B.Sc.Course(First Semester)

University of Babylon-College of Engineering

Environmental Engineering Department

Chapter Four (Solid Waste Management)

4.1 Solid Waste Generation Rates

4.1.1Measures used to quantify solid waste quantities

The principal reason for measuring the quantities of solid waste generated, separated for recycling and collected for further processing or disposal is to obtain data that can be used to develop and implement effective solid waste management programs. Therefore, in any solid waste management study, extreme care must be exercised in deciding what actually needs to be known and in allocating funds for data collection. the measures and units used to quantify solid waste quantities are discussed below.

Volume and weight measurements:

Both volume and weight are used for the measurement of solid waste quantities. Unfortunately, the use of volume as a measure of quantity can be misleading. For example, a cubic yard of loose wastes is a different quantity from a cubic yard of wastes that has been compacted in a collection vehicle, and each of these is different from a cubic yard of wastes that has been compacted further in a landfill. Accordingly, if volume measurements are to be used, the measured volumes must be related to either the degree of compaction of the wastes or the specific weight of the waste under the conditions of storage.

To avoid confusion, solid waste quantities should be expressed in terms of weight. Weight is the only accurate basis for records because tonnages can be measured directly, regardless of the degree of compaction. Weight records are also necessary in the transport of solid wastes because the quantity that can be hauled usually is restricted by highway weight limits rather than by volume. On the other hand, volume and weight are equally important with respect to the capacity of landfills.

Suggested units of expression for different generation sources are considered in Table 4.1. In predicting residential solid waste generation rates, the measured rate seldom reflects the true rate because there are confounding factors (onsite storage and the use of alternative disposal locations) that make the true rate difficult to assess. Most solid waste generation rates reported in the literature prior to about 1990 are actually based on measurement of the amount of waste collected, not the actual amount generated, excluding the amount of waste material that was:

1. Recycled (directly and indirectly),
2. Ground up in kitchen food waste grinders,
3. Burned in fireplaces,
4. Composted, and
5. Stored temporarily.

Table 4.1: Suggested units of expression for solid waste quantities

Type of waste	Discussion
Residential	Because of the relative stability of residential wastes in a given location, the most common unit of expression used for their generation rates is Ib/capita • d. or (kg/capita. d).
Commercial	Commercial waste generation rates have also been expressed in b/capita • d.
Industrial	Ideally, wastes generated from industrial activities should be expressed on the basis of some repeatable measure of production, such as pounds per automobile for an automobile assembly plant or pounds per case for a packing plant. When such data are developed, it will be possible to make meaningful comparisons between similar industrial activities throughout the country.
Agricultural	Where adequate records have been kept, solid wastes from agricultural activities are now most often expressed in terms of some repeatable measure of production, such as Ib of manure/1400-lb cow • d and Ib of waste/ton of raw product.

4.2 Methods Used To Estimate Waste Quantities

4.2.1 Load-count analysis:

In this method, the number of individual loads and the corresponding waste characteristics (types of waste, estimated volume) are noted over a specified time period.

Example 4.1: Estimation of unit solid waste generation rates for a residential area. From the following data estimate the unit waste generation rate per week for a residential area consisting of 1200 homes. The observation location is a local transfer station that receives all of the wastes collected, for disposal. The observation period was one week.

1. Number of compactor truck load=9.0
2. Average size of compactor truck=20.0 yd^3

3. Number of flatbed loads=7.0
4. Average flatbed volume=2.0 yd^3
5. Number of loads from individual residents' private cars and trucks=20
6. Estimated volume per domestic vehicle=8.0 ft^3

Solution:

1. Set up the computation table to estimate the total weight. Use the specific weight data given in typical table(3.1) to covert the measured waste volume to weight.

Item	No.of loads	Ave.No. of volume, yd3	Specific Wt 1b/yd3	Total 1b
Compactor truck	9	20	500	90,000
Flatbed truck	7	2	225	3,150
Individual private cars	20	0.3	150	900
Total 1b/wk				94,050

2. Determine the unit waste collection rate based on the assumption that each household is comprised of 3.5 people.

$$Unit\ rate = \frac{94050\ Ib/wk}{1200 \times 3.5 \times 7\ d/wk} = 3.2\ Ib/capita.d = 1.45\ kg/capita.d$$

4.2.2 Weight-volume analysis:

The use of detailed weight-volume data obtained by weighing and measuring each load will certainly provide better information on the specific weight of the various forms of solid wastes at a given location.

.

4.2.3 Materials mass balance analysis:

The only way to determine the generation and movement of solid wastes with any degree of reliability is to perform a detailed materials balance analysis for each generation source, such as an individual home or a commercial or industrial activity. In some cases, the materials balance method of analysis will be required to obtain the data needed to verify compliance with state-mandated recycling programs.

4.3 Solid Waste Collection Rates

The difference between the amount of residential and commercial MSW generated and the amount of waste collected for processing or disposal will typically vary from 4 to 15%. The difference can be accounted for by amount of material:

1. Composted
2. Burned in fire places,
3. Discharged to sewers,
4. Given to charitable agencies,
5. Sold at garage sales,
6. Delivered to recycling centers,
7. Recycled directly.

4.4 Factors That Affect Waste Generation Rates

The effect of:

1. Source reduction and recycling activities,
2. Public attitudes and legislation, and

3. Geographic and physical factors on the generation of solid waste are considered in the following discussion.

4.4.1 Effect of source reduction and recycling activities on waste generation

Waste reduction may occur through the design, manufacture, and packaging of products with minimum toxic content, minimum volume of material, and/or a longer useful life. Waste reduction may also occur at the household, commercial or industrial facility through selective buying patterns and the reuse of products and materials.

4.4.2 Effect of public attitudes and legislation on waste generation

Along with source reduction and recycling programs, public attitudes and legislation also significantly affect the quantities generated.

Significant reductions in the quantities of solid wastes generated occur when and if people are willing to change of their own volition their habits and lifestyles to conserve natural resources and to reduce the economic burdens associated with the management of solid wastes. A program of continuing education is essential in bringing about a change in public attitudes.

4.4.3 Effect of geographic and physical factors on waste generation

Geographic and physical factors that affect the quantities of waste generated and collected include location, season of the year, the use of kitchen waste food grinders, waste collection frequency, and the characteristics of the service area.

4.4.3.1 Geographic location

The influence of geographic location include the different climates that can influence both the amount of certain types of solid waste generated and the time period over which the wastes are generated. For example, substantial variations in the amount of yard and garden wastes generated in various parts of the country are related to climates. That is, in the warmer southern areas, where the growing season is considerably longer than in the northern areas, yard wastes are collected not only in considerably greater amounts but also over a longer time.

4.4.3.2 Season of the year

The quantities of certain types of solid wastes are also affected by the season of the year. For example, the quantities of food wastes related to the growing season for vegetables and fruits.

4.4.3.3 Use of kitchen food waste grinders

While the use of kitchen food waste grinders definitely reduces the quantity of kitchen wastes collected, but do they affect quantities of wastes generated is not clear.

4.4.3.4 Frequency of collection

In general, where unlimited collection service is provided, more wastes are collected. This observation should not be used to infer that more wastes are generated. For example, if a homeowner is limited to one or two containers per week, he or she may, because of limited container capacity, store newspapers or other materials with unlimited service, the homeowner would tend to throw them away. In this situation the quantity of wastes generated may actually.