

## Compacted clay liner in sanitary landfill sites

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Landfill is regarded as Best Practicable of Environmental Option (BPEO) in disposing off solid waste and residues from incinerators. All waste disposal methods give negative impacts to the environment, and we have the option to choose one with lesser impacts. There are two perennial problems regarding landfills; leachate and methane gas. Leachate is very harmful and can contaminate soil and groundwater system underneath the landfill sites. In order to control this problem, sanitary (secured) landfills have utilised several types of liner materials such as compacted natural clay (soil) liner, bentonite clay, asphalt, geomembrane and geosynthetic clay liner. The main purpose of using these materials is to prevent the migration of polluted leachate into the surrounding area. Natural soil has several benefits compared to other liner materials, i.e. it acts physically by retarding leachate flow and chemically by sorption processes to attenuate the contaminants. The physical properties of soils are important in relation to their capability to be compacted to attain a minimum requirement of hydraulic conductivity of  $1 \times 10^{-9}$  m/sec.

Meanwhile, the chemical properties of soils are capable of controlling the attenuation of contaminants via various chemical processes namely ionic exchange, precipitation, complexation, and adsorption mechanisms. Soils with high clay contents (>10%) are capable of compacting to densities and permeabilities consistent with the function as a liner. Clay contents influence plasticity, natural moisture content and permeability of the soils. It also greatly affects several chemical parameters of the soils such as the cation exchange capacity (CEC) and specific surface area (SSA). Soils with high pH, high carbonate, organic, and amorphous oxides/hydroxides contents and high CEC-SSA values are favourable for liner materials and to a great extent control the natural attenuation of soils on pollutants.

In Malaysia, there are currently two secured landfill sites that have utilized compacted clay/soil as part of their landfill liner system. The landfill site in Waste Management Centre Bukit Nenas in Negeri Sembilan uses a meter-thick of compacted weathered granitic soil as part

of their liner. This *state-of-the-art* landfill is currently used to receive slags and ashes produced from the burning of toxic wastes (scheduled wastes) in their incinerator. This center has become the only place to receive toxic chemical wastes from factories in Peninsular Malaysia. Another example of sanitary landfills is Air Hitam Sanitary Landfill in Selangor, which is managed by Worldwide Landfills Sdn. Bhd. It utilizes weathered metasediment from Kenny Hill Formation as compacted clay liner. It is only used for disposal of domestic waste (municipal solid waste) from seven councils within the Klang Valley.

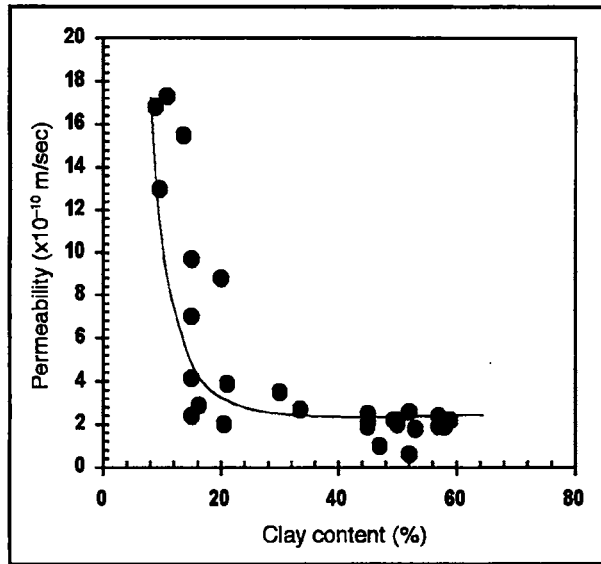


Figure 1. The relationship between permeability and clay content for all soil samples used in this study.

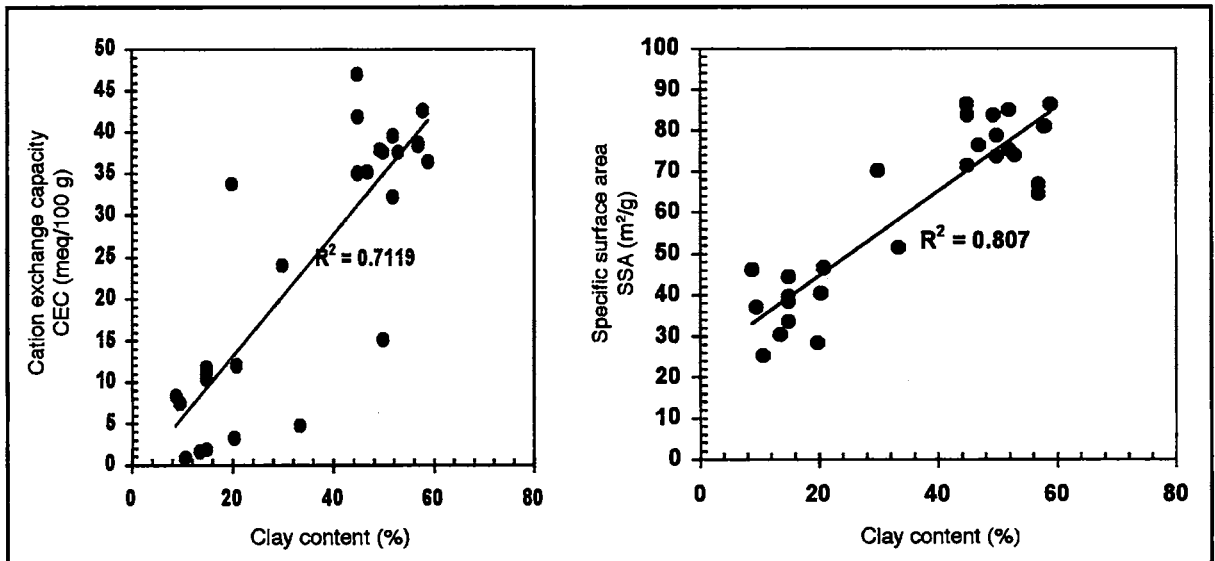


Figure 2. Linear correlation between the clay content with cation exchange capacity (CEC) and specific surface area (SSA).

