Environmental Impacts from Maritime Operations at Dinding River

Norazlina Abdul Nasir, Hanisah Johor, Fatin Zawani Zainal Azaim, Mahfuzah Zulkifli, Rahma Ardani Miswar

Abstract: ***Water quality characterized as a measure of the physical, synthetic, organic, and microbiological characteristics of water. Water quality monitoring and measurement give an experiential proof to support decision making on issues related to health and environmental impact. Maritime operations are one of the factors that contributed to the environmental impact, particularly on the water quality status. The interactions of Lumut water (Dinding River) with several maritime operations nearby can lead to marine pollution and bring negative effect to the natural habitation. Through preliminary observations, oil spillage and garbage were discovered at the surface water of Dinding River. This study is conducted to identify the current status of water quality at Dinding River. Water samples from 5 fixed stations along the river were collected regularly and analyzed to determine the status of water quality based on the chosen water parameters - Conductivity, Total Suspended Solids, pH, Total Dissolved Solids and Dissolved Oxygen. Pollution Index is used as a tool to determine the status of water quality at the research area. The results show that the water at Dinding River is moderately polluted.***

Index Terms: ***environmental impacts, maritime operations, water quality***

I. INTRODUCTION

Water is one of the irreplaceable necessary for all the living life forms and any variation in water may cause to an issue of the organisms' survival. Water is one of the most common and bizarre substance, which categorized under a natural resource. The water is being called as the universal solvent due to its extraordinary ability to dissolve more substances in greater quantity than any other liquid [1].

Tremendous populace and carelessness of human being make the water quality to be disintegrated day by day. An enormous industrial development that was taken place in every part of the world in the past few decades, has made an over-exploitation of an accessible resources and have caused contamination of air, land and water [6][8]. Hence, the water quality needs to be assessed in pursuance of determine its status, whether it is safe for the ecosystem and to identify the pollution level.

Dinding River has interaction and exposition to the marine activities, such as the operation of ports, jetties and other sources such as fish breeding in cage and agriculture activities as in Figure 1. Due to these maritime operations, the water at Dinding River seen to be unclean and polluted with discovered of thin layer of oil and sewage dumping.

Due to the marine pollution occurs and lacks data or published articles from the authorities regarding the current status of water quality at Dinding River, the researcher wants to identify the current status of water quality at the area. The objectives of this research are to collect the water samples at Dinding River weekly and to analyze the status of water quality at the research area.

Fig. 1 Location of Station

II. RESEARCH AREA AND SCOPE

This research study was conducted at Dinding River. The researcher then collected the water sample at five selected stations, on weekly basis using sampling techniques. The stations are labelled as A1, A2, A3, A4 and A5 (Figure 1). The collected water samples were analysed using five selected water quality parameters which are Conductivity, Total Suspended Solids (TSS), pH, Total Dissolved Solids (TDS) and Dissolved Oxygen (DO).

Revised Manuscript Received on October 05, 2019.

Norazlina Abdul Nasir, Maritime Management, University Kuala Lumuur Institute of Marine Engineering Technology, Lumut, Perak, Malaysia.

Hanisah Johor, Maritime Management, University Kuala Lumuur Institute of Marine Engineering Technology, Lumut, Perak, Malaysia.

Fatin Zawani Zainal Azim, Student Development, University Kuala Lumuur Institute of Marine Engineering Technology, Lumut, Perak, Malaysia.

Mahfuzah Zulkifli, Maritime Engineering Technology (MET) Section, Universiti Kuala Lumpur-Malaysian Institute of Marine Engineering Technology (MIMET), Lumut, Perak, Malaysia.

Rahma Ardani Miswar, Maritime Engineering Technology (MET) Section, Universiti Kuala Lumpur-Malaysian Institute of Marine Engineering Technology (MIMET), Lumut, Perak, Malaysia.

Retrieval Number: L40161081219/2019©BEIESP
DOI: 10.35940/ijitee.L4016.1081219

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

III. METHODOLOGY

Sampling Techniques

The sampling technique was used in data collection process, where water sample at Dinding River was collected weekly. The location of the sampling methods was fixed where 5 points were selected as stations. The radius between each station are 50 meters and above.

Observations

The surface water at Dinding River was observed such as based on the colour, whether it is murky or not. Based on the observations a thin layer of spilled oil and garbage were spotted at the surface water of Dinding River. It is believed that the sources of oil spillage came from the leaking on the hull of the ships, bunkering process and discharge water from the vessel or boat anchored near the area. The researcher observed the colour of the water and the present of foreign substances. This is due to spotted of garbage such as plastic bottles, food packaging, plastics and others on the surface of research area

Laboratory Experiment

Water samples that was collected is tested according to five chosen parameters, which are pH, Dissolved Oxygen (DO), Total Dissolved Solids, Conductivity and Total Suspended Solids (TSS). Each of these parameters has its own Standard Operating Procedure (SOP) and required to be tested in the laboratory.

The collected water samples were tested using 3 different equipment such as Bench 700 Series (pH) and YSI 556 Multi Probe System for Conductivity, Total Dissolved Solids and Dissolved Oxygen. HACH DR2800 Spectrophotometer was used to check Total Suspended Solid in the water samples.

Data Analysis using Pollution Index

Pollution index is one of the standards used to analyse the quality of surface water at the river. Pollution Index whereby is an index which express in numerical terms to transform the huge amount of data into a simpler manner which is a number that describe the level of water quality [2][9][10].

Pollution Index is a concentration aggregation or cluster form of more than one water quality parameters into single quantity that shows the overall status at the research area [2][10]. The formula of Pollution Index under WQI was used to analyse the data in which the function of Ci/Lj is where, Ci indicates the concentration of parameter i, and Lj indicates the concentration permissible value of parameter [3]. The pollution index can be determined by following water pollution index as follow:

$$Pij = \sqrt{\frac{\left(\frac{Ci}{Lij}\right)^2 M + \left(\frac{Ci}{Lij}\right)^2 R}{2}}$$

Pij = Pollution Index for specified water quality purpose
Ci = measured water quality parameters
Lij = standard water quality parameter for each parameter at specified water quality purpose
(*Cij/Lij*) M = Cij/Lij maximum
(*Cij/Lij)* R = Cij/Lij average

The standard indication of Pollution Index are as shown in Table 1.

Table. 1 Standard Indication Pollution Index

Pollution Index	Water Quality
$0 \leq Pij \leq 1.0$	Meet quality standards (good conditions)
$1.0 < Pij \leq 5.0$	Lightly polluted
$5.0 < Pij \leq 10$	Moderately polluted
$Pij \geq 10$	Heavily polluted

IV. RESULTS AND DISCUSSION

Data Analysis

All the water samples that were collected, a total of 60 samples, were analysed based on 5 chosen parameters. All samples were analyzed for pH, Conductivity, Total Dissolved Solid, Dissolved Oxygen, while only 24 water samples were tested for Total Suspended Solids due to the constraint of equipment. All data were analysed in details in terms of the parameters. The parameters' value were analysed and classified into their water quality classes as referred to the National Water Quality Standard for Malaysia (Table 2).

Table. 2 National Water Quality Standards for Malaysia

Parameter	Class					
	I	IIA	IIB	III	IV	V
Dissolved Oxygen	> 7	5 - 7	5 - 7	3 - 5	< 3	< 1
Conductivity	1000	1000	-	-	6000	-
pH	6.5-8.5	6 - 9	6 - 9	5 - 9	5 - 9	-
Total Dissolved Oxygen	500	1000		-	4000	-
Total Suspended Solids	< 25	25 - 50	50	50-150	150-300	> 300

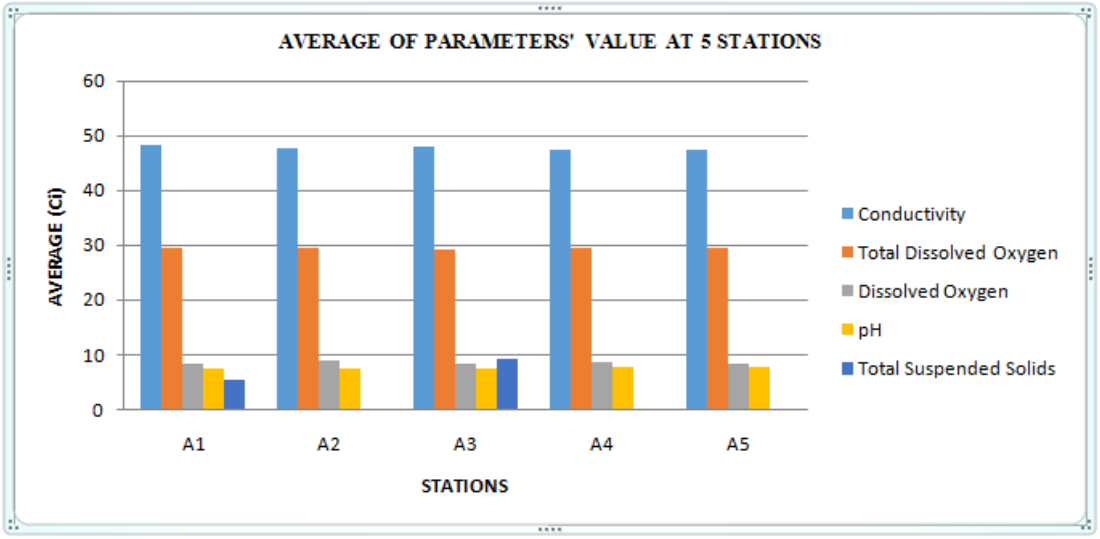

Fig. 2 Average water quality value at Dinding River

As can be seen in Figure 1, the result of the parameter at each station was within in the same range of value. This is because the water samples were collected at same location and underwent same activities such as private yachts operation, fishing activities, docking of ships and others. The average value for Conductivity is around 47.00 mS/cm and above, Total Dissolve Oxygen (TDS) is above 29.00 g/L and Dissolve Oxygen (DO) is around 8.00 mg/L and above. The value for Total Suspended Solids (TSS) is above 5.00 mg/L, while the value for pH is range between 7.48 to 7.54 which indicated the water is alkaline.

Conductivity

Figure 3 shows the conductivity value within the same range between 47.37 mS/cm and 48.17 mS/cm, where the highest value is 48.17 mS/cm recorded at Station A1 and the lowest value is 47.37 mS/cm at Station A5.

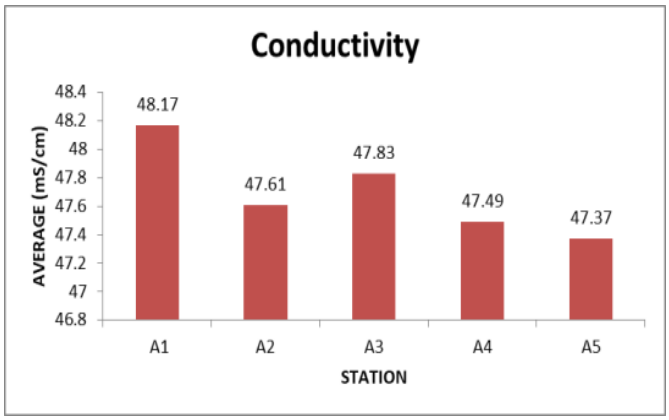

Fig. 3 Mean value of Conductivity at all stations

The value of Conductivity at all stations were classified into Class 1, due to the value was less than 1000, as referred to the Standard Indication National Water Quality Standard for Malaysia. Class I is within the conservation of natural equipment. It is considered that the amount of Conductivity at these 5 stations is in a good condition and practically no water treatment is required at the moment as the value meets the national standard.

According to [4], Conductivity is dependent on the water temperature, salinity and TDS. As it can be seen at the previous results at each station, the value of Conductivity is decreased significantly during week 11 and 12, where those weeks rained a lot. Rainy season has made the water temperature dropped too much. The value of Conductivity at Station A2 and A5 decreased due to decreasing of TDS.

Total Dissolved Solids

Figure 4 shows the average value of Total Dissolved Solid at 5 stations. As there are correlation existed between TDS and Conductivity, the value of TDS decreased and resulted the Conductivity's value to also decreased. The highest value recorded was at Station A4 is 29.38 g/L and the lowest value was at Station A3 is 27.25 g/L.

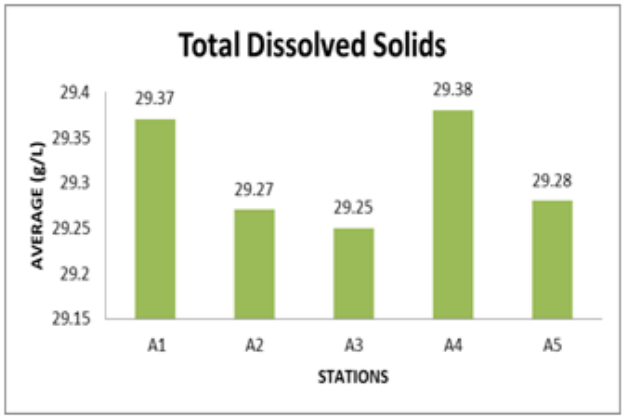

Fig. 4 Average value of Total Dissolved Solid

TDS at all stations can be classified into Class IV, the value more than 4000 mg/L requires extensive treatment. This is because high level of TDS will be toxic to the fish and fish eggs. If TDS ranged more than 2200-3600 mg/L, it will reduce the hatching and egg survival rates of aquatic life such as salmonids, perch and pike [5]. This can be dangerous if it left untreated day by day as it will decrease the number of fish.

Dissolve Oxygen

The mean values at all stations do not have much difference with each other as seen in Figure 5. The highest value was 8.87 mg at Station A2 and the lowest value was 8.18 mg at Station A3. Values of DO at all stations were classified into Class I according to the water classes of the standard indication because the concentration of DO in the water samples was greater than 7mg. Class I classified that the water meets the national standard and in the good condition.

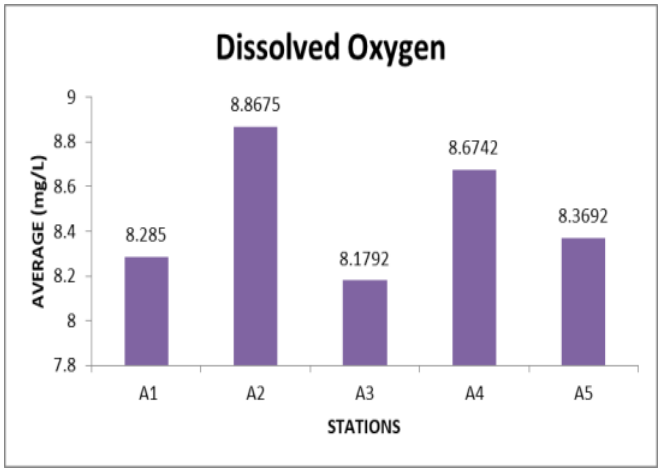

Fig. 5 Mean value of Dissolved Oxygen

This is a good thing because the DO is very vital to the aquatic life. They need to consume DO for breathing. Good concentration of DO in the water makes the aquatic life has no oxygen deficiencies which can harm their life [8].

pH

The highest value recorded for pH was 7.54 at A4, which it may occur due to the existence of wrecked ship near the station. The wrecked and rusted metal may lead the water to be alkaline with the increment of hardness. The lowest value was 7.48 at Station A2 and A3 (Figure 6). The pH value indicated that the water is quite alkaline.

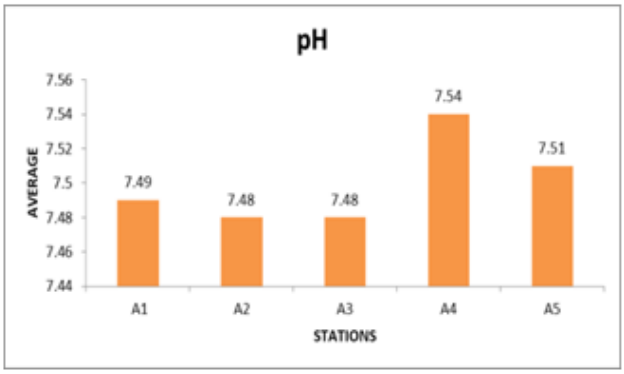

Fig. 6 Mean value of pH

According to the water classes of the standard indication, it is found that the pH level classified into Class I. It is considered that the pH level at these 5 stations is in a good condition. Aquatic life can also adapt and live in this current pH value. Hence, this indicates that there is practically no need for the water treatment.

Total Suspended Solids

The amount of TSS at Stations A3 was higher than Station A1 which was recorded 9.17, while Station A1 only 5.17 as seen in Figure 7. Both readings did not exceed the water quality standard indicator (25mg/L) which is good.

However, there were big differences in term of the value for both stations. It may occur because of the location of the station itself. Station A3 located outside the slipway which means it has been exposed directly to the current and waves from the ocean. Strong current and high waves may stir up the suspended solids at the seabed and lifted it to the surface.

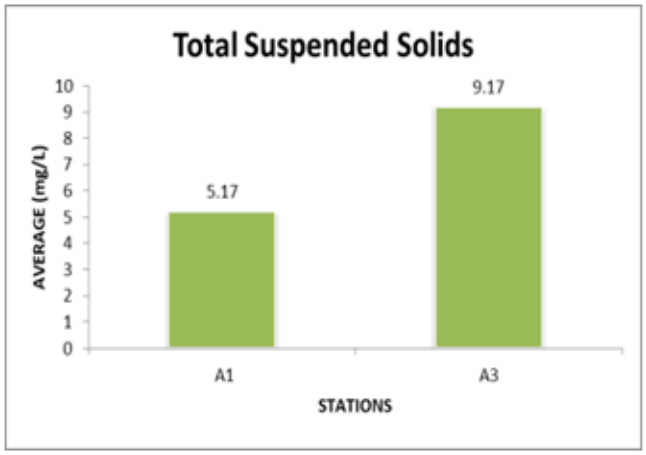

Fig. 7 Mean value of Total Suspended Solid

V. CONCLUSION

The status of water quality at all stations was moderately polluted (Table 3). It is because the water samples were collected at the same area, where the radius of each station was 50 meters. All the stations undergo the same weather, high and low tide, current and have same activities. It also explained why the parameters' value at 5 stations similar each other.

Although the research area does not interact with major maritime activities like in port, but the quality of the water is moderately polluted. The factors that contributed is due to massive oil spillage incident from ship. The oil spillage does bring negative impacts to the aquatic life as the oil will float at the surface area. As the oil will cover the surface water, the level of Dissolved Oxygen will decrease, and sunlight also cannot penetrate in the water to form photosynthesis process. Lack of oxygen will cause the aquatic life difficulties to breath.

Table. 3 Status of Water Quality based on each station

Station	Pollution Index	Status of Water Quality
A1	7.17	Moderately polluted
A2	7.28	Moderately polluted
A3	7.17	Moderately polluted
A4	7.29	Moderately polluted
A5	7.28	Moderately polluted

Anthropogenic activities conducted nearby such as there were barges that were docked nearby frequently, also influenced the water quality status. The result area also being a location for fishing activities and route for private yachts as there are Lumut Yachts Club that was located near Station A5. There were some possibilities that the yachts contributed to the oil spillage and dumping at the research area. The vessel discharged also contributed to the low water quality.

REFERENCES

1. Parmod, Kumar. (2013). Environmental Effect/ Impact Assessment of Industrial Effulent on Ground Water.
2. Sanchez, E., Colmenarejo, M.F., Vicente, J., Rubio, A., Garcia, M.G., Travieso, L. & Borja, R. 2007. Use of the water quality index and dissolved oxygen deficit as simple indicators of watersheds pollution. Ecol. Indic. 7: 315-328. W.-K. Chen, *Linear Networks and Systems* (Book style). Belmont, CA: Wadsworth, 1993, pp. 123–135.
3. D. Jubaedah, S. Hariyadi, I. Muchsin, and M. Kamal (2015). Water Quality Index of Floodplain River Lubuk Lampam South Sumatera Indonesia, International Journal of Environmental Science and Development, Vol. 6, No. 4, April 2015
4. Talley, L. (2000). Properties of seawater (lecture 2). In SIO 210: Introduction to Physical Oceanography. Retrieved from http://sam.ucsd.edu/sio210/lect_2/lecture_2.html
5. P. W. Scannell and L. L. Jacobs (2001), Effects Of Total Dissolved Solids On Aquatic Organisms Technical Report No. 01-06
6. Adolf K.Y. Ng & Su Song. (2010). The environmental impacts of pollutants generated by routine shipping operations on ports. Ocean & Coastal Management 53, 301-311.
7. EPA. (2000, November). Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras. Washington DC: Office of Water: Office of Science and Technology. Retrieved fromhttp://water.epa.gov/scitech/swguidance/standards/ upload/2007_03_01_criteria_dissolved_docriteria.pdf
8. Tiwari, Seema. (2015). Water Quality Parameter- A Review. International Journal of Engineering Science Invention Research & Development, Vol. I (IX).
9. Wetzel, R. G. (2001). Limnology: Lake and River Ecosystems (3rd ed.). San Diego, CA: Academic Press.
10. LCRA. (2014). Water Quality Indicators. In Colorado River Watch Network.Retrievedfromhttp://www.lcra.org/water/quality/colorado-river-watchnetwork/ Pages/water-quality-indicators.aspx

AUTHORS

Norazlina binti Abdul Nasiris a lecturer at the University Kuala Lumpur Malaysia Institute of Marine Engineering Technology (UniKL-MIMET),Lumut Campus, Perak, Malaysia She did her bachelor degree in Maritime Technology from the School of Ocean Engineering, Universiti Malaysia Terengganu (UMT), Kuala Terengganu, Malaysia and Master of Engineering (Marine Technology) from the Universiti Teknology Malaysia (UTM), Johor, Malaysia. Her research interest was in maritime operations related industry such as green ports, ports and ships emission and environments.

Hanisah Johor A Mathematics lecturer served under Maritime Management section at Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology (UniKL MIMET), Malaysia. She obtained her Master in Teaching Mathematics in year 2013 from Universiti Sains Malaysia. Graduated from Universiti Teknologi Mara, UiTM in Mathematics (2008). Published in Scopus with the tittle: Maneuvering and Submerged Control System for a Modular Autonomous Underwater Vehicle as a team member. Published in AIP with the tittle: Students' Perception on Application Calculus in Civil Engineering Courses as a main author.

Fatin Zawani Zainal Azaim Graduated with Diploma in Business Studies from Universiti Teknologi MARA in 2005. Received B. Ed. (Hon) in Teaching English as Second Language from University Teknologi MARA in 2009. Received Master in English as a Second Language from Universiti Teknologi MARA in 2011.Specialization is in teaching English as a second language, adult learners and counselling. Presently a Lecturer at UniKL MIMET lecturing English language subjects ranging from the fundamental knowledge like grammar to technical application like technical reports, presentation, and interview skills. She has conducted several preparatory classes for MUET and IELTS.

Mahfuzh Zulkifli Graduated with Bachelor of Maritime Operations (Hons) from Universiti Kuala Lumpur Malaysian Institute Marine Engineering Technology in 2019. She also a member of The Chartered Institute of Logistics and Transport Malaysia (CILTM) since 2018.

Rahma Ardani Miswar Graduated with Bachelor of Maritime Operations (Hons) from Universiti Kuala Lumpur Malaysian Institute Marine Engineering Technology in 2019. Currently attached at manufacturing company in logistic department.