ANALYTICAL MODELLING OF INORGANIC CONTAMINANTS IN LEACHATE

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The need for estimating the contaminant concentration of leachates from landfills has rapidly become important because of the increased demand for landfilling, causing serious pollution of water bodies in some places. The present study examines the movement of inorganics from waste into leachate in the course of time. Inorganics are discussed in two groups according to their solubilities in water. The first group of inorganics dissolve immediately in water (i.e. at time \( t = 0 \)). The inorganic compounds of the second group transfer into water over a longer period of time. The mathematical model is based on a porous and well-mixed medium, and on assumptions of dissolution dilution and mass transfer according to their infiltration rate. The agreement between theoretical and experimental results from laboratory and literature are investigated. After experimental verification, some mathematical relationships to predict the mass transfer coefficient \( (k) \) and maximum concentration \( (C_{\text{max}}) \) were also investigated.

Key Words—Landfills, leachate, mathematical modelling, inorganics, chloride, sodium, potassium, total solids, seasonal wastes.

Introduction

Landfilling is the ultimate facility in any solid waste disposal system. Leachate production with the application of this disposal technique becomes a very important problem for the environment. Changes in leachate pollutant characteristics with fill age cause difficulties in estimating the leachate hazards to groundwater and selection of the appropriate leachate treatment. For this reason, it is important to determine the changes in leachate quality with fill age in modelling studies. For this purpose, many experimental studies have been made under natural and laboratory conditions. In all these experimental studies, results have varied depending on ambient conditions and the physical and chemical compositions of the experimental materials used. Mathematical modelling studies which have been made by several investigators (Qasim & Burchinal 1970, Raveh & Avnimelech 1970, Wigh 1979, Lu et al. 1982) offer empirical and semi-empirical simulations obtained from experimental results. In these works, particular mathematical equations dealing with only their own experimental data were obtained. A comprehensive study was made by Straub & Lynch in 1982. They theoretically simulated various experimental data found in literature. Their study was composed of two different models. The first model was based on the assumption of a well mixed single reactor. These investigators have recommended an analytical solution and have used this solution to obtain approximate simulated curves. In the other model, the governing equation, which is widely used for unsaturated porous media by soil physicists, has been numerically examined, and good agreement with data from the literature has been
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