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AN ABSTRACT OF A DISSERTATION

FIRST PRINCIPLES AND ARTIFICIAL NEURAL NETWORKS MODELING OF
WASTE TEMPERATURES IN A FORCED-AERATION LANDFILL BIOREACTOR

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Williamson County, Tennessee, has established a 2.4-hectare forced-aeration landfill bioreactor on its county landfill site. This bioreactor system consists of vertical wells placed into the landfill to inject compressed air and leachate in an effort to attempt to aerobically degrade the wastes. Temperatures were used as a feedback parameter for the operation of the bioreactor system.

Over the past five years of operation, leachate from the bioreactor has steadily matured. When the air-header system was secure, with no air leaks, evidence of good air distribution between injection wells was established, and methane gas volumes dramatically decreased while internal temperatures steadily rose. Analysis of solid waste samples revealed statistically significant decreases in volatile solids, cellulose, lignin, and respirometry. When comparing the kinetic values typical for conventional landfills with the empirical kinetic values derived from this research, the use of bioreactor technology has substantially decreased the amount of time required for waste stabilization.

A mechanistic mathematical model, an artificial neural network model, and a Hybrid, semi-mechanistic, model were developed to predict waste temperatures for an aerated landfill bioreactor. Model error residuals from the Hybrid model were much less than the residuals from the mechanistic and ANN models.