

Analysis of the Content of Suspended Solids and Sedimentary Organic Matter in the Coastal Waters of Bokor, Meranti Island Regency

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Received: 20 April 2026; Accepted: 10 May 2026

ABSTRACT

This study aims to analyse the concentrations of Total Suspended Solids (TSS) and sediment organic matter, as well as their relationship, in the coastal waters of Bokor Village, Kepulauan Meranti Regency. The research was conducted from December 2024 to January 2025 using a survey method at three observation stations selected based on varying levels of human activity. TSS analysis was performed gravimetrically according to the Indonesian National Standard (SNI 6989.3:2019), while sediment organic matter was analysed using the Loss on Ignition (LOI) method. The results showed that TSS concentrations ranged from 10.4 to 17.56 mg/L and were within the good-quality standard for marine waters. The concentration of sediment organic matter ranged from 3.0% to 5.7%, which is categorised as low. A simple linear regression analysis indicated a weak positive correlation between TSS and sediment organic matter. This suggests that suspended solids account for only 10.1% of the variability in sediment organic matter, with the remaining variation influenced by other environmental factors.

Keywords: Total Suspended Solids, sediment organic matter, Bokor Village

1. INTRODUCTION

Land clearing for residential settlements has gone hand in hand with growing community needs, making water transport routes in Bokor Village crucial for local mobility and the economy. However, these activities also affect water quality in the surrounding area. They directly and indirectly affect the quality of nearby waters, particularly suspended solids and organic sediment.

In addition to anthropogenic inputs, land-use changes also influence the relationship between suspended solids and organic sediment. Increased human activities in maritime transportation, land clearing, and domestic waste can add to the load of suspended solids and simultaneously increase the input of organic matter transported to the water bottom. Suspended particles serve as a transport medium for organic matter, as they can carry and distribute both organic and inorganic compounds. Organic matter bound to suspended particles subsequently settles to the bottom of the water. If concentrations are too high, this can potentially lead to anoxic conditions that negatively impact the ecosystem.

Suspended solids originate from various sources, both natural (such as soil erosion and

plant detritus) and anthropogenic (such as domestic and industrial waste). The presence of suspended solids is closely linked to the organic matter content in sediments, as the majority of organic matter in water bodies is bound to suspended particles before eventually undergoing sedimentation. The deposition of suspended solids is one of the primary pathways for organic matter to enter the water bottom. Organic matter associated with suspended solids accumulates in sediments; thus, the higher the concentration of suspended solids in the water column, the greater the potential for increased organic matter in sediments. This is evident in calm aquatic ecosystems, such as estuaries and river mouths, where suspended solids act as a transport medium for particulate organic carbon (Wu et al., 2020).

2. RESEARCH METHOD

Time and Place

This study was conducted from December 2024 to January 2025 in the coastal waters of Bokor Village, Meranti Islands Regency (Figure 1). Analysis of suspended solids and organic matter in the sediment was performed at the Marine Chemistry Laboratory of the Department of Marine Sciences, Faculty of Fisheries and

Marine Sciences, Universitas Riau.



Figure 1. Research Location

Method

The method used in this study is a survey. This study collected primary data in the field and secondary data from a literature review, including journals, books, and articles.

Procedures

Selection of Research Stations

The research stations were selected using purposive sampling, which involves selecting stations based on activities likely to affect the waters in Bokor Village, Meranti Islands Regency. The research stations were divided into 3 groups, with 3 repetitions at each Station. Station I was located at a busy port, Station II was located at a river mouth, and Station III was located in a forest area.

Sample Collection and Handling

Sampling of suspended solids at the water surface was conducted using 250-ml bottles that had been rinsed three times with seawater from the sampling site. Water samples were collected using the sample bottles, ensuring no air remained inside, and then placed in an ice box. Water samples were collected at each sampling point.

Sediment organic matter samples were collected using a Van Veen Grab, weighed at 500 grams per sampling point, placed in plastic bags and labelled according to the Station, then placed in an ice box and transported to the marine chemistry laboratory for analysis.

Data Analysis

Analysis of Total Suspended Solids

The analysis of suspended solids samples complies with SNI 6989.3:2019: Water and Wastewater – Part 3: Gravimetric Method for the Determination of Total Suspended Solids (TSS). The suspended solids concentration is measured gravimetrically. Large floating

particles are separated, then the sample bottle is shaken to maintain homogeneity and prevent particles from adhering to the bottle walls. Whatman 42 filter paper is moistened with distilled water, heated in an oven at 105°C for approximately 15 minutes, and then weighed to determine the initial weight. Filtration is performed using a vacuum pump by slowly pouring 100 mL of the sample water until all the water has been filtered. The filter paper containing the retained suspended solids is reheated to 105°C for 30–60 minutes, then weighed to obtain the final weight. The calculation formula is as follows.

$$\text{TSS (mg/L)} = \frac{W_2 - W_1 \cdot 1000}{V}$$

W_1 = weight of blank filter paper (mg)

W_2 = weight of filter paper + residue after filtration and drying (mg)

V = volume of filtered water sample (mL)

Analysis of Organic Matter in Sediments

Analysis of organic sediment samples was conducted according to Heiri (2001) using the Loss on Ignition (LOI) method. Dishes made of aluminium foil were moulded in a glass beaker, then oven-dried at 105°C for 15–20 minutes. They were then cooled in a desiccator for 15 minutes and weighed to determine the dish weight (b). Fifty grams of the mixed sediment sample was placed in the dish and oven-dried again for 24 hours at 105 °C (until completely dry). Afterwards, it was cooled in a desiccator and weighed, yielding the value (a). The sample was then placed in a furnace at 550°C for 3 hours, cooled, and weighed (c). To determine the sediment's organic matter content, a formula developed by Pett (1993) was used.

$$\text{Total Organic Matter Content (\%)} = \frac{a-c}{a-b} \times 100\%$$

Description:

a = Weight of the dish and sample after temperature drying at 105°C (g)

b = weight of the cup (g)

c = weight of the crucible and sample after firing at 550°C (g)

Analysis of the relationship between suspended solids and organic matter content in sediments using simple linear regression. In addition, an ANOVA was conducted to compare suspended solids and organic matter content across stations.

3. RESULT AND DISCUSSION

Water Quality Parameters

The water quality parameters measured in the field at each Station were salinity,

temperature, pH, turbidity, and current velocity. The results of the water quality measurements taken in the waters off Bokor Village Beach are shown in Table 1.

Table 1. Water Quality

Environmental Parameters	Quality Standards *	Station		
		I	II	III
Temperature (°C)	28 - 32	30,33	28	31
Salinity (ppt)	Natural	21	18	25
pH	7 - 8,5	7,5	6	7,33
Brightness (cm)	-	41,67	48,67	51,67
Current Speed (m/s)	-	0,18	0,42	0,38
Dissolved Oxygen (mg/l)	>5	6,27	5,88	7,72

Description: Water quality standards under Government Regulation No. 22 of 2021 on the Implementation of Environmental Protection and Management

Suspended Solids Content

The results of the analysis of suspended

solids at each Station are shown in Table 2.

Table 2. Total Suspended Solids (mg/L)

Station	Sampling Points	Total Suspended Solids	Mean ± Standard Deviation	Criteria*
I	1-1	10,8	17,56 ± 6,80	Alright
	1-2	17,5		
	1-3	24,4		
II	2-1	12,2	12,93 ± 1,69	Alright
	2-2	11,7		
	2-3	14,9		
III	3-1	16,6	13,40 ± 2,98	Alright
	3-2	10,7		
	3-3	12,9		

Description: Water quality standards under Government Regulation No. 22 of 2021 on the Implementation of Environmental Protection and Management

The TSS concentration ranged from 12.93 to 17.56 mg/L. The highest TSS concentration was recorded at Station I, located at Tanah Kuning Port, at 17.56 mg/L. In contrast, the lowest TSS concentration was recorded at Station II, in the estuary, at 12.93 mg/L. The average total suspended solids values obtained at each Station are as follows: Station I at 17.56 mg/L, Station II at 12.93 mg/L, and Station III at 13.40 mg/L. Of the three stations, Station I showed the highest value, while Station II showed the lowest. The high total suspended solids value at Station I is strongly suspected to be influenced by port activities, ship movements, and artificial waves generated by ships, which cause erosion and result in sand and silt entering the water. Physical activities, such as ship movements, can increase particle resuspension and raise total suspended solids levels in coastal waters.

At Station II, the low total suspended solids value is due to its location at a river mouth, where water flowing from the mouth carries dissolved and suspended materials, including fine sediments, organic matter, and soil particles. River flow plays a major role in mobilising these particles into seawater, leading to lower total suspended solids values.

Organic Matter Content of Sediments

The organic matter content of the sediment ranged from 2.7 to 5.7%, with the highest value recorded at Station I, located at Tanah Kuning Port, at 5.7%. In contrast, the lowest organic matter content was found at Station III, located in an area with minimal activity. Analysis of total organic matter content in sediments in the waters of Bokor Village indicates that all monitoring stations exhibit relatively high values. At Station I, organic

matter content ranges from 5.0 to 6.3%, with an average of 5.7%. This value makes Station I the Station with the highest organic matter content. The high organic content is likely due to human activities around the site, such as settlements or the discharge of domestic wastewater, which flows into the water, is carried by currents, and

then accumulates on the seabed (Siregar et al., 2021). Station II has lower values than Station I, ranging from 3.0% to 4.1% with an average of 3.6%. The results of the analysis of sediment organic matter content at each Station are shown in Table 3.

Table 3. Organic Matter Content of Sediments (%)

Station	Sampling Points	Total organic matter	Mean ± Standard Deviation	Criteria*
I	1-1	5,8	5,7 ± 0,66	Low
	1-2	6,3		
	1-3	5,0		
II	2-1	4,1	3,6 ± 0,56	Low
	2-2	3,7		
	2-3	3,0		
III	3-1	3,2	2,7 ± 0,62	Low
	3-2	2,9		
	3-3	2,0		

Source: Reynold 1971

Nevertheless, this value still falls within the category of organic contamination. Meanwhile, Station III has the lowest values, ranging from 2.0% to 3.2% and averaging 2.6%. The low organic matter content may indicate more limited anthropogenic activity in this area.

Differences in Suspended Solids and Organic Matter Content in Sediments

An analysis of suspended solids and organic matter content in the sediment was conducted at each research station to examine variations in these values across locations. The measurement data for each Station are presented in Figure 2.

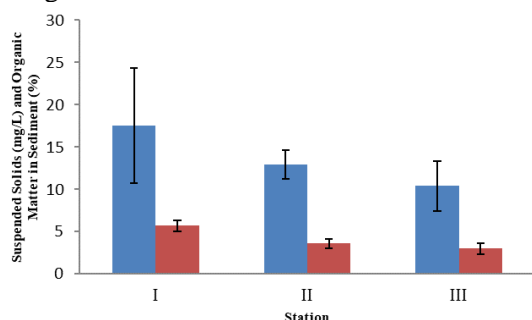


Figure 2. Differences in Suspended Solids and Organic Matter Content in Sediments

The highest concentrations of suspended solids and organic matter in the sediment were found at Station I, which is characterized by high levels of human activity due to its proximity to the port. The lowest concentration of suspended

solids was found at Station III, where human activity is minimal. In contrast, the highest concentration of organic matter in the sediment was found at Station II, located at the mouth of the Bokor River.

The Relationship Between Suspended Solids and Organic Matter in Sediments

A simple linear regression analysis was conducted to determine the relationship between suspended solids and organic matter in the sediment. The results are shown in Figure 3.

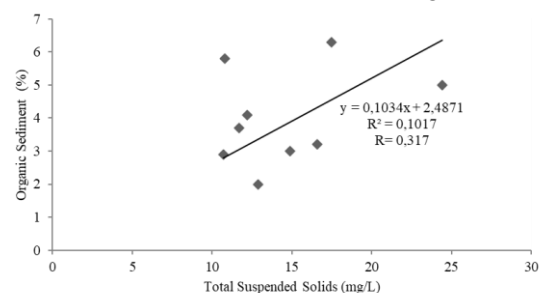


Figure 3. Relationship Between Suspended Solids and Organic Matter in Sediments

The regression equation yielded a correlation coefficient (R) of 0.317, indicating a weak relationship between the variables. The coefficient of determination (R²) was 0.101. The regression of the equation $y = 0.103x + 2.487$ yields a coefficient of determination (R²) of 0.101, meaning that suspended solids can only explain 10.1% of the variation in organic matter

in the sediment. At the same time, other factors outside the model influence the remaining 90.8%. Meanwhile, the correlation coefficient (R) was 0.303, indicating a weak relationship between the variables.

The values of both coefficients indicate a weak positive relationship between suspended solids and sediment organic matter. However, the low R^2 value (0.101) indicates that the influence of suspended solids on sediment organic matter is relatively weak. The relationship between suspended solids and sedimentary organic matter is weakly positive. This is supported by the study by Hanjaya et al. (2023) in the waters of Loji, Pekalongan City, which showed a weak positive relationship between suspended solids and sedimentary organic matter. This means that the higher the suspended solids content in the water, the greater the amount of organic matter accumulated in the

sediment. This is consistent with the concept that suspended particles are the primary medium for transporting organic matter in the water column before it settles.

4. CONCLUSION

The suspended solids content in the coastal waters of Bokor Village remains relatively good, while the organic matter content in the sediment is relatively low. Differences in suspended solids content between stations show no significant variation, whereas differences in organic matter content in the sediment show significant variation between stations. The relationship between suspended solids and sediment organic matter is weakly positive; suspended solids can still explain sediment organic matter content, although most of the variation is influenced by other factors.

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