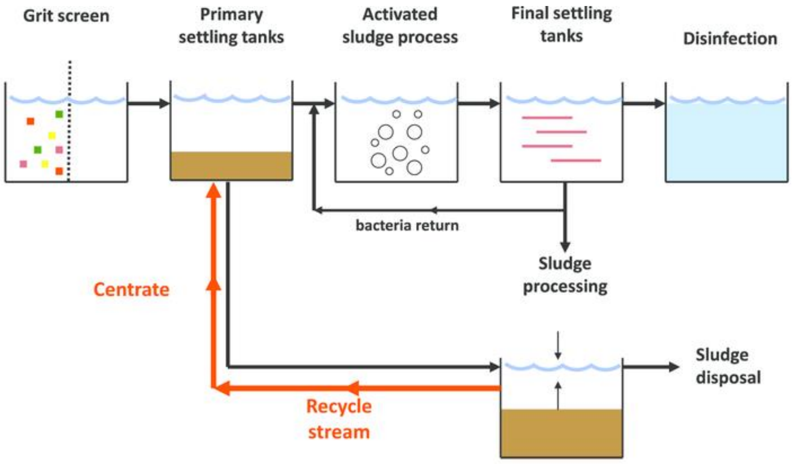

Figure 2: Process Description [6]

The initial step in treating the sewage is to filter it through a bar screen chamber, which will collect any floating debris. After that, the sewage would be collected in a collection sump, which would allow for a steady flow rate downstream by dampening the varied flow and characteristics that could otherwise cause operational problems. Coarse air bubble diffusers are used to keep the sewage in a mixed state here [144]. The Moving Bed Bioreactors (MBBR) will reduce BOD and COD by aerobic microbial activity when the sewage is equalised. A series configuration would be used by the MBBR Reactors. Coarse air bubble diffusers will supply the necessary oxygen. Separation of the surplus biosolids produced by the biological process will occur later on [145]. You can use the clear liquid that remains after disinfection for gardening and landscaping. After settling in the Tube settler, the biological sludge from the FAB is emptied into the Sludge holding tank, where it can be withdrawn on a periodic basis for proper disposal [146]. Tertiary treatment plants use a combination of pressure sand and activated carbon filters to recycle treated sewage. Total suspended solids and turbidity can be effectively removed by the pressure sand filter. If there is too much chlorine or unpleasant smell, the activated carbon filter can get rid of it.

The KLD is treated at the flow rate by the sewage treatment scheme's state-of-the-art moving bed bioreactor (Table 1).

Table 1: INLET Characteristics

Parameter	Units
PH	7-8
BOD	500 ppm max
COD	1000 ppm max
TSS	400 ppm max
OIL&GREASE	100 ppm max

Note: The raw sewage must not contain any additional parameter that above the aforementioned limits, is harmful, or will impact the biological process.

Conclusion

Despite the fact that certain nations have been utilising wastewater from urban areas for irrigation for quite some time, the main focus has always been on disposal. Greater focus on the purifying and constructive features of this practise has only been achieved recently. The general consensus is that wastewater should be used toward agricultural purposes. No comprehensive criteria or recommendations have been established for trees, however there are existing standards and guidelines for the use of wastewater in irrigation that pertain to crops. More research into the potential of using wastewater to irrigate tree plantations and forests is urgently needed for several reasons. Environmental factors, social and aesthetic concerns, economic benefits, and health factors are all part of the picture. There has been an increasing interest in the potential of waste water-irrigated tree plantations due to these factors, as well as the high demand for fuelwood and construction materials in many developing country cities to meet the needs of their increasing populations of low-income urban dwellers and the rising market prices of timber. Find out what needs to be in place for a specific number of toilets to be linked to one small-scale wastewater treatment facility. Development of detailed project ideas for subsequent execution by the involved nations. Given these goals, it's clear that the research isn't aiming to identify the optimal sanitation solution for every particular issue; rather, it's cataloguing the scenarios in which SSWTP is preferable to more traditional methods of sewage treatment or on-site wastewater disposal.

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