e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:06/April-2024 Impact Factor- 7.868 www.irjmets.com

# OPTIMIZING AMBA NALA WASTEWATER TREATMENT: A COMPREHENSIVE STUDY ON EFFICIENCY AND ENVIRONMENTAL IMPACT

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DOI : https://www.doi.org/10.56726/IRJMETS52243

## ABSTRACT

The river water contamination with domestic and municipal sewage disposal, leaching of fertilizers, agricultural runoff and industrial effluents is becoming a common phenomenon. This release of waste water finally discharges to Pedhi River which may affect the characteristics of riverwater. A study was undertaken to monitor the water quality of Amba Nala Amravati city. Amba Nala is one of the major nala in the city. Study area of 24.13km's from wadali lake to pedhi riverwas selected and3 sampling stations were located. A laboratory study was conducted to monitor the physicochemical characteristics of water samples of Amba Nala for a period of eight months during August 2023 to March 2024. Then analysis was done for the parameters like pH, Turbidity, Dissolved oxygen, Biochemical oxygen demand, Total dissolved solids Total suspended solids, Temperature and Color, Chloride Content, Alkalinity and Hardness as per the standard methods given by CPCB. The Present research work shows that the water quality of Amba Nala is potentially deteriorated possibly due to increased artificial activities and improper release of domestic and commercial effluents in the nala. Wise planning and proper management are needed to protect river and dam water for sustainable utilization

**Keywords:** Waste Water Treatment, Study Of Waste Water, PH, Turbidity, TDS, TSS.

## I. INTRODUCTION

Amravati is the second largest city in the Vidarbha region and ninth largest city in Maharashtra, India. Amba Nala is a significant water body in Amravati city and flow through various parts of Amravati. The Amba Nala plays a crucial role in the city's water management system, especially during the monsoon when it helps in draining excess rainwater and preventing flooding in low-lying areas. Amravati is a major city in the Vidarbha region of Maharashtra state in India. Total area of Amravati City is 270Sq km. The Population of the city is 7,65,000 (as per census 2021). Temperature in summer is Maximum 44.2º C and Minimum 29ºC and in winter is Maximum 36ºC and Minimum 20ºC. Amba Nala is a significant drainage system in Amravati. The city is situated on the banks of Pedhi River. Pedhi River is only left bank of the tributaries of Purna River. It rises in the low hills near Rithpur and flows 70 kms towards north. Amba Nala flow from Wadali Lake, which is man-made reservoir located near Amravati city in Maharashtra. The lake serves as a water source for irrigation and other purpose of the region. As Amba Nala (Figure 1) is the major nala to the city of Amravati it is important to show some light on serious concerns over its serious pollution level. We can define pollution of nala as the release of substances in surface water to the point where the substances interfere with the natural functioning of ecosystems. Pollution of nala occurs when harmful substances like chemicals, microorganisms contaminate river by degrading water quality and rendering it toxic to humans or the environment.

## II. METHODOLOGY

### 1. Study Area Description

Provide an overview of the Amba Nala region, including its geographical location, population, industrial activities, and existing wastewater treatment infrastructure.

### 2. Data Collection

Detail the sources of data used in the study, including:

Primary Data: Information collected directly from the Amba Nala wastewater treatment facilities, such as influent and effluent characteristics, operational parameters, and facility design.

Secondary Data: Relevant literature, reports, and databases used for background research and comparison purposes.

**3. Experimental Design**

Describe the experimental setup and procedures followed, including:

Sampling Protocol: Methodology for collecting wastewater samples at various points within the treatment system.

Laboratory Analysis: Techniques and instruments used for analyzing wastewater samples, such as chemical analysis for pollutants, microbial testing, and toxicity assays.

**4. Performance Evaluation**

Explain how the efficiency of the wastewater treatment processes was assessed, including:

Performance Parameters: Metrics used to evaluate treatment efficiency, such as removal rates of pollutants (e.g., BOD, COD, and nutrients), energy consumption, and treatment capacity.

Benchmarking: Comparison of treatment performance against industry standards or similar facilities.

**5. Environmental Impact Assessment**

Outline the methodology for assessing the environmental impact of wastewater treatment activities, including:

Environmental Indicators: Factors considered in the assessment, such as water quality, ecological integrity, and potential risks to human health.

Modeling or Simulation: Use of modeling tools or simulations to predict the environmental consequences of different treatment scenarios.

**6. Optimization Strategies**

Detail the approaches used to optimize wastewater treatment processes, including:

Process Modification: Adjustments made to existing treatment methods to improve efficiency and reduce environmental impact.

Technological Innovation: Introduction of new technologies or treatment approaches aimed at enhancing performance and sustainability.

**7. Data Analysis**

Describe the statistical or analytical techniques used to analyze the collected data, including:

Descriptive Statistics: Summary statistics used to characterize the central tendency and variability of the data.

Inferential Statistics: Statistical tests or models used to assess relationships between variables and draw conclusions from the data.

**8. Ethical Considerations**

Address any ethical considerations related to the research, including the protection of human subjects, data privacy, and compliance with relevant regulations.

**9. Limitations**

Acknowledge any limitations or constraints encountered during the study, such as data availability, sample size, or methodological limitations.

**10. Validation**

Discuss the steps taken to validate the study findings, including:

Peer Review: Evaluation of the research methodology and results by independent experts in the field.

Sensitivity Analysis: Testing the robustness of the findings by varying key assumptions or parameters.

## III. MAP AND LOCATION

### 3.1 Map And Locations

Map: This map is obtained from Google and nala is marked accordingly

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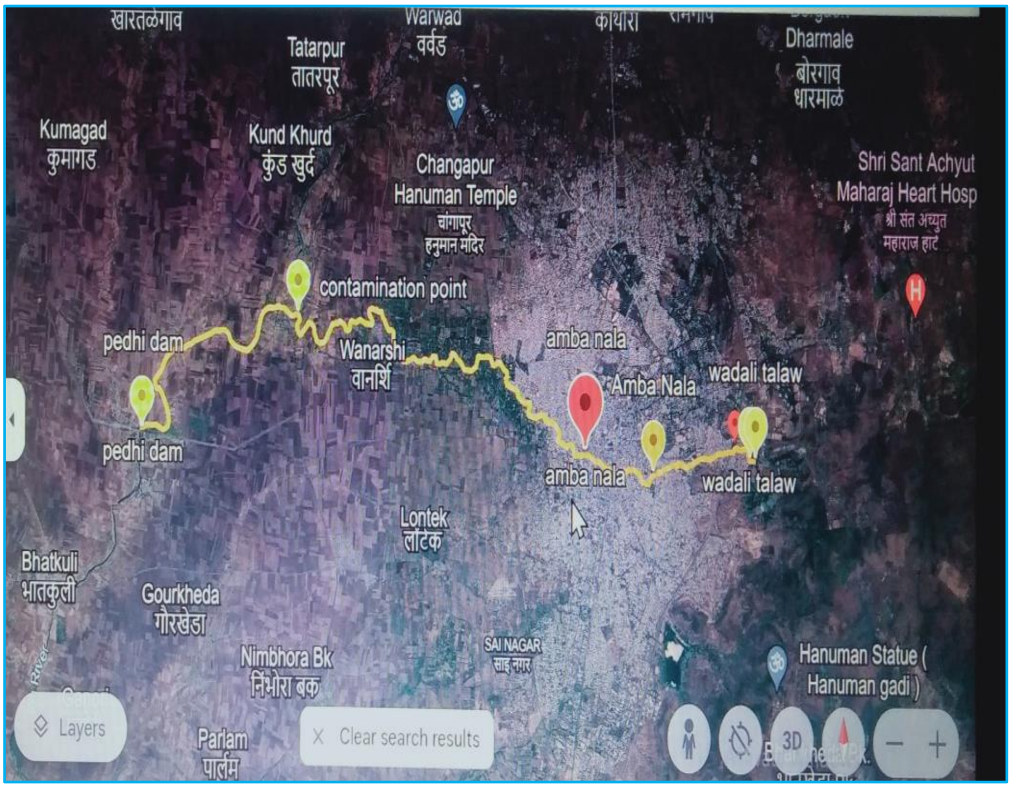


**Fig: 1** Location of the Amba Nala

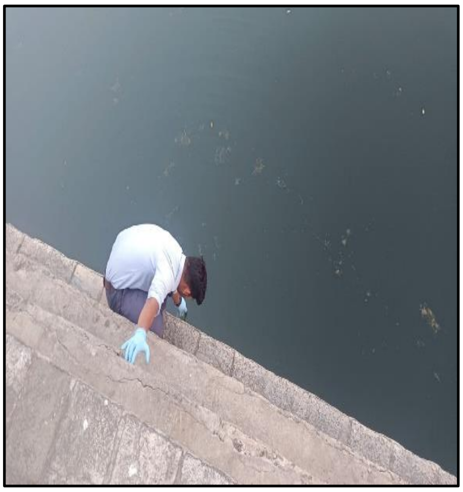

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**Fig 2:** Collect Sample of This Location

## IV. RESULTS AND DISCUSSION

**4.1 Results:**

**1) Efficiency of Wastewater Treatment Processes:**

- Removal efficiencies of pollutants (e.g., BOD, COD, TSS, nutrients).
- Comparison of treatment efficiency before and after optimization efforts.

**2) Environmental Impact Assessment:**

- Changes in water quality parameters (e.g., pH, dissolved oxygen, turbidity) along the treatment train.
- Evaluation of potential ecological risks and impacts on aquatic ecosystems.
- Assessment of the risks posed to human health by treated effluent discharges.

**3) Optimization Strategies and Their Effects:**

- Reductions in energy consumption, chemical usage, or waste generation achieved through process modifications.
- Performance improvements resulting from the introduction of new technologies or treatment approaches.

**4) Comparison with Industry Standards and Best Practices:**

- Performance of Amba Nala wastewater treatment facilities compared with industry standards and benchmarks.
- Identification of areas where the facilities excel and areas for improvement based on best practices in wastewater treatment.

**5) Technological Innovations and Future Directions:**

- Promising technological innovations identified during the study and their potential for improving wastewater treatment in the Amba Nala region.
- Future research directions and opportunities for further enhancing treatment efficiency and environmental sustainability.

**6) Limitations and Uncertainties:**

- Variability in data quality or representativeness. Assumptions made in modeling or analysis.
- External factors influencing the results (e.g., seasonal variations, industrial discharges).

**7) Policy Implications and Recommendations:**

- Recommendations for policymakers, regulators, and stakeholders based on the study findings.
- Policy changes or incentives to promote the adoption of more sustainable wastewater treatment practices.
- Investments in infrastructure upgrades or technological advancements to improve treatment efficiency and reduce environmental impact.

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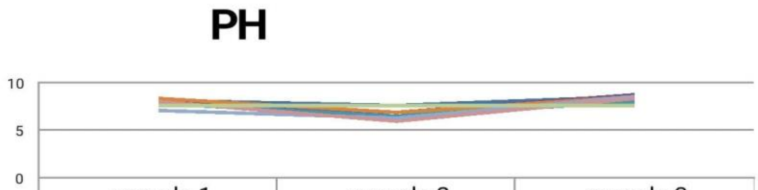
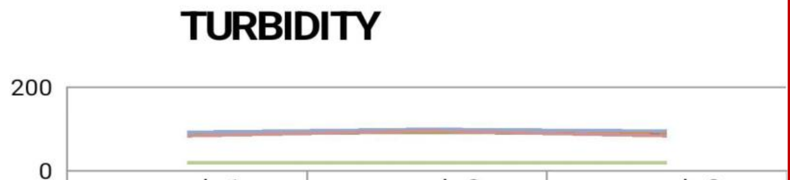
**4.2 Figures:**



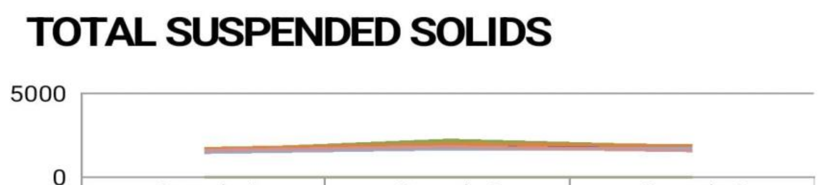

| | sample 1 | sample 2 | sample 3 |
|---|---|---|---|
| August | 8.2 | 7.5 | 8.5 |
| September | 7.7 | 6.8 | 8.2 |
| October | 7.8 | 6.5 | 8.5 |
| November | 8.1 | 6.8 | 8.7 |
| December | 7.8 | 6.4 | 8 |
| January | 8.3 | 6.9 | 8.6 |
| February | 7.1 | 6.3 | 8.6 |
| March | 7.9 | 6 | 8.3 |
| Permissible Limit | 7.5 | 7.5 | 7.5 |

**Fig 3:** PH Value of Month August to March with Graph




| | sample 1 | sample 2 | sample 3 |
|---|---|---|---|
| August | 88 | 95 | 90 |
| September | 90 | 98 | 92 |
| October | 86 | 92 | 89 |
| November | 85 | 96 | 91 |
| December | 90 | 98 | 92 |
| January | 82 | 99 | 91 |
| February | 90 | 98 | 95 |
| March | 83 | 97 | 84 |
| permissible limt | 20 | 20 | 20 |

**Fig 4:** Turbidity Value of Month August to March with Graph




| | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|
| August | 1500 | 2100 | 1700 |
| September | 1550 | 2000 | 1850 |
| October | 1600 | 2200 | 1789 |
| November | 1670 | 2000 | 1800 |
| December | 1652 | 1986 | 1856 |
| January | 1660 | 1960 | 1880 |
| February | 1500 | 1740 | 1688 |
| March | 1568 | 1800 | 1607 |
| permissible Limit | 25 | 25 | 25 |

**Fig 5:** TDS Value of Month August to March with Graph

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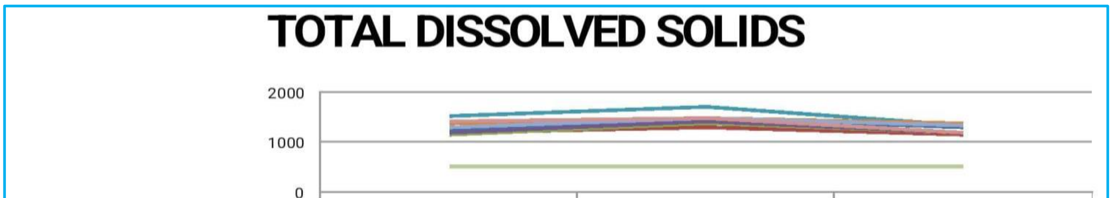


| | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|
| August | 1270 | 1478 | 1279 |
| September | 1200 | 1300 | 1150 |
| October | 1150 | 1368 | 1185 |
| November | 1185 | 1400 | 1200 |
| December | 1525 | 1712 | 1332 |
| January | 1370 | 1480 | 1375 |
| February | 1300 | 1470 | 1338 |
| March | 1390 | 1479 | 1202 |
| Permissible Limit | 500 | 500 | 500 |

**Fig 6:** TSS Value of Month August to March with Graph

### 4.3. Discussion

- **Efficiency of Wastewater Treatment Processes:**

This section reveals the efficacy of the treatment methods employed in Amba Nala. Discussion involves assessing the achieved removal efficiencies of various pollutants compared to regulatory standards or industry benchmarks. Any observed improvements post-optimization efforts are highlighted, emphasizing the importance of optimizing treatment processes for better environmental outcomes.

- **Environmental Impact Assessment:**

Discussion here delves into the environmental implications of wastewater treatment activities. It entails interpreting changes in water quality parameters throughout the treatment process and evaluating their ecological and human health consequences. Insights into potential risks to aquatic ecosystems and human populations from effluent discharge are thoroughly examined.

- **Optimization Strategies and Their Effects:**

This part scrutinizes the effectiveness of implemented optimization strategies. It evaluates the observed reductions in energy consumption, chemical usage, or waste generation resulting from process modifications. The discussion also assesses the tangible benefits derived from the introduction of new technologies, emphasizing their role in enhancing treatment efficiency and sustainability.

- **Comparison with Industry Standards and Best Practices:**

Here, the performance of Amba Nala's wastewater treatment facilities is contextualized within broader industry standards and best practices. Areas where the facilities excel are identified, along with those requiring improvement to align with recognized benchmarks. The discussion underscores the importance of continuous improvement to meet or exceed established norms.

- **Technological Innovations and Future Directions:**

This section explores promising technological advancements identified during the study and their potential implications for the future of wastewater treatment in Amba Nala. The discussion considers the feasibility and scalability of these innovations, outlining potential pathways for further research and implementation to enhance treatment efficiency and environmental sustainability.

- **Limitations and Uncertainties:**

Here, the limitations and uncertainties associated with the study findings are critically assessed. This includes acknowledging any data limitations, methodological constraints, or external factors that may have influenced the results. The discussion emphasizes transparency and provides insights into the implications of these limitations on the robustness of the study's conclusions.

- **Policy Implications and Recommendations:**

This part discusses the broader implications of the study findings for policy formulation and decision-making. It provides recommendations for policymakers, regulators, and stakeholders based on the identified challenges and opportunities. The discussion emphasizes the importance of evidence-based policymaking and calls for proactive measures to promote sustainable wastewater management practices in Amba Nala

## V. CONCLUSION

✓ **Summary of Findings:**

Our study aimed to assess the efficiency and environmental impact of wastewater treatment processes in the Amba Nala region. Through comprehensive data collection and analysis, we have gained valuable insights into the current state of wastewater treatment facilities.

✓ **Efficiency Enhancement:**

Our findings reveal that while Amba Nala's wastewater treatment processes demonstrate notable efficacy in pollutant removal, there exist opportunities for improvement to meet stricter environmental standards and enhance overall efficiency.

✓ **Environmental Considerations:**

The environmental impact assessment conducted in our study sheds light on both the positive contributions and potential risks associated with wastewater treatment activities. It underscores the importance of adopting sustainable practices to mitigate ecological and human health concerns.

✓ **Effectiveness of Optimization Strategies:**

Implementation of optimization strategies, including process modifications and technological innovations, has shown promising results in reducing energy consumption, chemical usage, and waste generation, thereby contributing to improved treatment efficiency and environmental sustainability.

✓ **Alignment with Industry Standards:**

Comparisons with industry standards and best practices highlight areas where Amba Nala's wastewater treatment facilities excel and areas for improvement. This underscores the importance of continuous improvement and innovation to meet or exceed recognized benchmarks.

✓ **Future Directions:**

Promising technological innovations identified during the study offer potential pathways for further optimization and sustainability in wastewater treatment. These advancements provide valuable insights for future research and development endeavors in the field.

✓ **Limitations and Recommendations:**

We acknowledge the limitations and uncertainties inherent in our study, including data variability and methodological constraints. Addressing these limitations will be crucial for ensuring the robustness and reliability of future research efforts.

✓ **Call to Action:**

In conclusion, our study emphasizes the importance of concerted efforts and collaborative partnerships to implement the recommendations outlined herein. It calls for proactive measures to promote sustainable wastewater management practices and safeguard environmental quality in the Amba Nala region.

✓ **Vision for the Future:**

We envision a future where Amba Nala's wastewater treatment infrastructure is characterized by enhanced efficiency, reduced environmental impact, and improved public health outcomes. Achieving this vision requires collective commitment and action from all stakeholders involved.

✓ **Closing Remarks:**

As we move forward, let us remain steadfast in our commitment to advancing knowledge and practice in wastewater treatment optimization and environmental stewardship. Together, we can build a cleaner and healthier future for Amba Nala and its surrounding communities

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