The authors must be commended for their efforts. Information from this type of investigation can establish the design parameters of a resource recovery plant. However, there are several points which might enhance the confidence of the procedure described by the authors. Initially, it must be recognized that to date there is no “standard” for estimating solid waste quantities or composition. Usually it is the available funding which determines the type of procedure employed. Data precision, desired and available funding decide whether you will conduct either a weighing program using existing or portable scales or a survey of waste collection capacities. It may also determine the scope and depth of your composition determination.

It appears that all but one of the objectives as stated in the problem definition were addressed. Seasonal variations of wastes could not be found in this or the original study. This is a critical factor and should not be ignored if subsequent surprises are to be avoided. It is this information that determines backup requirements for a resource recovery facility and assists in scheduling plant and equipment maintenance.

Waste survey categories and composition classifications may have been too simple. Most notable was the absence of the oversize classification on the survey form. Information on this category should include details on demolition wastes, white goods and heavy brush. Absence of this information seriously jeopardizes the usefulness of this data when considering the technology to be used in resource recovery as well as plant design capacity in relation to the available processible feed stock. Concerning composition classification, a more detailed breakdown should include separate categories for yard wastes and oversized wastes. Because of the trend in recycling in New Jersey, many communities have expectations to recover white goods and yard wastes for use as mulch or compost materials. The breakdown of wastes including these constituents and their application to surveyed tonnages would greatly assist communities in determining the success of programs adopted to recover these particular materials.

The sorting of ten 200-300 lb samples of solid wastes each day of the program raises some questions. Was the origin of the samples documented to show that they do not originate from the same area each day? Was moisture loss
It is the opinion of this writer that to formulate a study to determine the problems of handling solid waste, one needs a sample between April and May when yard cleanups are taking place, and garage, basement, and attic cleanups are underway. The next testing period should be October-November which is leaf season and winter cleanup project time. Also, it should be determined in mid-winter because the quantity of snow could cause the refuse to be extremely wet and heavy. The same would hold true for the spring and heavy rains. This, of course, would depend on the area of the country you want to test, and I am speaking primarily of the Northeast.

May I state that the conference was very educational and beneficial to those who attended.

Discussion by

Miro Dvirka
Cosulich Associates
Woodbury, New York

The paper describes a very detailed and extensive procedure in compiling statistical data to arrive at waste quantities and characteristics required for the implementation of a major resource recovery project.

The size of the project, the extent of the area surveyed, the multitude of sources, etc., made such a comprehensive study a necessity. It would be erroneous, however, to assume that the final data can be used without making provisions for variations in waste quantities and quality due to economic trends, changes in characteristics of industrial wastes, seasonal variations, etc.

It is important to stress that the survey is not necessarily a model for studies of smaller areas with better defined and less diversified sources.

AUTHORS’ REPLY

I want to thank the discussers for taking the time to review our paper and present their comments and criticisms of the paper and associated project work. The comments all fell under three general categories, and are divided accordingly on the following pages.

RANDOM SAMPLING FOR WASTE QUANTITY AND COMPOSITION ESTIMATION

Any attempt to measure the quantity and composition of municipal solid waste in a particular
waste shed provides only a snapshot of waste quantity and composition. Changes are inevitable during the course of a day, month, year, or over the life of a resource recovery project. Only a full time sampling and weighing of every pound of solid waste entering the landfill from that waste shed is going to provide a complete data base. Sampling for 1 day or 1 week may seem to result in a very narrow picture compared to 1 month or 1 year. Nevertheless, even the 1 year survey of daily waste composition will still require some assumptions about future waste composition and quantity after the survey is over. Understanding the sampling process and associated data qualifiers is therefore very important.

Several of the discussors alluded to this problem by commenting that the one-time summer survey did not account for seasonal variations, such as increases in yard waste during spring and fall seasons, vacation departures, moisture, etc. At the same time, they recognized that solid waste quantity and composition estimation is an expensive proposition, even for short periods of time. The experimenter must therefore be prepared to qualify the data based on what he or she knows about external factors affecting observed waste quantity and composition. No procedure is going to give you a perpetually useful piece of information. To properly design and implement a procedure can give you an excellent benchmark; nevertheless, a single, accurate data point will allow you to provide periodic adjustments of the data based on adjustments and external factors such as the commercial development, population demographics, etc.

Random sampling is only one way by which one can estimate the quantity and composition of solid waste received at a given landfill or proposed resource recovery plant. The procedure we presented is valuable to us because we have used the same approach on many similar surveys throughout the country. Consistency in procedure and associated sampling precision permit us to compare results from one city to another and predict precisions before we begin the survey. Some communities may prefer to employ a stratified sampling procedure, in order to determine quantity and composition from a given source type. Dividing the samples according to source categories provides a more precise estimate, but with a much smaller number of samples per source type. Random sampling is often preferred by those who want to observe the waste as the resource recovery plant will see it, arriving without any method of source control. In the final analysis, it is likely that the variations between these different sampling procedures are minor when compared to the variations encountered from season to season or year to year.

**SCALE OF SURVEY IMPLEMENTATION**

One of the reviewers commented that the procedure used in the Meadowlands may not be appropriate for smaller communities with more homogeneous waste streams and better control of the solid waste. I choose to differ with that statement, understanding the observation of the sampling experiment itself. The statistics involved do not change as a function of facility size. What does change is the practicality of implementing a major solid waste survey for a fairly small project. One would not anticipate spending $100,000 to weigh and sort solid waste when the total capital cost of the project was only $2,000,000. For major resource recovery projects, a major waste characterization project is probably appropriate due to the many different interest groups desiring the data, and the technical and financial risks associated with poor estimation of waste quantity and composition.

For small communities, the more homogenous waste stream and lack of commercial/industrial development would imply that the waste composition and quantity survey need not be as expensive in order to obtain the same precision of the ultimate estimates. This may in fact be true based on common sense, but no research has been done to date which shows that small community waste surveys producing the same results could indeed be any less expensive.

The practicality of conducting a major waste survey is therefore the deciding factor in my opinion. If the risk is small and the waste is well-controlled and well-defined, a waste survey may not be necessary. Communities considering development of small resource recovery projects should nevertheless consider that detailed waste composition and quantity surveys cost as much for a large city as they do a small city, and that the results of a less expensive survey will be less precise, less accurate, and possibly less useful than they would desire.
DIFFERENT USERS OF THE DATA

The discussers correctly noted that the many and varied end uses of the data may require different approaches to the composition and quantity survey. Any given resource recovery project has numerous groups vying for a certain type of data, with certain acceptable levels of accuracy and precision as well as custom components and parameters. These groups typically include the facility designers, planners, financial consultants and those preparing economic analyses, politicians and public works officials attempting to implement a flow control strategy, and recycling interests.

Each of these groups will probably need the data in a different form, and may or may not demand specific qualifiers and quantitative measures of bias for each. Attempting to satisfy all of these different groups can be the toughest part of a waste characterization project. Nevertheless, those planning such projects should address each one of these groups in advance (if appropriate) and be certain that the survey is conducted correctly the first time.

Conversely, if the particular group conducting the survey has a real interest in only selected parameters, there is a definite cost saving in reducing the scope of the survey to accommodate only those parameters. For example, attempting to expand the list of composition categories or sub-categories of waste type for a quantity survey is costly and should only be included when these outside parties express sincere interest in survey outcome.