EVALUATION OF LONG-TERM MONITORING DATA FROM FULL-SCALE MSW LANDFILLS WITH LEACHATE RECIRCULATION

J.W.F. MORRIS
jmorris@geosyntec.com
GeoSyntec Consultants, Columbia, Maryland, USA
N.C.VASUKI
Delaware Solid Waste Authority, Dover, Delaware, USA
J. A. BAKER
Waste Management, Inc., Lombard, Illinois, USA

Introduction and Objectives

US (and other) regulations imply that a discontinuation or reduction in post-closure monitoring and care requirements at municipal solid waste (MSW) landfills will be allowed once it can be satisfactorily demonstrated that a landfill is stable. Currently, proposed technical criteria for defining long-term landfill stability tend to focus on the characteristics of leachate and gas emissions from relatively old, stable waste. Interest in leachate recirculation and bioreactor landfills is intensifying in the US because waste decomposition, and hence the time to stabilization, is accelerated in these types of landfills. This paper presents findings from full-scale MSW landfill facilities with leachate recirculation. The data are compared to proposed stability criteria. Attention is also drawn to significant areas of uncertainty that are often overlooked.

Description of Landfill Facilities and Data Availability

The landfill facilities are located at the Delaware Solid Waste Authority's Central Solid Waste Management Center near Sandtown, Kent County, Delaware.

Area A/B Disposal Cells. Waste disposal at the two cells comprising the 9-acre Area A/B was conducted between October 1980 and October 1988. Leachate recirculation into the waste body occurred between June 1986 and March 1995. Various data on: (i) waste placement and landfill construction; (ii) leachate recirculation, production, and quality; (iii) gas generation and composition; and (iv) whole-area settlement were available for the period August 1983 through August 2001.

Test Cells 1 and 2. The 1-acre test cells were constructed between August 1989 and August 1990. Leachate recirculation occurred in Cell 1 between August 1990 and October 1996 (Cell 2 was a dry control cell). The test cells were dismantled between October 1996 and October 1998. Extensive data on: (i) test cell construction; (ii) leachate recirculation, production, and quality; (iii) gas generation and composition; and (iv) waste settlement were available for the period August 1989 through October 1996. A time capsule study of waste degradation in each cell was also conducted.

Three Proposed Technical Criteria for Waste Stability

Characteristics of Leachate. The proposed criteria are that concentrations of selected parameters from the major categories of contaminants in landfill leachate must be equal to or below typical concentrations in leachate from well-decomposed MSW. Six parameters were selected: (i) pH and specific conductance; (ii) dissolved organic matter (e.g., BOD and COD); and (iii) inorganic macrocomponents (e.g., ammonia and nitrate). No heavy metals or xenobiotic organic compounds (XOCs) are selected because their concentrations are generally low and depend significantly on waste composition.

Characteristics of Gas. The proposed stability criteria are that: (i) cumulative gas generation must have exceeded 95 percent of the theoretical total amount; and (ii) that the current generation rate must be less than 5 percent of the peak rate.

Landfill Settlement. It is proposed that settlement is complete when the percentage of settlement during the last year is less than 5 percent of the total settlement recorded since the last placement of waste.

Data Evaluation and Findings

Data were evaluated with respect to the three criteria outlined above. Data from the leachate recirculation and non-recirculation test cells were also directly compared in order to assess the effects of leachate recirculation on waste stability and estimate the efficiency of recirculation.

Area A/B Disposal Cells. With the exception of ammonia, it was found that the concentrations of the selected stability parameters in leachate were at or below typical values. Gas data, which was limited, generally agreed well with modeled predictions, although application of the gas stability criteria suggests that waste stabilization is a long way off. Annual settlement in 2001 was 2 percent of the total post-closure settlement.

Test Cells 1 and 2. Significant differences in gas volumes and the extent of waste degradation in the time capsule study were noticed between Cells 1 and 2. Leachate quality did not vary significantly between the two cells (with the exception of pH and ammonia). Based on an investigation of settlement and the behavior of leachate and gas production, it was concluded that the recirculation efficiency in Cell 1 was poor.

Further Research Questions

Stability criteria for ammonia may have to be met in terms of mass flux rather than concentrations. Does this imply the need to control leachate production (i.e., perpetual cap maintenance)?

A detailed investigation into mechanisms of preferential flow of recirculated leachate through the landfilled waste mass, and how such preferential flow may be minimized, is needed in light of the findings from Test Cell 1.