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Classification Based Water Quality Index (WQI) in UTM River

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ABSTRACT

Water is important for drinking, bathing, washing, cooling, and protecting to continue surviving. Rapid development in human activities causes several of water issues and problems especially in river pollution. Water pollution occurs in Sekudai River through UTM River. Therefore, this research study is conducted to determine factors contribution to UTM River pollution through classification based Water Quality Index (WQI). Sampling area is concentrate along UTM River with setting of seven (7) stations in upstream, middle stream, and downstream river. Analysis showed majority parameters for DO, BOD, COD, NH3-N, SS, and pH are in class three and only minority is in class two or one, which result in calculation for WQI is class three in station 1 to station 7. UTM River proved water quality is in slightly polluted condition due to human activities which cause contamination through concrete waste, chemical waste, garbage and washing wastewater, restaurants, chain stores, gas stations, and so on. Continuous human activities will cause UTM River to be totally polluted and causing 'dead' river, which will reduce human quality life and destruct environment. Therefore, human should be controlled, reduced, responsible, and ethically to protect the environment from 'missing' forever.

Keywords: Water, Human Activities, Factors, Slightly Polluted, Destruct

I. INTRODUCTION

Water is important for living beings to continue surviving. Water is used for drinking, bathing, washing, habitat, cooling, and etc., depend on the usage activity. As general, water can be existed in liquid, solid, and gas form, due to the characteristic of H_2O or H-O-H. H_2O is refer as two hydrogen atom with positive charge and one oxygen atom with negative charge, which causing the water to become permanent dipole [9]. Hence, pure water not only can exist in H-O-H, but also in H^+ and OH^-. Usually, H^+ can be form into H_3O^+ or $H_9O_4^+$ which depend on where the positive combination of molecule situated, while OH^- can be in the form of $H_7O_4^-$ with maximum combination up to three molecules [9]. There is formula used to describe partition coefficient, K_d as below [10];

$$K_d = [A]^x [B]^y / [A_xB_y];$$
$$\text{where } A_xB_y \leftrightarrow {}_xA + {}_yB$$

Where A, B and AB can be refer as concentration A and B, and complex of AB, where this formula can be used in dissociation of water as below [9];

$$K_d = [H^+] [OH^-] / [H_2O]$$

Therefore, water body can contain various organic and inorganic molecules in solution and mixture [5]. Only pure water molecule can be disturbed or mixed with foreign materials to produce other molecular forms, which is also known as water contamination. Water purity can be measured by its quality, which refers to physical, chemical and biological characteristic that change from its natural or original condition. So, the presence of impurities or foreign material in water showed a sign that the water is polluted.

Based on world statistic, majority of developing countries with 70 percent of industrial wastes had dumped untreated into the water and caused pollution to usable water supply [8]. As evidence, about 99 million pounds (or 45 million kilograms) of fertilizers and chemicals are used each year, and about 2 million tons (or 1.8 billion kilograms) of human waste are disposed into waterways around the world every day [8]. These action had cause many river to be polluted in all world, for example Ganges River (India), Jian River (China),

Jakarta River (Indonesia), Pasig River (Philipines), Tiete River (Brazil), and Yamuna River (India) [1]. At the same time, other factors that contributed to major river pollution can be listed as industrial chemical waste dumping, rubbish dumping, and failure in sewage treatment. The main issues to cause all pollution problems are increasing of population numbers and uncontrolled rapid development. Until today, demands toward development and facilities are never showed reduction and the percentage of river pollution is continuously increased. Therefore, this problem becomes more serious in river pollution because it's not only reduces the percentage of freshwater, but also affect the quality of environment to become worse.

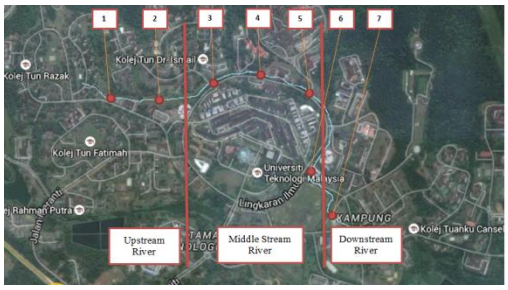
Simultaneously, the development is also take places in developing countries like Malaysia, which also listed in the contamination of river water. As a proof to the statement, 195 (41%) out of 473 rivers are considered as polluted, which indicates almost half of the total river are polluted and it is considered as serious with dangerous situation [2, 5-6]. Water pollution is no exception to the rivers that exist in Johor Bahru, especially the Melana River and the Sekudai River which is in slightly polluted. Interestingly, both of these rivers are connected by another small river name UTM River (figure 1). In other words, UTM River can be refer as the starting point or upstream river which flowing the water into Sekudai River (figure 1). According to the Environmental Quality Report in 2012, stated that Sekudai River is slightly polluted due to human activities like daily wastewater (including washing, bathing), industrial wastes, domestic sewage, and others [4, 7]. Therefore, this research study is carried out to determine the water quality in UTM River based on Water Quality Index (WQI), which have probability to contribute river pollution to Sekudai River.

Sources: Google Map (2015)

Figure 1: UTM River, Melana River, and Sekudai River

II. METHODS AND MATERIAL

This research study is carry out at Johor Bahru, especially towards the river that contributes higher percentage of water pollution. Hence, the sampling area will be UTM River, which consider as one of the factors to cause contamination to Sekudai River (figure 2). Along the UTM River, there are seven (7) stations will be selected to collect the sample and undergoes for analysis. In analysis, water sample will be test for six (6) parameters, namely Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solid (SS), Ammoniacal Nitrogen (NH_3-N), and measurement of acidic or alkalinity of an aqueous solution (pH) [3]. From analysis, the result will be calculating using Water Quality Index (WQI) formula to indicate the water pollution in river, which can be showed in figure 3 [2].



Sources: Google Map (2015).

Figure 2: Seven stations to collect water samples in UTM River.

WQI FORMULA AND CALCULATION

FORMULA

WQI = (0.22 * SIDO) + (0.19 * SIBOD) + (0.16 * SICOD) + (0.15 * SIAN) + (0.16 * SISS) + (0.12 * SIpH)
where;
SIDO = Subindex DO (% saturation)
SIBOD = Subindex BOD
SICOD = Subindex COD
SIAN = Subindex NH_3-N
SISS = Subindex SS
SIpH = Subindex pH
0 ≤ WQI ≤ 100

BEST FIT EQUATIONS FOR THE ESTIMATION OF VARIOUS SUBINDEX VALUES

Subindex for DO (in % saturation)	
SIDO = 0	for x ≤ 8
SIDO = 100	for x ≥ 92
SIDO = -0.395 + 0.030x2 - 0.00020x3	for 8 < x < 92
Subindex for BOD	
SIBOD = 100.4 - 4.23x	for x ≤ 5
SIBOD = 108 * exp(-0.055x) - 0.1x	for x > 5
Subindex for COD	
SICOD = -1.33x + 99.1	for x ≤ 20
SICOD = 103 * exp(-0.0157x) - 0.04x	for x > 20
Subindex for NH_3-N	
SIAN = 100.5 - 105x	for x ≤ 0.3
SIAN = 94 * exp(-0.573x) - 5 * | x - 2 |	for 0.3 < x < 4
SIAN = 0	for x ≥ 4
Subindex for SS	
SISS = 97.5 * exp(-0.00676x) + 0.05x	for x ≤ 100
SISS = 71 * exp(-0.0061x) - 0.015x	for 100 < x < 1000
SISS = 0	for x ≥ 1000
Subindex for pH	
SIpH = 17.2 - 17.2x + 5.02x²	for x < 5.5
SIpH = -242 + 95.5x - 6.67x²	for 5.5 ≤ x < 7
SIpH = -181 + 82.4x - 6.05x²	for 7 ≤ x < 8.75
SIpH = 536 - 77.0x + 2.76x²	for x ≥ 8.75

Sources: Malaysia Environmental Quality Report (2012)

Figure 3: Water Quality Index (WQI)

III. RESULTS AND DISCUSSION

Analysis for parameters of DO, BOD, COD, SS, NH_3-N, pH, and the result for WQI can be showed in the table 1.

Table 1: Analysis of water quality in UTM River

S	F							Class
	A	B	C	D	E	F	G	
1	3.91	4.2655	19	0.83	6.69	33	56.26	III
2	3.83	5.2945	27	0.72	6.72	22	54.98	III
3	3.92	3.6365	17	0.75	6.82	37	56	III
4	4.58	4.79	27	0.6	6.82	30	55.82	III
5	5.62	3.9305	24	0.62	7.03	14	57.73	III
6	4.92	3.549	28	0.6	7.05	32	56.94	III
7	4.18	4.5105	29	0.69	7.2	25	54.66	III

*A=DO, B=BOD, C=COD, D=NH_3N, E=Ph, F=SS, G=WQI, S=Station, F=Frequency

According to the standard classification for water quality in DOE (2012), DO parameter showing that most of the station is in class three, except for station 5 that exist in class two. Next, BOD parameter are also showing the water quality in all stations are class three and the result are the same as NH_3-N which is class three for all stations. Continuously, majority stations of pH parameter are in class two. Meanwhile, analysis of COD parameter shows station one, three and five are in class two, and class two, four, six, and seven are in class three. Lastly, parameter of SS in station two and five are remain class one, but other stations are result in class two. In overall, majority parameter for DO, BOD, COD, NH_3-N, SS, and pH are in class three, and only minority is in class two or one. On the other hands, calculation for WQI is also proving that station 1 to station 7 is in class three. In other words class three is considered as slightly polluted, which required extensive treatment to restore back water quality in the river. Basically, after the treatment, this water can only be used for livestock drinking, and for tolerant species. Normally, it still can be used for economic value such as tourism perspective.

The main factors to cause water contamination in UTM River are human activities. In station 1 and station 2, most of the activity carried out is residential and commercial, which include restaurants, chain stores, shopping malls, gas stations, and others. Meanwhile, station 3, 4, 5, and 6 are across the Universiti Teknologi Malaysia (UTM) before the water is flow into Sekudai River. The water quality condition becomes worse when UTM River is flowing through faculty of Electrical Engineering and Mechanical Engineering. This is because the building is still in construction for Electrical Engineering (figure 4). So, most of the concrete waste will be transport together with water especially in raining day into drains before enter the UTM River. At the same time, the chemical waste from Mechanical Engineering is also letting it flow into UTM River. Until station 6, the river flow across colleges and causing water pollution through garbage and wastewater from washing activities (figure 5). Before UTM River enters Sekudai River, the water will go through station 7, which is referring as downstream river. At the moment, residential activities is carried out and having a high percentage to cause pollution to UTM River and Sekudai River. Therefore, the water pollution is occur along UTM River and if the human activities is continuously, this will cause the river to change from slightly polluted to polluted.

Figure 4: Construction in faculty of Electrical Engineering

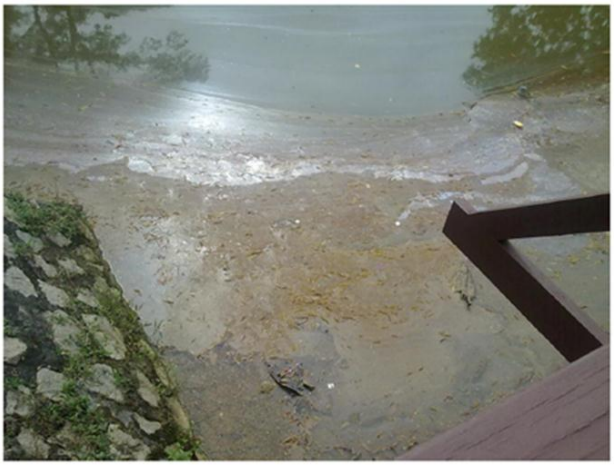


Figure 5: Water pollution in UTM River

IV. CONCLUSION

Last but not least, Sekudai River can be polluted due to many factors, which also include water flow from the UTM River. Contamination can occur in UTM River due to human activities, which included concrete waste, chemical waste, garbage and washing wastewater, restaurants, chain stores, gas stations, and so on. Although this situation is seen as minor problems, but it will affect directly and indirectly the chain of relationship between ecosystems that involved, for example human and river, river and animals, and animals and human. If these activities are continued, then it will cause UTM River and Sekudai River to be 100 percent polluted and leading to 'death' river. So, when the river is listed as 'dead' river, this will affect human quality life through bad odor and spreading diseases, and destruct the natural of environment through 'killing' and cause extinction of aquatic animals. Hence, human activities should be controlled and reduced to protect the environment from 'missing' forever.

V. REFERENCES

[1]. Bittner, M. (July 04, 2013). The World's Most Polluted River. EHS Journal. Retrieved from http://ehsjournal.org/http:/ehsjournal.org/michael-bittner/the-worlds-most-polluted-rivers/2013/

[2]. Department of Environment (DOE) Malaysia (2012). Malaysia Environmental Quality Report 2012.

[3]. Hua, A. K. (2016). Pengenalan Rangkakerja Metodologi dalam Kajian Penyelidikan: Satu Kajian Kes. Malaysian Journal of Social Sciences and Humanities, 1(1), 17-23.

[4]. Hua, A.K. (Jun 2015). Kualiti sumber air di Malaysia: Satu analisis. Geografia: Malaysian Journal of Society and Space. 11(6), 98-108.

[5]. Hua, A.K. (May 25, 2015). An Indication of Policy Study towards Water Resource in Malacca State: A Case Study of Malacca River, Malaysia. International Research Journal of Social Sciences, 4(6), 15-20.

[6]. Hua, A. K. (August 2015). Law Enforcement and Water Resources of the Malacca River A Case Study of Public Perception. International Journal of Scientific Research in Science & Technology, 3(1), 111-116

[7]. Hua, A. K., & Marsuki, M. Z. (2014). Public perception towards environmental awareness. Case study: Malacca River. International Journal of Academic Research in Environment and Geography, 1(2), 53-61.

[8]. National Geographic Official Portal (2015). Water Pollution. Retrieved from http://environment.nationalgeographic.com/environment/freshwater/pollution/

[9]. Pharma Corama Official Portal (2015). Water, H2O, chemical characteristics explaining biological role. Retrieved from http://www.pharmacorama.com/en/Sections/Elements-Water-1.php

[10]. US Environmental Protection Agency (August 1999). Understanding variation in partition coefficient, Kd values. Office of Air and Radiation. 1, 1-212.