UNIVERSITI PUTRA MALAYSIA

ASSESSMENT OF SRI PETALING LANDFILL TOWARDS POLLUTION IN AN UNCONFINED AQUIFER

ABDELATIF MOKHTAR AHMED

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ASSESSMENT OF SRI PETALING LANDFILL TOWARDS POLLUTION IN AN UNCONFINED AQUIFER

By

ABDELATIF MOKHTAR AHMED

Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy in the Faculty of Science and Environmental Studies
Universiti Putra Malaysia

January 2001

DEDICATED TO

MY PARENTS, SISTERS AND BROTHERS

AND

TO MY WIFE (AMANI), DAUGHTER (AIA) AND SON (AHMED).

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

ASSESSMENT OF SRI PETALING LANDFILL TOWARDS POLLUTION IN AN UNCONFINED AQUIFER

By

A.M. AHMED

January 2001

Chairman: **Wan Nor Azmin Sulaiman, Ph.D.**

Faculty: **Science and Environmental Studies**

An investigation on the extent of leachate from a landfill towards the surface and groundwater pollution was carried out using resistivity imaging survey. Aquifer parameters determined were porosity, hydraulic conductivity, resistivity and the associated formation factor. The aquifer type was indicated to be an unconfined. It was covered with a superficial layer of hard materials ranged in thickness between 1 and 2 m with high resistivity ranged from 87 to 1726 Ωm. The depth to the aquifer from the surface ranged between 1 and 3 m. The aquifer materials having variable resistivity values ranged between 15 and 150 Ωm, and associated porosity values ranged between 18 and 35%. The aquifer thickness ranged between 14 to 47 m. The bed rock ranged in resistivity between 48.6 and >9329 Ωm and has irregular topography, and its depth from the surface ranged from 20 to 38 m. Resistivity values of rock samples varied between 39 and 1238 Ωm, while for soil samples between 9

and 74 Ωm. The hydraulic conductivity varied between 0.8 x 10^{-8} and 11x 10^{-8} m/sec for rock samples and between 5.2 x 10^{-7} and 23.1 x 10^{-7} m/sec for soil samples. The subsurface porosity distribution of the formation along each line of resistivity survey was also established. Within the landfill groundwater flow was estimated towards the downstream area. Leachate production was interpreted from the resistivity survey lines within the landfill. The leachate migrated following the ground water flow patterns from east to west and from north to south directions. The leachate movement towards the downstream as interpreted from resistivity survey lines was supported by the results of the groundwater chemistry. Chemical analysis of the groundwater revealed that the pH was slightly alkaline downstream (8.1) compared to acidic pH at the upstream bore hole. The Na, K, Ca, Cl concentrations and EC were statistically significant in the downstream area. These results supported the fact of inorganic pollution in the area. No sign of heavy metals pollution in the surface and groundwater. The resistivity survey was also used to interpret the TDS distribution within the landfill and in the regional area. The TDS distribution indicated high ion (up to 15435 mg/l) concentration within the landfill. These high TDS amounts verified the waste decomposition, leachate production and inorganic pollution within the landfill body. Soil exchangeable bases were significantly higher in the downstream saturated zone compared to the vadose zone. With the exception of Cd, the concentration ranges of all trace elements (Cu, Zn, Cr, Pb, and Ni) of the landfill soils were below the upper limits of baseline concentrations as published from different sources.

Abstrak tesis yang dikemukakan Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah.

PENILAIAN TAPAK PELUPUSAN SAMPAH SRI PETALING TERHADAP PENCEMARAN AKUIFER BEBAS

Oleh

A.M.AHMED

Januari 2001

Pengerusi: **Wan Nor Azmin Sulaiman, Ph.D**

Fakulti: **Sains dan Pengajian Alam Sekitar**

Satu kajian telah dijalankan keatas air larut lesap dari tapak pelupusan sampah keatas air permukaan dan air bawah tanah dengan cara pengimejan resistiviti. Antara parameter akuifer yang dikaji ialah keporosan, kekonduksian hidraulik, resistiviti dan faktor formasi yang berkaitan. Daripada kajian ini didapati bahawa sistem akuifer adalah bebas. Ianya diliputi oleh satu lapisan bahan keras dengan ketebalan di antara 1 dan 2 m yang mempunyai resistiviti yang tinggi iaitu dari 87 hingga 1726 Ωm. Kedalaman dari permukaan ke akuifer tersebut adalah di antara 1 dan 3 m. Bahan akuifer tersebut mempunyai nilai resistiviti diantara 15-150 Ωm dan keporosan diantara 18 dan 35%. Tebal lapisan akuifer tersebut adalah diantara 14 hingga 47 m. Batuan dasar mempunyai nilai resistiviti antara 48.6 dan >9329 Ωm dan mempunyai topografi yang tidak seragam dan teletak pada kedalaman dari permukaan di antara 20 hingga 38 m. Nilai resistiviti bagi sample batu berbeza diantara 39 dan 1238 Ωm dan bagi tanah pula dari 9 dan 74 Ωm. Kekonduktiviti hidraulik berbeza dari 0.8 x 10^{-8} and 11 x 10^{-8} m/s untuk sam pel batu dan 5.2 x 10^{-7} dan 23.1 x 10^{-7} m/s untuk sampel tanah. Taburan keporosan sub-permukaan bagi

formasi disepanjang garis kajian resistiviti telah juga ditentukan. Didalam tapak pelupusan didapati air tanah mengalir kearah hilir kawasan tersebut. Penghasilan air larut lesap telah dikesan melalui interpretasi garis kajian resistiviti di dalam kawasan tapak pelupusan. Air larut lesap didapati mengalir mengikut corak pergerakan air tanah iaitu dari arah timur ke barat dan dari utara ke selatan. Interpretasi pergerakan air larut resap melalui garis kajian resistiviti telah dibantu dengan keputusan analisis kimia air tanah. Analisis kimia air tanah menunjukkan pH yang sedikit beralkali (8.1) di bahagian hilir berbanding dengan pH yang berasid di lubang gerundi hulu. Kepekatan Na, K, Ca dan Cl, dan EC didapati secara statistik signifikan di bahagian hilir tapak pelupusan. Keputusan ini membuktikan berlakunya penyemaran bahan tak organic di bahagian hilir. Tiada tanda-tanda yang menunjukkan sebarang pencemaran logam berat samada dalam air permukaan atau pun air bawah tanah. Kajian resistiviti juga digunakan untuk mentafsirkan taburan jumlah pepejal terlarut (TDS) dalam tapak pelupusan dan kawasan berdekatan. Bacaan pepejal terlarut yang lebih tinggi (15435 mg/l) menunjukkan kepekatan ion yang tinggi berlaku dalam tapak pelupusan itu. Ketinggian jumlah TDS yang diperolehi juga mempastikan berlakunya penguraian pelupusan, penghasilan air larut lesap dan pencemaran tak organik dalam badan tapak pelupusan berkenaan. Bes tukarganti tanah di dapati tinggi di zon tepu berbanding zon pengudaraan di bahagian hilir. Kecuali Cd, kepekatan bagi elemen-elemen lain (Cu, Zn, Cr, Pb, dan Ni) di tanah tapak pelupusan adalah dibawah tahap kepekatan tertinggi garisdasar yang dibenarkan seperti yang diterbitkan dari sumber-sumber yang berlainan.

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MOHD. GHAZALI MOHAYIDIN, Ph.D.
Professor
Deputy Dean of Graduate School
Universiti Putra Malaysia

Date:

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