ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Heavy Metal Content On Sediments Seawater Around Tanjung Jati Power Plant in Jepara District, Central Java Province, Indonesia.

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ABSTRACT

Steam Power Plant Tanjung Jati B, administratively located in the area Tubanan-Flower, Jepara, Central Java province, bordering the waters of the Java Sea. Therefore the quality of marine waters Tanjung Jati become so important that it needs to be a study of the condition of these waters. This research was conducted by analyzing the heavy metal sediments with Atomic Absorption method Spectophometer. Sediment sampling carried out on a 4 point that SD.1 (sediments on the plan dumping area), SD.2 (sediment dredging area on the plan), SD.3 (sediment on jetty existing area), SD.4 (sediments on the outfall existing area). Sediment analysis based on the results of the Sea, known to some parameters such as Chrome (Cr) mg / l 7.32 -12.97, Copper (Cu) mg / l 6.98 -11.04, Lead (Pb) mg / l 0.333 to 3 , 88, Mercury (Hg) mg / l <0.004 to 0.06, Nickel (Ni) mg / l from 3.77 to 5.44, Selenium (Se) mg / l 0.025 -0.089, Silver (Ag) mg / l 0.665 to 4.89, Zinc (Zn) mg / l 271 - 681, Iron (Fe) mg / l 13.632- 27 295, Titanium (Ti) <0.05 -382, Manganese (Mn) mg / l 359-489. The concentration of heavy metals contained in the sediment has a value that is below standard, but it may allow the process of bioaccumulation of heavy metal biomagnification dam and if it persists in the long term it feared could be harmful to marine ecosystems and the health of surrounding communities

Keywords: Heavy Metals, Marine, Sediment, Bioaccumulation, Biomagnification

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ISSN: 0975-8585

INTRODUCTION

Tajung Jati power plant is a coal-fired power plant projects are highly significant in supplying the electricity needs in Indonesia which is about 20% of the total requirement of electricity island of Java and Bali with coal as an energy source is expected to increase the carrying capacity of infrastructure in promoting economic development in Indonesia. [10]. The existence Tajungjati power plant in Jepara district has been able to boost the economy by encouraging the creation of employment opportunities, business opportunities and increased local revenues with an increase in per capita rose by 10%. [1] But in addition to a good impact, of course, each operating a project negative impact so that the necessary studies on the adverse effects of activities and critical operations power plant Tanjungjati, especially studies on ocean conditions and heavy metal content in marine waters around Tajung Jati. The fear is well-founded because the waste produced by the power plant industry Tanjungjati contain heavy metals which allows bio-concentration can lead in marine sediments occur that could ultimately lead bioaccumulation in organisms living jarigan marine waters and biomagnification in the food chain in the ecological system. [2] .

Analysis of the power plant fly ash waste is known to contain heavy metals Tanjungjati as follows Pb (lead) at 0.79 ppm and Cr (Chromium) of 0.67 ppm [11]. Heavy metals Chrome (Cr), Copper (Cu), Lead (Pb), Mercury (Hg) Selenium (Se) Silver (Ag), Zinc (Zn), Iron (Fe), Titanium (Ti), Manganese (Mn) is heavy metals are usually produced by industries that utilize coal as an energy source. Studies conducted in India showed that the concentrations of heavy metals (Fly Ash) is Nickel (Ni) 77.6 ppm, Cadmium (Cd) 3.4 ppm, antimony (Sb) 4.5 ppm, arsenic (As) 43.4 ppm, Chromium (Cr) 136 ppm and Lead (Pb) 56 ppm [13].

Heavy metal is a chemical compound that is very difficult pesisten and degraded naturally, so as to disturb the balance of marine ecosystems. Genesis pollution in the bay of Minamata caused by exposure to heavy metal mercury is a very valuable lesson and shown to cause ecological disruption and cause disease in people around, even menimbukan genetic disorders caused by exposure to heavy metals in the long term. Assessment and monitoring system of heavy metals atropogenik an activity to be an important for the ecological balance that will come, and the metal bioaccumulation in the sediment [2,5]. Mercury is a heavy metal which can be decomposed into methylmercury and can cause genetic changes in the structure of human DNA, therefore merkury very dangerous. Mercury will experience biokonsnetrasi in soil and sediment so that it can undergo bioaccumulation and biomagnification. Similarly, the chromium that can accumulate in other waters, by the oxidation reduction cromiim namely in the form of Cr III and Cr IV. Chromium III can undergo biomagnification and inhibit metalloenzyme system, whereas Cr (VI) is poisonous and can be magnifications especially in marine waters. (8.9) bioaccumulative properties of heavy metals is possible because of the lipophilic nature of the heavy metals are quite high and depends on factors biaccumulation (Cowgill, 1976 EPA), addressing speed bioaccumulation factor of heavy metals as follows Iron (Fe) < Lead (Pb) < Mercury (Hg) < Manganese (Mn) < Chrome (Cr) < Selenium (Se) < Silver (Ag) [12]

MATERIAL AND METHODS

Water and Sediment Sample Collection:

The average air temperature in the waters around the study area has a range of 25 to 29.5 ° C. the air temperature does not have a significant change in wind direction dg dominanadalah from the East is as much as 41.3%, the second dominant direction of Northwestern as much as 22.9%. Speed is the most dominant of 2-4 knots as much as 55% and the average speed on the dominant direction of 3.67 knots, the stability of the atmosphere is a class F (stable).

The sampling was conducted at four sampling points as follows: SD.1 (sediments on the plan dumping area), coordinates 6°23'55,82 ", SD.2 (sediment dredging area on the plan), coordinates 6 ° 25'59,69" , SD.3 (Sediment on Jetty Existing Area), coordinates 6°26'25,50 ", SD.4 (sediments on the outfall existing area), coordinates 110°44'57,00" 6 ° 26'28,80 "

Sediments were sampled from the bottom marine waters by using a grab sampler and packed in black polythene bag. All the samples were kept in ice-box, brought to the laboratory and stored at -4 ° C before performing heavy metal analyzes. The psychohydrochemical properties such as pH, salinity and temperature were measured at the time of collection samples but were not presentedin this study. Figure 1, shows the sediment sampling points, as follows:

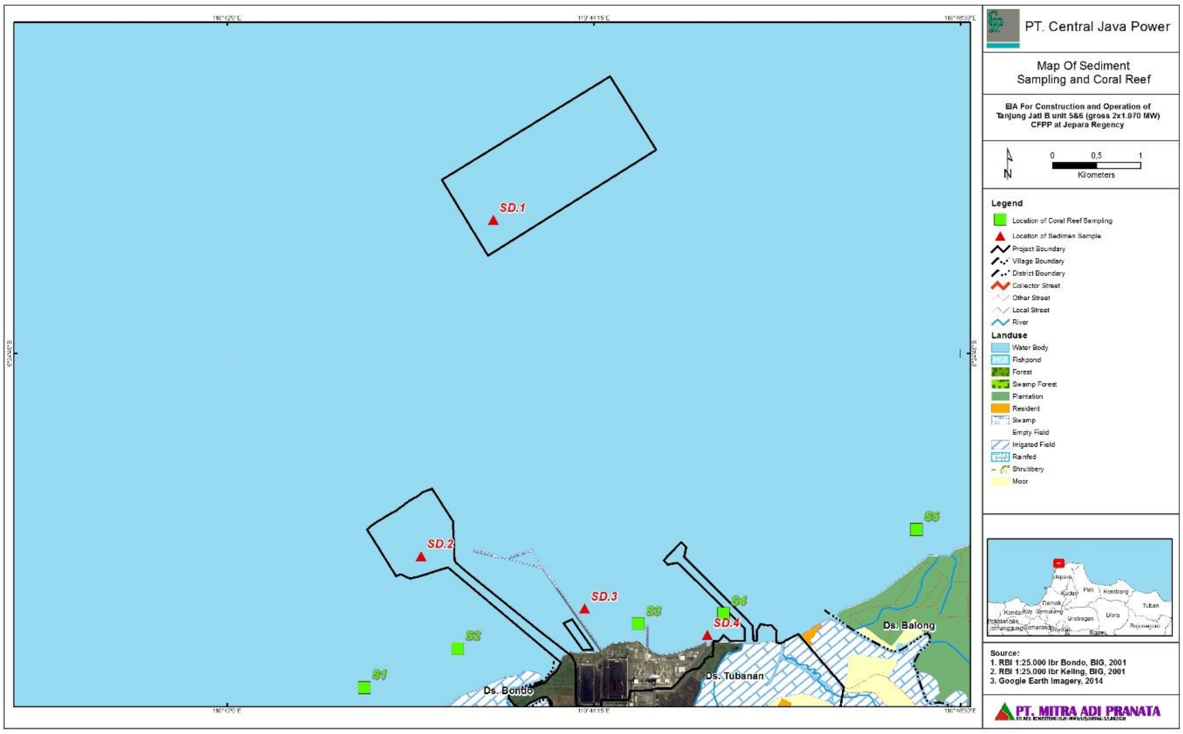

Figure 1. Sampling Point Marine Sediments and Coral reefs Around Steam Power Tanjung Jati

Sample extraction

Identification of pesticide in quantity made based on standard operating procedures for water sampling methods and analysis [3]. One hundred milliliter of water sample was transferred into a 500 mL separatory funnel, added 5 mg NaCl powder and pH measured. A 50 mL n-heksana was added to the sample and shaken for 10 min. The sample was allowed to settle for 30 min to enhance separation of two phases. The upper organic layer was collected in 300 mL Erlenmeyer flasks, while the lower aqueous layer was transferred into a 500 mL separatory funnel. The extractions were repeated two times using 50 mL n-hexane. The upper organic phase was cleaned by adding 100 mL purified water and shaken for 3 min. The sample was allowed to settle to enhance separation of two phases and then discarded the lower aqueous layer. The extractions were repeated two times using 100 mL purified water. The extracts were added with 5 mg anhydrous sodium sulphate and concentrated to about 1 mL using a vacuumrotary evaporator operating at 25 rpm and temperature of 35°C. The sediment samples were dried up on room temperature in the lab, grinded by mortar-pestle and sieved with 2 mm sieve pore. Twenty gram sediment samples were placed in 250 mLErlenmeyer flask, added with 40 mL acetone and shaked for 30 min. After separation was achieved, the extracts were decanted. The sediments were reextracted for twice. The extracts wereconcentrated to about 30 mL using a vacuum rotary evaporator operating at 25 rpm andtemperature of 35°C. The extracts were added with 100 mL 10% NaCl and 50 mL n-hexane, shaken for 20 min. The sample was allowed to settle to enhance separation of two phases and decanted the lower aqueous layer into 250 mL separated funnel. The following procedure was similar to the water sample procedure above mentioned except the final results of concentrated extracts were5 mL.Each of the crude extracts was then dissolved in 10 mL hexane and were cleaned by passing through chromatographic column that filled by florisil and anhydrous sodium sulphate. The cleanextracts were concentrated on a rotary evaporator to approximately 2 mL [3,4]

Atomic Absorption Spectophometer

The tools used to detect heavy metal AAS Varian Spectra AA 220FS Analytical Instruments equipped. Standard solution / standard solution is a solution whose concentration is already known as a measuring tool titrant volume standard solution. The solution to be specified concentration or levels, measured in volume using volumetric pipette and placed in Erlenmeyer. [3,4]

Standard solution Chrome (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag), Zinc (Zn), Iron (Fe), Titanium (Ti), Manganese (Mn) of 100 mg / L were made into 10 mg / L in 100 ml of solution. Then create standard solutions from a solution of heavy metals measured 10 ppm at a concentration of 0.2; 0.4; 0.6; 0.8 and 1 mg / L which was diluted with nitric acid. The standard dilution of heavy metals (Chrome, Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag), Zinc (Zn), Iron (Fe), Titanium (Ti), Manganese (Mn)) and samples containing heavy metals Chrome, Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag), Zinc (Zn), Iron (Fe), titanium (Ti), Manganese (Mn), measured absorbansnya by absorbance versus concentration calibration curve by using the linear regression equation, so that can know the result. "[4]

RESULTS AND DISCUSSION

The concentration of heavy metals in sediment Tanjungjati marine waters is due to the activity Tanjung Jati which has been operating since 1997, and will be expanded to Tanjung Jati B Power Plant Units 5 & 6 start in 2016. Therefore, the results of this analysis can show the current conditions and predictions marine sediment quality forthcoming. Table 1 shows the results of analysis of marine sediments in the waters around the Tanjung Jati Jepara

Tabel 1. Result Analysis of Sea Sediments in the waters around the Tanjung Jati Jepara

METAL	Result of Detection				Threshold Effect Concentration	Reff.
	SD1	SD2	SD3	SD4		
Chrome (Cr) mg/l	7,32	9,88	12,97	9,54	43,00	NOAA (1991)
Copper (Cu) mg/l	6,98	9,84	11,04	10,36	32,00	CBSQG (2000)
Lead (Pb) mg/l	3,88	2,6	2,27	0,333	36,00	CBSQG (2000)
Mercury (Hg) mg/l	0,06	0,029	<0,004	0,003	0,18	CBSQG (2000)
Nickel (Ni) mg/l	4,88	5,44	5,01	3,77	23,00	CBSQG (2000)
Selenium (Se) mg/l	0,089	0,058	0,025	0,033	5,00	CBSQG (2000)
Silver (Ag) mg/l	1,07	0,578	4,89	0,665	1,60	CBSQG (2000)
Zinc (Zn) mg/l	681	271	566	288	120,00	CBSQG (2000)
Iron (Fe) mg/l	27.295	13632	16753	17102	20.000,00	Ontario (1993)
Titanium (Ti)	139	<0,05	<0,05	382	-	-
Manganese (Mn) mg/l	359	426	489	463	460,00	Ontario (1993)

(Source: primary data)

1. NOAA (1991) = Long, E.R. and L.G. Morgan. 1991. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration. Seattle, Washington.
2. CBSQG (2000a) = MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000a. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39:20-31.
3. Ontario (1993) = Persaud, D.R., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediments in Ontario. Standards Development Branch. Ontario Ministry of Environment and Energy. Toronto, Canada.

Results of analysis of heavy metals marine sediments around Tanjung Jati addressing is still below the standard limit is like Chrome (Cr) mg / l 7.32 -12.97, Copper (Cu) mg / l 6.98 -11.04, Lead (Pb) mg / l 0.333 to 3.88, Mercury (Hg) mg / l <0.004 to 0.06, Nickel (Ni) mg / l from 3.77 to 5.44, Selenium (Se) mg / l 0,025 - 0.089, Silver (Ag) mg / l 0.665 to 4.89, Zinc (Zn) mg / l 271 -681, Iron (Fe) mg / l 13.632- 27 295, Titanium (Ti) <0.05 -382, Manganese (Mn) mg / l 359-489 determined by standard NOAA (1991) CBSQG (2000a) Ontario

(1993), except kensentrasi Fe (iron) 27 295 (SD1) with 20.000 standard. This is because the area of iron sands producer, especially the Monggo. Despite all the heavy metals were detected below the standard limit but concerns terjadinnya bioakulmulasi and biomagnification should form the major concern.

Bioaccumulation is an ongoing process of accumulation of biologically where heavy metals are concentrated in the sediment presisten very difficult to be degraded naturally this causes heavy metals easily absorbed by organisms that live in marine sediments and accumulate in tissues tubuhnnya. Heavy metal that accumulates then through the food web in marine ecosystems caused in the process of biomagnification predator hereinafter. The concentration of heavy metals in accordance with the higher trophic levels in the food web. West metals dissolved in water and sediments tend to form complexes with organic and inorganic ligands. Inorganic metal complex compounds vary substantially in terms of bioavailability with marine organisms. Beedasarkan research conducted by Fisher showed that there is a direct correlation between the level of the metal solubility in seawater in the process of phytoplankton bioavailability and toxicity. [14]. Heavy metal compounds in marine sediments in the form of organic and inorganic vary with the nature will undergo a process of bioconcentration, forming adsorption bond with other chemical compounds that selautnya will be absorbed by the sea orgnisme either directly or indirectly. [5]

Heavy metals Mekuri (Hg) in nature will break down into elements Hg0, MgCl2, H3C-Hg-CH3 and monomethyl mercury (ClHg-CH3), compounds organic mercury significantly are more toxic than inorganic mercury while mercury inorganic lipophilic be methylated by micro-organisms and will accumulate through the food chain [19]. Heavy metal pollution of marine waters arsenic measured by percentage and efficient arsenic. Bioaccumulation arsenic become arsenobetaine in the form of arsenic in mussels Mytilus edulis, as follows arsenate <2 ng / g, arsenite <2 ng / g monomethylarsonic <2 ng / g dimethylarsonic <2 ng / g, dimethylarsene <2 ng / g, trimethylarsoniobutyrate 6 ng / g, tetramethylarsimun ion 8 ng / g, choline arsenio 30 ng / g, trimethylarsediopropionat 65 ng / g and arseniobetain 100 ng / g, while the efficiency of the food chain bioaccumulation of mercury based on inorganic mercury 0.0005 ng / g (ɱ / m 3) in water, inorganic mercury sediments to 200 ng / g, inorganic mercury in fish 1000 ng / g and inorganic mercury in dolphin 5000 ng / g, indicating a process of bioaccumulation in the chain of food webs [19]. Therefore the heavy metal pollution in marine waters, especially in the sediment should be a great concern especially by stakeholders who issuing rules and regulations marine waters.

Effect Of Temperature

Sea water temperatures measured in the region of the action plan TJB Power Plant Units 5 & 6 around 28.7 to 31.1°C. Water temperature affects the oxygen content in the water (Oxygen Level to be low if the temperature increases); speed photosynthesis by aquatic plants; the metabolic rate of aquatic organisms; and the sensitivity of organisms to toxic materials is increasing, this leads to the absorption of heavy metals by organisms in the sediment of the higher [14, 19].

Parameter temperature significantly affects linearly increasing the percentage bioabsorsi cobalt, cadmium, and zinc in organisms [21]. This shows that the increase in temperature increases the decomposition rate of organic cause dissolved oxygen content in the water to be reduced because the oxygen will be used mainly for the oxidation of organic matter. This causes the water becomes less good quality and biodiversity of organisms to be reduced. Optimum absorption process at a temperature of 40 ° C ([20].

Effect of pH (Potential of Hydrogen)

Based on the results of measurements of pH or acidity of the seawater in the waters around the power plant plan (about 7.9 to 8.1), which means that when compared to the quality standards they meet quality standards in place (6.5 to 8.5) and including the normal category, but if it lasts a long time will be more acidic pH which is made possible due to the nitrification process organic matter decomposition process results through biochemical processes. Metal toxicity affects linearly with heavy metal toxicity, the more acidic the waters of a condition of a heavy metal toxicity will be more toxic [15]

Supporting research carried out in analyzing the environmental status of the waters around Tanjung Jati by analyzing bio-indicator of coral reefs, as follows:

Analysis Of Coral Reef Damage

The study also analyzed the damage to marine damage Damage Coral Sea waters as bio-indicators. The results of the survey of coral reef ecosystems in the area around the power plant Tanjung Jati identity shows that 4 point dive location is not found their coral reef ecosystems. The coral observations made by the method of direct observation with a dive at the following coordinates S1 (Coral Reef monitoring sampling points) = 6°26'48.09"S 110° 42'50.55"T, S2 = 6°26'33.70"S 110°43'24.98"T, S3 = 6°26'24.54"S 110°44'31.53"T, S4 = 6°26'20.88"S 110°45'2.91"T, S4 = 6°25'49.83"S 110°46'14.03"T. At one station in the form of cover rock bottom waters amounted to 26.60%, and silt as much as 70.70%. Organisms found in station 1 is Crinoids, Gorgonian and Sponge. The condition of these organisms found in the percent cover is low at respectively 1.90%, 0.30% and 0.5% Sponge, While at the station 2, cover in the form of rock bottom waters (4.50%), rubble (6.60%), sand (49.4%) and silt (36, 95%). Organisms found at station 2 is Gorgonian, Aglaophenia, and Sponge each with a cover of 0.20%, 1.45% and 0.90%. At the station 3. Rock, Rubble and Silt each with an area of forest cover amounted to 8.90%, 0.70% and 89.30%. Organisms found in the station 3 is Gorgonian and Sponge each covering some 0.50% 0.40% dam. At the station 4. Rock, Rubble and Silt, each covering some 11.50%, 0.50% and 87.00%. Organisms that exist in this location is crinoids and Gorgonian each covering some 0.7% and 0.3%. At station 5 There are bottom waters cover Rock, Rubble and Silt each with an area of forest cover 3.65%, 1.75% and 92.30%. Organisms that exist in this location is Bulu Ayam (Aglaophenia) and Sponge each with an area of forest cover amounted to 2.15% and 0.15.%. Based on this analysis, the environmental quality criteria including polluted category. (16)

Table 2. Results a Survey of The Seabed Around The Compiler Structure Tanjung Jati

No	Type	St 1		St2		St 3		St 4		St 5	
		P(cm)	C (%)	P(cm)	C (%)	P(cm)	C (%)	P(cm)	C (%)	P(cm)	C (%)
1	Crinoid	190,00	1,90			10,00	0,10	70,00	0,70		
2	Gorgonian	30,00	0,30	20,00	0,20	60,00	0,60	30,00	0,30		
3	Hydroid			145,00	0,15					215,00	2,15
4	Rock	2.660,00	26,60	450,00	4,50	890,00	8,90	1.150,00	11,50	365,00	3,65
5	Rubble			660,00	6,60	70,00	0,70	50,00	0,50	175,00	1,75
6	Sand			4.940,00	49,40						
7	Silt	7.070,00	70,70	3.695,00	36,95	8.930,00	89,30	8.700,00	87,00	9.230,00	92,30
8	Sponge	50,00	0,50	90,00	0,90	40,00	0,40			15,00	0,15
Total		10.000,00	100,00	10.000,00	100,00	10.000,00	100,00	10.000,00	100,00	10.000,00	100,00

(Source: primary data)

Coral reef ecosystems are productive ecosystems in coastal ecosystems. Coral reefs in about Tanjung Jati have the diversity that is not diverse and abundant coral reefs die, due to the amount of material disposition of solid material so katifitas photosynthesis reefs may be hampered (16)

CONCLUSION

Condition and concentration of heavy metals in sediments around the Java Sea waters operasiomnal power plant in Tanjung still below the standard limit. However, this is very important because heavy metals include compounds presisten and bioaccumulative and miomagnifikatif so if prolonged exposure to heavy metals will be permesalahn for the environment and human health. research support

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