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Comprehensive Study of Effective Microorganisms in Wastewater Treatment

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Abstract

Effective Microorganisms (EM) are microbial cultures composed mostly of lactic acid bacteria, yeasts, and photosynthetic bacteria. Many of the microbes in these cultures are helpful to plants, people, animals, and the environment, and are utilized to create and increase the freshness of foods. This product has been widely used as a medium to improve water quality, mostly in rivers and lakes. This study focuses on the drainage area near Arked Mawar Cafeteria, UTHM Pagoh. The main objective of this study is to determine the optimal dose and optimal reaction time for COD and BOD reduction using Effective Microorganisms (EM). The primary goal of this study is to determine whether this product can treat wastewater from the UTHM cafeteria before releasing it into a lake or river. From a visual inspection test conducted, compared to before applying EM, the wastewater would gradually clear after adding EM. Results from this study show that EM is effective and has an average reduction effect of at least 85% on COD and 70% on BOD. In this study, the reduction of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) can all be achieved using an Effective Microorganisms (EM) treatment approach.

1. Introduction

Several ways to treat wastewater, including using Effective Microorganisms (EM). It makes advantage of both anaerobic and aerobic metabolic processes. In addition, it belongs to a specific class of beneficial microorganisms that can be employed to enhance numerous biological functions. These microorganisms, which can be found in wastewater treatment facilities, agricultural settings, and environmental remediation sites, are typically composed of multiple strains of bacteria, yeast, and other microbes that work together to produce positive results [1].

Previous research indicates that a variety of techniques have been used to treat drain wastewater [2]. Thus, Effective Microorganisms (EM) approach has been used to conduct the study. This research was obtained to investigate if the EM approach is appropriate for channelling wastewater from the drain into the river. Furthermore, only four out of the six factors (BOD, COD, AN, SS, temperature, DO, and pH) meet Malaysian water quality criteria sufficiently low to permit effluent to be dumped into rivers and lakes without polluting them. The BOD and COD characteristics of the wastewater from the drain are the main subject of this investigation.

Since Effective Microorganisms (EM) do not contain any hazardous materials that could endanger the UTHM population, EM was selected as a solution to reduce the sub-index of COD and BOD in wastewater at a drain near Arked Mawar Cafeteria, UTHM Pagoh. Depending on the origins and kinds of pollutants present, drainage water

might have different harmful values. The following particles or silt in drainage water can cause turbid, which lowers light penetration and harms aquatic environments [3].

Additionally, toxins and nutrients that are connected to the sediment might be transported by it. High water temperatures can harm aquatic ecosystems by decreasing oxygen solubility and stressing aquatic life. These conditions are frequently linked to industrial discharges or a lack of riparian vegetation [4]. In addition, numerous pathogens, including bacteria, viruses, and parasites, may be present in it [5]. Hazardous material exposure in polluted water, such as pesticides, heavy metals, and industrial pollutants, can result in both acute and long-term health concerns, such as cancer, neurological disorders, and reproductive difficulties [6].

Thus, using EM, this product's utilisation of organic materials lowers the cost of treating and cleaning the foul-smelling wastewater in the drain, which is especially unpleasant and pollutes the lake at UTHM. It is practical and affordable to treat wastewater in locations such as cafeterias using accessible, safe treatment methods [7]. To ensure that wastewater discharge meets Malaysian guidelines, it is crucial to lower the parameter of COD and BOD. The goal of this research is to ensure that this approach indicates promise in achieving this goal.

The purpose of this study is to identify the properties of the initial pH, initial temperature, initial dissolved oxygen, initial AN, COD, BOD, and SS raw parameter values. Using Effective Microorganisms (EM) to determine the ideal dose and timing for COD and BOD reduction comes in second. The final step involves determining the ideal parameter value to reduce COD and BOD using Effective Microorganisms (EM).

2. Materials and Methods

Effective Microorganisms (EM) has been used as a cleaning agent in wastewater treatment for the drainage area near Arked Mawar Cafeteria, UTHM Pagoh which was the location of this study. Since this study has focused on COD and BOD reduction, the optimal values for reducing COD and BOD levels, EM dosage, and reaction time were determined. Samples collected were analyzed at the Environmental Technology Engineering Laboratory, focusing on COD and BOD parameters, collected in mid-January 2024. Fig.1 shows the flow of the research methodology.

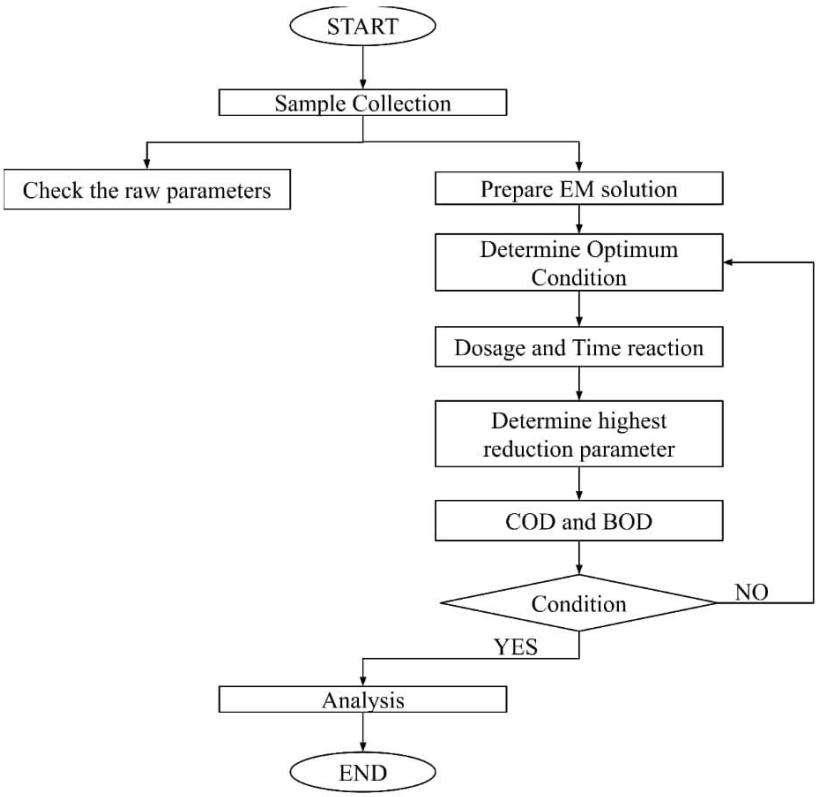

Fig. 1 *Research Methodology Flowchart*

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Referring Fig.1, the optimum dosage of Effective Microorganism (EM) is determined by the highest percentage of the reduction parameter chosen which are Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). This study is being carried out by setting the dosage of EM which are 0.5 ml, 1.0 ml, 1.5 ml, 2.0 ml, 2.5 ml, 3.0 ml, 3.5 ml and 4.0 ml [3]. The reaction time is also set to 4 minutes. This study is conducted in exact sequence to get the controlled variable value. The optimum reduction result will be set as the optimum value for dosage of EM along with referring to previous studies for more accuracy. All the settings for the dosage of EM are repeated to get the average reading.

The optimum reaction time is determined so that the variable has been set up to reach the optimum conditions for EM. At this level, one optimum value has been set which is the dosage of EM. The values of the variable for time reaction are 4 minutes, 8 minutes, 12 minutes, 16 minutes, 20 minutes, 24 minutes, 28 minutes and 32 minutes. All the variables will be adjusted until they reach the suitable setting. After the study of the parameters involved, which are Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) reached the optimum value using the variable, the optimum reaction time will also be set. The accuracy of the chosen optimum value is referred to in previous studies to ensure accuracy. All the settings for time reaction are repeated to get the average reading.

3. Result and Discussion

The wastewater sample was first measured based on the six data of the experiment that the wastewater needed to go through to check the water quality index. The parameters that need to be checked are Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH value, Ammoniacal Nitrogen (AN), Suspended Solids (SS) and initially Dissolved Oxygen (DO). Table 1 shows the data of raw parameters of wastewater.

Table 1 *Raw parameters of wastewater*

Parameter	Result
COD	660.48 mg/L
BOD	2272.5 mg/L
SS	326.67 mh/L
AN	2.385
pH	6.56
Temperature	25 °C
DO	8.64 mg/L

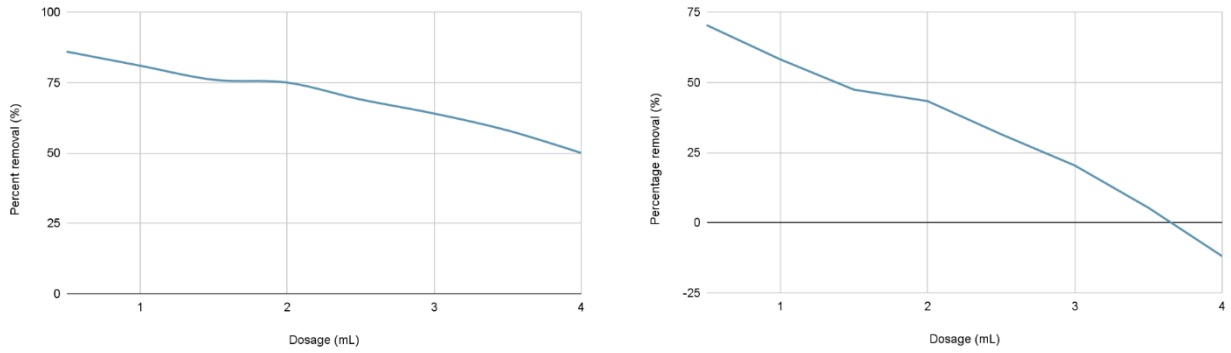
Effective Microorganisms (EM) can reduce pollution before being discharged into rivers or lakes. Based on the data obtained from the Table 2 and Table 3, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are the selected parameters. It can demonstrate the effectiveness of EM in treating drainage water and the optimum result for this study.

Table 2 *Optimum dosage of EM*

Sample	Blank	1	2	3	4	5	6	7	8
Dosage (mL)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
COD (mg/L)	0	301	425	535	576	696	809	962	1137
BOD (mg/L)	0	195.65	276.25	347.75	374.40	452.40	525.85	625.30	739.05

Table 3 *Optimum reaction time of EM*

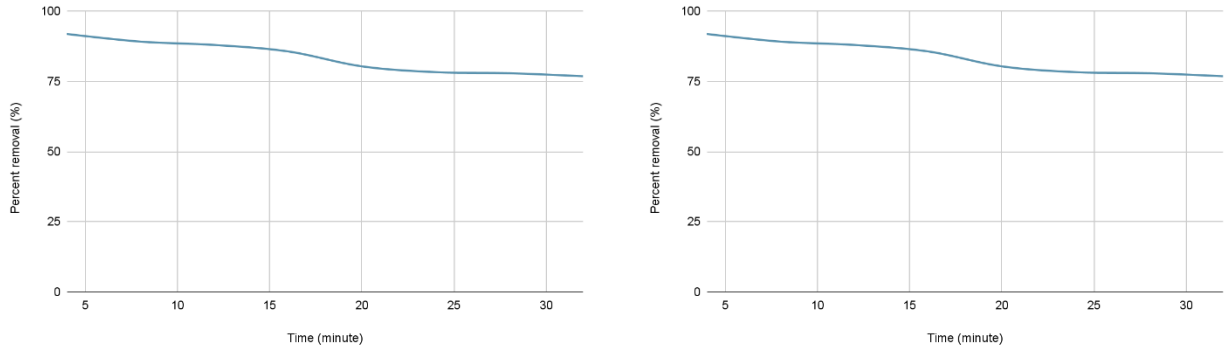
Sample	Blank	1	2	3	4	5	6	7	8
Time (minute)	0	4	8	12	16	20	24	28	32
COD (mg/L)	0	185	247	274	326	406	494	503	527
BOD (mg/L)	0	120.25	160.55	178.10	211.90	263.90	321.10	326.95	342.55



(a) (b)

Fig. 2 *(a) Dosage effect on COD; (b) Dosage effect on BOD*

Based on Fig. 2, it was found that the highest recovery percentage and concentration for COD and BOD in response to EM dosage effects were 86.75% and 70.38% respectively at 0.5mL.



(a) (b)

Fig. 3 *(a) Reaction time effect on COD; (b) Reaction time effect on BOD*

Based on Fig.3, it was found that the highest recovery percentages and concentrations for COD and BOD, responding to EM effects, were 91.86% and 81.79% respectively, observed at the 4-minute mark.

4. Conclusion

Effective Microorganisms (EM) has the potential to effectively treat wastewater and restore water quality from the research area. The wastewater sample from cafeterias, originating from food waste, has high BOD and COD levels. Therefore, the results showed sub-indexes COD and BOD were reduced but still high due to solid waste accumulation and residual food waste. Thus, the primary goal of this research has been achieved since EM could treat wastewater. The foul odour and sickening visual were greatly reduced which provide much more comfortable surrounding for people to pass by. To improve this research, the other parameters should have been considered instead of just focusing on certain parameters to get more accurate and satisfying result. In addition, it is recommended to filter the solid waste in the wastewater sample before investigating the parameters.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design, data collection, analysis and interpretation of results, draft manuscript preparation****: Nur Anis Ayuni Binti Mohd Azmi, Nur Zuhairah Binti*

Saidon, Nurul Natasya Nabila Binti Jamaludin, Izat Bin Yahaya. All authors reviewed the results and approved the final version of the manuscript.

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