APPLICATION OF SELF-POTENTIAL METHOD TO ESTIMATE SALTWATER DISTRIBUTION AROUND BRINE WELL IN MANIS RAYA VILLAGE, SINTANG REGENCY

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ABSTRACT

This research aims to estimate saltwater distribution around the of Manis Raya Village, Sintang Regency. This research uses the self-potential method by a fixed base configuration. Measurements in the field applied eight tracks that have a length of 120 m each with a distance of 5 m for each track and 5 m for each porous spot. The distribution of saltwater around the brine well was obtained by interpolation using the kriging method. The measurement results show that the self-potential at the research location is -99.38 mV to 158.32 mV. The interpretation results show that the area of accumulated saltwater distribution is negative, located on the east, southeast, south and west sides of the . The low self-potential of saltwater is likely due to the accumulation of ions in the area. The saltwater distribution zone is suspected to be about 48 m to the southeast of the brine well.

Keywords: *Brine well; Fixed base; Porous spot; Saltwater distribution; Self-potential*

ABSTRAK

[Title: Penerapan Metode Self Potensial untuk Mengestimasi Sebaran Air Asin di sekitar Sumur Garam Desa Manis Raya, Kabupaten Sintang] *Penelitian ini bertujuan untuk mengestimasi sebaran air asin di sekitar sumur garam Desa Manis Raya Kabupaten Sintang. Penelitian ini menggunakan metode self potential dengan konfigurasi fixed base. Pengukuran di lapangan menerapkan delapan lintasan dengan panjang masing-masing 120 m dengan jarak setiap lintasan sejauh 5 m dan jarak setiap porous spot sejauh 5 m. Sebaran air asin di sekitar sumur air garam diperoleh dengan interpolasi menggunakan metode kriging. Hasil pengukuran menunjukkan bahwa potensial alami di lokasi penelitian adalah -99,38 mV hingga 158,32 mV. Hasil interpretasi menunjukkan bahwa daerah yang menjadi akumulasi sebaran air asin bernilai negatif, yang terdapat di sisi timur, tenggara, selatan dan barat dari sumur garam. Potensial alami air asin yang cenderung rendah diduga disebabkan karena akumulasi ion-ion pada daerah tersebut. Zona sebaran air asin diduga sejauh 48 m ke arah tenggara dari sumur garam.*

Kata Kunci: *Sumur garam; Fixed base; Porous spot; Sebaran air asin; Self potential*

INTRODUCTION

Saltwater in a well generally occurs due to dynamic seawater intrusion and static fossil water (Purnama, 2020). The brine well in Manis Raya Village, Sintang Regency, has a surface diameter of about 1.5 m and has orange water. The potential of this brine well is utilized by the local community to obtain salt by boiling and settling it in a tank. In the agricultural sector, the presence of this brine well is a serious problem because it is located in a rice field area so that salt water distribution can affect plant growth. Poor plant growth can be caused by the salt content contained in the soil (Simbolon et al., 2013). The presence of sodium and chloride ions in salt makes it difficult for plant roots to absorb water and nutrients from the soil. The distribution of saltwater in the soil around agricultural land needs to be studied to anticipate its effects.

The self-potential method is one of the geophysical methods generally used to map the distribution of groundwater (Haraty et al., 2022; Hutabarat et al., 2020; Wahid et al., 2024). This method is based on the self-potential found in soil or rock (Wahidah et al., 2021). The presence of self-potential is also closely related to the weathering of the rock or mineral body, variations in rock properties, bioelectic movement of organic matter, pressure gradients, temperature at the liquid surface, and other natural phenomena with the same occurrence process. There are several self-potential types caused by groundwater factors, including electrokinetic potential, diffusion potential (liquid junction), Nerst potential (shale), and mineralization potential (Telford et al., 1990).

The self-potential method is generally used to investigate groundwater. This method is often chosen because of its non-destructive nature and simple equipment. Previous studies that have been conducted using this method include estimating the distribution and pattern of water flow (Muhardi, Kaharudin, et al., 2021), identifying leachate distribution (Prasetya et al., 2022), investigating soil movement (Santoso et al., 2020), identifying leaks in dams (Thanh et al., 2020), and estimating geo-thermal reservoirs (Febriani, 2020).

METHOD

The research location is in Manis Raya Village, Sepauk District, Sintang Regency. The brine well in this village is located at coordinates 0º01'42”-0º01'46” S and 111º11'13”-111º11'17” E. Data were collected on June 14, 15 and 17, 2023. The tools used in this research are a porous pot, digital multimeter, cable, measuring tape, handy talky, log sheet, and digger. In this research, the material used is a CuSO4 solution. Measurements in the field applied eight tracks with a length of 120 m each with a distance of 5 m between each track and 5 m between each porous spot, as shown in Figure 1..

The configuration used in field data measurement is the fixed base configuration. In this configuration, two porous pot electrodes are planted in the ground at the point of the track that has been made (Muhardi, Perdhana, et al., 2021). One of the electrodes is fixed, and the other moves at the same distance along the measurement track (Adriati et al., 2023). The data measurement technique using the fixed base configuration is shown in Figure 2.

Data was obtained in the field through porous pot distance to the reference point and self-potential data. The self-potential data obtained are based on self-potential data and rover self-potential data. Base potential data is used to correct daily variations in self-potential measurements obtained for each track. In correcting daily variations and noise correction, the data obtained from the measurements are averaged and corrected to the initial readings. The corrected self-potential data were then created isopotential contour maps and interpolated using the kriging method to analyze saltwater distribution around the brine wells. Interpretation is done by reading the isopotential contour map, which is then connected to the source of the self potential anomaly, geological conditions, and past research.

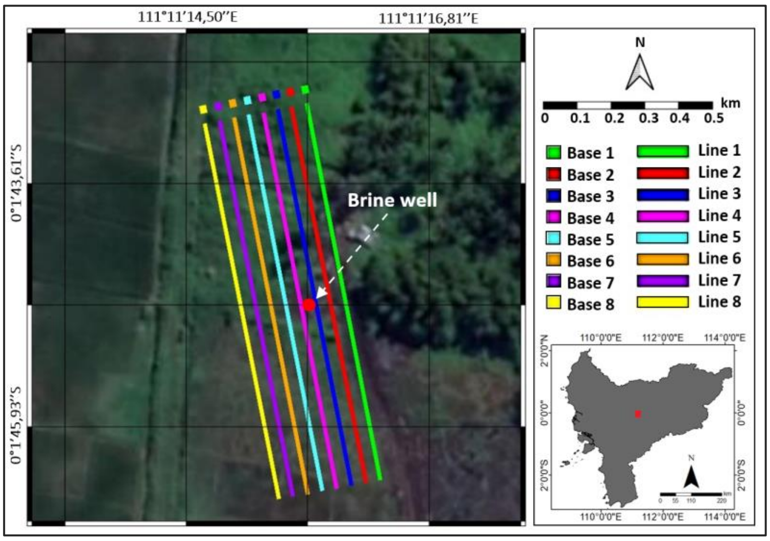


Figure 1. Measurement design in the research location

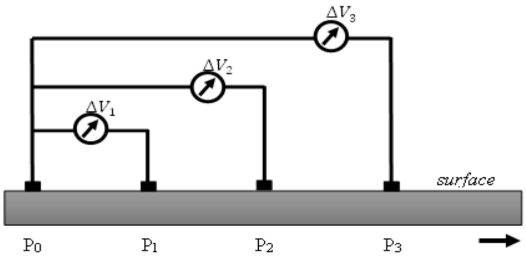
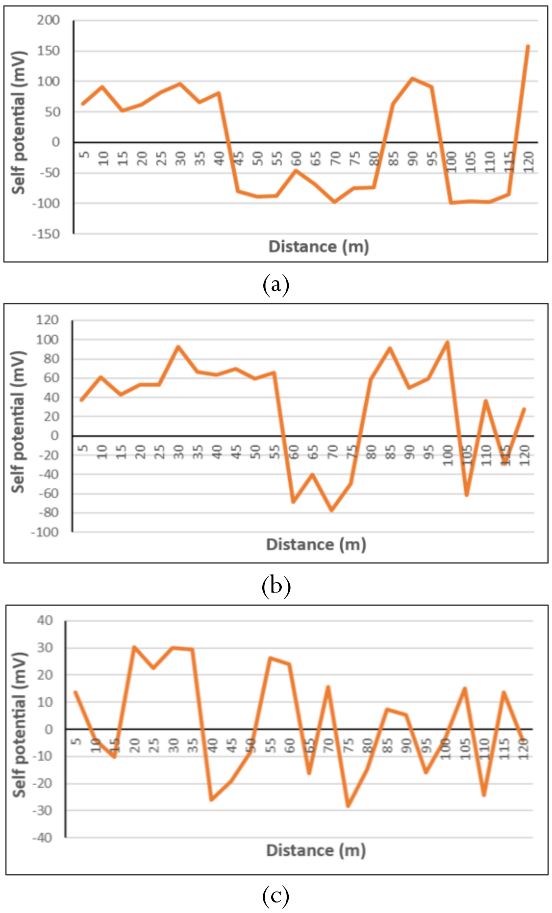


Figure 2. Self-potential data measurement by fixed base configuration (Santoso et al., 2020)

RESULT DAN DISCUSSION

After correction on each track, the distribution of self-potential data at the research location obtained values ranging from negative to positive, with the highest self-potential data of 158.32 mV and the lowest of -99.38 mV. The change in self-potential data with distance on the eight trajectories shows no regular pattern. Track 1, 2, 3, and 4 generally have more negative values, especially at 60 m to 80 m, than the other traverses. These four tracks' low self-potential data are due to the ditch located right next to track 1 and the brine well enclosed by lines 3 and 4. The self-potential distribution in the research location after daily correction is shown in Figure 3.



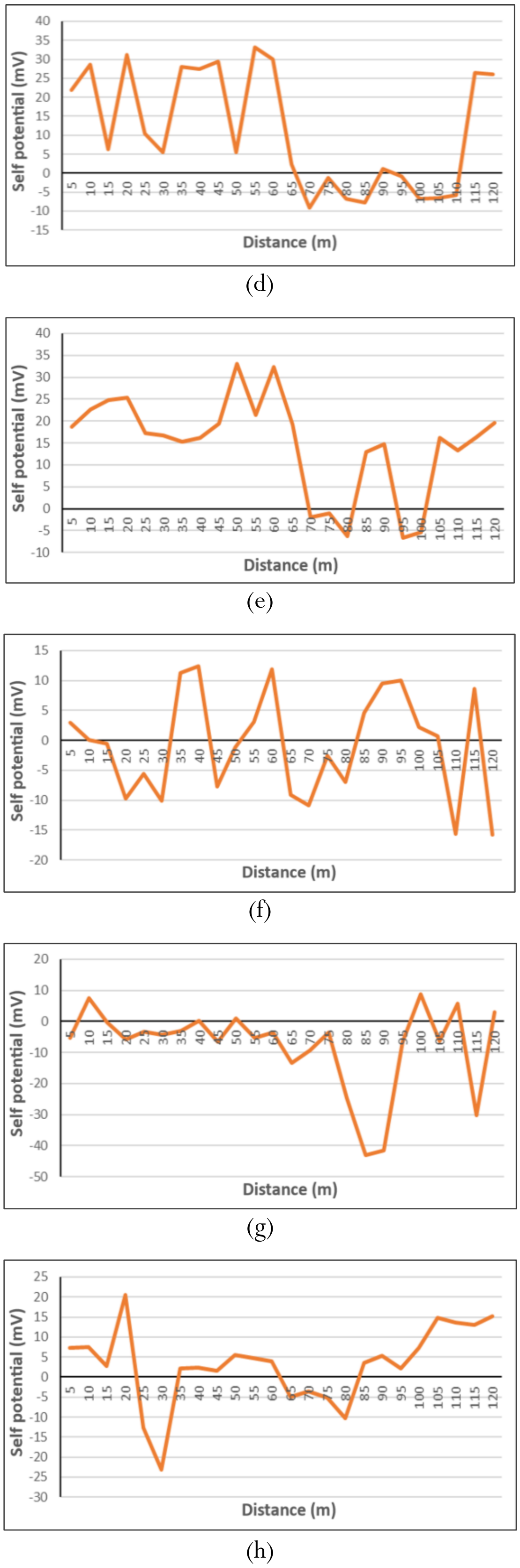


Figure 3. Graph of corrected self-potential data (a). Line 1, (b). Line 2, (c). Line 3, (d). Line 4, (e). Line 5, (f). Line 6, (g). Line 7, (h). Line 8.

The results of the interpretation of self-potential measurements that have been made daily corrections in the form of isopotential cross sections are shown in Figure 4. The isopotential contours obtained have daily corrected potential data of -99.38 mV to 158.32 mV. Negative potential anomaly zones are located in the research site's east, southeast, and south-to-west areas, characterized by purple to dark green appearances. The most negative potential anomaly was identified in the eastern direction of the brine well with the lowest potential data of -99.38 mV, which is thought to be due to the presence of a water source originating from a ditch 5 m from track 1. In comparison, the highest potential anomaly is in the southeast direction of the brine well, with self-potential data of 158.32 mV.

The self-potential anomaly displayed at the research location is thought to be caused by several things. The first is soil layers with different ion concentrations, for example, in sand and clay or between freshwater and saltwater. The second is soil stratification based on fluid flow in the form of groundwater, where groundwater contains many ions whose flow creates a potential at the ground surface, often called flow potential or electrokinetic potential. Third, environments with sulfide compounds, namely underground water, undergo an electrochemical process that produces a potential called the mineralization potential (Tambunan dan Pertama, 1997).

The presence of saltwater is thought to be due to the reappearance of ancient saltwater and salt rocks. This is supported by the Ketungau and Melawi basins, which are sedimentary. These sedimentary basins are assumed to be the site of ancient saltwater deposits that became salt rock and then buried over a long geological period. These deposits then underwent a tectonic process that caused the salt rock to rise to the overlying reservoir layer. These salt rocks are located in the reservoir layer, which contains sandstone material, and the alluvium layer, which includes sand, gravel, and mud (Purba, 2023).

In this research, groundwater mixed with saltwater accumulates at self-potential ranges from -99.38 mV to 0 mV (MacAllister et al., 2016). The low saltwater self-potential data is due to the accumulation of saltwater in the subsurface. The high conductivity in saltwater causes an electric current to flow significantly (Tambunan dan Pertama, 1997). As a result, the surrounding electric potential becomes lower. Freshwater accumulation is more significant than saltwater accumulation, which may be a factor in the low self-potential data measured in the saltwater zone (Mawaddah dan Fajriani, 2021).

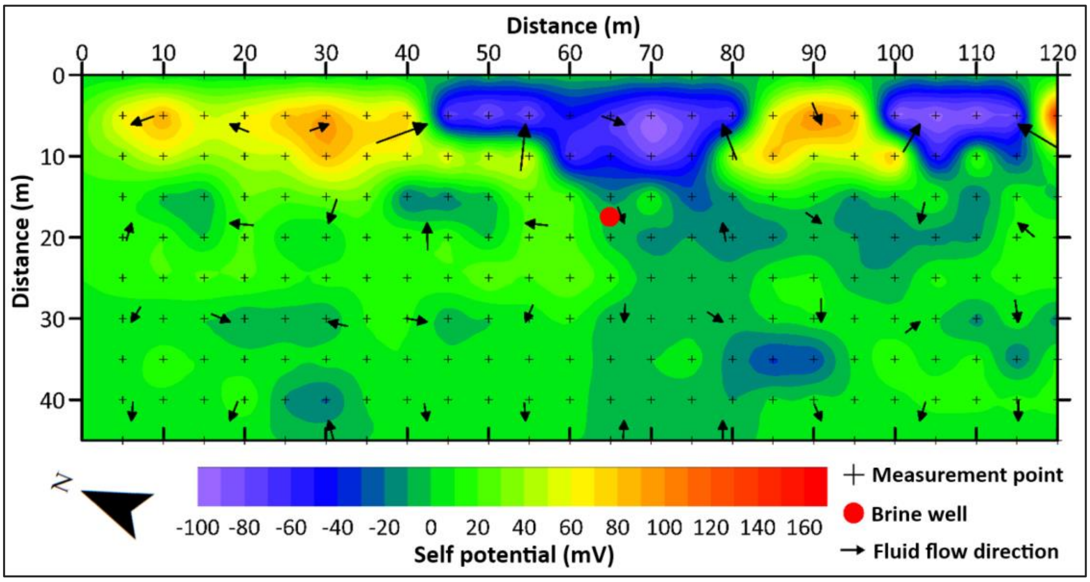


Figure 4. The isopotential map of the self-potential distribution

CONCLUSIONS AND SUGGESTIONS

Measurements in the field applied eight tracks that have a length of 120 m each with a distance of 5 m for each track and 5 m for each porous spot. The distribution of saltwater around the brine well was obtained by interpolation using the kriging method. The measurement results show that the self-potential at the research location is -99.38 mV to 158.32 mV. The interpretation results show that the area of accumulated saltwater distribution is negative, located on the east, southeast, south and west sides of the brine well. The low self-potential of saltwater is likely due to the accumulation of ions in the area. The saltwater distribution zone is suspected to be about 48 m to the southeast of the brine well.

Suggestions that can be given in this research are that further research is needed using a different configuration, namely the leapfrog configuration. We recommend that data be collected on the same day to avoid conditions of variation in weather influence.

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