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ANALYSIS OF ORGANIC CONTENT IN SEAWATER AND SEDIMENT IN THE SOUTH OF BENGKALIS ISLAND RIAU PROVINCE

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ABSTRACT

Organic matter has an important role in marine ecology and it can be used as an indicator of water fertility. The content of organic matter in the waters in a certain amount can be useful for aquatic biota, but if it exceeds the acceptable threshold for the environment and organisms, it can cause disturbances. The content of organic matter in the waters will increase due to waste from households, agriculture, industry, and organic waste from land that is carried into the waters. Various community and industrial activities both on land and waters in the South of Bengkalis Island can provide input of organic matter in the waters. The method used in this research is a survey method that is carried out directly in the field to collect data and samples which are then analyzed. This study aims to determine the content of organic matter in water and sediment and analyze their possible relationship. The results showed that the organic matter content of the water ranged from 34.36 – 35.96 mg/L and the organic matter content of the sediment ranged from 4.78 – 13.78%. The content of organic matter in the waters has not exceeded the quality standard threshold. The results of a simple linear regression test showed a positive relationship with an R^2 value of 0.712, which means that the relationship between the organic matters content of water and sediment is quite strong (71.2%). The types of sediment in the southern waters of Bengkalis Island are the mud type.

Keywords: Organic matter, Bengkalis Island, Sediment, Water, Marine

1. INTRODUCTION

Organic matter content is one measure of water fertility. Organic matter has an important role for organisms in marine waters, including as a source of food (energy), a source of vitamins, a source of material for bacteria, plants, and animals, and as a substance that can play an important role in regulating plankton life[1]. The content of organic matter in waters can be useful for aquatic biota while not exceeding the threshold that is acceptable to the environment, if it exceeds the threshold that is acceptable to the environment and organisms, it can cause disturbances. Reduced water quality due to the decomposition process is one of the disturbances caused by the enrichment (eutrophication) of organic matter that exceeds the environmental threshold. Decomposition by microorganisms carried out anaerobically due to reduced dissolved oxygen in the waters will produce toxic compounds that can disturb various organisms in the waters.

The southern waters of Bengkalis Island are one of the waters found on Bengkalis Island. The southern waters of Bengkalis Island are located in the Malacca Strait[2]. The southern waters of Bengkalis Island have quite busy water activities. The southern waters of Bengkalis Island are a crossing route and inter-island transport activities. These conditions are indicated to directly or indirectly provide input of organic matter to the southern waters of Bengkalis Island. In addition, the southern waters of Bengkalis Island also receive

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input of organic matter from the mainland of Bengkalis Island. Bengkalis City, which faces directly to the southern waters of Bengkalis Island, is the most populous area in Bengkalis Regency, which is thought to provide a fairly high input of organic matter to the southern waters of Bengkalis Island. The southern mainland of Bengkalis Island also has various community and industrial activities that are thought to provide input of organic matter to the southern waters of Bengkalis Island through river flows that will end and end up in the sea.

The input of organic matter from land starts from the upstream of the river where human, industrial, and urban activities are discharged into the river until it is carried by the river flow to the estuary in the sea. Organic matter that enters the water is dissolved on the surface and water column. Over time, organic matter in the water will accumulate into sediments. The speed of accumulation of organic matter in the surface and water column to the sediment depends on the oceanographic factors of the water itself.

One of the constituent particles of sediment in the waters is organic matter. Plant debris in the form of mangrove litter and associated animals around the waters are the main sources of organic matter in the waters. The feces of biota and the remains of dead organisms that accumulate in sediments are other sources of organic matter in sediments[3].

This study aims to determine how much organic matter content is in water and sediment and determine the relationship between water organic matter content and sediment organic matter content. The benefit of this research is as initial information on the condition of the southern waters of Bengkalis Island so that it can be used as a reference and consideration in the management of the southern waters of Bengkalis Island and development on Bengkalis Island, Bengkalis Regency.

2. RESEARCH METHOD

Time and Place

This research was conducted in January - February 2022 in the southern waters of Bengkalis Island, Bengkalis Regency, Riau Province (Figure 1).

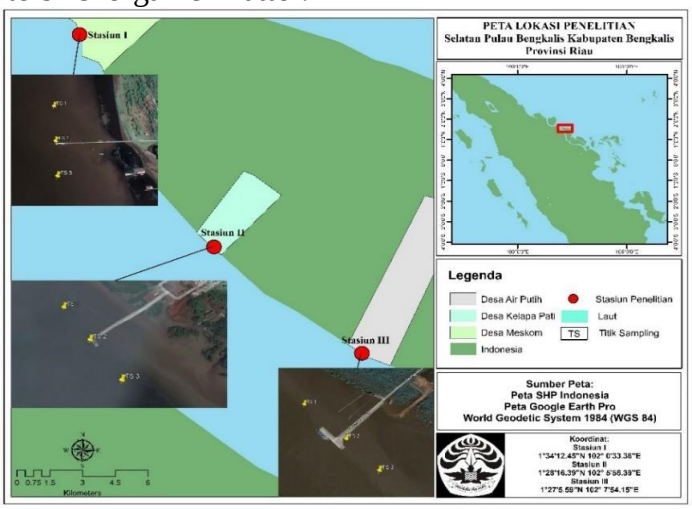

Figure 1. Map of research locations

Methods

The method used was a survey method conducted in the field directly to collect data and samples, then brought to the laboratory for analysis. The research station was determined by purposive sampling, namely the placement of stations carried out with certain considerations and specific criteria at each research station. The number of research stations is 3 stations consisting of 3 sampling points. The sampling location was carried out in the intertidal zone. Station I was located in the waters of the tourist beach of Prapat

Tunggal Beach, Meskom Village, station II was located in the waters of Kelapa Pati Village adjacent to the fish market, and station III was located in the waters near the ferry port of Air Putih Village (Figure 1).

Procedure

Water and sediment samples taken directly from each research station are the main materials used in this study. Oceanographic parameter data obtained directly (*in situ*) from the field consisted of salinity, temperature, brightness, current speed, acidity (pH), and depth. Water and sediment samples obtained were then analyzed at the Chemical Oceanography Laboratory, Department of Marine Science, Faculty of Fisheries and Marine, Riau University.

Data Analysis

Water Organic Matter Content

The content of organic matter in water was analyzed using the Titrimetric method of SNI 06-6989.22-2004[4]. The first step is to heat 100 mL of distilled water at a temperature of 70^o C then added 5 mL of sulfuric acid. Added 10 mL (V_1) 0.01N oxalic acid solution (N_1) then titrated with potassium permanganate 0.01N until pink and record the volume of use (V_2) and calculated the actual normality of potassium permanganate (b).

$$b = \frac{V1 \; x \; N1}{V2}$$

The next step included 100 mL (d) of sample water and added 3 boiling stones and added potassium permanganate until pink. Add 5 mL of 8N sulfuric acid (c) and heat on a hot plate at 105^o C ± 2^o C until boiling added 10 mL of 0.01N potassium permanganate and heated again to boiling for 10 minutes. Titrate with 0.01N potassium permanganate until pink and record the volume of use (a) (if the volume of use is more than 7 ml then dilute (f) and repeat the test). Calculate using the formula:

$$\text{TOM (mg/L)} = \frac{[(10+a)b-(10xc)]1x31.6x1000xf}{d}$$

Sediment Organic Matter Content Analysis

Analysis of organic matter content in sediments using the *Loss on Ignition* method[5]. The first step is the cup is put in the oven at 105^o C for 15 minutes then cool in a desiccator for 15-20 minutes and weigh as the weight of the cup (b). Sediment samples are put in a cup ± 50 g and put in the oven at 105^o C for 24 hours after that cool in a desiccator for 15 minutes and then weighed (a). The dried samples are then burned in a furnace at 550^{o}C for 3 hours, then cool in a desiccator for 30-60 minutes, and then weighed (c). Calculate using the formula:

$$\text{Organic matter content (\%)} = \frac{a - c \; x100}{\text{a-b}}$$

Sediment Fraction Analysis

Sediments taken from the research site were used for sediment type analysis. The stages of sediment analysis followed the instructions of Rifardi[6], using the multistage sieving method to obtain ø1- ø4 and the pipette method to obtain ø5- ø7. The classification of sediment fractions was based on the proportion of gravel, sand, and mud particles.

Analysis of the Relationship between Water Organic Matter Content and Sediment Organic Matter Content

Simple linear regression analysis was used to analyze the relationship between water organic matter content and sediment organic matter content, using *SPSS software*. Simple linear regression analysis is an analysis to see the relationship between one influencing or independent variable (X) and the influenced or dependent variable (Y)

3. RESULT AND DISCUSSION

Water One of the small outermost islands is Bengkalis Island. Geographically, the coordinates of Bengkalis Island are 1^o 31'29" LU and 102^o 28'13" BT is located in the Malacca Strait and is directly n with Malaysia. The population of Bengkalis

Island is mostly spread in the southern part of Bengkalis Island, directly facing Sumatra Island and separated by the Bengkalis Strait. The southern part of Bengkalis Island has several inter-island ferry ports[7].

The southern waters of Bengkalis Island are an inter-island ferry traffic area. Vegetation along the south coast of Bengkalis Island is Mangrove (Rhizopora) and Api-Api (Avicennia). The waters of Prapat Tunggal beach are a fairly productive fishing area with much standing gombang fishing gear and at the same time a tourist beach that is quite crowded with visitors, the waters of Kelapa Pati Village are an area adjacent to Bengkalis City with dense community activities, and the waters of Air Putih Village are an area that is a Ro-Ro ferry port to and from Bengkalis Island.

Oceanographic Parameter Conditions

Measurement of oceanographic parameters to describe the condition of the research waters carried out. Oceanographic parameter measurement values can be seen in Table 1.

Table 1. Oceanographic parameter measurement values

Station	Sampling Point	Salinity (‰)	Temperature (℃)	Brightness (cm)	Current Velocity (m/s)	pH	Depth (m)
I	1	24	32	16	0,071	7	3,5
	2	25	30	35	0,09	7	4,3
	3	24	32	28	0,074	7	3,8
	Average	24,33	31,33	26,33	0,08	7	3,87
II	1	23	31	45	0,072	7	4,9
	2	23	31	41,5	0,161	7	3,8
	3	24	32	53	0,112	7	3,5
	Average	23,33	31,33	46,50	0,12	7	4,07
III	1	23	30	82,5	0,13	7	3,1
	2	22	29	59,5	0,14	7	3,5
	3	23	30	69,5	0,22	7	3,7
	Average	22,67	29,67	70,50	0,16	7	3,43

Based on Table 1, the average value of oceanographic parameter measurements at station I is salinity 24.33‰, temperature 31.33℃, brightness 26.33 cm, current speed 0.08 m/s, pH 7, and depth of 3.87 m. The average value of measurements of oceanographic parameters at station II is salinity 23.33‰, temperature 31.33℃, current speed 0.12 m/s, brightness 46.50 cm, pH 7, and depth 4.07 m. The average value of oceanographic parameter measurements at station III is salinity 22.67‰, temperature 29.67℃, brightness 70.50 cm, current velocity 0.16 m/s, pH 7, and depth 3.43 m.

Various activities of aquatic organisms are affected by salinity. Salinity is influenced by river flow, water circulation patterns, rainfall, and evaporation. Salinity at the three research stations is in the range of 22-25‰. Freshwater input as well as waste discharges from rivers and community activities such as market and ship activities can provide freshwater input to waters, where these activities greatly affect salinity in marine waters. Budianto et al.[8] stated that the salinity of estuary waters is 5-35 ppt, and community activities and freshwater flow from small rivers are thought to cause low salinity values in the waters.

Season, weather, depth, and brightness are all factors that affect the temperature in water. Solar radiation and evaporation are the main factors that affect temperature. The temperature measurement value at the three research stations is in the range of 29 - 32 ℃. The temperature is good enough to support the life of organisms and activities in these waters.

Nugraha et al.[9] stated that the general temperature of the sea surface is 20-30 ℃, and various organisms and aquatic activities can take place well in that range. The temperature measurement results are relatively following the standard, except at station I sampling point 3 and station II sampling point 3.

Photosynthetic activity is closely related to the brightness of the waters which can increase the productivity of a water body. Good photosynthesis will directly affect the organic matter content in the waters. Primary producers use organic matter as nutrients when performing photosynthesis. The range of water brightness at three stations is 16 - 82.5 cm. According to Suparjo[10] states that the life of organisms in the waters can take place well when the brightness value is more than 0.45 m or more than 45 cm. The water conditions of the three research stations are still at the standard, except at station I which has an average water brightness below 45 cm.

The wind that generates surface currents is a factor that affects the surface currents of ocean waters. The current velocity in shallow waters is also influenced by tidal conditions and the topography of the location of these waters. The current speed at the three research stations was in the range of 0.071 - 0.22 m/s. Based on research by Yogaswara et al.[11] stated that the speed of sea surface currents is in the range of 0.0341 - 0.277 m/s.

The life of organisms in the waters is influenced by various factors, one of which is acidity (pH). At this pH, various aquatic organisms such as phytoplankton can live and develop normally because pH 7 is a neutral pH category. So that primary organisms such as phytoplankton and algae can carry out photosynthesis and use organic matter as nutrients. This is supported by the statement of Novriadi[12] which states that generally, organisms in marine waters are sensitive to significant pH fluctuations, and marine biota-like pH is in the range of 7-8.3.

Overall, the water quality is in optimal condition. These optimal conditions allow decomposing microorganisms to break down organic matter that is eventually utilized by various organisms as nutrients. Producer organisms such as phytoplankton utilize these nutrients to be able to carry out photosynthesis which ultimately fertilizes the waters.

Organic matter content of seawater

Analysis of organic matter content in seawater to show the content of organic matter contained in water in the southern waters of Bengkalis Island. The results of the analysis of water organic matter content at each research station can be seen in Table 2.

Based on Table 2 and the Oneway ANOVA test, the sig. value is 0.593, meaning p> 0.05, which shows that the organic matter content in water between stations does not show a significant difference. The average water organic matter content at station I is 35.29 mg/L, station II is 35.56 mg/L, and station III is 35.73 mg/L. The highest water organic matter content at station II sampling point 2 is 35.96 mg/L and the lowest at station II sampling point 3 is 35.29 mg/L. According to Supriyantini et al.[3], based on the Decree of the State Minister of Population and Environment Number 2 of 1988 concerning Wastewater Quality Standards states that the threshold for organic matter content in water is 80 mg/L so that the content of water organic matter in the southern waters of Bengkalis Island is still in the range of good quality standards and has not exceeded 80 mg/L.

The southern waters of Bengkalis Island have a fairly high mangrove density, which contributes to the entry of organic matter into these waters. In addition to the input of organic matter from mangroves, in the southern waters of Bengkalis Island, several large rivers can carry organic matter from land as a result of human and

industrial activities. The research location is also a ferry port and fishing harbor which is quite dense so these activities also have an impact on the input of organic matter into these waters. Mangroves are one of the main sources of organic matter in the waters, followed by human and industrial activities from land that enter river bodies and empties into marine waters[3].

Table 2. Seawater organic matter content values

Station	Sampling Point	Water organic matter content (mg/L)
I	1	35,82
	2	34,36
	3	35,69
Average		35,29 ±0,81
II	1	35,42
	2	35,96
	3	35,29
Average		35,56 ±0,35
III	1	35,69
	2	35,69
	3	35,82
Average		35,73 ±0,08

Organic matter content of sediments

Analysis of organic matter content in sediments to show the content of organic matter contained in sediments in the southern waters of Bengkalis Island. The results of the analysis of sediment organic matter content at each research station can be seen in Table 3.

Table 3. Sediment organic matter content values

Station	Sampling Point	Sediment organic matter content (%)
I	1	10,43
	2	4,78
	3	10,32
Average		8,51 ±3,23
II	1	10,2
	2	11,24
	3	6,77
Average		9,40 ±2,34
III	1	10,18
	2	13,78
	3	11,47
Average		11,81 ±1,82

Based on Table 3 and the *Oneway ANOVA* test, the *sig.* value is 0.325, meaning $p > 0.05$, which indicates that the organic matter content in sediments between stations does not show a significant difference. The average sediment organic matter content at station I is 8.51%, station II is 9.40%, and station III is 11.81%. The lowest sediment organic matter content value at the station I sampling point 2 is 4.78% and the highest sediment organic matter content at station III sampling point 2 is 13.78%. Based on the classification of sediment organic matter content according to Reynold *in* Budianto et al.[8], the average sediment organic matter content of the three research

stations is classified as moderate because it is in the range of 7-17%.

Sediment Type

The results of sediment type analysis at each sampling point in the southern waters of Bengkalis Island can be seen in Table 4.

Table 4. Sediment-type analysis results

Station	Sampling Point	Sediment Fraction (%)			Sediment Type
		Gravel	*Sand*	*Mud*	
I	1	1,82	33,15	65,04	Mud
	2	1,13	5,16	93,71	Mud
	3	2,83	10,92	86,25	Mud
II	1	0,22	3,13	96,65	Mud
	2	0,14	8,61	91,26	Mud
	3	0,29	4,07	95,64	Mud
III	1	1,13	12,36	86,51	Mud
	2	0,4	4,75	94,85	Mud
	3	0,37	3,71	95,92	Mud

Based on Table 4, it is known that the type of sediment at each research station is mud. There is no difference in sediment type between stations, presumably due to the influence of geographical conditions and water conditions that are almost the same. The water conditions of the three research stations are almost similar because they are located in locations where there are river flows, then at all research stations also have quite dense activities, namely at station I, namely community activities in the form of beaches and waves, station II is a fish market port area, and station III is an inter-island ferry port with dense activity. The research stations are also located in the same area, namely the Bengkalis Strait; these conditions are indicated to cause the type of sediment from the three stations to be almost the same. According to Ahmad et al.[13] river flow affects the size of the floating sediment discharge value. The value of floating sediment discharge in river waters will be greater if the river flow discharge is greater. Likewise, if the value of the river discharge flow is getting smaller, the value of floating sediment discharge in the river waters will also be small. Besides being influenced by the presence of river flow, the type of sediment is also influenced by oceanographic factors in the region.

Relationship between Water Organic Matter Content and Sediment Organic Matter Content

Analysis of the relationship between organic matter content in water and organic matter content in sediment to show the effect of organic matter content in water on organic matter content in the sediment. The relationship between organic matter content in water and organic matter content in sediment based on a simple linear regression test can be seen in Figure 2.

Based on Figure 2 above, it is known that the correlation value (r) is quite strong at 0.844 with an R^2 of 0.712 which means that the water organic matter content and sediment organic matter content have a strong relationship of 71.2%. The *p*-value of *Anova* is 0.004 (0.004 <0.05) which means that the content of water organic matter influences the content of sediment organic matter. Organic matter carried by currents, both by ocean currents and from rivers over time will experience deposition in sediments. The deposition of organic matter in the sediment will increase the concentration of organic matter content in

the sediment. The period for organic matter in the water to settle into the sediment is influenced by the influence of currents and other oceanographic parameters.

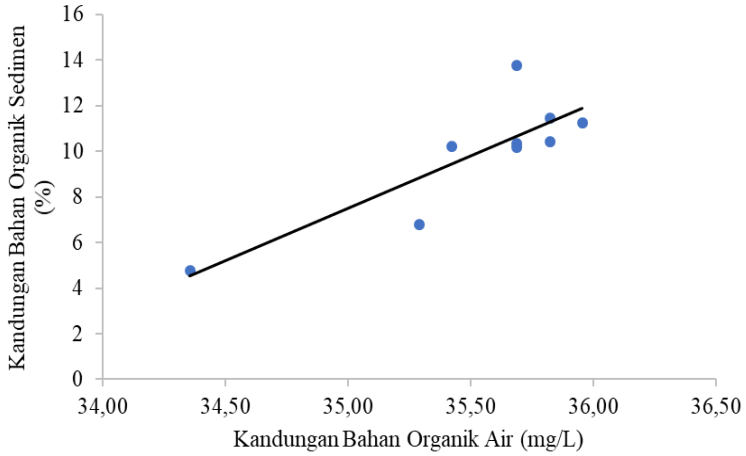

Figure 2. Relationship between water organic matter content and sediment organic matter content

4. CONCLUSION

The average water organic matter content between research stations ranged from 35.29 - 35.73 mg/L so the water organic matter content in the southern waters of Bengkalis Island has not exceeded the quality standard threshold. The average sediment organic matter content between research stations ranges from 8.51 - 11.81%, where the classification is in the medium classification. The relationship between water organic matter content and sediment organic matter content is shown by the value of R^2 = 0.712 which means that the relationship between water organic matter content and sediment organic matter content has a strong relationship (71.2%). Further research needs to be done to determine other influences such as biological oxygen demand (BOD), phosphate content, nitrate, mangrove litter, total suspended solids (TSS), chlorophyll, and others that can influence the content of organic matter in water and sediment in the southern waters of Bengkalis Island, Riau Province.

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