Geoelectric Configuration and Data Processing Design to Identification and Position of Shallow Heavy Metal Waste (Zn)

by Eddy Ibrahim

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Abstract. This paper presented a practical with empiric analysis and applied evaluation of the robust technique and shows that significant performance benefits can be achieved in geoelectric resistivity applications to identification and position of shallow heavy metal waste (Zn). These benefits are demonstrated in field trials of a new design configuration and data processing Geoelectric methods. An original contribution has been made in establishing a procedure for the measurements of Geoelectric for shallow heavy metal Zn waste on the field scale. This enables the maximum resolution of a robust system to be characterized by shallow heavy metal Zn waste as a basic analogue recording geoelectric system with multi electrodes configuration variation. These expressions prove to be helpful to design configuration and data processing in characterizing geoelectric performance systems (raised current, various configurations of the electrode) and could improve data quality and allow information other than conductor depth to be collected for a defined application.

Keywords: Geoelectric resistivity method, Configuration electrode, identification and position, Robust technique, Heavy metal Zn waste

1 Introduction

The geoelectric method is very suitable for shallow and deep exploration so it is widely used in geophysical exploration such as bedrock, monitoring the direction and velocity of groundwater flow (White, 1988 op. cite Ibrahim E, 2006), geothermal, observing the movement of salt water (Fried, 1975). Op .cite Ibrahim E, 2006), increases the slope and slope of coal (Sutopo, et al, 2007), detects the position of groundwater aquifers and can detect seepage and pollutant pollution caused by oil leaks below the ground surface (Bambang, E, 2002 op. cite Ibrahim E, 2006, Sutopo. 2009, 20011, 2012).

The activity to be carried out is to identify the distribution of heavy metal (Zn metal) below the surface using the geoelectrical resistivity method. The special electrical properties of the Zn catalyst are expected to provide different resistivity information from the environment. The resistivity value will then be the basis for determining the accumulation and distribution of the Zn catalyst. The results of this activity are expected to be used as a guide in the management of these heavy metals.

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2 Method

2.1 Preparation and Measurement Tools

Preparation for Measurement. Implementation

1. Determine the object of research in the form of a Zn catalyst in the form of a solid and small in size along with the environmental conditions to be measured.
2. Study of the regional geology of the research area.
3. Application of appropriate methods and configurations. In this case, the Wenner configuration method is used which has good data density and resolution so that small objects can be identified.
4. The instrument calibration is carried out by taking a sample of the Zn catalyst to be tested under predetermined conditions.
5. Determine the direction, length and spacing of the electrodes. The electrode spacing used is 0.4 m with a maximum track length of 25.6 m. By using a small space between the electrodes, the lateral data density will be better.

Instrument. The equipment used in the measurement is the Ares model resistivity meter (Figure 3.1). This tool consists of two main components, namely: a receiver device, which is a device for regulating and measuring the electric current flowing from the device through electrodes that have been properly installed in the area to be measured. The electrode is a medium where electricity is injected into the earth.

Figure 1. Ares instrument and accessories

2.2 Types and Specifications of Measuring Instruments.

A. Resitivitymeter

a. Transmitter
   Power up to 300 W
   Current up to 2.0 A
   Voltage 10 – 550 V (1100 Vp-p)
   Protection full electronic protection
   Precision 0.1 %

b. Receiver
   Input impedance 20 MΩ
   Input voltage range ±5 V
   Mains frequency filtering 50 or 60 Hz
   Precision 0.1%

c. Support Methods
   - 2D/3D-Multi-Electrode Resistivity and IP Tomography
   - VES – Vertical Electrical Sounding
   - RP – Resistivity Profiling
   - SP - Self Potential
   - Borehole survey
   - User defined survey

B. Standard Accessories
- Transport case
- T-piece (for connection of multi-electrode cable sections and cables for current and potential electrodes)
- Cable for external 12 V battery
- RS232C and USB cables
- AC adapter (for all countries)
- Measuring software ARES

C. Optional Accessories
- 12 V attachable battery pack with fast 3-stage battery charger
- Multi-Electrode cable sections – active (intelligent) and passive multi-conductor (classic)
- Attachable 48-channel adapter for multi-conductor cable
- VES-Adapter (for 5 pairs of potential electrodes)
- Cable reels
- Standard electrodes, non-polarisable electrodes
- Interpretation and mapping software

Data Acquisition Technique. The data obtained in the form of electrical resistivity values will be used to see variations in the anomalies of each object where the data is the result of the acquisition of current values, potential differences and the configuration of the electrodes used.

Data collection is carried out with the following steps:

1. Arrange a series of resistivity meters for the Wenner configuration and activate the resistivity meter and then flow electric current to the medium below the earth's surface.
2. Starting the measurement of electric current flowing (I) and potential difference (V) between two electrode points automatically through the tool.
3. Take measurements as in steps 1-2 and so on.

   From the measurement data, calculations are carried out to determine the apparent resistivity value.

The results of the calculation of apparent resistivity values are then processed using the Res2Dinv program for 2D, the results of the interpretation will be obtained from a 2D cross section, from the distribution of subsurface electrical resistivity values according to the number of data collection points and the number of datum points (n). The results of interpretation of the position of heavy metal waste for 2 D (Figure 2.2 and Figure 2.3)

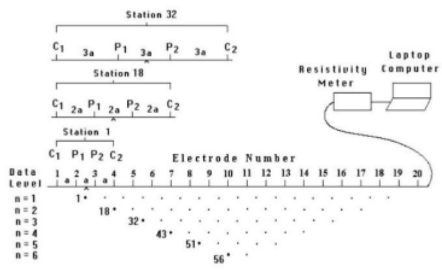

Figure 2. 2 D data Acquisition Techniques **(Loke, 2006)**

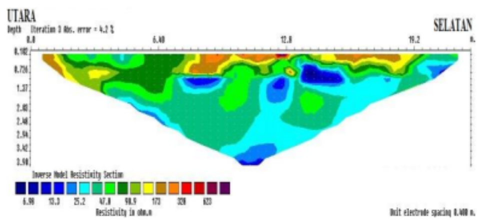

Figure 3. Result of 2D data Processed (Documentation research)

3 Result

Information of Research Area. The location of this research is a landfill area of PT. X which is located in the green barrier area and is in the form of a cube with topographic conditions in the form of a ladder (slope) and conical at the top (Figure 3.1). Geographically the position of this location is located at the coordinates as below:

Location	Coordinate Point
1	S 02º 58´ 750´´ E 104º 47´ 652´´
2	S 02º 58´ 760´´ E 104º 47´ 650´´
3	S 02º 58´ 763´´ E 104º 47´ 639´´
4	S 02º 58´ 748´ E 104º 47´ 639´´

Figure 4. Research Area (Documentation research)

At the research location, there are fairly homogeneous plant species, the vegetation that grows is shrubs, and tropical plants with relatively large stem sizes
The research at this location was carried out at 3 levels at the beginning because this section indicated the presence of Zn catalyst content which was known through surface sampling and additional information provided by PT. X.

Traverse line and data acquisition. The research location, which has a tiered contour. The track length is determined according to the length of the research area, which is 25.6 m and the distance between the tracks is 0.5 m with the starting point of the study (0 m) near the road in the green barrier area.

Field data acquisition begins with the installation of electrodes along the path at a predetermined point. The electrode installation is done manually by plugging the electrode rod into the ground then the electrode is tied using rubber so that the electrode and iron cables can be fused. Each of the 8 electrodes has a tip that can be connected to 8 other electrodes with a total of 64 electrodes in one pass. After all the electrodes are installed with a predetermined distance, the electrode connections at the 32 and 33 electrode points are connected to the resistivity meter which at the time of the study used the ARES type.

The electrode configuration used in the field is the Wenner configuration, which is a configuration that puts the electrode on the electrode the same distance, in this study the distance used is 0.4. The reason for choosing this configuration is because the data density obtained is better laterally and the resolution is better than other geoelectric configuration methods.

Interpretation of Geoelectric profile. The length of one measurement path at the research location is 25.6 m with a penetration depth of measurement varying from 3.9 meters to 4.7 meters, this is adjusted to the conditions and topography of the area at the time the measurements were made. From a total of 3 measurement paths, 2 paths were found to indicate the presence of a Zn catalyst which was characterized by a resistivity value of 5-10 ohm.m.

Traverse line 1. Measurements on this track are carried out when the wet track conditions are 0.5 meters from the previous track. The measurement path length is 25.6 meters with a penetration depth of up to 4 meters, 64 electrodes are used (Figure 3.2). Based on the resistivity section below, there is no indication of Zn catalyst.

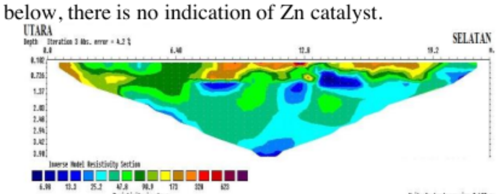

Figure 5. Cross section of 2D Resistivity for traverse line 1

Traverse line 2. Track 2 is at the top of the embankment level/slope so that the track is relatively flat. Measurements on this track are carried out when the track conditions are wet.

The coordinates are 02058'45.1"/104047'38.7". The measurement path length is 25.6 meters with a penetration depth of up to 4 meters, 64 electrodes are used (Figure 3.3).

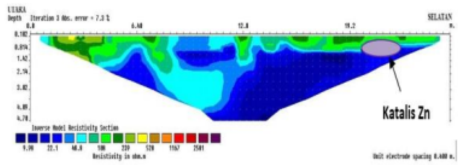

Figure 6. Cross section of 2D Resistivity for Traverse line 2

Indications of the presence of a Zn catalyst are located at a distance of 20-22 meters from the starting point of the measurement. Located at a depth of 0.3 meters to 1.2 meters from ground level. This is based on anomalous changes at the same distance and depth as the 9th track, marked by a resistivity value of 10-22 ohm.meter

Traverse Line 3. Track 3 measurements were carried out when the track conditions were slightly wet. This trajectory is located at coordinates 02058'45.2"/104047'38.7". Just like the previous track, the track length is 25.6 meters with 64 electrodes used. Based on the resistivity cross section produced in Figure 3.4, there are indications of the presence of a Zn catalyst at a depth of 0.3-1 meters at a distance of 20-22 meters from the zero point of measurement. Indications of the presence of a Zn catalyst are in the resistivity range of 10-22 ohm.meter. The change in resistivity color to a slightly light blue color compared to the 2nd path indicates a reduction in the accumulation of Zn catalyst compared to the previous path.

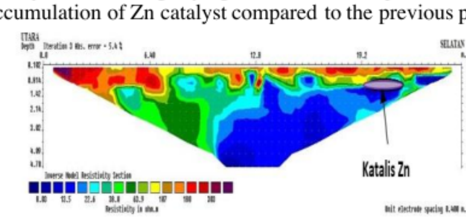

Figure 7. Cross section of 2D Resistivity for traverse line 3

Zn Catalyst Distribution Zone Indication. The research location is a tiered embankment area, geoelectric measurements start at the lower area to the higher area.
The interpretation of the geoelectrical measurement results shows that the indications of the Zn catalyst zone are in the 2nd and 3rd paths.

Based on the cross-sectional resistivity profile, the results of the average measurement of the presence of a Zn catalyst are at a depth of 0.25 meters to 1.15 meters below the surface.

The lithology section of the 2nd track (Figure 3.5) is made based on the results of the resistivity section generated and validated through excavations carried out in the field. The Zn catalyst is located at a depth of 0.25 m to 1.15 m from the surface.

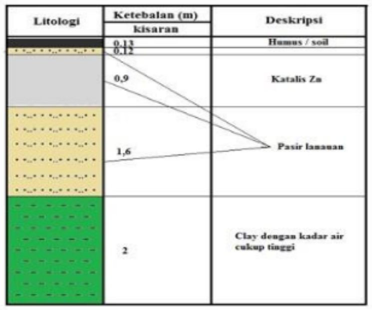

Figure 8. Cross Section of Lithology Traverse line 2

In the lithological cross section of the 3rd track (Figure 3.6) it is known that the Zn catalyst has a thickness of 0.78 m. Located at a depth of 0.25 m to 1.03 m from the surface. This lithological section is made based on validation through excavation based on the resulting geoelectric section

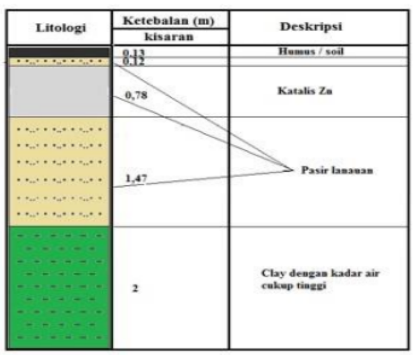

Figure 9. Cross Section of Lithology Traverse line 3

4 Conclusion

Based on the cross-sectional resistivity generated from the measurement location, it was found that there was an indication of the presence of Zn catalyst at the measurement location. The second and third measurement locations did not find any indication of accumulation of Zn catalyst.

At the measurement location, 3 measurement lines were carried out with a distance between measurement lines of 0.5 m. The measurement paths that are suspected of having Zn catalyst distribution are paths 2 and 3.

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