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Research paper

Improvement of Sungai Sebulung Water Quality Using Effective Microorganism

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Abstract

Effective Microorganism (EM) is a practical and less costly method to enhance water quality. Sungai Sebulung is one of the rivers in Malaysia that have been treated using EM. This study has been carried out to find the effectiveness of EM and its suitability to the condition of Sungai Sebulung. This study will also evaluate Water Quality Index (WQI) of the river. The WQI of Sungai Sebulung is 56.2 and can be classified as a Class III. The average concentration of DO, BOD, COD, AN and TSS at Sungai Sebulung were 3.88 mg/L, 10.7 mg/L, 54 mg/L, 3.78 mg/L and 26.2 mg/L respectively. The result obtained shows the quality of Sungai Sebulung is the same compared to 2016.

Keywords: *Water quality; Effective Microorganism (EM); Water Quality Index (WQI); Dissolved oxygen (DO); Biochemical oxygen demand (BOD); Chemical oxygen demand (COD).*

1. Introduction

Degradation of river water quality prohibits its availability for human use and ecosystem and affect the optimum management of water resources [1]. Biological treatment, especially the use of microorganisms to improve polluted water quality is effective and widespread due to low capital and cost compared to chemical treatments. Therefore, in recent years there has been a growing interest in the use of biological purification techniques for water as the best alternative option environmentally and economically [2]. Effective Microorganism (EM) is one of the biological treatment method being used in river rehabilitation process. Various conventional methods are in practice for purification of water and removing the pollutant contaminants, but most of them are costly and non-ecofriendly [3]. EM in solid and liquid form are effective to inhibit algae growth, decompose sludge, kills pathogen and reduce odors problems in rivers from high concentration of ammonia, hydrogen sulfide and methane. In the scope of Water Quality Index (WQI), EM can reduce the concentration of total suspended solids (TSS), dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD) and pH [4]. EM in solid form is known as EM Mudballs whereas in liquid form known as EM solution which is (EMAS) is a mixture of molasses sugar and non-chlorinated water or rice rinse [2]. Effective Microorganism (EM) is a concept developed by a Japanese horticulturist, Teruo Higa from University of Ryukyus in [5]. He reported that EM consists of 80 different microorganisms that are capable to decompose many organic matters. The initial stage of the technology was based on combination a multi types of microbes, and was subsequently refined to include principal types of organisms commonly found in all ecosystems. These were then mixed in molasses medium and maintained at low pH under optimum conditions [6]. Effective microorganisms are a mixture of groups of organisms that have a reviving action on humans, animals, and the natural environment. Studies has shown EM have many applications such as gardening, agriculture, livestock, algae control, composting and household use [2]. For this study, Sungai Sebulung have been chosen to evaluate effectiveness of EM on Water Quality Index (WQI), phosphate and iron. Sungai Sebulung is one of the rivers in Johor that have been polluted. Johor Bahru City Council (JBCC) have made an effort to rehabilitate the water quality of Sungai Sebulung using the Effective Microorganism (EM) technology since 2004 under Sebulung River Settlement Revival Program (SRSRP) [7]. Effective Microorganisms (EM) was being chosen as the solution to reduce the water pollution at Sungai Sebulung because it does not harm aquatic life in the river. Besides, by applying EM in the river, the cost to treat and clean the river can be reduced as EM is relatively cheap and use only waste material [8]. There are many rivers around Malaysia and other countries treated with EM technology.

In Johor, JBCC have been using EM as a treatment method for many rivers including Sungai Segget, Sungai Stulang, Sungai Sungai Tebrau and Sungai Sebulung [4]. In 2009, a study was carried out on the tributary of Sungai Senai and Sungai Skudai. These two rivers are on the progress of rehabilitation work by using the EM technology. The Water Quality Index (WQI) of these rivers have been improved from Class IV to Class III [9]. Sungai Kelian also has been involved with the EM technology for the river water quality improvement programme. On the 25th March 2009, the Penang State Government with help from EM Biotechnology Experts launched a rehabilition programme for Sungai Kelian. In a short period of 3 months, WQI of Sungai Kelian improved from Class IV to Class III [10]. On January 25th 2010, a group named Go Green Team launched environmental remediation to rehabilitate a 3-acre polluted lake at Malaysia National Zoo [11]. The mission was to create a healthier, cleaner sustainable environment in and around the lake, providing a pleasant visit to visitors. In order to rejuvenate the lake by improving water quality of the lake, the Go Green team used EM technology

[11]. EM was also used as biofilter to improve domestic effluent quality before being discharged into river at the residential college in Universiti Malaysia Pahang (UMP) which discharge domestic effluent into Sungai Belat [12]. In Egypt, Quhafa waste water treatment plant (WWTP) use EM mainly to reduce phosphorus concentration in effluent [13]. The objective of this study is to evaluate the effectiveness of using EM at Sungai Sebulung in terms of WQI improvement and its effect on phosphate and iron

2. Materials and Method

2.1. Study Location

Sungai Sebulung flows along Kampung Melayu Majidee in the district of Larkin, Johor Bahru with the latitude, N 01° 30' 44.11" and its longitude, E 103° 44' 49.29". It is 10 km from Johor Bahru causeway. Sungai Sebulung is a tributary of Sungai Tebrau. The flow starts from Larkin Zone (upstream) and flow along Kampung Melayu Majidee (the middle part) and ends at Kampung Bendahara (downstream) in which the length of this river is approximately 5 km. The river is under supervision of Johor Bahru City Council (JBCC) for rehabilitation activities [14].

The main source of Sungai Sebulung pollution is from the upstream area which is Larkin industrial area which include a factory that process animal feed. Sungai Sebulung is also surrounded by squatters and what makes it worst is sullage from the houses are drained directly to the river [12].

2.2. Sampling Stations

Six sampling stations have been chosen along Sungai Sebulung for sampling activity. Table 1 shows the coordinate of all sampling station and Figure 1 shows the upstream, middle and downstream of Sungai Sebulung.

Table 2.1: Coordinate for sampling station at Sungai Sebulung

Station	Coordinate
S1	01° 30' 42.1'' N 103° 44' 39.5'' E
S2	01° 30' 43.1'' N 103° 44' 43.2'' E
S3	01° 30' 43.9'' N 103° 44' 48.6'' E
S4	01° 30' 44.0'' N 103° 44' 50.5'' E
S5	01° 30' 44.2'' N 103° 44' 57.4'' E
S6	01° 30' 45.2'' N 103° 44' 59.3'' E

(a)

(b)

(c)

Fig. 2.1: (a) Upstream, (b) Middle and (c) Downstream of Sungai Sebulung

2.3. Analysis

In-situ analysis was conducted at the river dissolved oxygen (DO), pH and temperature by using YSI Proplus multi parameter water quality checker. Laboratory analysis was conducted at the Environmental Engineering Laboratory, Faculty of Civil Engineering, UTM Skudai. Analysis include biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solid (TSS) was conducted based on Standard Method for Water and Wastewater Analysis. Ammoniacal nitrogen (AN), orthophosphate and iron was conducted using HACH DR6000 spectrophotometer.

3. Result and Discussion

Figure 3.1 shows the average concentration for DO, BOD, COD, AN and TSS for all sampling stations. The average DO concentration for Sungai Sebulung was 3.88 mg/L which is Class III according to National Water Quality Standard (NWQS) [15]. For BOD and COD, the average concentration at Sungai Sebulung were 10.73 mg/L and 54 mg/L respectively and classified as Class IV [15]. The average TSS concentration for Sungai Sebulung was 26.2 mg/L and classified as Class II [15] whereas AN was classified as Class V with average concentration of 3.78 mg/L.

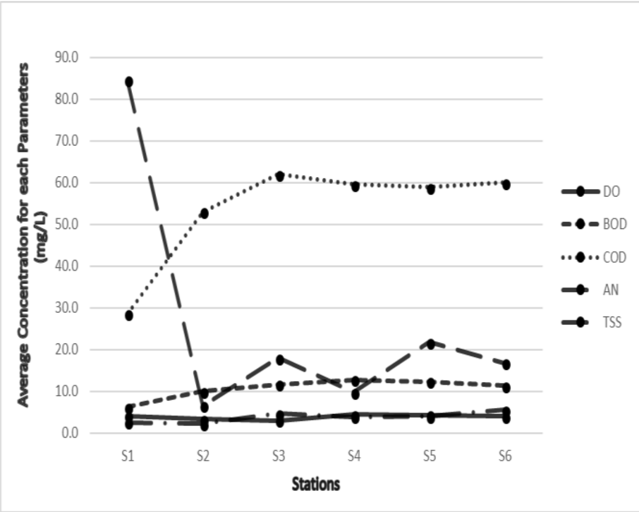

Fig. 3.1: Graph of average concentration for WQI parameters against sampling stations at Sungai Sebulung

Figure 3.2 shows the average concentration of orthophosphate and iron for each sampling stations at Sungai Sebulung. The average concentration of orthophosphate at Sungai Sebulung was 1.5 mg/L. The high concentration of orthophosphate at the river was contributed by direct discharge of detergents from squatters around the river. The average concentration of iron for Sungai Sebulung is 3.67 mg/L which is Class IV according to NWQS. The high concentration is attributed from industrial activities from the upstream since station 1 records the highest concentration.

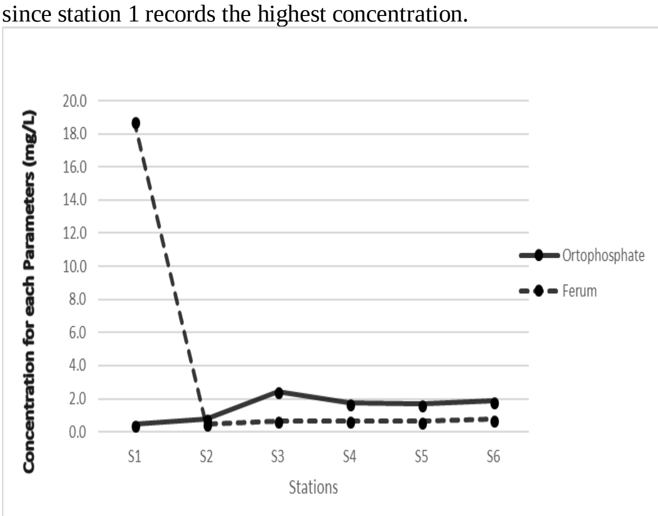

Figure 3.2: Graph of average concentration of orthophosphate and iron against sampling stations at Sungai Sebulung

4. Conclusion

The WQI of the river was 56.2 and classified as Class III. The low WQI index can be attributed to high AN and slightly low concentration of DO. During low flow of river water, DO level did not increase since some of the weirs are higher than water level. This cause the water cannot flow continuously. Hence, the weir height needs to be altered so that it can work well during low flow.

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