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System Dynamics Modeling of Dumpsite Leachate Control in Ogbomosoland, Nigeria

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ABSTRACT

Leachate pollution from landfills is a major source of environmental hazard in many Nigerian municipalities and there is the need to mitigate its effects. The aim of this study is to examine the leachate pollution and determine the effectiveness of liner system in leachate management of dumpsites in Ogbomosoland. The method of modeling using principles of system dynamics was employed to determine the interrelationships of leachate generation components for 50 years. Causal loops indicating the linkage of population, economic status, waste generation per capita and weather conditions to wastes and leachate generation were developed. A set of state model equations for Gas Produced (G_p), Precipitation (P_t), Degradation water-loss (W_g), Leachate Quantity (LQ_n), were formulated. Leachate management strategies of liner systems were studied, and the effectiveness of Compacted Clay (CC), High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Geosynthetic Clay (GC), Silt (SI), Sandy loam (SL), and Sand (SA) liners were examined. A user-friendly computer program for estimating leachate generation per time and breakthrough time for liners was then developed. The results showed that a direct relationship exists between leachate and G_p , P_t , W_g and LQ_n . Average leachate breakthrough times for the liners, in years, were CC (41.5), HDPE (14.0), LDPE (10.0), GC (1.1), SI (0.1), SL (0.01), and SA (0.00002). In conclusion, dumpsite leachate pollution was established as having negative effects on the groundwater resource. Compacted Clay liner is therefore recommended for use in curtailing its menace.

KEYWORDS

System Dynamics; Dumpsite; Leachate; Pollution; Ogbomosoland

Cite this paper

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