International Journal of
Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

DOI: 10.31695/IJASRE.2020.33837

Volume 6, Issue 6
June - 2020

Implementation of the AAS and Wenner Geoelectric Test to determine the Plumbum (Pb) distribution in River Border of Kanal Banjir Barat Semarang, Indonesia

Danusaputro H[1], Suripin[2], Sasongko D.P.[3], Sutanto. H[3]

[1]Doctoral Program on Environmental Science, Diponegoro University, Indonesia

[2] Civil Engineering Department, Engineering Faculty of Diponegoro University, Semarang, Indonesia

[3]Physics Department, Science and Mathematics Faculty of Diponegoro University, Semarang, Indonesia

---

ABSTRACT

The establishment of industry in the area around the Kaligarang River causes environmental pollution, one of which is a heavy metal that is suspected to occur seepage on river banks. To find out the presence of heavy metals below the surface, a Wenner Configuration Geoelectric Method and AAS (Atomic Absorption Spectrophotometry) were used to determine the Pb heavy metal seepage using wells and residents' river water samples. Geoelectric data collection and AAS Tests were carried out in Tanah Mas (A) and Semarang Indah (B) areas. In each field A (Tanah Mas) and B (Semarang Indah) geoelectric measurements were made using the Wenner method with 3 parallel lines. The result, in field A the first lane to the third lane is predicted as clay with resistivity values between 0.00844 Ωm to 15.75 Ωm at a depth of 0.5 meters to 6.91 meters. Pollutants can be predicted with a low resistivity value, for track A pollutants are identified with resistivity values between 0.00844 44m to 2.21 21m. At location B, the first to third lanes are predicted as clay with resistivity values between 0.037 Ωm to 9.68 Ωm at a depth of 0.5 meters to 6.91 meters. Pollutants at location B were identified with resistivity values between 0.037 Ωm to 2.81 Ωm. Based on the AAS test that has been carried out at 8 points of water and river sampling locations, only two locations were obtained that showed the presence of Pb heavy metals, namely residents' well water at location A, point three and river water samples at location B with a concentration value of 0.030 mg / L and 0.072 mg / L, so it can be concluded that there is no Pb heavy metal seepage in the residential area.
***Key Words**: Kaligarang River, Resistivity, Wenner configuration, AAS test.*

---

1. INTRODUCTION

Kaligarang River is one of the rivers that play an important role in the city of Semarang and is used as raw material for drinking water [1]. Various kinds of activities that are located along the Kaligarang river such as the establishment of industries contribute to various pollutants carried into the Kaligarang river [2]. The negative impact caused by the establishment of the industry is the use of rivers as a means to dispose of industrial waste so that it will cause water pollution.

Environmental pollution occurs due to the entry or inclusion of living things, substances, energy and or other components into the environment and or changes in the environmental order by human activities, natural processes so that the quality decreases to a certain degree that causes the environment to become less or no longer able to function [3]

Pollution of rivers by production results will also cause poisoning in animals that live along streams and humans because waste that seeps into the soil contains substances that can damage the human body such as heavy metals [4]. This will create a concern for the surrounding communities who are in the area because the water quality standards also change.

Disposal of waste from industries located around the Kaligarang river causes pollution of several heavy metals, especially Pb. Lead (Pb) is a bluish-gray or silvery soft metal found in sulfite deposits which are mixed with other minerals, especially zinc and copper [5]. Bodies of water that have conceded Pb ions or compounds will cause the amount of Pb that exists will exceed the concentration causing death to the aquatic biota.

In the Semarang Indah and Tanah Mas areas there are wells owned by the community around the river flow where the water is used for daily activities such as bathing, and washing where the well water looks muddy and is feared by heavy Pb seepage into the community wells [6]. Based on the problems that have been described above it is necessary to do further research whether or not the waste seepage, especially Pb.

In this study using the resistivity method. This method aims to determine the nature of the flow of electricity in the earth by detecting it on the surface of the earth. This method is done by injecting an electric current to the ground surface through a pair of electrodes and measuring the potential difference with another pair of electrodes[7]. If an electric current is injected into a medium and its potential difference is measured, the resistance can be identified. Another supporting method used in this study is the AAS (Atomic Absorption Spectrophotometry) to determine the elements contained in water samples.

2. RESEARCH METHODS

2.1 Time and Place of Research

This research was carried out in stages in two locations, namely in the Madukoro area of Tawang Mas and Tanah Mas in the Panggung Lor sub-district, which had taken geoelectric data and water samples from 17 March - 30 March 2018. In the geoelectric study conducted at two locations using the Wenner configuration, each location was taken with three lines parallel to the total stretch of each location of 40 meters.

2.2 Geoelectric Method

The geoelectric method is a geophysical method that studies the nature of electricity in the earth and knows how to detect it on the surface of the earth. This method includes the measurement of currents, natural potential, or due to the injection of currents into the earth. The purpose of the geoelectric method is to determine the electrical and rock formation properties related to the ability to conduct or inhibit electricity. This method is widely used to obtain a picture of the structure of the soil beneath the surface. One method that is often used to measure electrical current is resistivity [8].

The working principle of the geoelectric method is to inject an electric current into the ground using a pair of electrodes and measure the potential difference using another pair of electrodes. If an electric current is injected into the medium and its potential difference value is known, the resistance value of the medium can be known [9].

2.3 Wenner configuration

The Wenner configuration resistivity geoelectric method is a geoelectric method that can be used for resistivity mapping and resistivity sounding. The difference with other configurations is that of the same Wenner distance electrode configuration. The measuring point of the Wenner configuration lies between the first potential electrode and the second potential electrode. This can be shown in Figure 2.1:

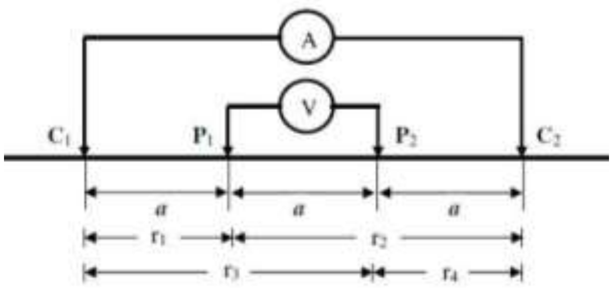

Figure 2.1: Wenner configuration

In the Wenner configuration, the distance of the potential electrode at P2 P2 is always 1/3 of the distance of the current electrode C1 and C2. If the distance of the current electrodes C1 and C2 are enlarged, the potential distance at

DOI: 10.31695/IJASRE.2020.33837

P1 and P2 is also enlarged, so that the distance at the potential electrode remains 1/3 of the distance of the current electrode. Wenner configuration has the advantage of accuracy in reading the electrode voltage P1 and P2 better by using relatively large numbers, this is because the electrodes P1 and P2 are relatively close to the electrodes C1 and C2, but cannot detect the homogeneity of rocks near the surface [10].

2.4 AAS (Atomic Absorption Spectrophotometry)

AAS (Atomic Absorption Spectrophotometry) or commonly known as Atomic Absorption Spectrophotometer is an analytical method for determining metal and metalloid elements whose measurements are based on the absorption of light of a certain wavelength by metal atoms in a free state. This method can be applied appropriately to analyze substances at low concentrations and is usually used to quantitatively analyze metal elements in solution. This way of analysis will be the total content of metal elements in the sample. In the analysis of certain metals can be done in a mixture with other metal elements without separation [11].
The working principle of this AAS method is based on the absorption of light by atoms, the atoms will absorb the light at certain wavelengths in their elemental properties. When the atoms of an element in the ground state are subjected to radiation, the atoms will absorb energy so that the electrons in the outer shell rise to a higher energy level or in this state commonly called excited and emit light [12]. Atoms in the sample will absorb some of the light from the light source. The amount of this absorption depends on the specific wavelength according to the energy needed. For Lead metal (Pb) it will absorb energy at wavelength 217 nm [13].

3. RESULTS AND DISCUSSION

Geoelectric data retrieval is done using the number of n as much as 6 with a spacing between the electrodes of 2 m and between the 5 m line. The limited use of the track is due to the narrow field conditions and the extension of the track is not possible, and only the cross-sectional area below the surface can be known about 7 m. The location of this research was conducted in two locations, namely Tanah Mas (A) and Semarang Indah (B). In each path to differentiate it is numbered 1,2, and 3 so that it can be used as a numbering line at locations A and B.
In a previous study conducted by Danusaputro in 2016 [14] with the identification of liquid waste seepage in Petompon settlement land using the dipole-dipole configuration geoelectric method, it can be seen that pollutants have a low resistivity value.

Geoelectric Test Results:

1. Measurement in Tanah Mas area (Location A)

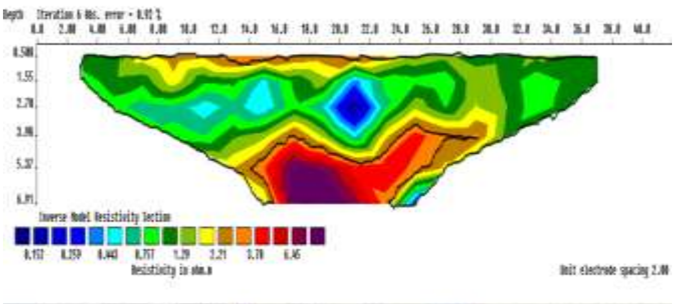

Figure 3.1: Section A1 of resistivity

Fig 3.1, on track A1 the rock that dominates is clay with resistivity values between 0.152 Ωm to 6.45 Ωm at a depth of 0.5 meters to 6.91 meters. Pollutants were identified with resistivity values between 0.152 Ωm to 2.21 Ωm.

DOI: 10.31695/IJASRE.2020.33837

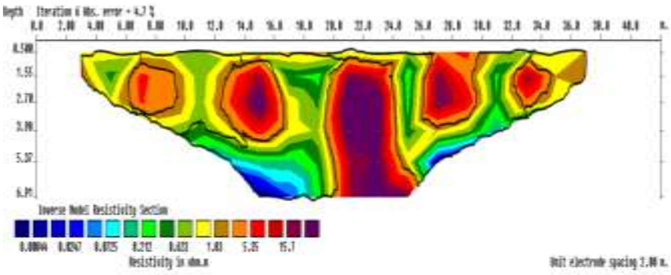

Figure 3.2: A2 resistivity section

Fig 3.2, at A2 path the dominant rock is clay with resistivity values between 0.00844 Ωm to 15.7 Ωm, located at a depth of 0.5 meters to 6.91 meters. Pollutants were identified with resistivity values 0.0084 84m to 1.83 Ωm.

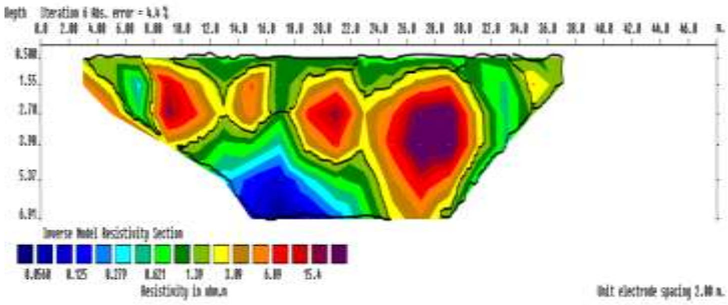

Figure 3.3: A3 resistivity section

Fig 3.3, at A3 track the rocks that dominate at this track are clays at resistivity between 0.0560 Ωm to 15.4 Ωm with a depth of 0.5 meters to 6.91 meters. Pollutants were identified with resistivity values of 0.0560 µm to 1.39 µm

2. Measurement in the Semarang Indah area (Location B)

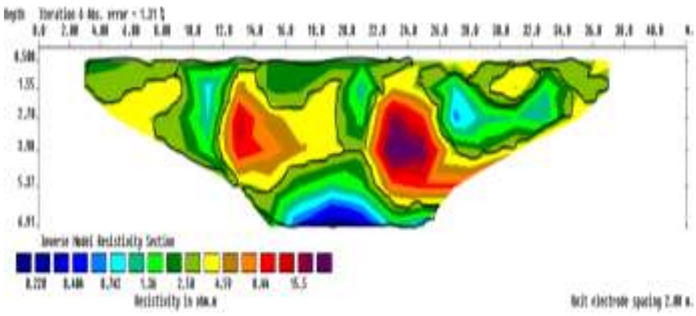

Figure 3.4: Cross-section of resistivity B1

Fig 3.4, at the B1 path the dominant rock is clay with resistivity values between 0.220 Ωm to 15.5 Ωm at a depth of 0.5 meters to 6.91 meters. Pollutants were identified with resistivity values of 0.020 µm to 2.54 µm.

DOI: 10.31695/IJASRE.2020.33837

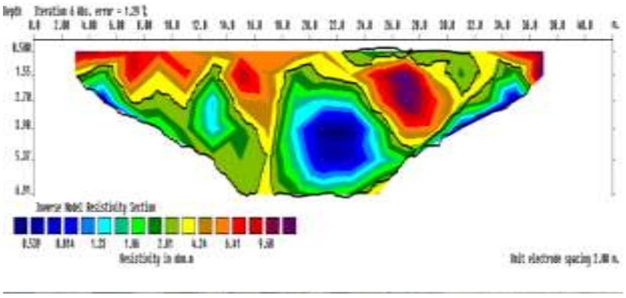

Figure 3.5: B2 resistivity section

Fig 3.5, in path B2 the dominant rock in this path is clay with resistivity values between 0.539 Ωm to 9.68 Ωm with a depth of 0.5 meters to 6.91 meters. Pollutants were identified with resistivity values of 0.539 Ωm to 2.81 Ωm.

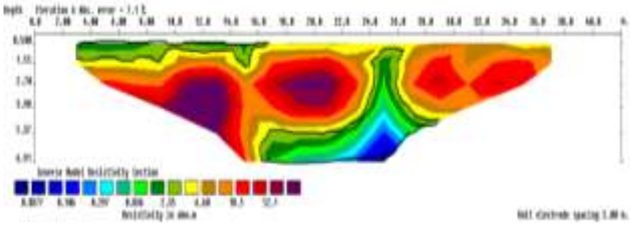

Figure 3.6: Cross-section of B3 resistivity

Fig 3.6, on the B3 path, the dominant rock is clay with resistivity values between 0.037 Ω to 6.60 Ωm at a depth of 0.5 meters to 2.5 meters. Pollutants were identified with resistivity values of 0.037 Ωm to 2.35 Ωm.

3. Cross-section Correlation

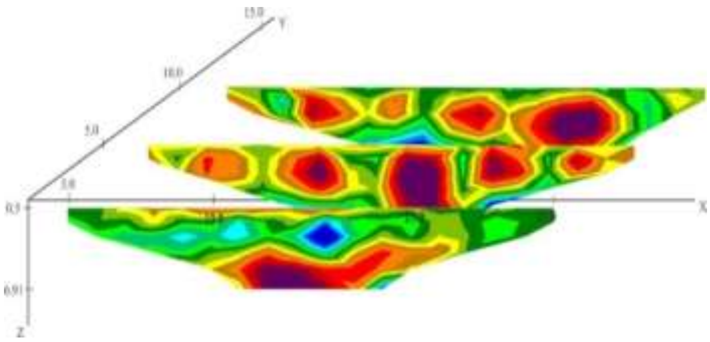

Figure 3.7: Correlation of cross-section A

Fig 3.7, research conducted at location A can be concluded that the distribution of pollutants occurs at a depth of 0.5 meters to 6.91 meters with a stretch that varies from a stretch of 3 meters to 37 meters, these pollutants are colored in blue, green, and yellow.

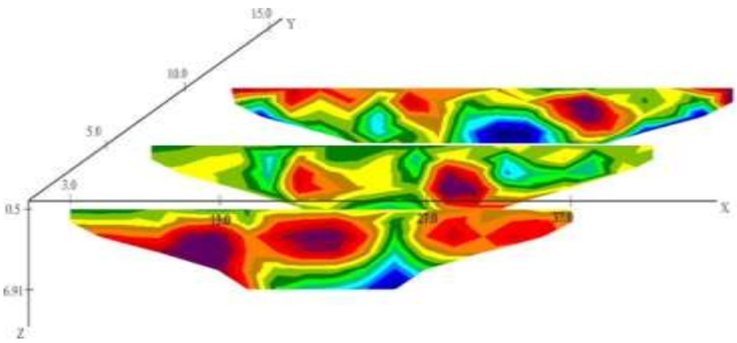

Figure 3.8: Correlation of cross-section path B

DOI: 10.31695/IJASRE.2020.33837

Fig 3.8, research conducted at location B, it can be concluded that the distribution of pollutants occurs at a depth of 0.5 meters to 6.91 meters with a stretch of 3 meters to 36 meters, these pollutants are marked in blue and green.

Based on geoelectric research that has been shown in the cross-section of the resistivity at the study site, it is generally clay rock. Pollutants were detected at all study sites with a depth of between 0.5 meters to 6.91 meters

AAS Test Results

Table 3.1. Pb Heavy Metal Concentration

Location	Concentration (mg / L)
River A	-0, 074
Well A1	-0,038
Well A2	-0,088
Well A3	0.030
River B	0.073
Well B1	-0,060
Well B2	-0,060
Well B3	-0,064

Based on the AAS test (Table 3.1) that has been done the minus sign which is at the metal concentration shows zero or no heavy metal contained, while the positive sign indicates the presence of heavy metal content in water samples [15]. In 8 locations of water sampling, only 2 points were detected for the presence of Pb heavy metals, namely the third well (A3) located in the Tanah Mas area with a concentration value of 0.0030 mg / L and the river located in the Semarang Indah area (B) with a concentration value of 0.073 mg / L.

4. CONCLUSION

Based on the interpretation of the resistivity cross-section, areas containing heavy metals at the study site are on all trajectories both in Tanah Mas and Semarang Indah with depths from 0.5 meters to 6.91 meters. There were only 2 AAS tests at 8 sampling locations that identified Pb heavy metals at the study site, so it can be concluded that pollutants carrying Pb did not seep into the well.

ACKNOWLEDGMENT

The author would like to thank the PPLH Center for Environmental Research Diponegoro University for providing input so that this research can be completed.

REFERENCES

[1] Sastrawijaya, A.Tresna, 2000, Environmental Pollution, PT Rineka Cipta, Jakarta

[2] Suharto, 2005, Impact of Lead Metal (Pb) Pollution on Health. Society of Indonesian Health Magazine No.165 / Nty, Airlangga University, Surabaya

[3] Danusaputro, H., Sutanto, H., Rahmawati, T., 2017, Identification of the Distribution of Pollutants with the Resistivity Method of Dipole-Dipole Configuration at the Area of Kaligarang River Central Java, Advanced Science Letters Vol. 23, pp: 6609–6612

[4] Law No. 32 of 2009 concerning Environmental Protection and Management

[5] Wastewater quality standard in Presidential Regulation Number 16 of 2015 concerning the Ministry of Environment and Forestry.

DOI: 10.31695/IJASRE.2020.33837

[6] Morais, F., 2012, Study of Flow in Vadose Zone From Electrical Resistivity Surveys, Journal of Sociedade Brasileira de Geofisica.Vol.26 pp: 115-122

[7] Telford, WM, Sheriff, RE, Geldart, LP, 1990, Applied Geophysics, 2nd edn., Cambridge University Press, New York Loke, MH, Chambers, JE, Rucker, DF, Kuras, O., and Wilkinson, PB, 2013, Recent Developments in The Direct-Current Geoelectrical Imaging Method, Journal of Applied Geophysics. 95 pp: 135-156.

[8] Douglas, U.S., Donald M.W., Holler, F.J., 2004. Fundamentals of Analytical Chemistry Eight Edition. Canada. Brooks / Cole

[9] Loke, M.H., Chambers, J.E., Rucker, D.F., Kuras, O., and Wilkinson, P.B., 2013, Recent Developments in The Direct-Current Geoelectrical Imaging Method, Journal of Applied Geophysics. 95 pp: 135-156.

[10] Windarto J., Pawitan H., Suripin., And Januar J.P., 2008, High Prediction Model of the Semarang Kaligarang River Water Surface with Artificial Neural Networks, Technique Vol 29 No.3 ISSN 0852-1697 pages 189-195.

[11] Tareen, AK, Imrana Niaz Sultan, IN, Pramuk Parakulsuksatid, P., Shafi, M., Khan, A., Mohammad Waseem Khan, MW, Hussain, S., 2014, Detection of heavy metals (Pb, Sb, Al, As) through atomic absorption spectroscopy from drinking water of the Pishin District, Balochistan, Pakistan, International Journal of Current Microbiology and Applied Science vol 3 (1) pp: 299-308

[12] Li, X., Yu, H., He, Z, 2015, Pollution Characteristics of Mineral Resource Exploitation based on Geochemical Analysis - A Case Study of a Mining Area in Yalong River Watershed, EJGE Vol. 20 [2015], Bund. 15 pp: 6445-6457

[13] Grygar, TM, J. Elznicová, J., Tůmová, S., Faměra, M, Balogh, M., Kiss, T., 2016, Floodplain Architecture of an actively meandering river (the Ploučnice River, the Czech Republic) as revealed by the distribution of pollution and electrical resistivity tomography

[14] Nabeel F., Warnana D.D., and Bahri U.S., 2013, Phosphate Distribution Analysis Using the Wenner-Schlumberger Configuration Geoelectric Method: Case Study of Saronggi, Madura, Journal of Science and Arts Pomits. 2 (1) pp: 2337-3520.

[15] Jiang X., Lu W.X., Zhao H.Q., Yang Q.C., Yang Z.P., 2014, Potential Ecological Risk Assessment and Prediction of Soil Heavy-Metal Pollution Around Coal Gangue Dump, Natural Hazards and Earth System Science., Vol. 14 pp: 1599-1610.

DOI: 10.31695/IJASRE.2020.33837