

Article

Leaching Behaviour of Synthetic Leachate through a Sewage Sludge and Red Gypsum Composite as Intermediate Landfill Cover

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Abstract: This paper examines the environmental impact of the use of compacted sewage sludge: red gypsum (SS:RG) mixture as intermediate landfill cover in terms of yield and quality of leachate as characterised by hydraulic conductivity and leaching behaviour. A series of column tests using the constant head method is carried out by percolating the synthetic leachate through samples that have been compacted at various degrees (60, 70, 75, 80 and 85%). The leachate quality is monitored at pre-determined days for pH, COD, Cu, Fe and Zn. In general, hydraulic conductivity decreases in three stages, in which the first stage is mainly attributed to the particle rearrangement and hydration of calcium silicate hydrate (CSH). The hydration of CSH increases the pH, which causes the heavy metal to precipitate and be entrapped within the matrices of CSH gel, thereby further reducing the porosity and hydraulic conductivity. A minimum of 75% compaction has shown favourable final porosity, hydraulic conductivity, and leachate quality, although a minimum of 80% compaction is recommended in order to achieve a satisfactory compressive strength of greater than 345 kPa for a landfill operation.

Keywords: degree of compaction; intermediate landfill cover; hydraulic conductivity; leaching behaviour



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1. Introduction

A cover system is customarily employed to isolate the landfilled waste from the surface environment, which can be categorised as the daily, intermediate, and final covers. The primary function of the daily cover is to seclude the landfilled waste from pests and rodents as well as to minimise the odour for the night before the commencement of the new operation the next day. Therefore, daily cover requires a minimum thickness of soil but not much concern on the specification of hydraulic conductivity, as the reduction in the precipitation of rainwater is not its main purpose. For the final cover, which is applied after the completion of a landfill, it needs to be compacted to achieve a permeability of less than 10^{-7} cm/s to mitigate the emission of landfill gas and the infiltration of rainwater as well as leachate yield by diverting the rainwater to surface runoff [1–3].

An intermediate cover, on the other hand, is a permanent layer applied on compacted waste in a landfill cell for a period between 7 and 180 days during landfill work progression [3]. It is designed to control the infiltration of rainwater and to provide access to heavy