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Project Summary

Evaluation of Processed Municipal Wastes in Landfill Cells

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This project demonstrated the decomposition effect of preprocessing landfilled wastes as relates to leachate and gas production and the concentrations of the waste constituents in those leachates and gases. The study was performed in Franklin, Ohio, where five landfill test cells (buried concrete landfill simulators) were monitored. These five concrete test cells contained municipal refuse which was processed as follows: (1) shredded and baled; (2) baled; (3) baled and saturated with water; (4) shredded; and (5) unprocessed. These processing methods were evaluated by collecting leachate and gas samples to determine moisture balances, leachate pollutant concentrations, and gas compositions.

Compared with unprocessed wastes, the baled wastes produced large quantities of dilute leachate, and the shredded wastes produced smaller quantities of more concentrated leachate. Gas composition data from the wastes were inconclusive because of numerous gas leaks and the small volume of gas produced in the system.

This Project Summary was developed by EPA's Hazardous Waste Engineering 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

Municipal solid waste (MSW) that is placed in a landfill initially decomposes under aerobic conditions. This process slows down as the available oxygen is exhausted, and anaerobic decomposition commences. With the onset of anaerobic digestion, gas is liberated in the form of methane, carbon dioxide and trace gases such as hydrogen sulfide. The generation of these gases presents potential problems in the physical area of the landfill site, mainly because of the methane content. Methane forms an explosive combination with the oxygen in air when present in concentrations of 5 to 15 percent. Thus it is important to determine the amount and rate at which methane is produced in a landfill situation. To calculate these data, quantitative and qualitative information is needed on both the methane produced and the other gaseous components involved.

Landfills will produce leachate when subjected to precipitation. This leachate is formed by the dissolution of both organic and inorganic materials as the water infiltrates the waste layers of the landfill area. The leachate will continue its filtration through the landfill, ultimately moving out of the fill area and into the surrounding soil. Since the leachate could contain large amounts of heavy metals, pesticides, or herbicides, contamination of both surface and subsurface water is a distinct possibility.

Methods and Materials

Three preprocessing steps for MSW were evaluated i.e., shredding, shredding and baling, and baling alone. Also studied was the effect of a saturated landfill environment on gas and leachate production. All data were compared with those obtained from untreated wastes as a control.

The facility designed to accomplish this goal consisted of five identical, concrete, in-ground test cells large enough to contain approximately 10,000 kg of municipal solid waste in a simulated landfill configuration. See Figures 1 and 2 for facility layout and design, respectively.

A larger instrumentation cell of similar design was also constructed to collect data, gas samples, and leachate.

The following type of pretreated solid waste was placed in each of the five test cells.

Cell	Type of Pretreatment
1	Shredding and Baling
2	Baling
3	Baling (saturated conditions)
4	Shredding
5	No pretreatment

To help ensure waste uniformity, the initial concept was to obtain all the solid waste from the City of Oakwood, Ohio. During the early phase of the project, the local baling facility was damaged by fire. New facilities were found in Georgia: a baling facility in Cobb County and a shredder facility in DeKalb County. The MSW was first shredded and then transported to the test site in Franklin, Ohio. Because of the extremely complex logistics (including material, equipment, and personnel requirements) as well as the financial requirements, it became impracticable to obtain nonbaled MSW from this same source. Instead, the nonbaled MSW was obtained from the original source, Oakwood, Ohio.

An additional requirement of the contract called for the characterization of the solid waste at the different facilities. Therefore, provisions were made for handsorting the solid waste at each facility from which waste was obtained. Three of these sorts were performed for each facility in order to better categorize the solid waste used in this study. A comparison of the results of the waste categorization procedures is illustrated in Figure 3.

Once the cells were filled and instrumented, they were sealed and the test monitoring was initiated. During the test period, all cells but No. 3 were subjected to moisture additions and drainage that approximated the net infiltration pattern of landfills in the midwestern United States.

Results

Nearly 6 years of monitoring the effects of preprocessing MSW resulted in data that may affect both future landfill simulation studies and landfill technology in general.

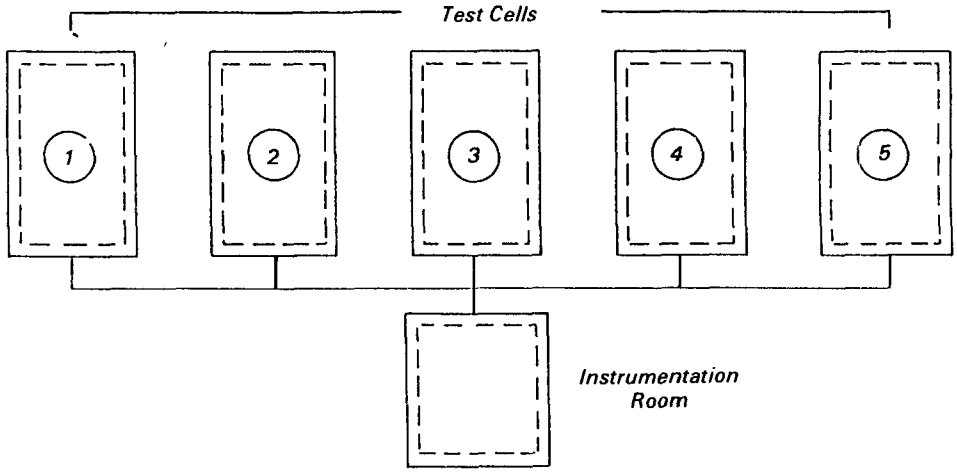

Figure 1. Test cell arrangement.

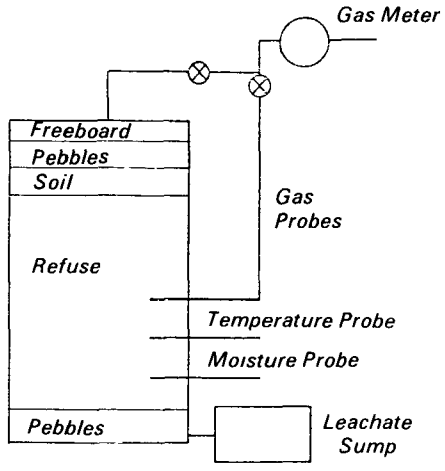

Figure 2. Stylized diagram of test cell.

This study concluded that temperature differences among wastes in landfill simulators need not be taken into account when evaluating waste processing methods. The temperature data collected in this study indicated that the baled cells had higher initial temperatures than the nonbaled test cells because of aerobic decomposition. After this initial stabilization period, no major temperature differences existed between the cells at any one time. Of course, seasonal changes occurred in the internal temperatures of the cells, but each cell matched its neighbor very closely.

When compared with unprocessed wastes, the baled wastes produced large quantities of dilute leachate and the shredded wastes produced smaller quantities of more concentrated leachate. Leachate from waste that was both baled and saturated with water was similar to the unprocessed waste in leachate volume and concentration. Gas composition data from the wastes were inconclusive because of numerous gas leaks and the small volume of gas produced in the system. Recommendations are included to alleviate this problem for future landfill situations.

Conclusions

In summary, the data indicate that baling alone and shredding alone are the processes to consider when designing sanitary landfills. A locality should choose a preprocessing method based on the rate of leaching desired in that area.

Although collection of volume data was plagued by a constant battle to maintain gas-sealed test cells over nearly 6 years of monitoring, this study yielded valuable information for future researchers who must construct test facilities to study gas generation in a landfill environment. The following recommendations are made for the construction of future gas-tight test cells and for collecting accurate gas measurements:

1. Landfill test cells should be constructed of steel rather than concrete to eliminate the possibility of cracks developing as a result of ground settling.

2. All gas collection lines should consist of metal tubing with high-quality tube fittings.

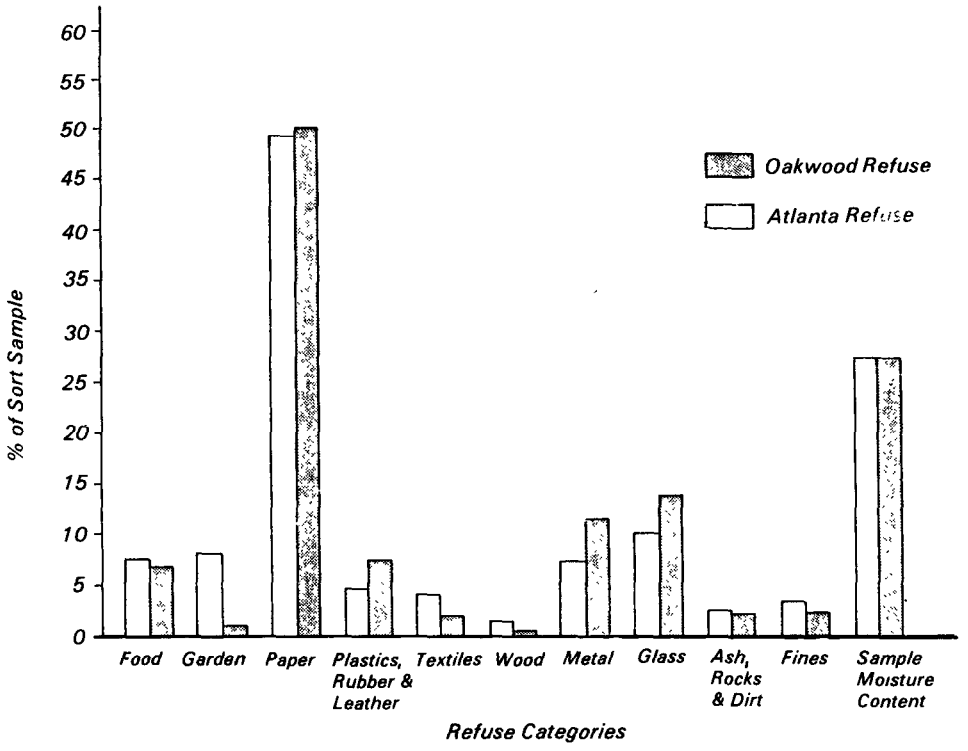

Figure 3. *Refuse composition comparison.*

3. All gas should be collected with aluminized plastic or Tedlar* gas bags rather than direct connections to gas meters.

4. Continuous welding should be used in any areas that require sealing, such as the test cell lids.

5. In any case where welding is not feasible, the surfaces to be sealed should be smooth and unnotched to ensure positive placement of any gasket material. Such gasketed surfaces should incorporate a sealant and be drawn together with a bolt-and-nut arrangement.

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***Dirk Brunner** and **Norma Lewis** were the EPA Project Officers (see below).*
The complete report, entitled "Evaluation of Processed Municipal Wastes in Landfill Cells," (Order No. PB 85-117109; Cost: $11.50, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
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*For further information, contact **Norbert B. Shomaker** at:*
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