GLOBAL INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

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Cite this article: Hazimah, H., Jabnabillah, F., & Sabrina, N. (2024). Qualitative Analysis of Seawater Quality on Bulan Island in Batam . Global International Journal of Innovative Research, 2(6). Retrieved from https://global-us.mellbaou.com/index.php/global/article/view/184

Received: May, 2024
Accepted: June, 2024

Keywords: Pulau Bulan, Lead (Pb), Zink (Zn)

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Published by:

GLOBAL SOCIETY PUBLISHING

Qualitative Analysis of Seawater Quality on Bulan Island in Batam

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In line with the increase in population and socio-economic development activities, various problems arise in marine ecosystems in coastal areas where waste is disposed of or because of weathering ships passing by in the waters. This can cause pollution and reduce the quality of seawater physically, chemically, and biologically, and it can damage the balance of the ecosystem. These physicochemical factors include temperature, pH, total solute (TDS), lead (Pb), iron (Fe), magnesium (Mg), sodium (Na), zinc (Zn), nickel (Ni), and copper (Cu). This study aims to help qualitatively improve seawater quality in the Bulan Island region's waters. The research method for the physical parameters of odor, color, and taste used organoleptic methods, while the chemical parameters for pH used a pH meter, TDS used a TDS meter, and contacted metals using a qualitative method. The results of the research are based on the parameters of smell, taste, and color of the Indonesian Ministry of Health standards, while the highest temperature is found in the middle of the sea, namely (31.7 oC). The highest pH parameter was found in the water at Sagulung Port (7.9) and the lowest at seawater (7.5), while the highest TDS value was found in seawater at Sagulung Port (209 ppm) and the lowest at Pulau Bulan Port. (108 ppm), from the results of the pH and TDS tests the three samples still met the standards of the Indonesian Ministry of Health. The metal quality test found that the seawater of Pulau Bulan Port, mid-ocean sea air, and sea air at Sagulung Port identified the presence of Lead (Pb) and Zink (Zn) metals.

1. Introduction

Marine ecosystems, especially coastal areas, are important areas from various planning and management points of view, and are very productive and provide economic value to humans. In line with population growth and increased socio-economic development activities, there are various problems arising in marine ecosystems in coastal areas caused by communities that make the sea a dumping ground for polluting waste and garbage so that it can damage the balance of marine ecosystems (Istarani and Pandebesie, 2014; Umasugi et al., 2021).

The above is reinforced by the statement of Hamuna et al., (2018) who explained that the problem that is very dominant for coastal, coastal and marine areas is pollution which results in a decrease in the quality and quantity of coastal and marine resources. Deterioration in water quality will reduce the usability, yield, productivity, carrying capacity and carrying capacity of aquatic resources which ultimately reduces the wealth of natural resources. According to Gholizadeh et al., (2016) that any changes in ecosystems are vulnerable due to anthropogenic activities that can endanger the habitat of fish and other aquatic organisms. The entry of organic and inorganic pollution into coastal water bodies can cause water quality to degrade its physical and chemical functions. The potential of coastal and marine waters as a source of food for the community will be disrupted. These physico-chemical factors include: temperature, pH, Dissolved Oxygen (DO), heavy metals such as lead (Pb), zinc (Zn), Nickel (Ni), Copper (Cu) and several other parameters (Murugan et al., 2021; Wahyuningsih et al., 2021). The high level of human activity in utilizing uncontrolled water areas can potentially cause pollution and reduce water quality which can be measured from the condition of the physical and chemical parameters of the waters (Hairati Arfah and Simon I. Patty, 2016; Hamuna et al., 2018).

Batam is the largest city in the Riau Islands province, Indonesia. Batam City area consists of Batam Island, Rempang Island and Galang Island and other small islands in the Singapore Strait and Malacca Strait areas. Batam, Rempang, and Galang islands are connected by Barelang Bridge. According to the Batam City Population and Civil Registration Office, in 2021 the population of Batam reached 1,193,088 people, with a density of 1,153 people/km^2. Batam City is part of the Batam–Bintan–Karimun (BBK) free trade special area.

Batam is one of the cities with a very strategic location. In addition to being on international shipping lanes, the city has a very close distance and is directly adjacent to Singapore and Malaysia. As a planned city, Batam is one of the fastest growing cities in Indonesia. When it was built in the 1970s by the Batam Authority (currently named BP Batam), Batam City had a land

area of 715 km^2, while the total area reached 1,575 km^2 (Dukcapilkemendagri, 2022). The coastal and marine waters of Batam city are included in the administrative area of Riau Islands Province. As an archipelagic province and located internationally, this area has reliable marine and fisheries potential so it is named as a maritime area. The waters of the moon island are waters located in the southwest area of the city of Batam has great potential marine resources. The waters have estuary ecosystems, mangroves, seagrasses, coral reefs and seawater lakes (lagoons) in which can be found various types of biota that have economic value. The Moon Island region is quite crowded in the use of coastal areas as sea transportation, ports, and agribusiness companies in the field of integrated livestock export-oriented and international scale. So this study aims to determine the quality of sea waters of the Moon Island region based on the condition of physical and chemical parameters, especially heavy metals lead (Pb), iron (Fe), Magnesium (Mg), Zinc (Zn), Nickel (Ni) and copper (Cu).

2. Method

This type of research is qualitative research carried out in the laboratory. Sampling based on purposive sampling. Data was taken as many as three stations, namely sea water at the Moon Island port, sea water in the middle of the sea, and sea water at the port of Sagulung island. Measurement of temperature using a digital thermometer, smell, taste, and color using organoleptic methods. Metal measurements were carried out qualitatively (color change) where as many as 3 water samples were taken and stored in bottles, then added HNO3 solution as much as 2 mL and heated at a temperature of 95 oC for 30 minutes and then cooled, after the cold sample was added reagents and seen the changes that occurred. Each sample was carried out three times. Sample collection and analysis procedures are referenced from surface water sampling guidelines (APHA, 23ndEdition, 3030-B,3113-B, 2017).

3. Result and Discussion

Pulau Bulan is famous as the island of pigs because this island is the largest pig livestock as a supply of pork to Singapore. In addition to the shrimp and crocodile farming sector, and the agricultural aspect. In this study, the degree of acidity (pH), total dissolve solvent (TDS), the presence of lead metal (Pb), iron (Fe), magnesium (Mg), sodium (Na), zinc (Zn), nickel (Ni) and copper (Cu) was identified in seawater samples with several reagents that are usually found in laboratories, both test laboratories and educational laboratories. The reagents in question include HCl, NaOH, KI and NH4OH. The addition of these reagents is able to provide positive and negative test results in the form of color changes and the formation of deposits with certain

colors. The changes that occur are based on the reactions that have been summarized in Table 1 and Table 2.

Table 1. Location of observation of temperature, salinity, brightness, DO and coordinates

No	Lookout Location	Temperature	Construction	Taste	Color	pH	TDS	Coordinates
1	Moon Island Port	31,3	Odorless	Salty	Bening	7,8	108	N 1o00'31.1'' E 103o56'11.7''
2	Mid-Sea	31,7	Odorless	Salty	Bening	7,5	204	N 1o01'14.4'' E 103o55'46.1''
3	Sagulung Port	31,1	Odorless	Salty	Bening	7,9	209	N 1o02'06.64'' E 103o92'94.65''

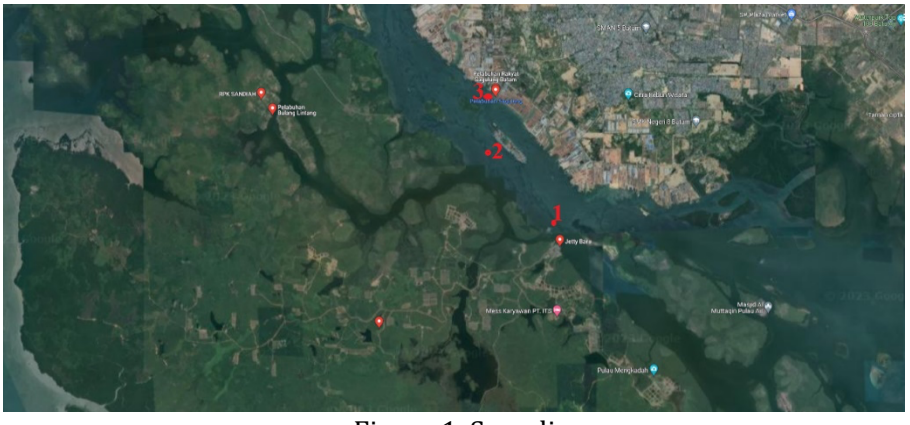

Figure 1. Sampling map

Table 2. Reaction tabulation

No	Lookout Location	Temperature	Construction	Taste	Color	pH	TDS	Coordinates
1	Moon Island Port	31,3	Odorless	Salty	Bening	7,8	108	N 1o00'31.1'' E 103o56'11.7''
2	Mid-Sea	31,7	Odorless	Salty	Bening	7,5	204	N 1o01'14.4'' E 103o55'46.1''
3	Sagulung Port	31,1	Odorless	Salty	Bening	7,9	209	N 1o02'06.64'' E 103o92'94.65''

Measurement results tend to be relatively the same between stations. However, it can

be seen that the mid-sea water is relatively high while it is relatively low in the seawater of Sagulung port. This happens because rising temperatures can cause stratification or layering of water, this stratification of water can affect water stirring and is needed in order to spread oxygen so that the layering of water in the bottom layer does not become anaerobic. Changes in surface temperature can affect physical, chemical, and biological processes in these waters. High temperature values are obtained at the sampling point in the middle of the sea. The temperature value obtained is still relatively natural and still ideal for marine tourism purposes. The higher the temperature in a water, the lower the solubility of oxygen, and the higher the toxic power. The increase in temperature in aquatic waters during the day is influenced by environmental conditions, weather, and wind. The intensity of sunlight entering the surface can cause temperature changes in the morning and afternoon. High temperatures can cause heavy metal compounds to dissolve into water due to a decrease in the rate of adsorption into particulates (Setiawan, K et al., 2019; Pingki and ., 2021).

According to KEPMENKES No. 1 of 2004 and Government Regulation of the Republic of Indonesia No. 82 of 2001 states that temperature quality standards for port waters are natural. What is meant by natural here is the normal condition of an environment that varies at any time (day, night, and season). However, according to Permenkes No. 416 of 1990, the temperature quality standard is 25 ± 30^{o}C. When viewed the temperature measurement results from the four points as mentioned above, all measurements from the four points are above 30 °C. If we refer to Permenkes No. 416 of 1990 states that the temperature threshold for water is 25 ± 30^{oC,} this shows that the water temperature in Pulau Bulan Port, Midsea, and Sagulung Port has exceeded the predetermined threshold and this indicates that when viewed from the temperature, the waters of Sagulung Port-Moon Island are classified as polluted water in the sense that water is no longer suitable for use.

Test the colors on all three samples using the sense of sight. The analysis obtained is on the clear sea water of Sagulung Port-Moon Island. From these three samples, it can be known the results of the reading of the level of water turbidity which is then adjusted to the clean water turbidity standards set by the minister of Health

(MENKES). Then, an odor test was carried out on each sample. The determination of the smell of water is determined using the sense of smell. The smell of water can be one of the physical parameters of determining water quality. The readings are adjusted to the standard smell of water. Based on the analysis obtained on the sea water of Sagulung Port-Pulau Bulan odorless. The color and smell of seawater samples from Sagulung Port-Pulau Bulan show that they meet the criteria of the Minister of Health. While the taste is carried out with the five indara flavors. The sea water of Sagulung Pulau Bulan tastes salty because the sea water has salt content.

The degree of acidity (pH) is the negative logarithm of the concentration of hydrogen ions released in a liquid and is an indicator of good or bad water. The pH of a body of water is an important parameter in monitoring the stability of waters. Variations in the pH value of waters greatly affect the biota in a water. In addition, the high pH value greatly determines the dominance of phytoplankton which affects the level of primary productivity of a body of water where the presence of phytoplankton is supported by the availability of nutrients in marine waters (Rukminasari et al., 2014). Based on the results of the data analysis above, it can be seen that pH is the level of acidity of a solution. The degree of acidity has a change in value over a certain period of time, the pH will change erratically depending on the factors that influence it. These factors include temperature, the process of decomposition of organic matter, photosynthesis or the presence of other elements submerged into water. The pH obtained in this measurement varies, some are less than 7 so it is acidic, and there are also pH measurement results that are more than 7 so it is alkaline. The solubility of metals in water is controlled by the pH of the water. A low pH can affect the solubility of heavy metals in waters. An increase in pH decreases the solubility of metals in water, because an increase in pH will change stability from carbonate form to hydroxide that forms bonds with particles in water bodies, so it will precipitate to form mud. While a low pH can cause the solubility of metals in water to be greater. Spatially, the pH value in the waters of Sagulung Port-Pulau Bulan looks evenly distributed at almost all sampling points. In the table, it can be seen that the pH value has decreased and increased. A decrease in the pH value in a water indicates an increase in organic compounds in the waters. In addition, the distribution of salinity levels is thought to affect the distribution of pH values in the waters of Lembar Port. The increase in pH

value from rivers to the sea is caused by mixing fresh water from land with low salinity levels with sea water with high salinity levels. Based on the Decree of the State Minister of Environment Number 51 of 2004, the pH quality standards that have been determined are between the range of 6.5 – 8.5. If you consider the overall pH measurement value obtained at three points in the Sagulung Port-Moon Island seawater, all measurement results do not exceed the predetermined threshold, this shows that the seawater on Bulan-Sagulung Island is still suitable for use in other words not included in the category of polluted water.

From the three TDS measurement results, the average distribution of TDS values was 449 ppm with the highest value produced at sampling at the first point with a TDS value of 209 ppm and the lowest value obtained at the second sampling point with a TDS value of 104 ppm. The high value of TDS is due to the fact that this sampling point is very close to the resting place of ships in Sagulung Port-Pulau Bulan, because the sampling point is very close to the ship, there is an oil spill or dirt from the ship that mixes with water which then makes the water cloudy and over time settles and becomes a solid dissolved in water. High TDS values are also influenced by rock weathering, runoff from the soil and anthropogenic influences (in the form of domestic and industrial waste) (Harmilia and Dharyati, 2017; Hidayat et al., 2016). Dissolved materials in natural waters are not toxic, but if excessive can increase the turbidity value which will further inhibit the penetration of sunlight into the water column and ultimately affect the process of photosynthesis in the waters. According to the Regulation of the Minister of Health No. 416 of 1990 concerning Terms and Supervision of Water Quality, it is stated that the maximum level of TDS allowed is 1000 mg / L. If you pay attention to the results of TDS measurements from the three points above, the results obtained are still below the predetermined threshold. This means that when viewed from the TDS parameters, the waters around Sagulung Port-Moon Island are still classified as clean water, in other words, unpolluted water. TDS is closely related to electrical conductivity. The cause of the increase in the amount of TDS is the dissolved solids contained in the solution, while the value of electrical conductivity in waters is influenced by the number of ions contained in the waters. The greater the amount of dissolved solids, the greater the number of ions in a solution, because the amount of dissolved solids contains ions arranged into

compounds in the dissolved solids, so TDS values and electrical conductivity are likely to have a comparable relationship.

Based on the results of the data analysis above, it can be seen that chemical parameters are an indicator / benchmark used as a reference to measure water quality related to chemistry. Heavy metals are high molecular weight metal elements. In low levels, heavy metals are generally already toxic to plants and animals, including humans. The heavy metals measured in this study are: Fe (iron), Cu (copper), Pb (lead), Zinc (Zn), Magnesium (Mg), and Nickel (Ni). Based on the results of heavy metal causative tests using potassium iodide (KI), hydrogen chloride (HCl), sodium hydroxide (NaOH), and ammonium hydroxide (NH4OH). The sample was wet digestion using nitric acid (HNO3) and aqua regia or the ratio of nitric acid and hydrochloric acid (1:3) which was heated in a hot plate for 30 minutes, then the sample was added with test reagents. From the test results, it was found that the three samples with the addition of sodium hydroxide reagent produced a white precipitate so that it can be said that the samples contained lead metal (Pb) and zinc (Zn), to ascertain the amount of lead and zinc levels contained in the seawater of Sagulung Port-Pulau Bulan.

4. Conclusion

Based on the results of the research that has been done, the conclusions of this study are:

1. The results of measuring physical parameters, namely temperature, color, taste and smell in the waters of Sagulung Port-Moon Island which have been carried out at three measurement points with temperature values ranging from 31.1 ℃ - 31,7 ℃, odorless, colorless, and salty.

2. The results of chemical parameter measurements consisting of TDS, pH, heavy metals Fe (iron), Cu (copper), Pb (lead), Zn (Zinc), Mg (Magnesium), and Ni (Nickel) in the waters of Sagulung Port-Moon Island which have been carried out at three points obtained TDS measurements ranging from 108-209 ppm, pH ranging from 7.5-7.9, while qualitative metal tests in seawater Sagulung Port-Moon Island showed the presence of white deposits using NaOH reagents, then it can be concluded that the waters of Sagulung Port-Moon Island were identified as containing lead metal (Pb), and Zinc (Zn).

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