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TOPOGRAPHY, DUMPSITES AND GROUNDWATER STUDIES: AN OVERVIEW

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ABSTRACT

This study pictures a critical analysis on how geophysical imaging technique otherwise called tomography is applied on dump site studies to ascertain the level of contamination of groundwater. Imaging often exposes the movement of leachate from the dumpsite through the subsurface. The direct interaction between the leachate and groundwater brings about contamination of groundwater. The geophysical technique applied in defining the leachate migration is thus analyzed.

Keywords: Dumpsite, Tomography, Imaging, Groundwater, Leachate.

INTRODUCTION

Groundwater is the portion of subsurface water which occupies the part of the ground that is fully saturated and flows into a hole under pressure greater than atmospheric pressure. Groundwater occurs in geological formations known as aquifer: an aquifer (gravel/sand) maybe defined as a geologic formation that contains sufficient permeable materials to yield significant quantities of water to wells and springs; this implies an ability to store and transmit water (Chae Y. S, 2000). Groundwater is an important source of drinking water for mankind. It contains over 90% of the fresh water resources and is an

important reserve of good quality water. Groundwater like any other resource, is not just of public health and economic value, it also has an important ecological function (Armon R and Kitty, 1994), hence the need for it to be free from contamination of any kind.

In many of the third world countries like Nigeria, uncontrolled land disposal of solid waste is a common practice. The unregulated waste dumps and landfill causes a number of environmental and human health hazards, the most significant of them being the groundwater contamination. Growing concerns about public health and degrading groundwater quality due to the polluting waste dumps and landfills call for proper method of determining the presence of these contaminants in groundwater in dump sites and septic tanks.

The leachate being the largest lasting emission of waste dump sites (Kylefers et al 2003), is most significant of all waste dump site hazards. The leachate of the open dump yards directly contaminates the ground and surface water resources (N. Rajkumar et al 2010). It becomes part of the groundwater flow system immediately they reach the water table (S. O. Ariyo and E. M. Enikanoselu, 2007). The extent of pollution is greater in high rainfall areas less humid and arid areas, and permeable soil permits rapid movement zone (Ariyo S.O. et al 2007). Leachate corresponds to atmospheric water that has percolated through waste, interacting with bacteriological activity especially organic substances. Its composition is a function of the nature and age of the dumpsite, the type of wastes, the geological nature of the site and the climate (Esmail et al, 2009).

Most groundwater originates from rainfall that has entered the ground. About one- fourth of the quantity of precipitation infiltrates the soil and recharges local aquifers and sediments that store and transport groundwater. Shallow permeable water table aquifers are most susceptible to contamination due to specific site characteristics as, distance from the contamination source to aquifer, residence time of water in the unsaturated area, presence of clay and organic matter in the unsaturated area, potential of a particular contaminant to decompose, amount of precipitation that affects recharge (Ancuta Rotaru et al, 2008).

DISCUSSION

Tomography

This is an imaging technique which generates a cross-sectional picture of an object by utilizing the objects response to non-invasive, non-destructive energy of an external source. In geosciences, tomography is classified by utilized source; Siesmic and radar tomography use wave propagation, electrical resistivity tomography utilizes a static potential field. Tomography is basically applied to saturation where detailed picture of the subsurface is needed.

Electrical Resistivity Tomography (ERT)

Electrical imaging represents a re-emergence of an old technology which has been hampered by high cost compared to other methods. With the present improvement in field equipment design capability, and the development of computer algorithms necessary to effectively and accurately reduce and present the geophysical data. In groundwater studies, ERT is applied in the:

i) Detection of flow of groundwater contamination.

ii) Investigation of waste disposal sites.
iii) Estimation of groundwater movement and contaminated areas.
iv) Estimation of ground compaction and stability.

The data needed is usually collected using ABEM Lund Imaging system (LIS) together with Terrameter SAS 4000. The resistivity imaging survey is conducted around the study area surrounding the dumpsite. Processing and interpretation of data is usually done through the use of computer packages like RES2DIV package (Loke, 1999).

2-D Lund Imaging Survey:

The Lund resistivity imaging system is an automatic electrical imaging suited for automatic resistivity and induced polarization (IP) profiling (ABEM, 2004). It consists of a multi-electrode system for high resolution 2 –D and 3-D resistivity surveys and is used for defining geological structures. Data is obtained for the horizontal and the vertical variation of the resistivity. It involves measuring series of constant separation traverses along the same line but with the electrode spacing being increased with each successive traverse. Increasing separation of electrodes lead to greater depth penetration and therefore the measured apparent resistivities may be used to construct a vertical contoured section displayed the variation of resistivity both laterally and vertically over the section (Barker et al, 2001).

Induced Polarization Tomography:

The inclusion of induced polarization method is to enhance hydrogeological interpretation such as discriminating equally

electrical conductive targets such as electrolytic or metallic ion contaminants plumes. This data is collected simultaneously with the electrical resistivity data in time domain which gives apparent electrical chargeability. The interpretation of IP data can also be achieved through the use of RES2DINV.

Refraction Tomography:

Refraction Tomography uses digital seismographic records to image the interior of the earth. It relies on picking " travel time anomaly" for Seismic energy over that expected from a simple layer earth model. Data is majorly acquired using the ABEM Trarralock MK 6 with local gun powder or sledge hammer as a source of energy and geophones as receivers. Interpretation and analysis of refraction data is usually achieved through the REFLXW package.

CONCLUSION

Tomography gives a more detailed analysis of the subsurface within the area of dumpsites. This is because it presents horizontal and vertical variation of the resistivity of the subsurface. Hence the need to utilize this procedure rather than just vertical electrical sounding which reveals one dimensional model of the subsurface.

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