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## Distribution of Turbidity Values, Total Suspended Solids and Heavy Metals Pb, Cu in Tanah Merah Beach Waters and Semujur Island Waters, Bangka Tengah Regency

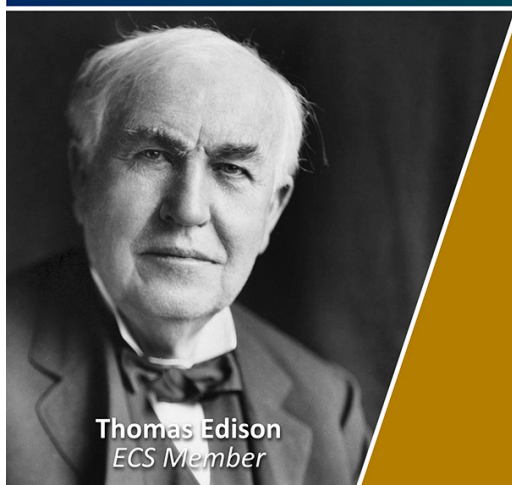
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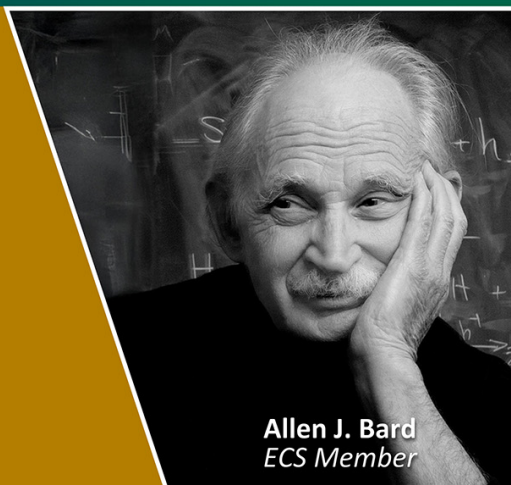


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# Distribution of Turbidity Values, Total Suspended Solids and Heavy Metals Pb, Cu in Tanah Merah Beach Waters and Semujur Island Waters, Bangka Tengah Regency

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**Abstract.** The high activity of tin (Sn) mining in the coastal areas of Bangka waters has an impact on turbidity, suspended solids, and increased levels of heavy metals (Pb, Cu). The study was conducted from February until April 2020 aims to determine the relationship between turbidity, total suspended solids (TSS), and concentrations of Pb and Cu in the Tanah Merah beach waters (TM) and Semujur Island waters (SM) which are characterized by the presence or absence of tin mining. (Sn) as a source of pollution. The results showed that the level of turbidity in TM (0.8-3.4 mg/l) was higher than in SM (0.4-0.8 mg/l) and Total Suspended Solid values in TM (149-185 mg/l) were lower than in SM (165-202 mg/l) and between (155-175 mg/l). The concentrations of heavy metals Pb in TM (0.05-0.09 mg/l) and Cu in TM (0.01-0.02 mg/l) were lower than in SM (Pb: 0.12-0.14 mg/l) and Cu (0.04-0.1 mg/l). Turbidity levels and high TSS values can be affected by the speed and direction of ocean currents. Heavy metals Pb and Cu are thought to be bound very effectively by TSS, their distribution is strongly influenced by the direction of the current and the velocity of the current formed.

## 1. Introduction

The Province of Bangka Belitung Islands is located between 105°-108° East and 03°30' South. The total area of 81,582 km<sup>2</sup> consists of a land area of 16,281 km<sup>2</sup> (19.96% of the total area) and the remaining 65,301 km<sup>2</sup> (80.04%) in the form of marine waters. There are two large islands of Bangka area of 11,481 km<sup>2</sup> and Belitung islands covering an area of 4,800 km<sup>2</sup> and is composed of 950 pieces of small islands plus the length of the beach 2,189,553 km [1]. The islands of Bangka and Belitung have long been known for their potential and reserves of tin (Sn) mining which are the largest in Indonesia, so this tin ore mining exploration activity continues to this day. Tanah Merah beach waters, Bangka Tengah



Regency is one of the places where currently there is quite a lot of tin ore (Sn) mining activities, while the waters of Semujur Island are quite far from these mining activities.

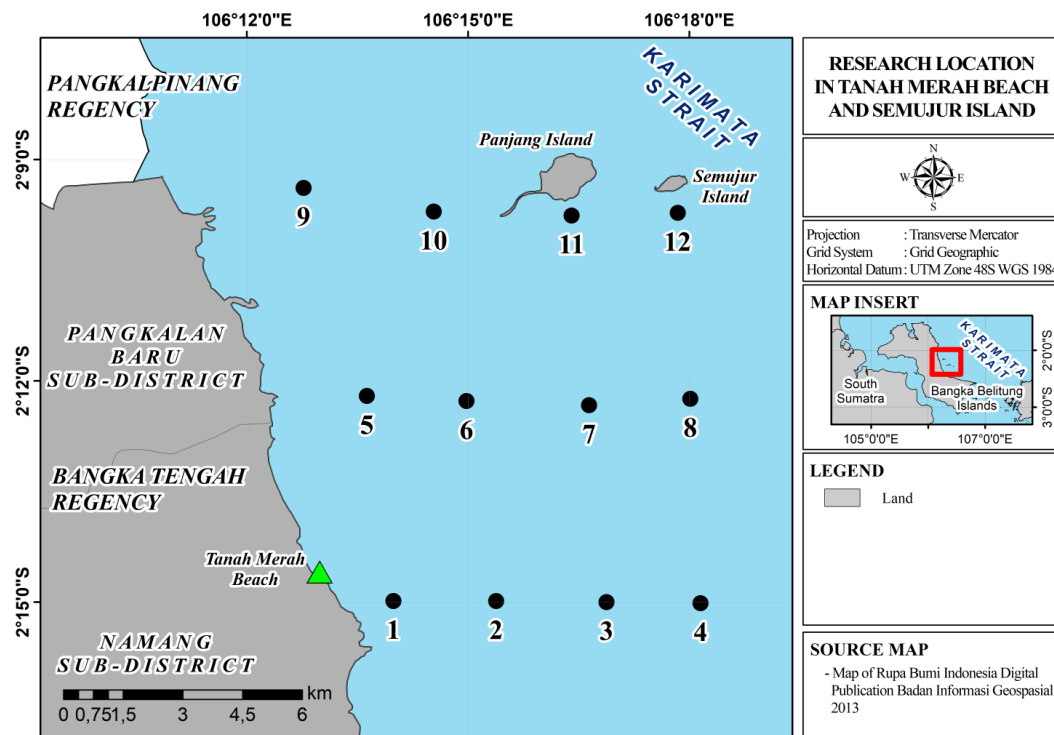
The exploitation of Sn ore mining in coastal areas can produce waste and have an impact on damage to the seabed soil structure and sea waters pollution especially heavy metals and turbidity or total suspended solid. According to [2,3] that the heavy metals that commonly pollute the waters in urban areas are Pb, Zn, Cu, Cd, and Co; while the USEPA (the United States for Environmental Protection Agency) lists the most pollutants that are wasted in the environment, including Copper (Cu), Zinc (Zn), Chromium (Cr), Lead (Pb), and Nickel (Ni) [4].

Coasts and oceans not only receive waste from Sn mining activities in the sea but also receive mining waste runoff from the surrounding land. The flowing waste will result in changes in water quality in coastal and marine areas, damage nutrients, and can result in decreased water carrying capacity, including nitrogen elements and parameters that are very influential in marine life (algae and plankton) [5]. Tailing runoff in the form of fine sand scattering in water bodies causes sunlight to be blocked from entering the water column due to high suspended solids and water turbidity around the mining site. The high of these two parameters also results in high heavy metal elements bound in the suspended material in cloudy water conditions. Based on the explanation above, the research entitled "Distribution of Turbidity Values, Total Suspended Solids and Heavy Metals Pb, Cu in Tanah Merah beach and Semujur Island waters, Bangka Tengah Regency" is very important to do.

## **2. Materials and Methods**

The research was conducted from February to April 2020 in the coastal area of Bangka Tengah Regency, Bangka Belitung Islands Province, Indonesia. Sampling was conducted at two location: Tanah Merah (TM) and Semujur Island (SM), which are located in the Districts of Namang and Pangkalan Baru, respectively. The first location is a tin mining activity location, and the second location is a mining free zone. A total of 4 stations were taken at each location, as shown in Figure 1.

Water samples were taken using a Nansen water sampler and put into bottles of High-Density Poly Ethylene (HDPE), then preserved with nitric acid ( $\text{HNO}_3$ ) until the pH reached 2 and stored in an icebox. Seawater samples were analyzed levels of lead using Atomic Absorption Spectrophotometry (AAS) [6, 7]. Chemical analysis was carried out in the Laboratory of Research and Standardization Industry Palembang. Water quality data measured in the field will be compared with the Decree of the Minister of Environment of the Republic of Indonesia Number 51 of 2004 on the Marine Water Quality Standards [8]. The data obtained are presented in tabular form and discussed descriptively. Water quality measurements are carried out directly. Flow velocity is calculated by the real-time flow measurement system using Acoustic Doppler current profiler (ADCP) [9] and the current direction is determined by Surface Hydrology Software [10]. The turbidity was measured using a turbidity meter; the total suspended solid (TSS) was measures using a Whatman filter paper with a pore size of 0.45  $\mu\text{m}$ ; the salinity was measured using a hand refractometer. The degree of water acidity (pH) was measured using pH meter (Hanna HI 98107) and the dissolved oxygen concentration using a DO meter (Lutron 5510, with an accuracy of 0.001 mg/L. Transparency was measured by a disk and depth was measured on a scale.



**Figure 1.** Location Research in Tanah Merah waters and Semujur island waters

### 3. Result and Discussion

The results of the air quality research for the two locations, namely Tanah Merah beach, and Semujur island waters, and the locations between these two locations are shown in Table 1. The results of temperature measurements at the two locations ranged from 28-31°C. Research results from other researchers state that average temperature value at the eastern waters of Bangka Island are 29.30°C [11], while for the southern waters of Bangka the temperature ranges from 28.5-30.8°C [12], and these conditions show normal or natural values. Water conditions in tropical areas such as in Indonesia [13]. Temperature distribution in strong regions of Indonesia is closely related to the monsoon cycle in which seasonal variations are in the area above the oceanic circulation, which is presented by wind winds [14-16]. Indonesian waters characterized by temperature include important factors in coastal processes such as biological activity, momentum and heat exchange, interactions with the surrounding air, and climate change [17,18]. Changes in sea air temperature are caused by the intensity of solar irradiation, geographic location [19], the flow of heat energy at the atmospheric boundary, while changes in salinity levels are caused by the displacement of freshwater through rain and evaporation processes [20].

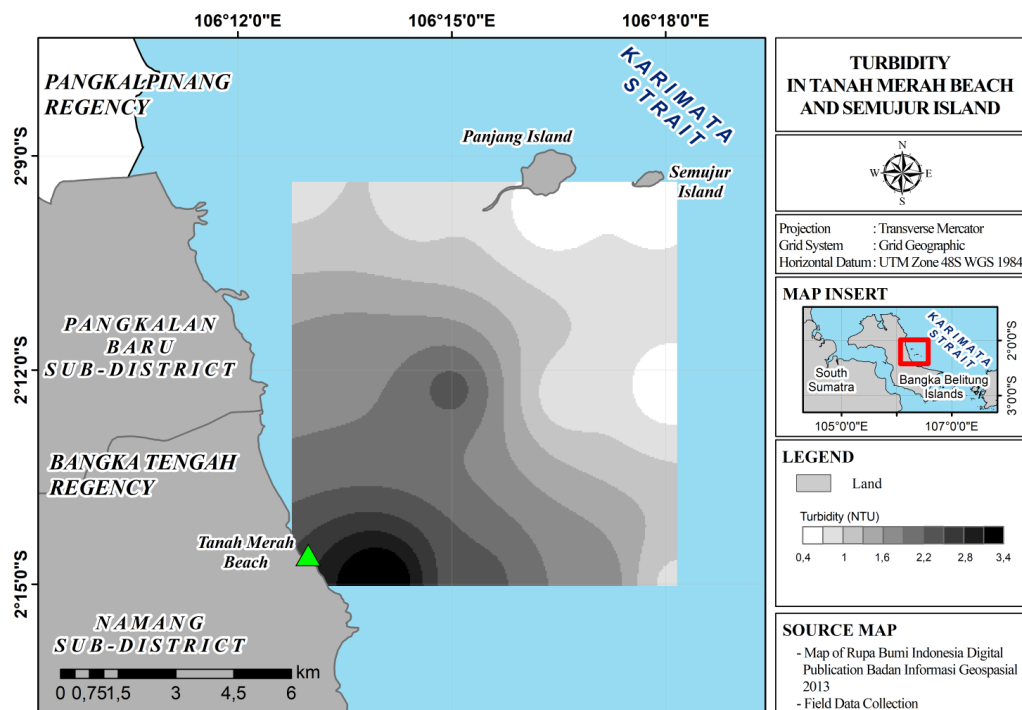
The results of salinity measurements in the study area ranged from 28-32 ppt, this value indicates normal conditions following the natural characteristics of marine waters [21]. This is following previous research conducted by [11], that the salinity value in Bangka waters has an average of 32.67 ppt, and salinity in the surface layer ranges from 29.54-31.46 PSU [12]. Changes in salinity levels are caused by the movement of freshwater through the process of rain and evaporation. seawater which can maintain the stability of the pH of seawater. The high pH value is probably caused by the presence of alkaline substances which are mostly contained in tin ore carrier sand [12, 22]. The results of measurements of water turbidity in the study area ranged from 0.4-3.4 NTU (table 1), the results of this measurement are still below the set seawater quality standards, high values are found at research stations that are close to tin mining activities, namely Tanah Merah beach (1.8-3.4 NTU), (Figure 1). The value of water turbidity

in Semujur island is relatively low, between 0.4-0.8 NTU, because it is located quite far from the source of pollutants, namely tin (Sn) mining activities, where sea sand mining is an activity that has the potential to cause increased turbidity (Figure 2) [23].

**Table 1.** Water quality measurements in two research locations

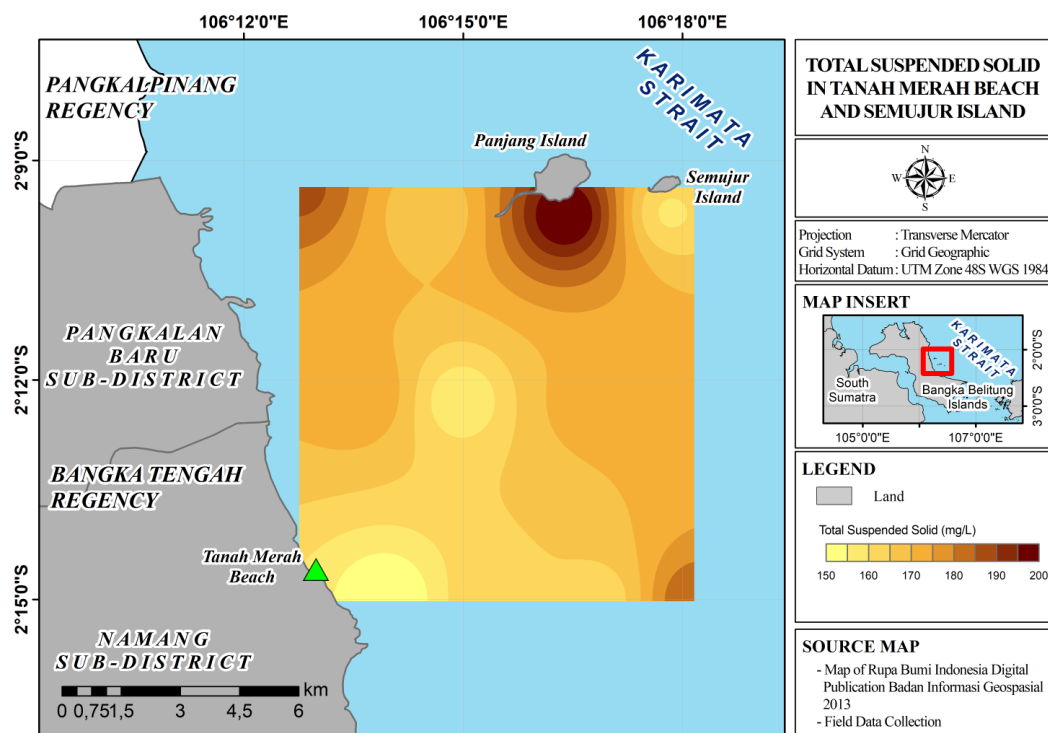
Parameter	Stations												
	1	2	3	4	5	6	7	8	9	10	11	12	QS
Current velocity (m/s)	0.14	0.21	0.19	0.19	0.21	0.14	0.19	0.30	0.22	0.24	0.32	0.21	-
Temperature ( $^{\circ}\text{C}$ )	31	29	29	29	29	28	31	29	27	29	28	28	Natural
Salinity (ppt)	31	32	32	32	29	28	34	31	32	31	30	30	Natural
pH	8.49	8.52	8.4	8.54	8.5	8.44	8.4	8.52	8.4	8.4	8.4	8.5	7-8.5
Turbidity (NTU)	3.4	2.2	1.8	0.8	1.8	2.2	0.7	0.4	0.8	0.8	0.4	0.5	5.0
Total Suspended Solid (mg/l)	149	163	162	185	175	155	172	173	187	165	202	159	0.015
Logam Pb (mg/l)	0.09	0.06	0.06	0.05	0.05	0.04	0.07	0.10	0.14	0.12	0.14	0.14	0.008
Logam Cu (mg/l)	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.008

\* Description: QS = Quality Standards are based on the decision of the Minister of Environment of the Republic of Indonesia Number 51 of 2004 for marine organism (biota) life.



**Figure 2.** Turbidity value in Tanah Merah waters and Semujur island waters

Tin mining is the largest source of regional revenue (PAD) for the Bangka Regency with natural resource potential with abundant tin mineral content [24]. Tin (Sn) mining activities which cause the water to become cloudy due to tailings slurry, damage to the seabed soil structure, and damage to the sea. Offshore mining degrades air quality, alters the seabed causing changes in biodiversity, and increases the mortality of coral reefs and the fish associated with them [25]. The results of the total suspended solids measurement in the study area ranged from 149-202 mg/l (Figure 3). The range of total suspended solids measured in the study area was very high because it had exceeded the set seawater quality standards [26] namely 0.015 mg/l. High values were obtained in the waters of Semujur island (165-202 mg/l) compared to values measured in locations close to tin (Sn) mining, Tanah Merah beach ranged from (149-185 mg/l). The high value of suspended solids in the location far from the source of pollutants (tin mining activities) indicates that the role of the current is very dominant and influences the distribution material, as indicated by the measured current velocity in the location of the Semujur island waters which is much higher at Tanah Merah beach waters, which ranges from 0.21 to 0.32 m/s (table 1). Seawater circulation is applied by the monsoon wind system [27, 28].

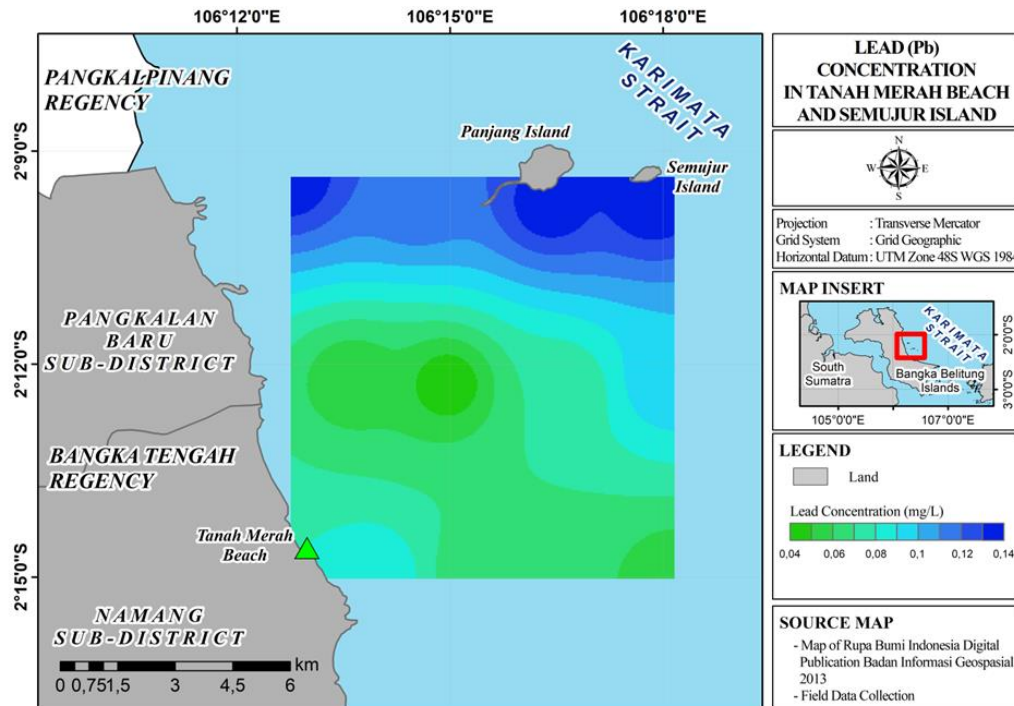


**Figure 3.** Total Suspended Solids Value in Tanah Merah waters and Semujur island waters

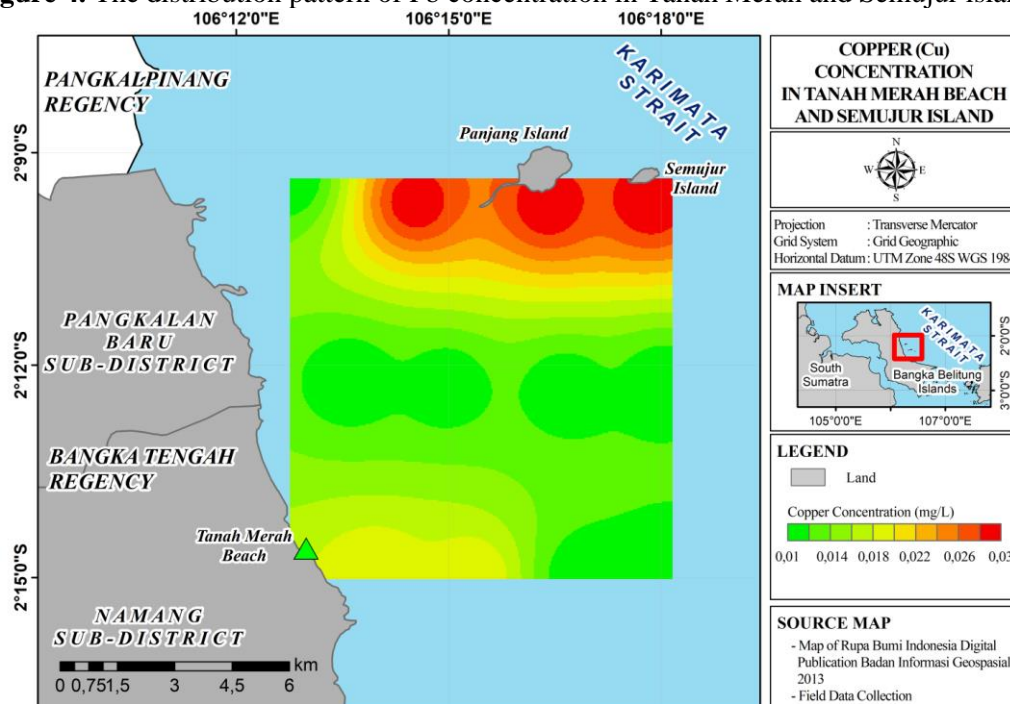
Tidal movements will be dominant in the spread of total suspended solid (TSS) in waters [29] which are complemented by other supporting factors such as longshore currents, waves, and so on [30]. Important currents in both dissolved and suspended matter [31] include oceanic plankton. The stronger the currents that are formed, the farther the ocean matter is distributed. The current velocity measurement value in the waters of the whole island is quite strong because the measurement speed is 0.5 m/s. Research [30] explains that the current velocity in the Bangka Sea in the West monsoon tends to be higher than the East monsoon. The current speed in the Bangka Sea ranges from 0.3 m/s. Ocean currents are said to be strong/very strong if the value is 0.5 m/s. The measurement results of Pb metal measurement in the study area showed a fairly high number, ranging from 0.04-0.14 mg/l (Table 1) because it exceeded the set seawater quality standards, namely 0.008 mg/l (Table 1) [26]. High Pb heavy metal values were found at sampling locations close to the waters of Semujur Island, which were



between 0.12-0.14 mg/l compared to locations close to Tanah Merah beach waters, namely 0.05-0.09 mg/l (Figure 4). The high concentration of Pb in the waters of Semujur Island is also the same as the result of the measurement of suspended solids. This shows that heavy metal Pb is very effective at being bound by suspended solids with a fine texture or sediment fraction. Suspended Solid (SS) are solid materials, such as inorganic and organic materials (clays and clays) that directly affect life [32, 33].



**Figure 4.** The distribution pattern of Pb concentration in Tanah Merah and Semujur islands



**Figure 5.** The distribution pattern of Cu concentration in Tanah Merah and Semujur islands

Fine sediment fractions such as clay, mud, or fine mud are very effective at binding organic matter, nutrients, and heavy metal pollutants in the water. The results of Cu metal measurements in the study area ranged from 0.01-0.03 mg/l (Table 1). The high concentration of Cu was the same as the measurement of Pb, namely in locations close to the waters of Semujur island, which was 0.03 mg/l, while on the beach of Tanah Merah it was lower, namely 0.02 mg/l (Figure 5). The concentration and composition of the heavy metal are controlled and controlled by local activities [34-36] in this study, local tin mining activities. As with South African research, mining activities are a major source of environmental pollution [37].

#### 4. Conclusion

The results of this study can be considered as follows:

1. The value of air turbidity in Tanah Merah beach waters is higher than that of Semujur island waters, on the other hand, the TSS value is lower.
2. The heavy metal concentrations of lead (Pb) and copper (Cu) in Tanah Merah beach waters are lower than in Semujur island waters.
3. The high concentration of lead (Pb) and copper (Cu) heavy metals in the waters of Semujur island was also followed by an increase in the value of Total Suspended Solids. The current velocity affects the distribution of the concentration of heavy metals and total solids suspended in the waters of Semujur island.

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