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Project Summary

Comparison of Leachate Characteristics from Selected Municipal Solid Waste Test Cells

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Leachate characteristics were compared for samples taken from a municipal solid waste test cell at Boone County, Kentucky, and for samples from other similar research projects. Leachate concentrations and mass removals from five test cells were compared for at least three chemical parameters. Weighted mean concentration histories were compared both graphically and with a simple mathematical description of the concentration trend over time. Cell performances were not identical, but the normalized leachate data did indicate repetitive trends and a range of performance.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The Boone County Field Site (BCFS) was established to investigate production of leachate from municipal solid waste test cells and other environmental effects of landfills. Research was also conducted to determine the effect of cell size on leachate characteristics and history and to compare the performance of identical small-scale cells. Five municipal solid waste test cells were constructed during 1971 and 1972. The research was concluded and the site was closed in September 1980.

One of the primary conclusions reached in the Boone County study was that most of the leachate constituent concentration histories showed generally similar trends. The concentration history appeared to be based more on cumulative leachate volume rather than on time. Results also indicated that both identical cells and different-sized cells demonstrated a range of leachate behavior rather than statistical similarity. The object of this study was to compare results from other municipal refuse test cells with those of the BCFS to determine whether leachate characteristics were similar over a wider range of experimental conditions.

Two of the BCFS cells and three additional test cells were chosen for comparison. One was a field-scale cell constructed in Sonoma County, California, during 1971. The two other were from small-scale municipal refuse cell research conducted at Georgia Institute of Technology in Atlanta, Georgia, by Frederick G. Pohland, and the U.S. Environmental Protection Agency (EPA) Center Hill Research facility in Cincinnati, Ohio. Data for the selected test cells are summarized in Table 1.

For these five cells, only chemical oxygen demand (COD), chloride, and iron were analyzed on a regular basis throughout the entire project period for all five studies. As a result, comparative analysis of leachate composition had to be limited in scope.

Findings

Typical weighted mean concentration histories and mass removal plots are shown in Figures 1 through 4. Data are displayed as a function of cumulative leachate volume rather than of time.

Table 1. *Summary of Test Cell Data*

Test Cell	Avg. Annual Leachate (L/kg dry refuse)	Refuse Mass Dry Weight (kg)	Max Refuse Depth (m)	Refuse Dry Density (kg/m^3)
BCFS #1	0 57	286,000	2 56	429
Sonoma Co Cell C	1 91	352,000	2.62	460
BCFS #2B	0.58	2,113	2.56	314
Georgia Institute of Technology Control Cell	2.15*	636*	3.28	186
Center Hill #4	0.99	1,855	2.4	290

*Estimated Values

Leachate volume and mass removals have been normalized by dividing by the dry weight of refuse in the cell. Leachate volume and mass removal from the control cell at Georgia Institute of Technology had to be estimated since leachate volumes were not recorded.

Graphic comparisons of weighted mean concentration histories and mass removals for the two field-scale cells indicated performance similarity for COD, sodium, potassium, and ammonia-N. Chloride concentrations and mass removals had similar trends, but the Sonoma data were very erratic during the late portions of the study. Iron concentrations showed little similarity. Indications were that iron concentrations were diluted by higher rates of leachate flow, apparently because of a time-dependent rate of iron availability from the refuse mass. Calcium removals in the Sonoma study were only 60% of those in the Boone County field cell, perhaps because of dilution from higher leachate production. Ammonia-N removal differed by only 15% at a cumulative leachate volume of 4.5 L/kg of dry refuse.

Graphic comparisons of leachate characteristics from the small-scale cells were limited to the Boone County and Center Hill studies because of lack of leachate volume data from the work at Georgia Institute of Technology. Weighted mean concentrations for COD for Boone County and Center Hill had similar peaks at field capacity followed by comparable downward trends. Mass removals were almost identical over the full range of the study. COD mass removed from the field-scale cells was only 60% of that from the two small cells. Peak concentrations of chloride in the two small cells were only slightly different, but the concentrations in the Boone County cell tended to be higher throughout the study period, resulting in a mass removal almost twice that recorded at Center Hill. Iron showed very little similarity in concentration or mass removal, perhaps because of limited solubility and subsequent dilution in the higher flow Center Hill cell.

Cell performance was also compared using a simple exponential equation describing the leachate constituent concentration trends. The equation correlated reasonably well with the leachate history data over time (from the point at which the cells achieved field capacity to a cumulative leachate volume of 4.5 L/kg of dry refuse). This correlation was demonstrated by the fact that 13 of the 20 curve fittings had correlation coefficients of 0.95 or greater. Lower peak concentrations at field capacity were generally predicted for cells with the highest leachate production rates. The mass generation rate constant in the equation increased with higher leachate flow rate. Further modifications to the equation were needed to make more definitive performance comparisons.

The full report was submitted in fulfillment of Purchase Order No. C2652NAST by Regional Services Corporation, Inc., under sponsorship of the U.S. Environmental Protection Agency.

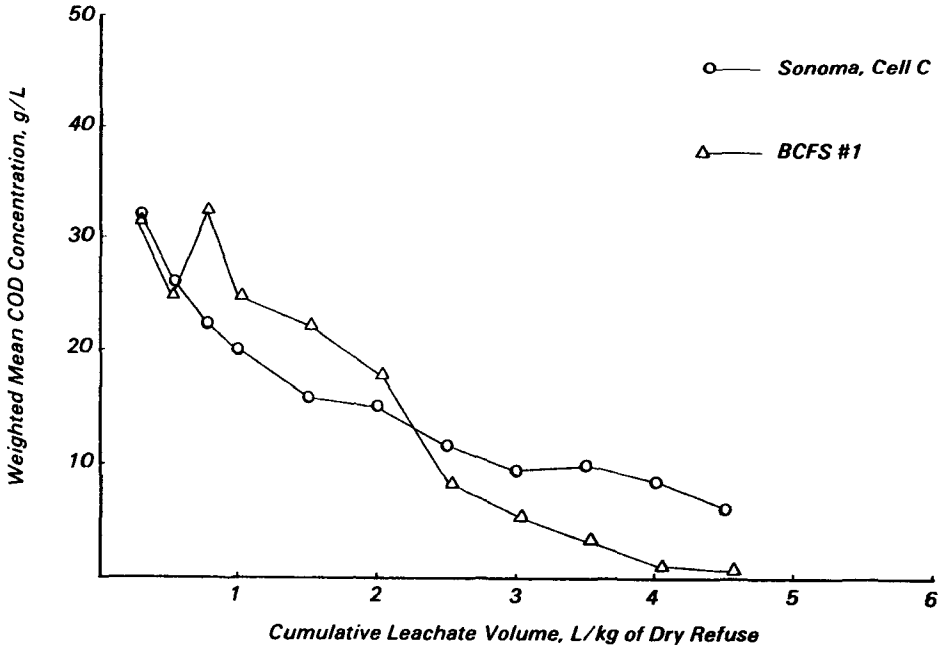

Figure 1. *COD concentration history.*

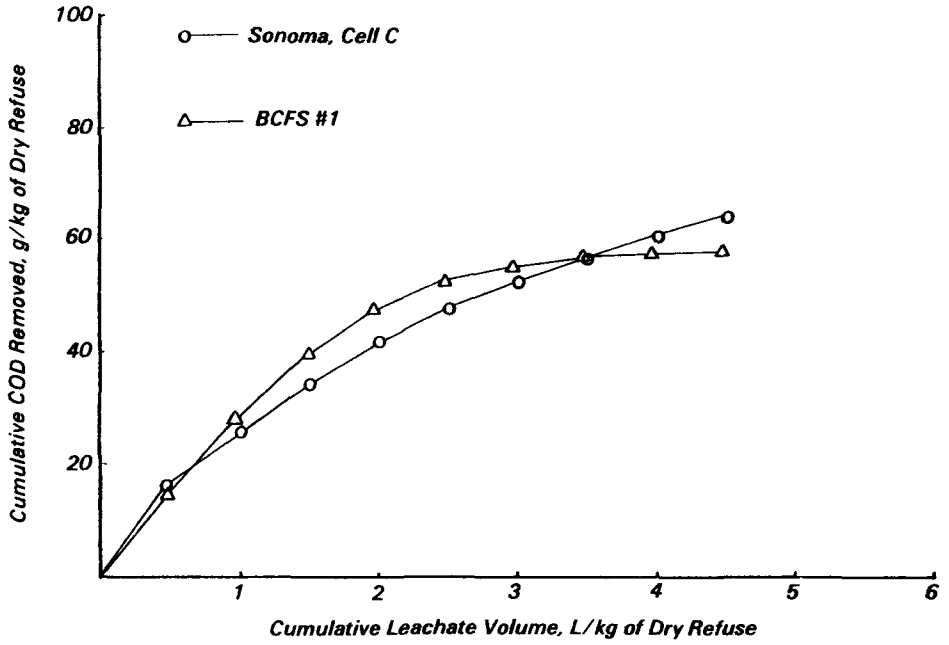

Figure 2. *COD mass removal.*

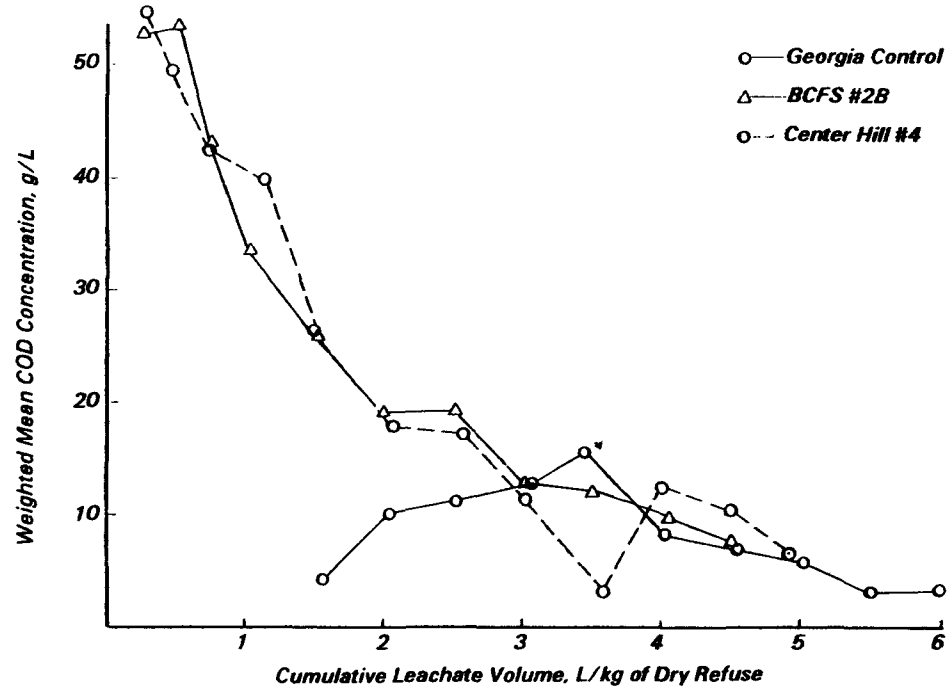

Figure 3. *Small cell COD concentration history.*

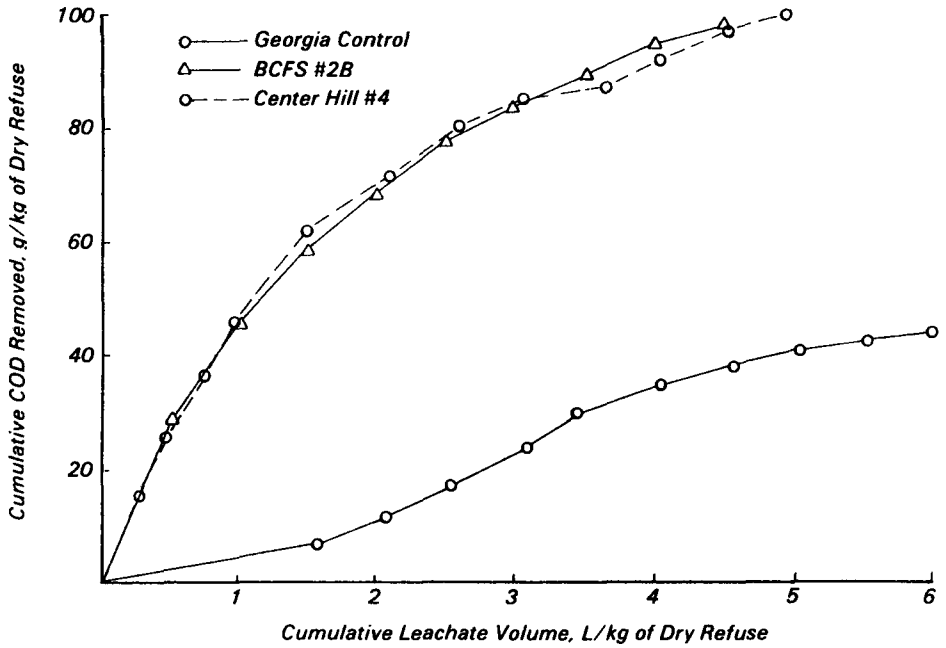

Figure 4. Small cell COD mass removal.

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***Norma M. Lewis** is the EPA Project Officer (see below).*
The complete report, entitled "Comparison of Leachate Characteristics from Selected Municipal Solid Waste Test Cells," (Order No. PB 84-220 276; Cost: $10.00, subject to change) will be available only from:
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