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The Study of the Efficiency of Purple Non-Sulfur Photosynthetic Bacteria in Wastewater Treatment Using an SBR System

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Abstract:

This study investigates wastewater treatment using an SBR (Sequencing Batch Reactor) system combined with photosynthetic bacteria at varying bacteria-to-wastewater ratios. The main goal was to evaluate the efficiency of these bacteria in treating wastewater from Satthasamut School. Experimental testing at the Pak Lat Reservoir, Thailand, was conducted to observe the efficacy of the treatment system under three different ratios: 1:60, 1:120, and 1:240. Results showed significant improvements in water quality across all ratios, with the 1:120 ratio proving to be the most effective. This paper discusses the effectiveness of photosynthetic bacteria in wastewater treatment, focusing on the effects of bacteria concentration on water parameters such as pH, dissolved oxygen (DO), and optical density (OD). The study also highlights the influence of natural factors on treatment efficiency and offers recommendations for future studies.

Keywords — **wastewater treatment, photosynthetic bacteria, SBR system, bacteria-to-wastewater ratio, water quality**

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I. INTRODUCTION

The use of photosynthetic bacteria in wastewater treatment has gained attention due to their ability to remove organic pollutants while producing oxygen through photosynthesis. This study aims to assess the efficiency of photosynthetic bacteria for wastewater treatment in a Sequencing Batch Reactor (SBR) system. The treatment was tested at the Pak Lat Reservoir, located in Thailand, with wastewater samples sourced from Satthasamut School. The bacteria-to-wastewater ratios tested were 1:60, 1:120, and 1:240. This paper presents the findings of this investigation and evaluates the optimal ratio for improving water quality based on parameters such as pH, dissolved oxygen (DO), and optical density (OD).

II. METHODOLOGY

The study was conducted in an experimental setup using an SBR system combined with photosynthetic bacteria collected from the Pak Lat Reservoir. The system was designed to treat wastewater from Satthasamut School under three different bacteria-to-wastewater ratios: 1:60, 1:120, and 1:240. These ratios were chosen to observe the influence of bacteria concentration on the treatment effectiveness. The parameters measured included pH, DO, and OD, which were monitored over a period of nine days to assess the treatment's progress. The results were analyzed to determine the optimal ratio that would produce the clearest water and maintain water quality within acceptable standards.

III. RESULTS

A. Photosynthetic Bacteria Collection

The photosynthetic bacteria collected from the Pak Lat Reservoir showed significant growth when cultured. Notably, these bacteria exhibited a rapid color change to purple within nine days, which was the fastest reaction time observed during the study. This quick reaction may be attributed to the floodgate system of the reservoir, which creates conditions conducive to bacterial growth when the gate is closed, allowing bacteria to accumulate in large numbers.

B. Wastewater Treatment Results

Three different bacteria-to-wastewater ratios were tested: 1:60, 1:120, and 1:240. The following observations were made:

Bacteria-to-Wastewater Ratio 1:60: This ratio produced the most optimal pH but the lowest DO, indicating an imbalance in oxygen levels.

Bacteria-to-Wastewater Ratio 1:240: This ratio resulted in a high pH that exceeded acceptable standard limits but also produced the highest DO levels, suggesting an imbalance in the chemical composition.

Bacteria-to-Wastewater Ratio 1:120: This ratio produced the clearest water with both pH and DO within the acceptable range. Optical density values were the lowest at this ratio, which correlates with the highest water clarity.

C. Conclusion from Results

The treatment efficiency varied depending on the bacteria-to-wastewater ratio. Among the three ratios tested, the 1:120 ratio was found to be the most effective, producing the best water quality with acceptable pH, DO, and OD levels. These findings highlight the importance of selecting the appropriate bacteria concentration for optimal wastewater treatment.

IV. DISCUSSION

A. Impact of Bacteria Concentration on Water Quality

The presence of photosynthetic bacteria has been shown to improve water quality by reducing organic pollutants and increasing dissolved oxygen levels. However, the concentration of bacteria plays a critical role in determining treatment success. Higher bacteria concentrations were observed to lower pH and increase oxygen consumption, which led to an imbalance in the water quality at ratios of 1:60 and 1:240. On the other hand, the balanced levels at 1:120 were most effective in promoting efficient wastewater treatment.

B. Natural Influences on Treatment Efficiency

Natural factors such as water flow, temperature, and sunlight exposure may have influenced the treatment process. At the Pak Lat Reservoir, the floodgate system may have contributed to the rapid bacterial growth observed, leading to quicker and more effective wastewater treatment.

V. CONCLUSIONS

This study concludes that using photosynthetic bacteria in an SBR system provides an effective solution for wastewater treatment. The bacteria-to-wastewater ratio of 1:120 was found to be the most efficient in improving water quality, as evidenced by the optimal pH, DO, and OD levels. Future studies should consider additional natural variables such as tidal variations, as well as the potential for using specific species of photosynthetic bacteria to further enhance treatment efficiency.

VI. RECOMMENDATIONS

Further research is needed to optimize the use of photosynthetic bacteria in wastewater treatment. Future studies could focus on:

Exploring the influence of tidal variations and seasonal changes on wastewater treatment efficiency.

Investigating specific strains of photosynthetic bacteria to determine which offer the best performance in wastewater treatment.

Extending the testing to other wastewater sources to confirm the effectiveness of the bacteria-to-wastewater ratio across different settings.

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