UNIVERSITI TEKNOLOGI MARA

INVESTIGATION OF THE DIELECTRIC PERMITTIVITY DIVERSITY AGAINST SOIL CONTAMINATION BY GPR DUE TO LNAPL

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Thesis submitted in partial fulfillment
of the requirements for the degree of
Geomatics Science and Surveying

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with theregulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The most crucial parameter to be investigated for environmental engineering survey was the dielectric permittivity of the sub-surface material by using Ground Penetrating Radar (GPR). A limitation occurred on the GPR result when Light Non-Aqueous Phase Liquid (LNAPL) posed into the soil that commonly analysed by dielectric permittivity. Other factors that affected soil contamination parameter were temperature and moisture content which caused the dielectric permittivity diversity in time propagation. This research motivated the contaminated soil investigation with a focus on the temporal dielectric permittivity variation due to the presence of LNAPL. GPR method was used to gain the dielectric permittivity variation with aid of analysis regarding the time-based of LNAPL presence that interacted relatively with the soil moisture and temperature. Diesel filled to contaminate the dry sandy site. GPR measurement carried out by using 800MHz frequency while the temperature and soil moisture reading recorded during scanning. Dielectric permittivity of LNAPL zone retrieved based on dielectric contrast in radargram, GPR signal amplitude, time travel, and electromagnetic wave velocity. Uncontaminated soil permittivity was 9.591 among 13.5% of moisture and 27℃ temperature recorded. Highest dielectric permittivity value identified was 17.674 at the higher moisture percentage and temperature in the last observation. LNAPL caused a high loss of electromagnetic wave scattering, but sometimes increased the radar signal amplitude, and lead the dielectric permittivity to its higher value for larger increment of soil moisture at the saturated sand. By using the average of absolute percentage error, found that the difference between actual and calculated depth of pipe were 0.038% error in average. Root Mean Square (RMS) in velocity analysis resulted 0.045 m/ns correction for a succession of velocity. Normalised Root Mean Square Error (NRMSE) produced 0.089 of similarity between the de-noised and raw GPR data. This research attributed analysis uses for the subsurface engineering and comes about reliable with discoveries from geophysical study that conceivable to recognize contaminant.

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