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Project Summary

Optional Cost Models for Landfill Disposal of Municipal Solid Waste

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Forty-five landfills and associated transfer stations, balers, shredders, and transportation networks were analyzed to determine costs for building and operating a landfill and to identify the factors that have the greatest impacts on those costs. The landfills studied ranged in size from under 100 to more than 5000 tons per day and were located across the continental United States.

A primary concern of the study was to determine whether baling or shredding reduced landfill costs. Analysis of the data indicates that any savings incurred at the landfill, due to prior baling or shredding, usually does not compensate for the added cost of these more sophisticated processing facilities for the average case. On the other hand, baling or shredding might be feasible in a situation where component costs for the entire landfilling system are high.

Another important finding is that landfilling is only a small portion of total costs. On the average, both the haul and the processing components of the system are more expensive than the landfilling component.

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

All steps in solid waste management cost money. An effective manager will try to find the system that acceptably handles wastes at minimum cost. But the number of options is large, and detailed engineering studies of every option are expensive. Simple methods are needed to structure the various options and estimate rough costs for each step so that extravagant options can be eliminated. The remaining possibilities can then be analyzed in depth.

This project was designed to determine the average costs of each option. Cost data were collected and analyzed from 45 operating solid waste management facilities, and methods were developed to relate these findings to other local community information. The methods make it possible to compare the costs of systems with direct haul, transfer stations, balers, shredders, and various landfill locations and characteristics. Incinerators and systems with significant resource recovery were not included in this study.

Waste is generated along various collection routes and hauled in the collection trucks to a processing facility or a landfill. If the waste is processed, it is then transported in large vehicles to the landfill. Three types of processing were studied—transfer, bailing, and shredding. The landfilling costs depend on the types of processing as well as the landfill design (depth, number of lifts, etc.). Landfill construction costs, including liners, leachate control systems, excavation, and other site-related costs, depend on site conditions.

Site Selection

The original plan called for the collection of data from nine sites for each of the following five solid waste management schemes, for a total of 45 sites:

- Direct haul systems
- Transfer stations
- Balers-untied
- Balers-tied
- Shredders

To meet the overall objectives of the project, a set of criteria was developed for the selection of solid waste management facilities to be used in the data base:

- The waste from the processing facility had to be landfilled (minimal ferrous recovery was acceptable),
- Records of the weights of wastes processed had to be available,
- The facility had to have been in operation for at least 1 year before January 1980, and
- Parties at the site had to be willing to participate in the study.

The selection process consisted of contacting persons knowledgeable in the field and evaluating results of an extensive literature review. After a potential site was identified, local officials were contacted to verify site characteristics and data availability. Many potential sites were eliminated because of the lack of scales. After elimination of all sites that did not meet the set criteria or did not have records of the weights of waste processed, the final list of candidate sites included 2 tied balers, 7 untied balers, and 14 shredders.

Because of the limited number of acceptable sites, a new selection strategy was devised. First, all the balers were grouped together. Second, every effort was made to include all of the acceptable shredder and baler facilities. Finally, transfer stations and direct haul facilities were selected to insure a reasonable sample distribution of the following parameters:

- size (with an effort to focus on smaller facilities
- ownership (including private and public facilities), and
- geographical location (selected to permit reasonable logistics for field work).

With this new selection process, the final sample consisted of 12 balefills, 9 shredfills, 11 transfer stations, and 13 direct haul systems. Of these 45 sites selected, 18 had some form of leachate collection, and another 16 plan leachate facilities in the future. Of the 18 sites with leachate collection, 7 discharge leachate to a sewer, 4 recycle leachate over the fill, and 7 have onsite leachate treatment. Over half of the sites have some sort of liner. Eighteen sights use natural clay liners and five sites use some form of manmade liner. Table 1 shows the distribution of facilities by type and size.

Data Collection

Substantial data were collected from each of the solid waste management systems visited. Information fell into three basic categories: background, operations, and costs. The data were gathered during a series of previsit telephone interviews, a site visit, a review of documents, and followup telephone calls. A detailed interview guide was developed to insure that the correct questions were asked and to provide a mechanism for organizing the information collected.

Collection of background data was necessary to identify which parties actually incurred costs for the various components of the solid waste management systems. A special questionnaire was developed for use during the previsit telephone interviews to determine which parties were responsible for which components.

The hypothesis was that the main operational factors affecting cost are haul, processing, transfer, landfill operations, and landfill construction. For these components, data were collected on the size of the operation based on weights of waste processed.

Haul operational data focused on the factors that influenced the resources dedicated to hauling wastes in collection vehicles from the final pickup point to the discharge point. The resources invested include labor time, equipment time, and fuel. Data were collected on the percent of the work day dedicated to hauling rather than to collection, the distance of the haul, the average tons per load, and the crew size.

Processing operational data were meant to reflect the efficiency with which the facilities are used. Data were collected on the design capacity, the actual wastes processed, days lost to down time, hours of operation per day, and days per year. Availability of storage capacity for both processed and unprocessed waste was determined. For shredders, the average particle size and the existence of metal separation were noted. For balers, the type of facility (either tied or untied) and the size and weight of the bales were recorded.

Transfer operational data focused on the resources used in transporting processed wastes to the landfill face. Data gathered included vehicle type and capacity, crew size, transfer distance, and round trip time.

Landfill operational factors that might influence cost (other than size) included the number and types of waste streams handled, age of the facility, method used, number and height of lifts, amount of daily cover, and source of cover.

Landfill construction data included type of liner if any, type of leachate collection and treatment if any, and landfill method used. Another important factor was whether the landfill construction was phased with operations or whether the fill was constructed all at one time.

The cost data collected for each component of the solid waste management system were divided into capital and operational costs to assure costs were comparable from site to site. The costs were standardized for labor rates, inflation, and discounting method. Thus the labor and capital portions of each cost had to be calculated.

Conclusions and Recommendations

The cost data collected from the 45 case study sites were analyzed using statistical methods. Also developed was a series of cost curves that illustrate the influence of various parameters on the cost of different components.

For both haul in the collection vehicles and haul in the larger transfer vehicles, increasing vehicle capacity reduced costs. A 10-percent increase in vehicle size led to a 6- to 7-percent decrease in costs across all sites.

Baling and shredding had little effect on the cost of transportation in large vehicles. As expected, shredders and balers had higher capital and operating costs than transfer stations which offset other cost-reducing factors such as size.

Table 1. *Number of Sites by Size and Type*

	Design Capacity (metric tons)				
Type of Site	*0-100*	*100-300*	*300-600*	*600+*	*Total*
Haul	*4*	*3*	*2*	*4*	*13*
Transfer	*1*	*1*	*6*	*3*	*11*
Shredder	*—*	*3*	*2*	*4*	*9*
Baler	*3*	*3*	*4*	*2*	*12*
Total	*8*	*10*	*14*	*13*	*45*

Large processing facilities did not appear to be much, if any, cheaper per ton than small ones. The actual hours of equipment operation did affect costs, however.

Increases in landfilling capacity reduced costs considerably. A 200-ton-per-day facility was 27 percent less expensive per ton than a 50-ton-per-day facility. Baling and shredding also helped. A balefill was 43 percent less expensive per ton than a conventional landfill, and an uncovered, shredded waste fill was 70 percent less expensive to run. Thus the extra processing does lead to savings in landfilling, but not enough to offset the extra processing cost.

No model was developed for landfill construction costs. These costs varied greatly and were influenced by a large number of site-specific characteristics.

Study results confirm that high-tech processing is expensive and can be justified only if it eliminates considerable landfill construction costs or greatly increases in-place density, thus spreading landfill costs over a longer period. Since the former is not likely to bring sufficient savings, the latter may become the key factor in decisionmaking.

Such analyses often require an estimate of in-place density (the total amount of solid waste that can be disposed of per acre of landfill). Though there are many theoretical or experimental estimates of densities that can be achieved through compaction, baling, or shredding, very few actual operational data exist on in-place densities. None of the 45 sites in this study (which included most of the major balers and shredders) kept records of in-place density. Thus the collection of operational in-place density data through landfill surveys could greatly improve the decisionmaking process.

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***Oscar W. Albrecht** and **Douglas C. Ammon** were the EPA Project Officer (see below).*

The complete report, entitled "Optional Cost Models for Landfill Disposal of Municipal Solid Waste," (Order No. PB 85-176 808/AS; Cost $13.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

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