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Characteristics of Leachate Infiltration through the Red Earth Profiles: A Laboratory Based Study

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Abstract

Municipal Solid Waste (MSW) management is a severe problem in Sri Lanka. As a remedy, a new sanitary landfill is planning to implement in Aruwakkalu, Puttalam district for dumping the Colombo MSW. Aruwakkalu area is covering Natural Red Earth (NRE), which considered as a strong adsorbent. However leachate released from possible MSW dump has significant threat on the environment. Therefore, this study is aim to identify possible leachate infiltration characteristics under different density profiles of NRE. The laboratory scale experimental design was conducted with five filter columns that filled with NRE, which was collected from Aruwakkalu area. The columns were filled up to 10 inches height under selected density range that occurred in NRE (1.4 gcm^{-3} - 1.6 gcm^{-3}). Leachate from Karadiyana landfill site was diluted 50% and 200 ml of leachates were added to each column while maintaining standard flow, filtrate were collected from each column for chemical and physical analyses. Approximately two days interval was maintained between leachate each feeding events and sampling of the filtrate. Experiment was conducted few months until major physical and chemical changes that occurred in filtrate and NRE columns. NRE characteristics such as surface chemistry, particle size and shape were studied using Scanning Electron Microscope (SEM). X-ray Florescence analysis (XRF) was done to identify total chemistry. Elusion analyses were conducted under different pH to investigate soluble fractions of NRE. Further, Fourier-Transform infrared spectroscopy (FTIR) analyses were done to study adsorption sites. X-ray Diffraction analyses (XRD) were done to identify secondary minerals present in NRE. Cation Exchange Capacity (CEC) was studied for NRE samples using laboratory experimental setup. Atomic Absorption Spectroscopy (AAS), multiparameter electrodes and Spectrophotometer were used to study leachate and filtrate such as Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solid (TDS), conductivity, pH, salinity, Oxidation-Reduction Potential (ORP), phosphate, nitrate, and other selected elements (Fe, Zn, Pb, Cu, and Ni). Results indicate a significant reduction of conductivity and TDS from the filtered leachates in different soil columns. It has been noted, gradual incensement of TDS and conductivity with the time, however compare to raw leachate values are small in the filtrate. There were no considerable changes of pH with time. Selected anionic and cationic parameters reflect progressive and regressive changes during the period of experiment due to different process in the soil columns. Time taken for the percolation of leachate from each soil column was increased with the time due to compaction of soil with the continuous addition of leachate.

Keywords: Red earth, Leachate, Landfill, Soil column,