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Implementing electrical resistivity tomography to delineate soil contamination zone, Southern Baqubah City, Iraq

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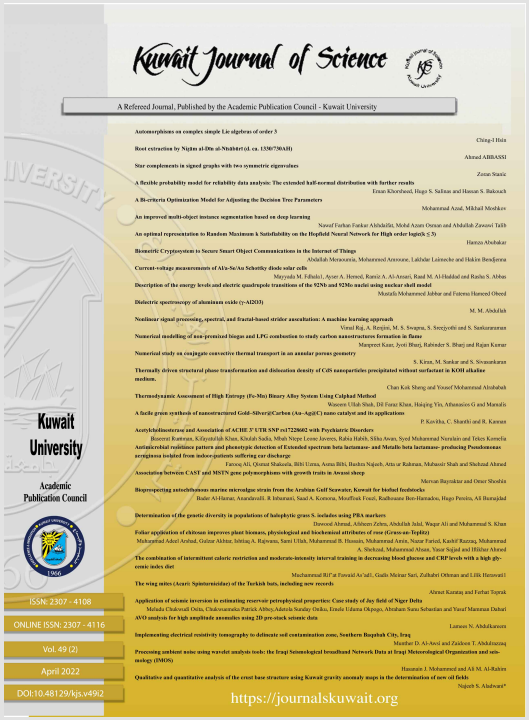

Abstract

The electrical method is one of the most successful geophysical methods in identifying and evaluating the subsurface pollution area, in addition to the ease of applying its surveys and their low cost. An electrical resistivity tomography (ERT) survey was carried out in diyala university campus, southern Baqubaa city, Iraq. The main objective of this study was to evaluate the efficiency of ERT for buried sewage system detection as well as to assess the environmental impact of this system on the surrounding soil. Six parallel resistivity profiles were carried out at perpendicular direction to the axis of the sewage system, where six holes were drilled to collect soil samples for heavy metals concentrations analysis. 2D and 3D geoelectrical models were constructed to determine the distribution of resistivity and its relation with both buried structures and contaminated zones. The ERT results showed relative intermediate resistivity zone between 13m-16m distance, indicate the buried sewage system. Several rounded low resistivity zones (**>** 1 ohm.m) at a location close to both sides of the septic tank, were also shown in the clay layer. These zones may be representing the contaminated soil based on its very low resistivity and clayey material. The results of Chemical analysis showed a higher concentration of heavy metals near the septic system than area away from it. Much lower resistivity zones (<1 ohm.m) and the higher concentration of heavy metals observed near septic system indicate the impact of contamination by migration from the septic tank into the

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nearby soil. The results of this study confirm the efficiency of ERT for detecting a buried object and mapping contaminated zone for engineering and environmental applications.

References

Abdul Nassir, S.S., Loke, M.H., Lee, C.Y., Nawawi, M.N., 2000. Salt-water intrusion mapping by geoelectrical imaging surveys. Geophysical Prospecting, 48, 647-661. https://doi.org/10.1046/j.1365-2478.2000.00209.x

Abdulameer, A., Thabit, J.M., AL-Menshed, F.H., Merkel, B., 2018. Investigation of seawater intrusion in the Dibdibba Aquifer using 2D resistivity imaging in the area between Al- Zubair and Umm Qasr, southern Iraq. Environ Earth Sci 77:61. https://doi.org/10.1007/s12665-018-7798-3

Abdulrazzaq, Z.T., Al-Ansari, N., Aziz, N.A., Agbasi, O.E., Etuk, S.E., 2020. Estimation of main aquifer parameters using geoelectric measurements to select the suitable wells locations in Bahr Al-Najaf depression, Iraq. Groundwater for Sustainable Development, 11, 100437.

Al-Ebdaa, 2015. Soil investigation report for the new buildings of Diyala university_ part11, Report No.: ESR-015-08, p. 210.

Amidu, S.A., Olayinka, A.I., 2006. Environmental Assessment of Sewage Disposal Systems Using 2D Electrical-Resistivity Imaging and Geochemical Analysis: A Case Study from Ibadan Southwestern Nigeria. Environmental and Engineering Geoscience, 12(3): 261–272. https://doi.org/10.2113/gseegeosci.12.3.261

Anderson, B.A., Nordiana, M.M., Ismail, N.E., Jinmin, M., Nur Amalina, M.K., 2018. Buried Man- made Structure Imaging using 2-D Resistivity Inversion. Journal of Physics: Conf. Series 995 012075, https://doi.org/10.1088/1742-6596/995/1/012075.

Aziz, N.A., Abdulrazzaq, Z.T., Agbasi, O.E., 2018 Mapping of subsurface contamination zone using 3D electrical resistivity imaging in Hilla city, Iraq. Environ Earth Sci 78:502. https://doi.org/10.1007/s12665-019-8520-9.

Dahlin, T. 2001. The development of DC resistivity imaging techniques. Computers and Geosciences, 27(9): 1019–1029. https://doi.org/10.1016/S0098-3004(00)00160-6

Dahlin, T., Owen, R., 1998. Geophysical investigations of alluvial aquifers in Zimbabwe. Proceedings of the IV Meeting of the Environmental and Engineering Geophysical Society. Barcelona, Spain, pp. 151–154

Egwuonwu, G.N., Ibe, S.O., Osazuwa, I.B., 2011. Geophysical assessment of foundation depths round a

leaning superstructure in Zaria area, Northwestern Nigeria using electrical resistivity tomography. The Pacific Journal of Science and Technology 12(1): 472-486.

Gemail, K.S., Attwa, M., Eleraki, M., Zamzam, S., 2017. Imaging of wastewater percolation in heterogeneous soil using electrical resistivity tomography (ERT): a case study at east of Tenth of Ramadan City, Egypt: Environ Earth Sci 76:666, https://doi.org/0.1007/s12665-017-7013-y

Giang, N.V., Kochanek, K., Vu, N.T., Duan, N.B. 2018. Landfill leachate assessment by hydrological and geophysical data: case study NamSon, Hanoi, Vietnam. Journal of Material Cycles and Waste Management. https://doi.org/10.1007/s10163-018-0732-7

Hamzah, U., Jeeva, M., Ali, N.M., 2014. Electrical Resistivity Techniques and Chemichal Analysis in the Study of Leachate Migration at Sungai Sedu Landfill. Asian Journal of Applied Sciences 7(7):518-535: http://dx.doi.org/10.3923/ajaps.2014.518.535

Hamzah, U., Yaacup, R., Samsudin, A., Ayub, M.S., 2006. Electrical imaging of the ground water aquifer at Banting, Selangor, Malaysia. Environ Geol, 49:1156-1162. https://doi.org/10.1007/s00254-005-0160-6

Hasan, M., Shang, Y., Jin, W.J., Akhter, G., 2019. Investigation of fractured rock aquifer in South China

using electrical resistivity tomography and self-potential methods. J Mt Sci, 16(4), 850-869. https://doi.org/10.1007/s11629-018-5207-8

Hassan, A.A., AL-Awsi, M.D., Mutadhid, M. 2018. Application of 2D Electrical Resistivity Imaging Technique for Engineering Site Investigation, Journal of University of Babylon, Pure and Applied Sciences, 26(5): 74-85

Jassim, Z., Goff, J.C. 2006. Geology of Iraq. Published by Dolin, Prague and Moravian Museum, Brno, 341p.

Jayeoba, A., Oladunjoye, M.A., 2015. 2D Electrical Resistivity Tomography for Groundwater Exploration in Hard Rock Terrain. International Journal of Science and Technology, 4, 156-163.

Kabata-Pendias, A., Pendias, H., 2001. Trace element in soils and plants, 3rd edn. CRC Press, London.

Loke, M.H., 2001. Electrical Imaging Surveys for Environmental and Engineering Studies. A Practical Guide to 2-D and 3-D Surveys. RES2DINV Manual. IRIS Instruments. http:// www.iris-intruments.com

Loke, M.H., 2012. Tutorial 2-D and 3-D electrical imaging Surveys. https://www.geotomosoft.com/downlaoads.php. Accessed Aug 2019

Loke, M.H., Acworth, I., Dahlin, T. 2003. A comparison of smooth and blocky inversion methods in 2D electrical imaging surveys. Exploration Geophysics 34(1): 182–187. https://doi.org/10.1071/EG03182

Metwaly, M., Fouzan, A., 2013. Application of 2-D geoelectrical resistivity tomography for subsurface cavity detection in the eastern part of Saudi Arabia. Geoscience Frontiers, 4: 469-476. https://doi.org/10.1016/j.gsf.2012.12.005

Milsom, J., 2003. Field Geophysics, 3rd Edition, John Wiley and Sons Ltd.

Neville, A.M. 2006. Properties of concrete Pearson Education Limited.

Olaseeni, O.G., Sanuade, O.A., Adebayo, S.S., Oladapo, M.I., 2018. Integrated geoelectric and hydrochemical assessment of Ilokun dumpsite, Ado Ekiti, in southwestern Nigeria. Kuwait Journal of Science, 45(4).

Porsani, J.I., Elis, V.R., Shimeles, J.C., Moura, H.P., 2004. The use of GPR and VES in delineating a contamination plume in a landfill site: a case study in SE Brazil. J Applied Geophys, 55:199-209. https://doi.org/10.1016/j.jappgeo.2003.11.001

Rao, G.T., Rao, V.V., Padalu, G., Dhakate, R., Sarma, S.V. 2014. Application of electrical resistivity tomography methods for delineation of groundwater contamination and potential zones. Arab J Geosci,7:1373–1384. https://doi.org/10.1007/s12517-013-0835-3

Soupios, P.M., Georgakopoulos, P., Papadopoulos, N., Saltas, V., Andeadakis, A., Vallianatos, F., Sarris, A., Makris, J.P., 2007. Use of engineering geophysics to investigate a site for a building foundation. J Geophys Eng, 4: 94–103. https://doi.org/10.1088/1742-2132/4/1/011

Thabit, J.M., Khalid, F.H., 2016. Resistivity imaging survey to delineate subsurface seepage of hydrocarbon contaminated water at Karbala Governorate. Iraq. Environ Earth Sci 75:87. https://doi.org/10.1007/s12665-015-4880-y

Thabit. J.M., Al-Zubedi, A.S., 2015. Evaluation of three important electrode arrays in defining the vertical and horizontal structures in 2D imaging surveys, Iraqi Journal of Science, 56; 1465–1470.

Van Schoor, M., 2002. Detection of sinkhole using 2D electrical resistivity imaging. Journal of Applied Geophysics, 50)4) 393-399. https://doi.org/10.1016/S0926-9851(02)00166-0

Zaidi, F.K., Kassem, O.M., 2012. Use of electrical resistivity tomography in delineating zones of groundwater potential

in arid regions: a case study from Diriyah region of Saudi Arabia. Arab J Geosci, 5:327–333. https://doi.org/10.1007/s12517-010-0165-7

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