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Water Quality Monitoring and Classification at Panchor River

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Abstract : Water pollution is one of various types of pollution that exist in the post-revolutionary era. Rivers, as one of the water resources, are easily polluted, and water pollution is hazardous to the environment and human health. As a result, the study concentrated on monitoring the water quality and classification of the Panchor River in Johor, Malaysia. The goals of this study are to collect quantitative data on the physical, chemical, and biological characteristics of the river, as well as to determine the class of water in the river. This study was also carried out to raise awareness among Panchor residents about the importance of water quality. In addition to carrying out this project, six tests to analyse the water sample were carried out: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), Ammoniacal Nitrogen, pH, Dissolved Oxygen (DO). Furthermore, the Malaysian National Water Quality Standard was used as a reference to measure water quality and classify the water sample. Finally, it is critical to monitor the cleanliness of water sources in order to prevent water pollution. According to the results of the experiments, the Panchor River water quality index is in class III and is classified as slightly polluted. This study is important to measure the class of water and the suitable treatment for the river. Then the river water quality will always in good condition.

Keywords: Water Pollution, Water Quality Index, Ammoniacal Nitrogen, Panchor River, Water Quality Parameters

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1. Introduction

Water pollution is currently one of the most serious issues facing the world. Pollution from water sources such as rivers, seas, and streams will be a major issue for the environment and human health. Some human activities, such as deforestation, urbanisation, agriculture, marine dumping, and industrial waste, contribute to pollution [1]. Water pollution has serious consequences for biodiversity and aquatic ecosystems. Toxic chemicals can change the colour of water and increase the amount of minerals in it, causing eutrophication, which is harmful to aquatic life. Thermal pollution, defined as an increase in water temperature, contributes to global warming and poses a serious threat to aquatic organisms [2]. Furthermore, water pollution has a significant negative impact on public health. Drinking or coming into contact with contaminated water can cause diarrhoea, cholera, typhoid, dysentery, and skin infections [3]. Dehydration is obviously the most serious risk in areas where there is no drinking water. The Panchor River is the primary focus of this project.

The Panchor River may become polluted because of economic growth, and agriculture. Previously, the Panchor area experienced little economic growth. As time passes, the economy in this area expands, affecting the cleanliness of the Panchor River. For example, Pagoh Education Hub has been developed in this area [4]. This development will lead to the increase of population in this area. Even it has no direct effect on water quality, urbanization have a wide range of indirect consequences. In addition, there are agricultural activities in the Panchor area especially on palm trees and rubber tree since it is the popular agriculture activity in this location [5]. Agricultural activities are also one of the sources of water pollution.

The purpose of this research is to collect quantitative data on the physical and chemical properties of the river's water [6]. These characteristics can influence water quality and its suitability for a variety of uses, as well as the health and integrity of aquatic ecosystems. The study's goal is to determine the class of water quality at the location using the Water Quality Index (WQI). Water Quality Index (WQI) is a single number that can be easily calculated and used to describe the overall quality of water bodies used for various purposes.

2. Materials and Methods

A river water sample will be tested to determine the status of physical parameters such as suspended solids, pH, and temperature. Throughout the experiment, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), pH and Ammoniacal Nitrogen will be measured in addition to chemical parameters.

2.1 Materials

The Panchor River was chosen as the site of the test because there is a possibility that human activity will have an impact on the Panchor River's water quality. All physical and chemical parameters were determined in the laboratory through sampling and laboratory analysis.The experiments conducted by using some equipments and reagents, to get the data of the six parameters for the water quality.All the equipments and reagents are available in the environmental engineering laboratory.For each experiment, the tools and chemical reagents needed has been listed earlier with the specific amount needed and submitted to the person in charge in the laboratory to be reviewed.

2.2 Methods

First of all, to measure the water quality, the water sample from Panchor river has been collected using 10 litre of sampling bottle and stored in the cold room. The dissolved oxygen, temperature and pH of the sample checked before stored. After that, the six experiments implemented to the water sample to get the data of all the parameters. Furthermore, the data obtained has been analyzed and

calculated using the WQI formula, then water class has been determined using the table of National Water Quality Standards for Malaysia, based on the value of parameters.

2.2.1 Total Suspended Solid

TSS experiment has been implemented to measure the total suspended solid in the water sample. The experiment used three sample of filter paper to be examined. The weight of each filter paper recorded before the experiments. The filtration apparatus and oven with temperature of 103℃ - 105℃ used in this experiment. The filter paper inserted in the oven for one hour after through the filtration process with 5ml of water sample. Then, the weight of the three filter paper measured again to measure the weight of solid.

2.2.2 Biochemical Oxygen Demand

The BOD experiment is to determine the value of BOD for the water sample. Nutrient water has been made 24 hours before the BOD experiment. The sample size for the experiment determined by referring the dissolved oxygen, pH and temperature value of the water sample, that has been taken after the sampling process. Four BOD bottles used for this experiment, with the different amount of water sample and nutrient water. 3ml, 9ml and 11ml of water sample used for the three BOD bottle and one of the bottles is blank, which is only filled with nutrient water. The value of dissolved oxygen for each bottle recorded, then the bottles incubated at 20℃ for 5 days. After 5 days, the dissolved oxygen for each bottle checked and recorded, to calculate the DO depletion, and obtain the BOD of the water sample using the BOD formula.

2.2.3 Chemical Oxygen Demand

To obtain the value of COD for the water sample, the COD experiment has been implemented with 2 low range COD digestion vials. The first vial added with 2ml of water sample, then the second vial added with 2ml of deionized water, for the blank. Next, the vials heated in the DRB200 reactor with the temperature of 150℃ for two hours. Then the vial has been keep in rest for 20 minutes to be cooled, while inverted for several time. Furthermore, the DR6000 used to obtain the data of COD from the vials, using the low range test in the DR6000 setting. The sample data has been read and recorded three times, then the average of the COD has been calculated.

2.2.4 Ammoniacal Nitrogen

In this experiment, two mixing cylinders used to prepare sample and blank.25 ml of water sample added to one of the mixing cylinders, meanwhile 25 ml of deionized water added into the other cylinder, for the blank sample. Each mixing cylinder added with 3 drops of mineral stabilizer, then inverted. After that, 3 drops of polyvinyl alcohol dispersing agent added into each mixing cylinder and inverted for several times. Then, 1ml of Nessler reagent added into each mixing cylinder and inverted. After that, the timer has been set for 1 minute for the reaction time. Then, the two sample in the mixing cylinder transferred into the sample cell. Using the DR6000, the ammoniacal nitrogen concentration of samples has been read by referring to the blank sample. Finally, the average of the 3 times reading from DR6000 recorded.

2.3 Equations

The equation that use to calculate the Water Quality Index is Water Quality Index(WQI) formula:

$$WQI = (0.22 \times SIDO) + (0.19 \times SIBOD) + (0.16 \times SICOD) + (0.15 \times SIAN) + (0.16 \times SISS) + (0.12 \times SipH) \quad \textbf{Eq. 1}$$

SI=Subindex

The equation above used to calculate the water quality index for the water sample.This formula uses 6 parameters, which are DO, BOD, COD, TSS, Ammoniacal Nitrogen and pH. The formula also uses subindex in the calculation.

3. Results and Discussion

Laboratary result from the water sampling show the value of Dissolved Oxygen is 7.13mg/L. In general, dissolved oxygen is consumed by the degradation of organic matter in water [7]. While laboratory result from the water sampling show the value of Water Temperature is 27.2℃, Biochemical Oxygen Demand is 34.61mg/L, Chemical Oxygen Demand is 11mg/L, Ammoniacal Nitrogen is 1.55mg/L, Suspended Solid is 66.67mg/L and pH is 6.81. Generally, many factors such as the weather condition, sampling time, and location impact on the increase or decrease of temperature by which its role effect on the percentage of dissolved oxygen, biological activities, and other parameters [8]. After obtaining the result, Water Quality Index is Calculated based on Water Quality Index (WQI) formula and the Water Quality Index is 65.01. From the WQI result that is 65.01,the result is between the range 51.9 to 76.5 in the Water Quality Index row based on DOE Water Quality Index Classification table. As the range 51.9 to 76.5 is on the same column with class III, it is show that the classes for Panchor river is in class III. Last but no least, the classification of Water Quality for Panchor river is class III based on the **Table 1** DOE Water Quality Index Classification.

Table 1: DOE Water Quality Index Classification [9]

Parameter	Unit	Class				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/L	<0.1	0.1-0.3	0.3-0.9	0.9-2.7	>2.7
Biochemical Oxygen Demand	mg/L	<1	1-3	3-6	6-12	>12
Chemical Oxygen Demand	mg/L	<10	10-25	25-50	50-100	>100
Dissolved oxygen	mg/L	>7	5-7	3-5	1-3	<1
pH	-	>7	6-7	5-6	<5	>5
Total Suspended Solid	mg/L	<25	25-50	50-150	150-300	>300
Water Quality Index	-	<92.7	76.5-92.7	51.9-76.5	31.0-51.9	>31.0

Referring to the **Table 2** Water Classes and Uses, Panchor river needed extensive treatment for water supply which is in the category of water supply III on the table 2. In addition, it is also categorized as fishery III, which mean the river water is suitable for common fish and of economic value. Furthermore, the river water can be use as livestock drinking such as cattle, sheep, chicken and goats since the water categorized as class III.

Table 2: Water Classes And Uses [9]

Class	Uses
Class I	Conservation of natural environment Water supply I-Practically no treatment necessary Fishery I- Very sensitive aquatic species
Class IIA	Water supply II-Conventional treatment Fishery II- Sensitive aquatic species Recreational use body contact
Class IIB	Recreational use body contact
Class III	Water supply III -Extensive treatment required Fishery III- Common, of economic value and tolerant species, livestock, drinking
Class IV	Irrigation
Class V	None of the above

Lastly, according to the DOE water quality classification based on water quality index in **Table 3**, the classification for Panchor river is Slightly Polluted. This mean the river water in not suitable for water supply and needed some water treatment to increase the cleanliness and quality of the water [10]. The value of 65.01 for the WQI is approaching the polluted value which is 0-59.So the river water need to be monitored periodically for prevention of water pollution at the location

Table 3: DOE Water Quality Classification Based on Water Quality Index [9]

Sub Index & Water Quality Index	Index Range		
	Clean	Slightly Polluted	Polluted
Biochemical Oxygen Demand	91-100	80-90	0-79
Ammoniacal Nitrogen (NH3-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

4. Conclusion

As a result of this study, the objectives have been achieved, which are to obtain quantitative information on the physical and chemical characteristics of the river's water and to determine the class of water quality at Panchor river based on the Water Quality Index (WQI). Based on the results of the

experiments, all of the parameters (Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solid, pH, Ammoniacal Nitrogen, and Dissolved Oxygen) have been classified into the appropriate water classes for the Panchor River, as shown in the table Water Classes and Uses and according to the finding, water classes for Panchor river categorized as class III. This indicated that Panchor river still in control from pollution as the river needed extensive treatment. Furthermore, the Panchor river's condition has been determined by the value of the water quality index obtained through the WQI formula from the value of the SubIndex of the six parameters. According to the findings, the Panchor River benefits Panchor residents by providing a freshwater fish sources.

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