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Purifying Raw Water by Implementing Drinking Water Standards with a Functional Model

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Abstract

Ensuring access to clean and safe drinking water is vital for sustaining life and improving public health. However, many communities around the world face challenges in ensuring the quality of their water sources, particularly in areas where raw water is contaminated or lack of proper treatment facilities. This project aims to address this issue by designing and implementing a functional model for purifying raw water to meet drinking water standards.

It utilizes a multiple-step approach, beginning with the assessment of local water sources to identify contaminants and potential health risks. Subsequently, an appropriate purification system is designed, taking into account factors such as cost- effectiveness, scalability, and ease of maintenance. The functional model incorporates various treatment technologies, including filtration, disinfection, and chemical treatment, tailored to the specific contaminants present in the raw water.

Key components of the purification model include a pre-treatment stage to remove large particles and sediment, followed by advanced filtration methods to eliminate bacteria, viruses, and other microorganisms. Additionally, disinfection techniques such as chlorination are employed to further ensure the elimination of pathogens. Throughout the process, monitoring and quality control measures are implemented to verify compliance with drinking water standards and ensure the safety of the treated water.

Keywords: Raw water, Ease of maintenance, Filtration, Disinfection, Chlorination

Introduction

The absence of affordable, sustainable, and transformative water management solutions has resulted in over 70% of sewage in India being released without treatment, contaminating rivers, coastal areas, and groundwater reserves. The adoption of various methods for waste water treatment is rapidly emerging as a critical solution to address the escalating demands for water consumption and conservation. Presently, the lack of treatment options contributes to two major issues: untreated waste water discharged into water bodies pollutes the sources, making the water unfit for drinking, while water extracted from these contaminated sources for drinking purposes is often inadequately treated, posing significant public health risks.

A significant portion of wastewater originates from residential households, industries, and commercial establishments. Within homes, water used in sinks, showers, bathtubs, dishwashers, toilets, and washing machines is typically directed through a network of pipes to sewage treatment facilities. Industrial processes such as manufacturing and cooling often produce waste water that may contain chemicals and solid particles. Businesses such as hotels and restaurants also produce significant amounts of wastewater that should be cleaned and made available for the next use. Wastewater generated from various industries is often discharged directly into the surrounding environment and water bodies, with varying degrees of treatment or none at all. The rise of industrialization in recent years has exacerbated environmental degradation globally. Waste water carries a multitude of microorganisms, including viruses, bacteria, protozoans, and algae, which pose significant public health risks by being the culprits behind numerous waterborne diseases. The presence of untreated wastewater in water bodies severely impacts water quality, posing a direct threat to human health. Moreover, waste water effluents can contain emerging contaminants with endocrine-disrupting properties. Sometimes, these discharged waters carry contaminants that conventional treatment methods employed by industries fail to remove, further exacerbating environmental and public health concerns.

Water pollution stemming from agriculture has direct detrimental effects on human health. One notable consequence is the occurrence of the well-documented blue-baby syndrome, where elevated nitrate levels in water can induce methemoglobinemia, a potentially fatal condition in infants. Furthermore, the accumulation of pesticides in water sources and the food chain has been linked to adverse health outcomes in humans, prompting the widespread prohibition of certain broad-spectrum and persistent pesticides. However, despite these bans, some of these harmful pesticides continue to be used in economically disadvantaged countries, leading to both acute and likely chronic health impacts. Additionally, aquatic ecosystems bear the brunt of agricultural pollution, further exacerbating water quality degradation, which in turn can severely impede various productive activities, including agriculture itself. Wastewater treatment encompasses the purification of water by removing pollutants and coarse particles while eliminating toxic substances. Additionally, it involves the eradication of pathogens and the generation of bio-methane and nutrient- rich manure beneficial for agricultural purposes. This process is integral to reducing water wastage, relieving strain on natural water sources, and facilitating clean energy production. Studies demonstrate that wastewater treatment promotes sustainable resource management by enhancing access to clean water, reducing dependence on natural resources, recovering energy, and supporting agriculture. Thus, wastewater treatment stands as a cornerstone of sustainable practices in water conservation, energy generation, and agricultural enhancement.

In regions where raw water is contaminated or treatment facilities are inadequate, ensuring the quality of drinking water becomes a concern. The project "Purifying Raw Water by Implementing Drinking Water Standards with a Functional Model" is a response to this global imperative. By combining innovative technology with a commitment to meeting drinking water standards, this project endeavors to provide a sustainable solution to the urgent need for clean water in underserved communities.

Objectives of the study

The main goals of this project are as follows:

- To evaluate the effectiveness and efficiency of the implemented model in purifying raw water.
- To design a functional model for purifying raw water.
- To implement the designed model to meet drinking water standards.
- To maintain the standards of drinking water in water bodies.
- To improve quality of waste water by Functional model.
- Preservation of water quality of natural water resource.
- Elimination of pollutants, toxicants and many such contaminants by working model

Critical review on the literature

The literature presented offers a multifaceted view of wastewater treatment methodologies and their implications for sustainability, environmental protection, and public health. Silva (2023) emphasizes the importance of treating wastewater through innovative methods like energy recovery and community development to mitigate environmental impact and promote economic viability. Rout et al. (2021) delve into the distribution and removal of emerging contaminants (ECs), underlining the necessity of sophisticated medical equipment for effective elimination. Ilyas et al. (2021) provide a comprehensive review of Life Cycle Cost Analysis (LCCA) in wastewater treatment, demonstrating its growing importance in decision-making processes. Ezugbe and Rathilal (2020) explore the diverse applications of membrane technology, outlining its advantages and challenges for further research. Miklos et al. (2018) and Lee et al. (2014) delve into the efficacy of Advanced Oxidation Processes (AOPs) and flocculants respectively, in contaminant removal, while Deblonde et al. (2011) focus on identifying prevalent contaminants in wastewater for effective treatment strategies. Lefebvre and Moletta (2006) highlight challenges in purifying saltwater, emphasizing the need for advanced desalination technologies, while Larsdotter (2006) discusses scalable filtration methods for algae removal. Lastly, Gogate and Pandit (2004) and Chen (2004) delve into the integration of oxidation processes and advancements in electrooxidation research, showcasing ongoing efforts to enhance treatment efficiency and sustainability. Overall, these studies collectively underscore the interdisciplinary nature of wastewater treatment research and the pressing need for innovative solutions to address emerging challenges and promote environmental stewardship.

Methodology

Meticulously collected raw water samples from various water bodies in Hyderabad exhibit distinct levels and types of contamination, reflecting diverse sources and pollutants. Contamination origins vary, with industrial discharges and natural pollutants contributing to the water's impurity. Some pollutants are visible, underscoring the extent of pollution. Samples collected from locations such as Ibrahimpatanam Lake, Injapur Lake, Industrial Water in Bairamalguda Region, Jillelguda Lake, and Hussain Sagar Lake underwent processing, including filtration and preservation, to maintain sample integrity. Comprehensive testing assessed parameters like pH, turbidity, acidity, alkalinity, chlorides, hardness, dissolved oxygen levels, total dissolved solids, and specific contaminant concentrations. Analysis aims to provide insights into contamination extent and nature, guiding remediation efforts for community water safety. The water treatment process, vital for removing impurities and ensuring safe water for consumption and industrial use, involves screening, aeration, sedimentation, coagulation/flocculation, filtration, and disinfection. These steps remove debris, dissolved gases, suspended particles, and contaminants, ultimately providing clean and safe water to communities, ensuring public health and environmental protection. The choice of disinfectant and dosage depends on water quality and treatment objectives.

Experimental Study

Raw water samples were collected from nearby water bodies, showcasing varying levels and types of contamination. The experimental setup involved a series of treatment steps designed to remove impurities and contaminants from the raw water. Screening was initially employed to remove large debris, followed by aeration to eliminate dissolved gases and volatile organic compounds. Sedimentation and coagulation/flocculation processes facilitated the removal of suspended particles and organic matter. Filtration through various media further purified the water, removing smaller particles and microorganisms. Finally, disinfection using chemical disinfectants ensured the eradication of harmful pathogens. Throughout the experiment, parameters such as pH, turbidity, acidity, alkalinity, chlorides, hardness, dissolved oxygen levels, and specific contaminant concentrations were monitored to assess the effectiveness of the treatment process. The experimental study aimed to demonstrate the feasibility of implementing drinking water standards through a functional model, providing valuable insights into water purification methods for ensuring safe and clean drinking water.

Results and Discussions

Above outcomes shows that the functional model designed has been working well to remove the impurities and inorganic substances in the water samples. Physical appearance of the color of water has been improved too colorless. Hence it is been observed that most of the drinking water standards are obtained by the treatment process with functional model. By this, one can try to purify the water by themselves in their premises and can be utilized for the domestic purposes. Most of the limits are according to drinking water standards but there it is preferred to chlorinate again before used for the drinking purposes. Also, there the graphical representations which are within the limit.

Table 1 Results before treatment

S.No.	Tests Conducted	IBP Lake Water	Injapur Water	Industrial Water
1.	Turbidity	4 NTU	2 NTU	9 NTU
2.	p^H	8.63	8.8	9.37
3.	Acidity	60 mg/L	28 mg/L	68 mg/L
4.	Alkalinity	95 mg/L	115 mg/L	140 mg/L
5.	Hardness	422mg/L	165 mg/L	495 mg/L
6.	Chlorides	159 mg/L	299 mg/L	289 mg/L
7.	Conductivity	1.3 uS/cm	2.4 uS/cm	1.5 uS/cm
8.	D.O.	2.8 mg/L	6.5 mg/L	4 mg/L
9.	B.O.D.	3.2 mg/L	12.4 mg/L	7.2 mg/L

Table 2 Results after treatment

S.No.	Tests Conducted	IBP Lake Water	Injapur Water	Industrial Water
1.	Turbidity	3 NTU	2 NTU	3 NTU
2.	p^H	6.75	6.25	6
3.	Acidity	48 mg/L	48 mg/L	140 mg/L
4.	Alkalinity	10 mg/L	155 mg/L	50 mg/L
5.	Hardness	310 mg/L	345 mg/L	260 mg/L
6.	Chlorides	246 mg/L	219 mg/L	239 mg/L
7.	Conductivity	0.18uS/cm	0.12uS/cm	0.08uS/cm
8.	D.O.	0.7 mg/L	1.5 mg/L	2 mg/L
9.	B.O.D.	1 mg/L	2 mg/L	3 mg/L

Conclusion

This project has demonstrated a viable model for decentralized, point-of-use water purification that can reliably produce drinking water meeting international quality standards. The integrated treatment system leverages a combination of effective yet affordable technologies to remove a broad spectrum of contaminants from raw water sources. From the result obtained from these studies the following conclusions can be drawn:

- Low operating cost, making it suitable for resource-constrained regions.
- The color of the water has been cleared.
- The p^H range has been obtained.
- The acidity and alkalinity level in the desirable limits.
- Oxygen demands are maintained according to the standards.
- The desired standard values are maintained.
- Clean and safe for clearing the contaminants.
- Simple operation and maintenance.

Through further optimization and field testing, the researchers believe this water purification technology has significant potential to improve access to clean, safe drinking water for underserved populations around the world. Ongoing work will focus on validating the system's real-world feasibility, durability, and scalability to support widespread adoption and positive public health outcomes. Overall, this project has made an important contribution toward addressing the global water crisis by developing an innovative, practical, and sustainable solution for water treatment at the community level.

The implementing of drinking water standards through a functional model is essential for purifying raw water effectively. By adhering to established guidelines and regulations, we ensure that the water consumed is safe, clean, and free from contaminants. Through this approach, we can safeguard public health, promote environmental sustainability, and provide access to high-quality drinking water for all.

Key Findings

- Assessment of local water sources identified contaminants and health risks.
- Design of a purification system considered cost-effectiveness, scalability, and maintenance.
- Utilization of various treatment technologies including filtration, disinfection, and chemical treatment.
- Pre-treatment stage removed large particles and sediment from raw water.
- Advanced filtration methods effectively eliminated bacteria, viruses, and microorganisms.
- Disinfection techniques such as chlorination ensured the elimination of pathogens.
- Implementation of monitoring and quality control measures verified compliance with drinking water standards.
- Overall, the functional model successfully purified raw water to meet drinking water standards, addressing challenges in ensuring access to clean and safe drinking water.

Conclusion Points

- The assessment of local water sources was crucial in identifying contaminants and health risks, laying the foundation for effective purification strategies.
- The design of the purification system prioritized factors such as cost-effectiveness, scalability, and maintenance, ensuring practicality and sustainability in implementation.
- The utilization of various treatment technologies, including filtration, disinfection, and chemical treatment, showcased a comprehensive approach to water purification.
- The pre-treatment stage effectively removed large particles and sediment from raw water, preventing clogging and enhancing the efficiency of subsequent treatment processes.
- Advanced filtration methods demonstrated remarkable efficacy in eliminating bacteria, viruses, and microorganisms, significantly improving water quality.

- Disinfection techniques, particularly chlorination, played a crucial role in ensuring the elimination of pathogens, further enhancing the safety of the treated water.
- Implementation of monitoring and quality control measures provided assurance of compliance with drinking water standards, reinforcing confidence in the purified water's safety and quality.
- Overall, the successful purification of raw water to meet drinking water standards signifies a significant achievement in addressing challenges related to access to clean and safe drinking water, underscoring the importance of such initiatives in promoting public health and well-being.

Reference

Indian Standards

[1] IS 10500 (1983): Drinking Water

[2] IS 10500 - 2012: Indian Standard Specifications for Drinking Water Books:

[3] New Revised Edition Environmental engineering by author Dr.M.R. Gidde

[4] Environmental Engineering book by B.C. Punmia.

[5] Environmental Engineering (Vol.1) Water Supply Engineering by author Santhosh Kumar Garg.

Journal Papers:

[6] Salahi, A. Badrnezhad, R. Abbasi, M. Mohammadi, T. Rekabar, F. Oily wastewater treatment using a hybrid UF/RO system. Desalin. Water Treat. 2011, 28, 75-82.

[7] Kyllonen, H.M. Pirkonen, P. Nystrom, M. Membrane filtration enhanced by ultrasound: A review. Desalination 2005, 181, 319-335.

[8] Guo, W.S. Vigneswaran, S. Ngo, H.H. Chapman, H. Experimental investigation of adsorption-Flocculation-Microfilter hybrid system in wastewater reuse. J. Member.

[9] Nelson, M. and C.F. Guarino (1969). The use of fly ash in municipal waste treatment. Journal of the Water Pollution Control Federation, 41: 1905-1911.

[10] Viraragharan, T. and M.M. Dronamraju (1992). Utilization of coal ash. Water pollution control. Journal of Environmental Studies, 40: 79-85.

[11] Nelson, M. and C.F. Guarino (1969). The use of fly ash in municipal waste treatment. Journal of the Water Pollution Control Federation, 41: 1905-1911.

[12] Frijns, J.and M. Jansen (1996). Institutional requirements for appropriate wastewater treatment systems. ETC in cooperation with WASTE. 12-14 November, 1996. pp: 54-66.

[13] International Journal of Emerging Technologies and Innovative Research, ISSN: 2349-5162, Vol. 5, Issue 10, page no. 703-708.

[14] Bilateral waste-water land- treatment research Leach, LE, Duan, Z B, Wang S T.

[15] Wastewater Engineering: Treatment and Reuse (2003) Edition 4th published by McGrawn-Hill, New York.

[16] Southeast Regional Wastewater Treatment Plant Facilities Improvement Project and Geysers Effluent Pipe Line Project by INIS