Numerical Simulation Of Field-Scale Landfill Gas Emission

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Abstract

Controlling the odiferous landfill gas (LFG) [e.g., Hydrogen sulfide (H2S)] emission is an important environmental issue during operating a municipal solid waste (MSW) landfill. A combination of LFG collection system and landfill cover has been an adapted method to mitigate the issue nowadays. However, the efficiency of the combination is uncertain sometimes and there is a significant amount of fugitive LFG emitted in the operation. Recently, a co-extruded geomembrane comprised of a thin inner layer (0.05 mm) of ethylene-vinyl alcohol (EVOH) sandwiched between two layers of linear low-density polyethylene (LLDPE) overlain by 0.3-m silty soil has been introduced to enhance the performance of the system.

In this study, H2S transport through different intermediate covers with the gas collection system was evaluated using COMSOL Multiphysics®, Transport of Diluted Species in Porous Media and Darcy's Law interfaces. Coupled processes employing advective and diffusive flow of LFG was used to describe realistic transport close to the field condition. Six different configurations for the system, including soil alone, LLDPE, or co-extruded EVOH geomembrane cover with or without gas collection system, were numerically investigated. Also, the flux and concentration through the cover systems were compared in terms of different distances of gas well to evaluate the effect of gas collection system on controlling LFG emission. Predictions made with a numerical simulation parameterized by experimental data indicate that gas fluxes from intermediate landfill covers with the EVOH geomembrane are approximately two orders of magnitude lower than gas fluxes from an intermediate cover with the conventional LLDPE geomembrane. The co-extruded EVOH geomembranes with gas collection system can be more effective at reducing the emission of H2S relative to the LLDPE alone cover.