

Water Quality Study at Sembrong Dam Reservoir in Johor

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Dam, reservoirs and lakes are important in the conservation of basic national resource-water. In recent years, monitoring quality of water body or reservoir has become a main concern for the determination of current condition and long-term pattern for future management. The water quality study was assessed in Sembrong reservoir located in Kluang, Johor. Water samples at each point were collected in two sampling zones, i.e. Zone A (Sembrong) and Zone B (Merpoh). In situ measurement of biological, chemical and anions and metal parameters concentration obtained from the sampling stations on Sembrong dam reservoir for determined the water quality from both zone. Result indicated Zone A was categorized as Class III according to NWQS and Zone B was classified as Class IIA/B. Besides that, Zone B was better compared Zone A in every biological and chemical concentration for water quality analysis.

INTRODUCTION

Rivers play a major role for communities especially in fisheries and as a source of water for people residing within the vicinity. Important of water quality is to cover a wide range of approaches and conflicts. Water is super abundant material on the planet, as whole, but fresh potable water is not always available at the right time or the right place for human or ecosystem use [3]. Water quality refers to the physical, chemical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. Sembrong dam reservoir was built by damming a river. When a reservoir is built along a river's flow, the physical, chemical and biological conditions of the river are disrupted to some degree [2]. Since Sembrong dam reservoir is constructed on large lowland rivers with gradually sloping banks, it can be characterized by inundation of large areas, extreme horizontal variability with extensive shallows riparian vegetation and shallow reservoir. Such reservoir is usually eutrophic and high natural organic load are likely to contribute to the formation of an anoxic hypolimnion [9]. Shallow reservoir is usually well mixed by wind, and this leads to non-stratified condition [7]. Therefore, Sembrong dam reservoir can be categorized as shallow unstratified reservoir.

METHODOLOGY

Study Area and Sampling Methods. Utilization of water and significant nearby activities is the criteria that were selected on those sampling stations. There are total of 17 water quality-sampling stations of the Sembrong dam reservoir as indicated in Fig.1. The water quality sampling stations are divided into two sampling zones, i.e. Zone A (Sembrong) and Zone B (Merpoh).



Fig. 1 Study area and sampling stations of Merpoh and Sembrong stations.

Sample Collection and Data Analysis. Water samples were collected for 17 stations. The 10 cm below water in that river were collected from surface water. Each samples stations water stored in one-liter polyethylene bottles. The water samples kept in ice for further analysis in laboratory. The water samples were kept in refrigerator at temperature below 4°C. Parameters involved are BOD, COD, N H₃ - N, TSS and turbidity while pH and DO will measure directly at the station by using in-situ method due to process of obtaining the sample might change the measurement. All the result from the laboratory analysis records on the appropriate table. WQI calculates for each point using following WQI equation:

$$WQI = 0.22SIDO + 0.19SIBOD + 0.16SICOD + (1) 0.15SIAN + 0.16SISS + 0.12SIpH$$

RESULTS AND DISCUSSION

Table 2 shows water sampled in Sembrong River contains higher total coliform counts compared to Merpoh River. Total Coliform violations in the complied chlorine treated water posed problem within the water treatment plant [10]. The pH indicates contamination and acidification. Low pH allows toxic elements and compounds to become mobile. The lower the pH, the higher the hydrogen ion (H⁺) activity and the more acidic is the water [6]. The neutral pH is considered as 7.0. Theoretically, unpolluted streams normally show a near neutral or slightly alkaline pH. As seen from Table 2, Zone B from Merpoh shows a pH more neutrally rather than Zone A from Sembrong River. However, both zone are acceptable and suitable for conservation of natural environment supply because of limit from 6 to 9. DO is an essential parameter for the survival of all aquatic organisms. Oxygen is the most well established indicator of water quality. DO test present the amount of oxygen is available in river water. From Table 2, Sembrong River station shows an average of low BOD compared Merpoh river station. Hence, low DO, high BOD and COD rapidly decrease the oxygen content of the river making it difficult for the fish and other valuable aquatic fauna to survive. Oxygen concentrations vary with the volume and velocity of water flowing in a stream. The colder the water, the more oxygen it can hold [8].

Table 3 Chemical parameter concentrations

Zone	STN No.	Avrge Total Coliform {Cfu}	Avrge Total Faecal Coliform {Cfu}	pH	DO (mg/L)	TSS (mg)	NH ₃ -N (mg/L)	BOD (mg/L)
A	1	97	-	6.71	4.95	20	0.16	2.5
	2	101	-	6.79	4.63	14	0.11	3.0
	3	145	-	6.79	2.25	16	0.08	2.0
	4	148	-	6.86	4.80	9	0.12	2.2
	5	175	-	6.89	4.81	12	0.17	4.8
	6	97	<10 cfu	6.85	4.78	5	0.26	2.0

	7	120	<10 cfu	6.62	2.85	9	0.17	1.6
	8	28	-	6.82	4.88	59	0.25	1.3
	9	32	-	7.05	4.73	11	0.30	14.2
	Avrge	105	<10 cfu	6.82	4.3	17.2	0.18	3.73
	NWSQII A/B	500	100/400	6-9	5-7	50	150	3
B	10	32	-	7.02	5.10	20	0.19	2.1
	11	13	<10 cfu	7.89	5.90	6	-	2.7
	12	37	-	7.02	5.69	6	-	2.0
	13	12	-	6.97	5.09	5	-	1.0
	14	40	-	6.84	5.13	7	-	1.6
	15	33	-	6.81	5.42	26	-	3.2
	16	39	-	6.82	5.45	7	0.09	1.9
	17	57	-	6.75	5.81	6	0.08	0.8
	Avrge	33	<10 cfu	7.02	5.45	10.3	0.05	1.91
	NWSQII A/B	500	100/400	6-9	5-7	50	150	3

Suspended solid (SS) in water consist of inorganic and organic particles. Inorganic particles such as clay, silt and other soil constituent and organic material such as plant fibers and biological solids like algae, bacteria, plankton are found in water [10]. Sembrong River station shows a high of TSS compared Merpoh River station. Higher inorganic and organic particles in river contribute higher of TSS in river as well can effect turbidity in river water. Increasing the TSS value then increased the river to pollute.

NH₃-N indicates nutrient status, organic enrichment and health of water body. It commonly forms as organic, ammonia, nitrate, nitrite and gaseous nitrogen [5]. If higher value of NH₃-N recorded, then the river water considered as polluted. Result from Table 2 indicated that both river zones have a lower concentration of NH₃-N from this ammonical nitrogen analysis. Merpoh River shows lower NH₃-N concentration compared to Sembrong river station. Discharge of untreated sullage adds oxygen demanding substances, nutrients and toxic elements such as NH₃-N into the water, which in turn make the streams unsuitable for aquatic flora and fauna [4]. As such, like any other pollution source, sullage should also be treated effectively before discharged into the streams.

BOD is the amount of oxygen required by bacteria to stabilize organic matter under aerobic conditions. The BOD test involves the determination of oxygen uptake by bacteria under standard conditions that is five days incubation at 20⁰C. The concentration of BOD in water sample can determine the degree of pollution caused by microorganisms through biodegradation. If the BOD concentration is higher, then the water is considered polluted. Table 2 shows the concentration of BOD in Sembrong and Merpoh River at 17 stations involved for every sampling. Sembrong River shows high of BOD concentration compared Merpoh River. Thus, this can be classified Sembrong River as polluted. BOD is also related to DO and they are inversely proportional to each other [1].

Water Quality Index Classification. The classification of water quality of Zone A (Sembrong) and Zone B (Merpoh) followed the Water Quality Index (WQI). The DOE water quality classification based on water quality index refer on Table 4. The WQI of Sembrong River is 77.4, which is categorized as slightly polluted. Meanwhile, Merpoh River is considered clean based on the WQI of 86.9 in Table 3.

Table 3 Water Quality Index.

Zone	Parameters	Sub index and water quality index	Water quality classification based on water quality index
A	Biochemical Oxygen Demand (BOD)	84.6	Slightly polluted
	Ammonical Nitrogen (NH ₃ -N)	81.6	Slightly polluted
	Suspended Solids (SS)	87.6	Clean
	Water Quality Index (WQI)	77.4	Slightly polluted
B	Biochemical Oxygen Demand (BOD)	92.3	Clean
	Ammonical Nitrogen (NH ₃ -N)	95.2	Clean
	Suspended Solids (SS)	95.6	Clean
	Water Quality Index (WQI)	86.9	Clean

Table 4 DOE water quality classification based on water quality index.

Sub index and water quality index	Index range		
	Clean	Slightly polluted	Polluted
Biochemcial oxygen demand (BOD)	91 -100	80 - 90	0 -79
Ammonical Nitrogen (NH ₃ -N)	92 - 100	71 - 91	0 – 70
Suspended Solids (SS)	76 - 100	70 - 75	0 – 69
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59

CONCLUSIONS

As conclusion, it can be conclude that Sembrong River (Zone A) generally slightly polluted compared Merpoh River (Zone B) where is clear from pollution in Sembrong Dam. Due to Biological parameter where is Sembrong River shows high of Total Coliform rather Merpoh River. Besides that, all of chemical parameter shows that Sembrong River was not a good condition. According of Water Quality Index, Sembrong River was truly slightly polluted compared Merpoh River in Sembrong Dam.

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