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A STUDY OF SUSTAINABLE SEWAGE MANAGEMENT OF MITHI RIVER

Nusrat Fatima Sayed

Assistant Professor-Sociology

L.S. Raheja College of Arts & Commerce, Relief Road,

Santacruz (West), Mumbai 400054.

Abstract:

This paper addresses the pressing issue of sewage waste management in Mumbai's Mithi River, focusing on sustainable practices to alleviate environmental degradation. The Mithi River, centrally located in Mumbai, faces significant contamination from unregulated sewage discharge, posing threats to aquatic life and public health. This study investigates current sewage waste management methods, identifies challenges encountered by responsible authorities, and offers insights for conservationists, policymakers, and the public. It explores techniques like mechanical fine screening, grit removal, and biological aerobic treatment, emphasizing the role of microorganisms in wastewater treatment. Additionally, it examines the impact of the nitrogen cycle on sewage treatment and evaluates disinfection processes crucial for ensuring water safety. By proposing practical solutions, this research contributes to sustainable urban development and advocates for a cleaner, healthier environment in the Mithi River.

Keywords: *Mithi River, Sewage, Waste-water, Sludge, Treatment, Sustainable, Waste, Bacteria, Microbes, Screening, Grit.*

Introduction:

Mumbai's Mithi River is a crucial water body grappling with severe contamination owing to uncontrolled sewage discharge. This study delves into sustainable sewage waste management practices aimed at combating environmental degradation in the Mithi River. By scrutinizing existing techniques and challenges, this research aims to provide guidance for conservationists, policymakers, and the public, fostering a cleaner and healthier environment in line with Sustainable Urban Development goals. It explores sewage treatment methods such as mechanical fine screening, grit removal, and biological aerobic treatment, highlighting the importance of microorganisms in wastewater treatment. Furthermore, it discusses the nitrogen cycle's influence on effective sewage treatment and examines critical disinfection processes, particularly chlorine and chloramine methods, vital for maintaining the safety of public water supplies and preventing waterborne diseases. This research endeavours to assist stakeholders involved in sustainable sewage management for the Mithi River, advocating for innovative solutions to promote a cleaner and more resilient urban water environment.

Literature Review: C.S. Southwick (1976) has written that “the change in chemical, physical and biological qualities of water due to human activities and natural processes is called water pollution”.

In both developing and developed countries, the disposal of human wastes is a great challenge (Zimmel et al., 2004).

Due to increase in human population and growth of industries there is a considerable pressure on water bodies; the pollution level is increasing (Sahu et al., 1991).

Various anthropogenic activities like the discharge of domestic wastes, industrial effluents, recreational and municipal wastes have greatly affected physiochemical properties of river waters (Panda et al., 1991).

Ecological damage and a serious health hazard are mainly a result of deterioration in the quality of water which is mainly due to human activities, such as, discharge of industrial/domestic wastes, sewage , agricultural run offs, disposal of dead bodies etc. (Meitei et al., 2004).

Objective of Study:

1. The main objective of this research is to evaluate and propose sustainable sewage waste management practices for Mumbai's Mithi River to mitigate environmental degradation. Specifically, the study aims to:
2. Assess current sewage waste management techniques employed at the Mithi River Sewage Treatment Plant.
3. Identify and analyse challenges faced by authorities responsible for sewage treatment in the Mithi River.
4. Provide insights for conservationists, policymakers, and the public to contribute to a cleaner and healthier environment in the Mithi River.
5. Investigate sewage waste treatment methods, including mechanical fine screening, grit removal, and biological aerobic treatment.
6. Explore the role of microorganisms in wastewater treatment and their significance in reducing environmental impact.
7. Examine the nitrogen cycle in wastewater management, focusing on its different forms and the processes of biological nitrification and denitrification.
8. Investigate disinfection processes, with a focus on chlorine and chloramine methods, crucial for ensuring the safety of public water supplies and preventing waterborne diseases.

Methodology: This research relies on primary and secondary data obtained through interviews, discussions and on-site visits to the sewage treatment plant in Powai, Mumbai.

The methodology includes:

On-site Visits: Visits to the Mithi River Sewage Treatment Plant for first-hand observations and documentation of sewage waste management processes.

Interviews and Discussions: Structured interviews with key stakeholders, including plant operators, managers, and environmental experts, to gather qualitative data on existing sewage management practices and challenges.

Secondary sources : Maharashtra Pollution Control Board (M.P.C.B.). https://mpcb.gov.in.

Sewage Treatment Methods in the Mithi River:

1. **Mechanical Fine Screening:** Wastewater screening is a vital process in municipal and industrial wastewater treatment facilities, essential for removing solids present in the wastewater. The removal of these solids is crucial from the outset of the treatment process to prevent water contamination, protect equipment from damage, and maintain system efficiency. Failure to remove these solids can lead to unforeseen events that disrupt the ecological balance of an entire region.

   Types of Screens Used in Sewage Treatment Plants: Wastewater treatment screens are typically categorized into three groups: coarse, fine, and micro screens, with various variations within each category. These screens are distinguished based on mechanical characteristics and the size of the screening apertures.

   Screening in the Treatment of Wastewater: Coarse screens, with clear apertures ranging from 6 to 150 mm (0.25 to 6 in), are commonly used to

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remove heavy debris and coarse materials like rags. They can be manually cleaned or mechanically cleaned, with various mechanisms such as chain-driven screens, catenary screens, reciprocating rakes, and continuous belt screens.

Micro screening, utilizing drum screens with modest speeds and filtering textiles featuring 10–35µm apertures, is employed to remove the tiniest particles from untreated wastewater.

Fine screens, designed with clear apertures smaller than 6 mm, utilize perforated plates, wedge wire, or wire cloth to remove tiny particles. These include drum screens, step screens, and static wedge wire screens.

2. **Grit Removal:** Grit removal facilities are typically positioned before primary clarification and following screening and comminution processes to prevent large solids from obstructing downstream equipment. Grit, consisting of sand, gravel, cinder, and other heavy particles, is separated from the wastewater using various methods such as grit chambers, centrifugal sludge separation, and settling tanks.

   Types of Grit Chambers:: Aerated Grit Chamber: Utilizes spiralling wastewater flow and aeration to create a perpendicular spiral velocity pattern, allowing heavy particles to settle at the bottom while lighter organic particles are carried away.

   Vortex Grit Chamber: Generates a vortex flow pattern to settle grit particles at the bottom, which are then removed using a grit pump or air lift pump. Horizontal Flow Grit Chamber: Maintains an upstream velocity to separate heavier grit particles from lighter organic particles.

3. **Biological Aerobic Treatment:** Biological aerobic treatment relies on oxygen-dependent biological processes to degrade organic pollutants in wastewater. This method is highly effective, eliminating up to 98% of organic pollutants and producing a cleaner effluent compared to anaerobic treatment. Common methods include activated sludge process, trickling filters, aerated lagoons, and oxidation ponds.

A) **Activated Sludge Process:** This widely used method utilizes highly concentrated microorganisms to degrade organics and remove nutrients from wastewater, producing a high-quality effluent. Sewage containing organic matter and microorganisms is aerated in an aeration tank, promoting waste decomposition. The effluent is then separated in a settling tank, known as a secondary settler or clarifier.

B) **Trickling Filters:** These filters remove substances like ammonia from water and are employed after basic treatment. The secondary effluent from trickling filters can undergo further treatment or be discharged.

C) **Aerated Lagoons:** Aerated lagoons use mechanical aeration to add oxygen to the water, promoting biological oxidation of wastewater. The effluent from aerated lagoons can be reused, but settled sludge requires additional treatment.

D) **Oxidation Ponds:** These ponds facilitate interaction between bacteria, algae, and other species to consume organic materials from primary effluent. Oxidation ponds are productive and suitable for areas with sparse populations and ample open land, though the process is generally slow.

In conclusion, the sewage treatment methods in the Mithi River involve a combination of mechanical screening, grit removal, and biological aerobic treatment processes. These methods play a crucial role in mitigating environmental degradation and safeguarding public health in urban water environments.

Role of Microorganisms in Wastewater Management:

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- Microorganisms play a crucial role in the breakdown and removal of organic pollutants, nutrients, and pathogens in sewage treatment.
- Aerobic bacteria, anaerobic bacteria, and facultative bacteria contribute to biodegradation and nutrient cycling in wastewater treatment processes.

Nitrogen Cycle in Wastewater Management:

The nitrogen cycle influences the fate and transport of nitrogen compounds in wastewater.

Key processes include ammonification, nitrification, denitrification, assimilatory nitrogen reduction, and anammox. Understanding the nitrogen cycle is crucial for designing effective treatment strategies to remove nitrogen compounds and minimize environmental impact.

Disinfection Processes in Wastewater Treatment:

Disinfection is essential to eliminate pathogenic microorganisms and ensure the safety of treated effluent.

Key disinfection methods include chlorination, chloramination, UV irradiation, ozonation, and membrane filtration.

These methods effectively inactivate bacteria, viruses, and other pathogens, reducing the risk of waterborne diseases and protecting public health.

Conclusion: Effective sewage waste management is vital for mitigating environmental degradation and safeguarding public health in urban water environments like Mumbai's Mithi River. By implementing innovative sewage treatment practices, stakeholders can improve water quality, enhance ecosystem resilience, and promote sustainable urban development. This research provides valuable insights into the challenges and opportunities of sewage waste management in the Mithi River, offering practical recommendations for conservationists, policymakers, and the public.

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