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by Dwi P Sasongko

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RESEARCH ARTICLE

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Deployment Analysis of Heavy Metals on Residential Land Around Banjir Kanal Barat River, Semarang

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

[1]*Doctoral Program on Enviromental Science, Diponegoro University, Indonesia*
[2]*Department of Physics, Faculty Science and Mathematics, Diponegoro University, Indonesia*
[3]*Department of Civil Engineering, Faculty of Engineering, Diponegoro University, Indonesia*

Pollution of soil is where the introduction of substances or other component that is disruptive so it can reduce soil quality. These heavy metals pollution can come from industrial waste and domestic waste. To find out how the spread of soil contamination can be conducted geophysical exploration with resistivity method. The purpose of this study include identify the composition of heavy metals that contaminate soil in the area around Banjir Kanal Barat, Semarang. The research will be identification of the chemical composition of the soil in the area around the river Banjir Kanal Barat Semarang with the method of geochemistry using techniques of energy dispersive of X-ray (EDX) for which data is combined with the measurement of the value of soil resistivity method georesistivity to understand the structure of the subsoil of the earth's surface. From the results of the research with geoelectric method and this EDX test was concluded as follows: heavy metals are dominating the subsurface of the study site is Fe because it was close to the chemical industry waste products into Banjir Kanal Barat Semarang, Model distribution of heavy metal produced is of the underground resistivity value of the study sites, which are then interpreted and obtained that is dominated clay rock with resistivity values ranging from 4.32 to 17.1 Ωm with A4 trajectory indicates the percentage of metal pollution the most severe. The composition of heavy metals that contaminate soil in the area around the Banjir Kanal river Semarang among them Fe, Cu, Cd, and Pb.

Keywords: Heavy Metals, Soil Deployment, Georesistivity, EDX.

1. INTRODUCTION

Pollution that goes into the ground and then deposited as toxic chemicals in the ground. Toxic substances in the soil can have a direct impact to humans when in contact or can contaminate ground water and the air above it.[3] When water carries the waste flowing into rivers, lakes or the fields, the land will drain, so it will be contaminated with chemicals. Soil, plants or animals, and polluted water will have an impact on the carrying capacity of the environment.[10] The ingredients may be contaminated in plants and animals, and eventually end up in humans. Contamination occurs when there is a substance in the environment that cause unexpected changes both physical, chemical, biological or exceed applicable standards that disrupts the health of human existence, and human activities as well as other organisms.[9]

Banjir Kanal Barat Semarang is a continuation of Garang River under the dam Simongan up to the mouth of the river with a length of 5.3 km and a width ±50 m, serves as a sewer (drainage) the main city of Semarang who will continue dumping into the Java Sea. Fouling the river due to sewage treatment is not perfect by factories and industries can cause poisoning in fish and humans. Contamination of land is a state in which man-made chemicals enter and modify the natural soil environment through pore. Heavy metals are natural components of the environment that get excessive attention from hazards that may result. However harmful heavy metals, especially when absorbed by plants, animals or humans in large quantities. However, some heavy metals is an essential element for plants or animals.[2]

Georesistivity method is a method used to study the nature of the flow of electricity in the earth in a way to detect it in the earth's surface. Based on the value of the electrical resistivity, a subsurface structure of the earth can be known constituent materials, so as to understand more about the structure of the subsoil of the Earth's surface that is contaminated by wastewater containing organic compounds of various metals that are conductivity.[1]

EDX testing was conducted to determine the composition contained in soil samples later. Location mapping performed to determine the path length and measuring point. In addition, the entire measuring point position is determined using GPS. Results of mapping the location of the dots resistivity data retrieval and

*Author to whom correspondence should be addressed.

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data retrieval point drill. Resistivity data obtained were then processed using software RES2DInv Sounding Resistivity Interpretation which produces pitch curve and resistivity cross-section. From the results of the field and resistivity curve cross-section is used to make the contours of the resistivity distribution based on the depth obtained from the resistivity data processing using the software Surfer.[12] Contour resistivity distribution described in any depth to a depth of 10 meters. Besides comparing the results of the resistivity distribution pattern making contour also conducted chemical tests directly from soil samples using shallow drilling. Drilling was conducted in several locations at each point a depth of 1 meter to a depth of 4 meters. Drilling results of soil samples analyzed in the lab to get the heavy metal content. The analysis of soil samples carried out by SEM (Scanning Electron Microscope).[13]

From the above description that will be conducted this study aims to determine the pattern of Heavy Metals Pollution on Land Settlement around the Banjir Kanal Barat Semarang based resistivity value and composition of the heavy metals contained in the soil. From the above description and purpose of the virtues of this study was to estimate the potential ground resistivity changes in the value and composition of the heavy metals that are at each depth measurement at the measurement location settlement of the Banjir Kanal Barat. So predictable impacts that occur as a result of heavy metals stored in the soil on the land residence. As such readiness can be made a policy by local stakeholders in determining activity on the land.

2. EXPERIMENTAL METHOD

The research location is situated around the Banjir Kanal Barat. Sampling will be conducted in one districts, namely West Semarang districts. The acquisition of location data carried determine path length and measuring point. In addition, the entire measuring point position is determined using GPS. Results of mapping the location of the dots resistivity data retrieval and data retrieval point drill. Resistivity data obtained were then processed using software RES2DInv Sounding Resistivity Interpretation which produces pitch curve and resistivity cross-section. From the results of the field and resistivity curve cross-section is used to make the contours of the resistivity distribution based on the depth obtained from the resistivity data processing using the software Surfer. Contour resistivity distribution is described in every 1 m depth to a depth of 10 meters. At the time of data collection, as well as river water samples were taken for comparison. The results of the resistivity distribution pattern making contour also conducted chemical tests directly from soil samples using shallow drilling. Drilling was conducted on a point locations determined by the depth of 1 m to a depth of 4 meters. Drilling results of soil samples analyzed in the lab to get the heavy metal content. The analysis of soil samples carried out by SEM (Scanning Electron Microscope) is one type of electron microscope that use electron beam to retrieve a chemical composition of the analyzed heavy metals.

3. RESULTS AND DISCUSSION

The soil samples has conducted drilling depth of 4 meters around the West Flood Canal River Semarang to analyze the heavy metal content with EDX method. The results analysis obtained as shown in Table I. EDX test results indicate that there are four dominant heavy metals atom that contaminate the soil at the site of research, among them Fe, Cu, Cd and Pb.

At a depth of 1 meter (Fig. 1), seen heavy metal content most dominating Fe, i.e., 94.16%, followed by 3.27% Cd, Pb 2.42%, and the lowest is 0.14% Cu. At a depth of 2 meters (Fig. 2), still showed the highest are heavy metal Fe with a percentage of 93.81%, lower than the previous. Then, with a percentage of 4.48% Cd and Cu with a percentage of 1.71%. At these depths, the heavy metals Pb disappear or be 0%.

At a depth of 3 meters (Fig. 3), heavy metals Fe still dominates with a percentage of 98.94%. Then for Cu back down with a percentage of 1.06%. Metals Cd and Pb be lost with a percentage of 0%.

At a depth of 4 meters, heavy metals Fe still dominates with a percentage of 96.60%. Then the heavy metal cadmium

Table I. Results of compositions EDX method to the samples.

	A1 (At%)	A2 (At%)	A3 (At%)	A4 (At%)
Fe	94, 16	93, 81	98, 94	96, 60
Cu	0, 14	1, 71	1, 06	1, 23
Cd	3, 27	4, 48	0	2, 17
Pb	2, 42	0	0	0

Table II. Percentage of EDX test at a depth of 1 meter.

Element	(keV)	Mass %	Sigma	Atom %
Fe K	6.398	85.68	2.03	94.16
Cu K*	8.040	0.14	0.68	0.14
Cd L*	3.132	5.99	0.81	3.27
Hg M*				
Pb M*	2.342	8.18	1.53	2.42
Total		100		100

Table III. Percentage of EDX test at a depth of 2 meters.

Element	(keV)	Mass %	Sigma	Atom %
Fe K	6.398	89.53	0.99	93.81
Cu K*	8.040	1.86	0.93	1.71
Cd L*	3.132	8.61	0.92	4.48
Hg M*				
Pb M*				
Total		100		100

Table IV. Percentage of EDX test at a depth of 3 meters.

Element	(keV)	Mass %	Sigma	Atom %
Fe K	6.398	98.80	1.78	98.94
Cu K*	8.040	1.20	0.54	1.06
Cd L*				
Hg M*				
Pb M*				
Total		100		100

Table V. Percentage of EDX test at a depth of 4 meters.

Element	(keV)	Mass %	Sigma	Atom %
Fe K	6.398	94.37	0.89	96.60
Cu K*	8.040	1.37	0.65	1.23
Cd L*	3.132	4.26	0.54	2.17
Hg M*				
Pb M*				
Total		100		100

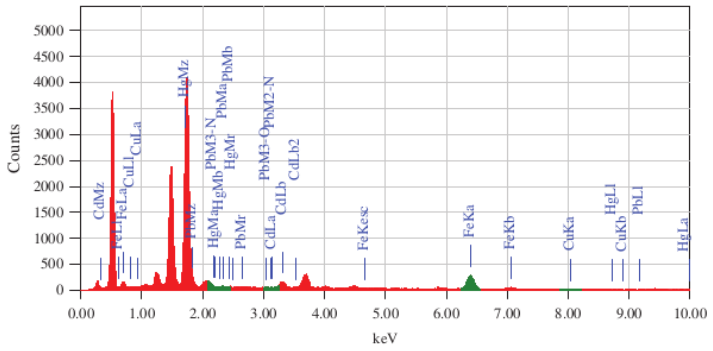

Fig. 1. EDX test results at a depth of 1 meter.

re-emerged with a percentage of 2.17%. Cu return ride although not significant, ie with a percentage of 1.23%. For heavy metals Pb nothing with a percentage of 0%. Overall, get the largest percentage is the heavy metal Fe as the study site were not far from the chemical industry waste products into the river Garang so that infiltration of pollution of the river into the land at the sites. Then the heavy metal cadmium has a fairly large percentage, but by less heavy metals Fe. Cu is also available on the test results with the percentage that was not great. The latter, Pb heavy metal that only appear at a depth of 1 meter, then showed a percentage of 0%.

When correlated with the results of geoelectric cross-section of dipole–dipole configuration, it appears that at a depth of 0 to 4 meters is dominated by clay rocks. Clay rock properties that will form hard lumps when dry and sticky when wet so it is quite difficult to process. This is caused by having a clay-sized particle is so small that bonds the particles in it more closely.

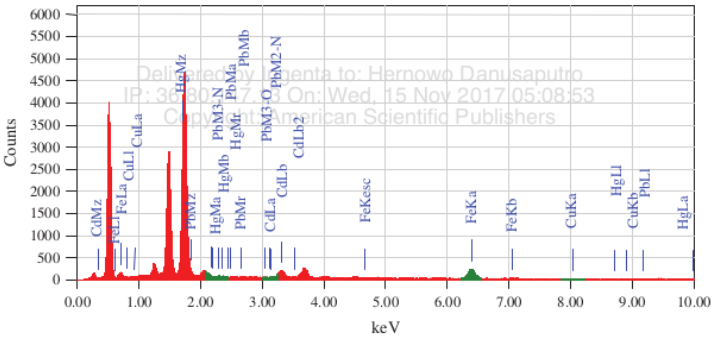

Fig. 2. EDX test results at a depth of 2 meters.

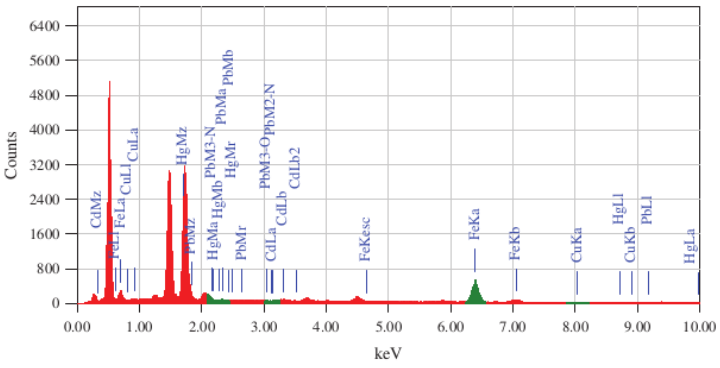

Fig. 3. Test results EDX at a depth of 3 meters.

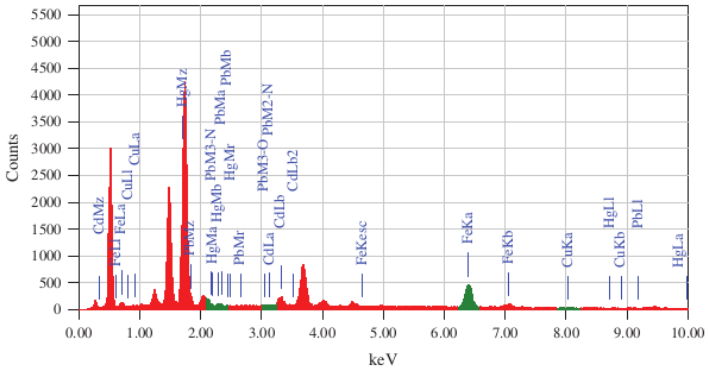

Fig. 4. EDX test results at a depth of 4 meters.

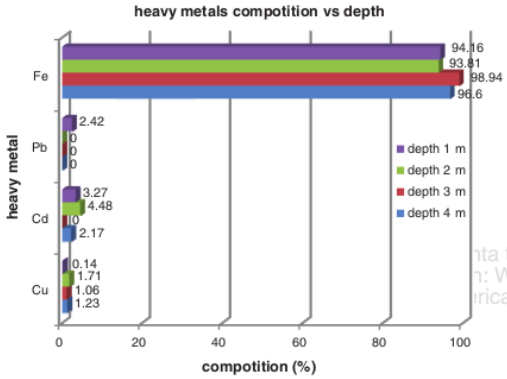

Fig. 5. The results of the correlation percentage of heavy metal composition and depth.

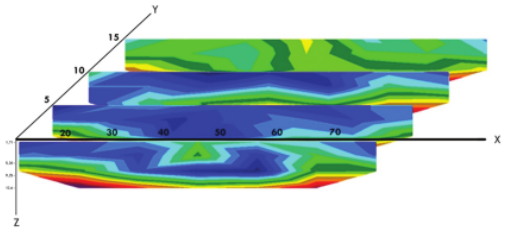

Fig. 6. Model of geo-electric.

4. CONCLUSIONS

From the results of the research we conclude:

1. Heavy metals are dominating the subsurface of the study site is Fe because it was close to the chemical industry waste products into the West Flood Canal River.
2. Layers dominated the study site is a rock clay binding because it has a very small particle size of the particles that bond strong. This also causes the heavy metals are not fully qualified for the deeper layers.
3. Heavy metals Pb only appears at a depth of 1 meter because it was blocked by a layer of clay so it does not qualify for the deeper layers.

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