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Study on the gas transport parameters of final cover soil of Maharagama landfill

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Gas exchange through the final compacted cover soil barrier plays a vital role for gas emission, fate and transport of toxic landfill gases. In Sri Lanka, engineered landfills are not usually available and the common procedure is to cover the waste with a good cover soil without providing gas venting facilities. This can be found at Mahargama dumpsite too. Once municipal solid waste is placed in a landfill, a complex sequence of biologically, chemically and physically mediated events occur relating to hazardous gaseous and liquid landfill emissions. Hence, cover soil of the landfill plays a major role in emission of landfill gases, because once the solid waste is covered with the soil, these gases are released to the atmosphere with high pressure, through this cover soil. Therefore, studying the cover soil parameters are of paramount importance in evaluating its future gas diffusion. The soil gas diffusion coefficient (D_p) and Air Permeability (K_a) govern the transport and emission of Green House gases and volatile organic chemicals in the unsaturated zone. In this study, soil gas diffusivity (D_p/D_o, D_o is gas diffusion coefficient in free air) and Air Permeability was measured in the soil which was used to construct Maharagama landfill site cover filling. Measurements were done in repacked samples at soil water matric potentials from pF= 1, 2, 3, 4.1 (pF=-LogΨ), air dried and oven dried condition. Air content was varied from 0 to 0.2 $m^3\ m^{-3}$. Gas diffusivity is changed from 0 to 0.05. Air Permeability varies from 0 to 70 μm^2. With the soil air content, gas diffusivity is gradually increased and the air permeability was monotonically increased. Soil air permeability was affected by the soil structure properties as well. The increase of dry bulk density and reduction of water content increases the amount of soil air content and hence increased the soil gas transport parameters. Methane concentrations in the atmosphere at several points were measured in order to produce a methane concentration contour map to identify the gas emission from the landfill site and the in-situ air permeability was measured in several points of the site for the comparison of in-situ and laboratory measurements.

The measured k_a values for differently compacted-samples were highly affected by compaction levels and sample preparation methods. Based on the model tests, a simple and single-parameter Buckingham based k_a model seems practically useful for predicting k_a values for differently-compacted soils at the landfill final cover. Besides, equivalent diameters d_{eq} for gas flow were calculated from the measured D_p/D_0 and k_a values. The d_{eq} seems to be a useful index to understand the effects of soil compaction especially on the gas advection as well as the structure changes due to the compaction in differently-compacted soils at the landfill final cover.

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