Method for Estimation of Waste Quality

1. Purpose

Waste quality is one of important basic data for planning of solid waste management. To know ratio of garbage or incombustibles in waste contributes to a better waste collection plan. By sorting waste by components, quantity of recyclable material contained in the waste can be known, which may be necessary for preparing a recycling plan. Calorific value is a determinant factor deciding on feasibility of waste incineration and designing incinerators.

Primarily, waste composition is expressed in terms of the following components, i.e., moisture, ash and combustible contents.

Secondly, it is physically classified into such components as paper, textile, plastic, glass, metal and so on.

Thirdly, it is chemically classified into such composition as carbon, hydrogen, nitrogen, oxygen, sulfur and chlorine.

Another important factor is low calorific value, which is measured by a calorimeter, or can be estimated by the composition.

In the following section, method and procedures for waste quality analysis are presented. Though there is no standardized method as recognized internatilnally, the following methods are standardized and adopted widely in Japan. However, for operation of calorimeter and chemical procedure for determination of elements standardized method depends on type of equipment. Establishment of Romanian standardized method is expected based on the methods described in this chapter.

2. Procedures of Waste Quality Analysis

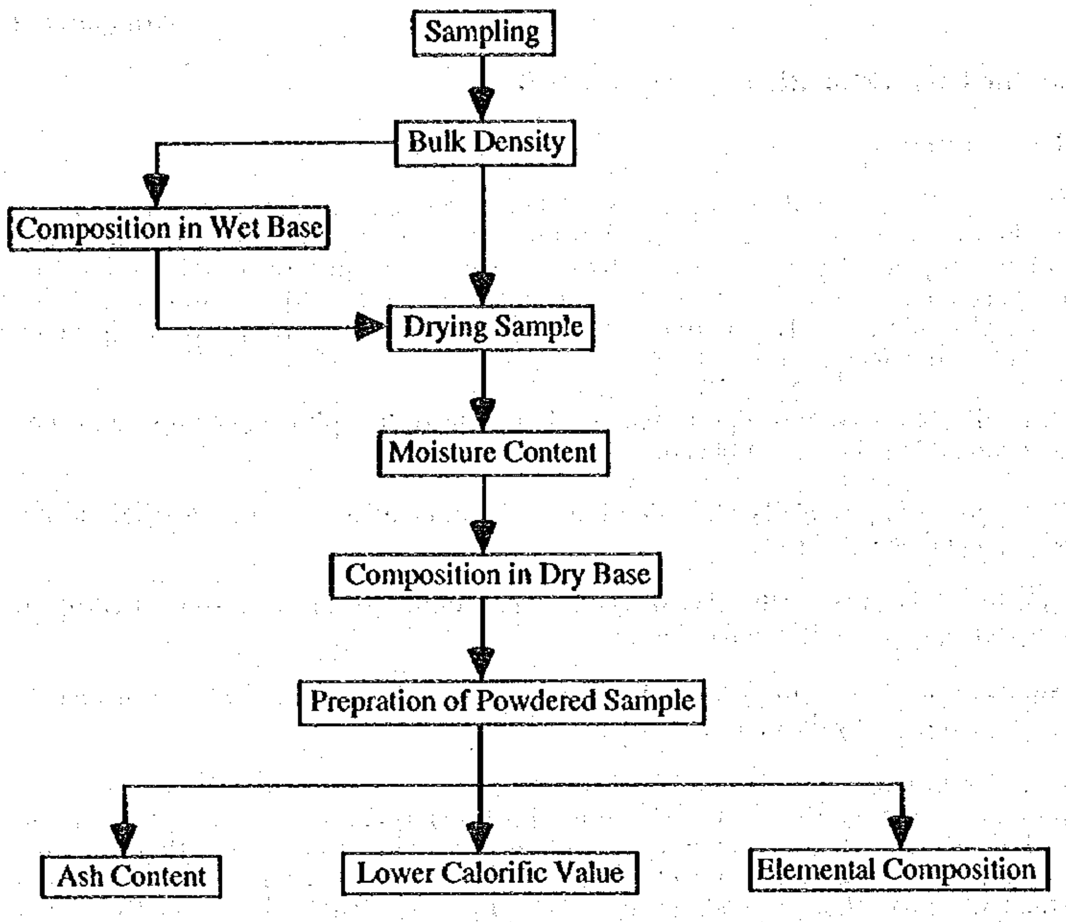
A series of procedures of waste quality analysis is shown as a flow chart in Fig. 2.2-1.

3. Sampling

Waste samples to be analyzed can be obtained from households, collection vehicles or waste pit of treatment facility. Random sampling from either source is necessary to obtain good representative samples. More than 200 kg of waste is desirable for the sample source. It is recommendable to take sample from as many vehicles as possible to lessen the characteristics of waste by area.

<u>Sampling Procedures</u>

(1) Mix waste well in containers of the vehicles if possible.
(2) Unload waste on floor. If large sized articles are contained, cut them into pieces smaller than 15 cm by 15 cm
(3) Mix them well again.
(4) Make the waste into cone-shaped mountain.
(5) Divide the waste into four sections.
(6) Choose two of four sections on opposite angle. and mix them well again.
(7) Repeat (4) to (6) three or four times, and then obtain about 10 kg of sample.



Fug. 2-1 Procedures of Waste Quality Analysis

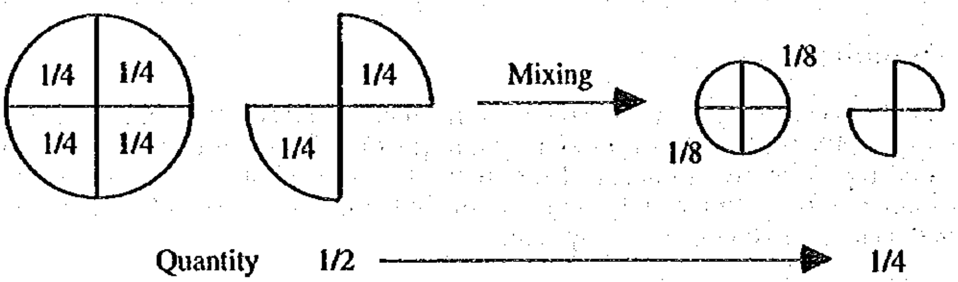


Fig. 3-1 Sample Division by Quartering

4. Bulk Density

Bulk density means weight per volume. This is an important factor to estimate weight of waste from its volume.

(1) Put the obtained sample into a container of which the capacity and the weight is known.
(2) Drop the container from 30 to 40 cm height three times.
(3) If the volume of waste reduces by this dropping, refill the waste supplementary and repeat the dropping.

(4) Repeat the refilling and dropping until the volume of waste does not reduce anymore.
(5) Measure weight of the sample and calculate the weight per volume by the following equation. The unit kg/litter is equal to tons/m^3.

Weight per Volume (tons/m^3) = weight of sample (tons) / capacity of container (m^3)

5. Composition in Wet Base

Waste composition by sorting components can be expressed in wet base or in dry base, but the composition in dry base is more preferable because composition in wet base does not necessarily indicate the original composition in weight. Moisture in waste mainly originates from kitchen garbage, and it moves to other components as time passes after discharged as waste. Thus, weight of paper in wet waste may be heavier than that in dried waste. This seems not reflect the original composition.

(1) Spread the sample over a plastic sheet or a platform and classify them into the following 10 categories of components by manual operation.
   a. Paper
   b. Textile
   c. Garbage
   d. Wood, bamboo and straw
   e. Plastics and synthetic resin
   f. Rubber and leather
   g. Metal
   h. Glass
   i. Ceramics and stone
   j. Other small particles smaller than 5 mm diameter. (This is obtained by using a sieve.)
(2) Weigh the each components and calculate percentages in weight.

5. Moisture Content

The sample is dried in a drier at constant temperature of 105 ± 5 °C for 3 to 5 days until the weight loses no more. Weigh the dried samples and calculate the moisture content by the following equation.

Moisture Content (%) =
(Wet Sample Weight (kg) - Dried Sample Weight (kg)) / Wet Sample Weight (kg)

6. Composition in Dry Base

Spread the dried sample over a plastic sheet or a platform and sort them according to the classification indicated in 2.4 Composition in Wet Base. Weigh each components and calculate percentages in weight.

7. Prepartion of Combustible Sample for Chemical Analysis

Powdered sample should be prepared for the following analysis as ash contents, calorific value and contents of elements. This sample is prepared from combustible components of the original sample. Thus, the direct result obtained is for this sample, and it should be converted into the value in the original waste by callculation. The composition of this powdered sample should be the same as that of the original composition with respect to the combustible components.

(1) Take a small portion of each combustible components.
(2) Grind each sampled components separately by mechanical grinder.

(3) Take each powdered components according to the composition shown by the composition in dry base, and mix them well as in the same composition of the original sample.

8. Ash Content

Ash contents indicate the ratio of incombustible matters in waste. Both incombustible components such as glass or metal, and ash contained in combustible matters should be taken into consideration.

(1) Put the powdered sample prepared in the section 2.7 into a porcelain crucible.
(2) Dry it at 105 ± 5 °C for 2 hours, and cool off for 30 minutes in a desicator.
(3) Weigh the crucible.
(4) Ignite the sample in the crucible at 800°C for 3 hours by an electric furnace.
(5) Weigh the crucible again.
(6) Calculate ash content in combustible components by the following equation.

Ash Content in the sample (%) =
Sample Weight after ignition/Sample Weight before ignition

(9) Calculate the ash contents in the combustible components of the original sample and add it to the incombustible contents, because incombustibles are regarded as all ash components. Total ash contents in the original sample is expressed by the following equation:

Total Ash Contents (%) =
Ash Contents in Combustibles (%) + Incombustible contents (%)

9. Content of Combustibles

Moisture, ash and combustibles are three major components. Moisture content is measured by the method shown in the section 2.5. Total ash contents in the original sample is obtained by the method and calculation shown in the section 2.9. The rest is considered to be combustible components. The content of combustibles is induced by the following equation.

Combustibles Content (%) = 100 - Moisture Content (%) - Ash Content (%)

10. Lower Calorific Value

Lower calorific value of sampled waste can be estimated by the following three methods; by a formula using combustible and moistures, by calorific value measured by a calorimeter, or by an estimation by elementary composition.

1) Estimation by Combustible and Moisture Contents

Lower calorific value can be estimated by combustible and moisture contents according to the following formula:

Lower calorific value (kcal/kg) = $4500 \times V/100 - 600 \times W/100$
where; V: Combustible content
W: Moisture content

This result tends to be lower than the result obtained by calorimeter of estimation from elemental composition.

2) Calorific Value Measured by a Calorimeter

Take the small portion of the powdered sample and measure the calorific value by calorimeter. Detail of operation of the calorimeter should be referred to a manual of each calorimeter. As a calorific value (Hc) obtained by a calorimeter means a higher calorific value of sole combustible components, lower calorific value should be calculated by the following two equations.

Higher Calorific Value of Original Sample (Hh) (kcal/ kg) =

$$Hc \times (100 - u)/100 \times (100 - W)/100$$

where; Hc: Calorific value indicated on the calorimeter
u: Contents of incombustibles in the original sample (%)
W: Moisture content

Lower Calorific Value of Original Sample (Hl) (kcal/ kg) = Hh - 6 (9H + W)

where; Hh: Higher calorific value obtained by the equation above
H: Hydrogen content obtained by elemental analysis, which is mentioned in the next section.
W: Moisture content

3) Estimation by Elemental Composition

Lower calorific value can also be estimated by elemental composition. Several formula are proposed as follows:

a. Dulong's formula
Lower calorific value (kcal/kg) = 81C + 342.5 (H - O/8) + 22.5S - 6 (9H + W)
where; C: Carbon content
H: Hydrogen content
O: Oxygen content
S: Sulfur content
W: Moisture content
Note; This formula fits well to fuel which contains much Carbon like coal.

b. Steuer's formula
Hl (kcal/kg) = 81(C - 3O/8) + 57 × 3 × O/8 + 345 (H - O/16) + 25S - 6 (9H + W)
Note; In this formula, it is assumed that half of oxygen contained is H_2O, and the rest is CO

c. Scheurer - Kestner's formula
Hl (kcal/kg) = 81(C - 3O/4) + 342.5H + 22.5S + 57 × 3 × O/4 - 6 (9H + W)
Note; It is assumed that all oxygen is CO.

11. Elemental Composition

For elemental analysis of waste, initially the sample of combustible components is analyzed, then each contents ratio to the original sample including incombustibles and moisture are calculated. The elements to be detected are carbon, hydrogen, nitrogen, oxygen, sulfur and chlorine. Elemental composition data is useful for estimation of the following value concerning incineration or land-fill.

a. Theoretical air volume required for complete combustion of waste in a incinerator.
b. Lower calorific value as a reference of heat durability of a incinerator. This is already referred in the previous section

c. C/N ratio indicating a suitability for composting and land-fill.
d. Generation of air pollution after incineration. N, S and Cl indicates the possible generation of sulfur oxide, nitrogen oxide and hydrogen chloride gas.

1) Carbon and Hydrogen

Theoretically, analysis method is detection of gassified elements generated by ignition of the sample at 800°C by an electric furnace. Carbon and hydrogen are detected as CO_2 and H_2O respectively. Fig. 2.10-1 shows an apparatus for detection Dried pure oxygen is used as carrier gas. Detectors used and estimation formula are as follows:

Determination of Carbon

Detector for carbon: a carbon dioxide absorber containing sodium carbon oxide

Carbon content (%) = 27.29 × Weight increase of detector (g) / sample weight (g)

Determination of Hydrogen

Detector for hydrogen: a moisture absorber for H_2O containing calcium chloride or magnesium perchlorate.

Hydrogen content (%) = 11.19 × Weight increase of detector (g) / sample weight (g)

2) Nitrogen

Nitrogen content is determined by Kjeldahl method, in which nitrogen as ammonium form is determined by titration. Ammonium is derived from decomposition of organic matter in sample by heated sulfuric acid. Details of the method is as follows:

(1) Take small portion of the sample between 5 to 10 g, weigh it and put it into a Kjeldahl flask with the capacity of 300 to 500 ml
(2) Add 80 ml of concentrated sulfuric acid to the flask and heat it. Add 0.5 to 1 g of decomposition accelerator (mixture of potassium sulfate:copper sulfate = 9:1). continue to heat until the contents becomes transparent.
(3) Add distilled waster up to 500 ml. Take 100 ml of the contents to a distilling flask and adjust pH of the contents to 7 by adding 4 % sodium hydroxide. Add the distilled water to the flask up to 350 ml.
(4) Put 50 ml of N/20 sulfuric acid solution into a receiver flask of the distilling apparatus. Start distillation until 250 ml of the distillate is obtained.
(5) titrate the distillate with N/20 sodium hydroxide by adding mixed indicator of methyl red and bromcresol green.
(6) Nitrogen content is determined by the following formula.

Nitrogen Content (%) = $(50 \times f_1 - af_2) \times 5 \times (1/\text{sample weight (g)}) \times 0.7/100 \times 100$

where; f_1 : Actual factor of N/20 sulfuric acid used (titrated respectively)
a : Quantity (ml) of N/20 sodium hydroxide needed for the titration
f_2 : Actual factor of N/20 sodium hydroxide used

3) Chlorine and Sulfur

Chlorine and sulfur are determined by titration of gassified elements generated by ignition of samples at 800°C by an electric furnace. Apparatus for gassification is similar to that for carbon shown in Fig. 2.10-1, but the detector is different. Detectors used and estimation formula are as follows:

Determinatin of Chlorine

Detector for chlorine : N/10 Sodium hydroxide

(1) Absorb the gassified chlorine by two detectors each of which contains 50 ml of sodium hydroxide.
(2) Collect the absorbents and make it 250 ml in total by adding distilled water.
(3) Take 25 ml of the diluted absorbent and add 5 ml of nitric acid, 5 ml of N/20 silver nitrate, 3 ml of Nitrobenzene and 1 ml of ferric sulfate ($Fe_2(SO_4)_3$)in ammonium solution.
(4) Titrate by N/20 ammonium thiosianate.
(5) Conduct blank test for unabsorbed detector by the same procedure.
(6) Chlorine content is determined by the following formula:

Chlorine content (%) = (b-a) × f × 250/25 × (1/sample weight (g)) × 1.773/1000 × 100

where; f : Actual factor of N/20 ammonium thiosianate used
a : Quantity (ml) of N/20 ammonium thiosianate needed for the titration
b : Quantity (ml) of N/20 ammonium thiosianate needed for the blank test

Determination of Sulfur

Detector for sulfur : 3% Hydrogen peroxide solution

(1) Absorb the gassified sulfur by two detectors each of which contains 50 ml of hydrogen peroxide solution.
(2) Collect the absorbent and make it 200 ml in total by adding distilled water.
(3) Take 10 ml of the diluted absorbent and add 40 ml of isopropyl alcohol, 1 ml of acetic acid and 3 or 4 drops of arsenazo III solution as an indicator.
(4) Titrate by N/100 barium acetate.
(5) Conduct blank test for unabsorbed detector by the same procedure.
(6) Chlorine content is determined by the following formula:

Chlorine content (%) = (a-b) × f × 200/10 × (1/sample weight (g)) × 0.163/1000 × 100

where; f : Actual factor of N/100 barium acetate used
a : Quantity (ml) of N/100 barium acetate needed for the titration
b : Quantity (ml) of N/100 barium acetate needed for the blank test

4) Oxygen

Oxygen content can be obtained by subtracting carbon, hydrogen, nitrogen, chlorine and sulfur content from total combustible content, that is, this is expressed as the following formula:

Oxygen content (%) =
Combustible content - (Carbon + Hydrogen + Nitrogen + Chlorine + Sulfur)

Time and Motion Study (TMS)

1. General

Time and Motion Study (TMS) is an important method to obtain basic data on actual conditions of collection and haulage service. TMS measures the following:

1. Time spent for each activity including waste loading, haulage, dumping, etc.
2. Weight of waste collected and hauled (a truck scale should be used.)
   (in the case of street sweeping: Net street length swept and waste amount collected)
3. Consumption of fuel and its cost.
4. Number of containers or bins from which waste is collected.

Based on data obtained loading efficiency, hauling velocity and efficiency can be measured. Further more, by combining cost data, cost efficiency also can be estimated. Such indicators are indispensable for evaluating existing collection and hauling systems, also applicable to street sweeping.

2. Method of TMS

1) TMS Team Formation

TMS team consists of the following members:

1. One team leader
2. One for time measurement and record
3. One for coordination

2) Necessary Equipment

1. One car for study team
2. Two chronometer
3. Record papers
4. Camera or video recorder
5. Truck scale

3) Time schedule

A time and motion study should cover a collection and haulage activities of a truck for a whole day. A typical flow of the activities are shown in the diagram hereto attached.

4) Record Sheet

A sample sheet used for recording time and other information is hereto attached.

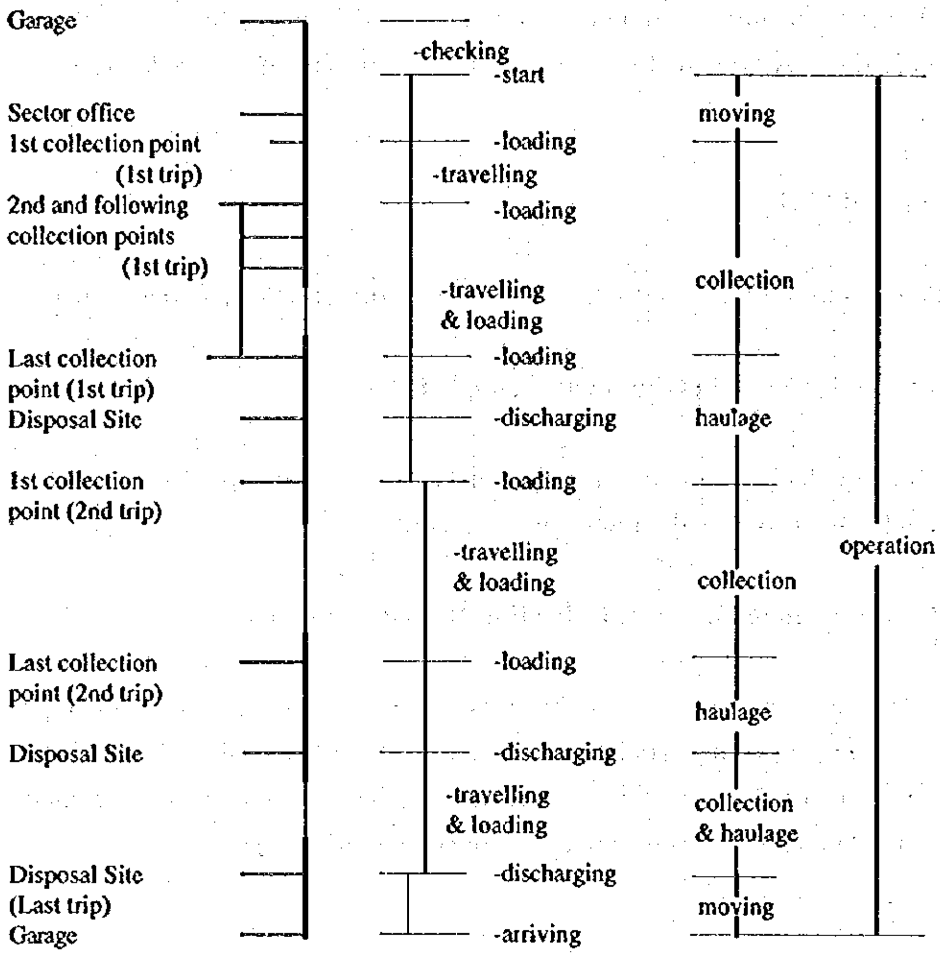
5) Processing of Data Obtained Through TMS

It is useful to calculate time and running distance for each trip (See a sample trip record hereto attached) based on information recorded on a sheet.

6) Comparison of Different Collection/Haulage Systems

As explained before, TMS should be conducted at least once for each type of collection/haulage system. Efficiency comparison should be made between different systems in terms of time spent and waste quantity hauled. Information on haulage amount should be used to estimate unit cost of collection/haulage.

Typical Activities Flow of Collection and Haulage



TMS Record Sheet (Example)

Record of Activities TMS No. ___________

Date Nov. , 1994

Car No.	Type	Capacity	Crew	Trip	Collection area	Mileage (km)	Fuel consumption	Collected container
			Driver:	1st				
		m^3	Worker A:	2nd				
		ton	Worker B:	3rd				

Start	Kind of Activities				
: ' "	Collection	Nos. of container	Traveling	Hauling	Other
1)	' "		' "	' "	( ) ' "
2)	' "		' "	' "	( ) ' "
3)	' "		' "	' "	( ) ' "
4)	' "		' "	' "	( ) ' "
5)	' "		' "	' "	( ) ' "
6)	' "		' "	' "	( ) ' "
7)	' "		' "	' "	( ) ' "
8)	' "		' "	' "	( ) ' "
9)	' "		' "	' "	( ) ' "
10)	' "		' "	' "	( ) ' "
11)	' "		' "	' "	( ) ' "
12)	' "		' "	' "	( ) ' "
13)	' "		' "	' "	( ) ' "
14)	' "		' "	' "	( ) ' "
15)	' "		' "	' "	( ) ' "
16)	' "		' "	' "	( ) ' "
17)	' "		' "	' "	( ) ' "
18)	' "		' "	' "	( ) ' "
19)	' "		' "	' "	( ) ' "
20)	' "		' "	' "	( ) ' "
21)	' "		' "	' "	( ) ' "
22)	' "		' "	' "	( ) ' "
23)	' "		' "	' "	( ) ' "
24)	' "		' "	' "	( ) ' "
25)	' "		' "	' "	( ) ' "
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Trip Record (Example)

System: Compactor (MEDIAS) + 110 ℓ steel bins

Registered number: 32B4157, Capacity: 10 m^3, Crew: 3,
Collection area: Sector 1
Date of Study: November 8, 1994 (Start work 6:34, Finish work 15:59, Work hours: 9:25)

Item	1st trip	2nd trip	3rd trip	Total
1) Loading time	1:54'	2:13'	–	4:07'
2) Traveling time and distance	18' 5.9 km	3' 1.6 km	– –	21' 7.5 km
3) Haulage time (to disposal site) and distance	47' 20.9 km	47' 19.7 km	– –	1:34' 40.6 km
4) Haulage time (to next trip) and distance	44' 16.7 km	– –	– –	44' 16.7 km
5) Collected waste	5.5 ton	5.5 ton	–	11.0 ton
6) Collection time efficiency { 1) + 2) } / 5) [min./ton]	24.0	24.7	–	24.4
7) Haulage velocity [km/h]	24.8	25.1	–	25.0
8) Moving time (to 1st trip) and distance	21' 11.7 km			
9) Moving time (to garage) and distance	32' 18.2 km			
10) Total operation distance	94.7 km			
11) Fuel Consumption	45 ℓ			
12) Fuel efficiency 10) / 11)	2.1 km/ℓ			

Efficiency Comparison of Different System (Sample)

Item / Collected Area / No. of trip	MEDIAS (110 ℓ) Sec. 1 / 2	PELIC. (110 ℓ) Sec. 3 / 2	LIAZ (110 ℓ) Sec. 2 / 2	RGR-16 (240 ℓ) Sec. 6 / 3	SRDAC (4 m³) Sec. 6 / 3	PELI-CON (4 m³) Sec. 5 / 2
1) Loading time	4:07'	4:04'	4:10'	2:03'	44'	4:33'
2) Traveling time and distance [km]	21' 7.5	40' 5.4	24' 8.8	19' 5.4	11' 4.5	50' 14.2
3) Haulage time (to disposal site) and distance [km]	1:34' 40.6	1:44' 32.9	51' 20.7	2:11' 59.3	3:32' 64.0	1:52' 33.4
4) Haulage time (to next trip) and distance	44' 16.7	34' 17.1	22' 11.5	1:05' 38.1	1:35' 36.4	23' 13.9
5) Collected waste ( ): theoretical figure	6.6 (11.0)	8.8 (11.6)	8.1 (9.7)	12.3 (17.2)	3.5 (3.9)	8.9 (16.7)
6) Collection time efficiency { 1) + 2) } / 5) [min./ton] ( ): theoretical figure	40.6 (24.4)	32.3 (24.5)	33.8 (28.2)	11.5 (8.3)	15.7 (14.5)	36.3 (19.3)
7) Haulage velocity [km/h]	25.0	21.7	26.5	29.8	19.6	21.0
8) Moving time (to 1st trip) and distance [km]	21' 11.7	31' 11.6	15' 5.1	18' 8.4	15' 5.6	24' 8.8
9) Moving time (to garage) and distance [km]	32' 18.2	23' 12.3	29' 15.0	31' 19.0	46' 18.9	27 13.5
10) Total operation distance [km]	94.7	79.3	61.0	156.7	129.4	83.8
11) Fuel Consumption [ℓ]	45	62	40	85	38	73
12) Fuel efficiency 10) / 11) [km/ℓ]	2.1	1.3	1.5	1.8	3.4	1.1

Technical Guidelines for Selection of Landfill Site

1) Landfill Site Selection

In selecting a sanitary landfill site, it is necessary to ensure that the site has a sufficient capacity to accept the planned landfill volume. In addition, the following aspects should also be jointly considered:

a. Efficiency of collection and transport
b. Surrounding conditions
c. Topography and geological conditions
d. Safety against disaster
e. Ultimate landuse plan
f. Layout of related facilities
g. Availability of cover soil
h. Landfill area is of sufficient size

In the construction of a landfill system it is necessary to plan with sufficient consideration each of the following factors. It is also important to carry out a preliminary assessment of the site.

a. Efficiency of Collection and Transport

Collection and transport costs form a large portion of the solid waste management cost. This amount varies with the collection method, the area of coverage, the location of the treatment plant and road traffic conditions. Generally, the larger the city, the lager the share of collection and haulage cost becomes. Therefore, in selecting a site, it is important to examine each of these items carefully so that collection and transport can be provided efficiently.

b. Surrounding conditions

The disposal site and traffic generated by collection and hauling vehicles can potentially cause environmental problems. Therefore, in order that the landfill system does not become a source of pollution in the surrounding area, it is desirable to carefully consider the following points and at the same time ensure that the system also contributes to regional improvement.

(a) Appropriate adjustment to all relevant urban planning regulations.
(b) Effluent discharge point.
(c) Haulage route, approach road and access road.
(d) If a housing area is located nearby, the conditions of the buffer zone (green belt) should be assessed for: noise, vibration and offensive odor.
(e) Check the location of the housing area and public facilities such as schools and hospitals.
(f) Availability of utilities such as electric power, telephone and water.

c. Topography and Geology

It is preferable to choose a site with good geological conditions to reduce construction and maintenance costs. As far as possible the landfill system should be built on nonpermeable ground, but not on soft ground or places where subsidence may occur. However, if such a situation is unavoidable it will be necessary to take countermeasures to prevent land subsidence.

Moreover, a site should not be chosen in an area with high rainfall or a watercatchment area, and where there is a water intake point located immediately downstream of the landfill site. As for underground water, it is important to study the conditions of the aquifer, the water level and water usage.

d. Safety Against Disaster

It is necessary to make a preliminary study to ensure that the landfill site is from, for example the risk of landslides, flooding subsidence or avalanches in the site.

e. Ultimate Landuse Plan

It is desirable that the landfill system should not only be seen to support environmental conservation, but should also contribute towards improving the well-being of people in the region.

In recent years, public consent has become a very important in the construction of landfill sites and their facilites. The effective use of the completed landfill has also become an important factor in obtaining public consent. A landfill system implemented in this way should therefore select an ultimate landuse plan which promises effective regional improvement, and which is based on the present situation of the surrounding area and the future plan for urban development.

f. Location of Related Facilities

In principle, solid waste treatment consists of the process of collection/hauling and treatment/disposal of wastes which must be done quickly without causing environmental problems and at the same time economically. Therefore, the related facilities should be located in a functional manner.

The location of a landfill system should preferably be:

(a) near the cleansing office and activity base of intermediate treatment facilities.
(b) near the pit where cover material is kept.

g. Availability of Cover Soil

In identifying the suitability of a landfill site, it is important to consider the availability of cover material in the vicinity, to facilitete the soil covering. Ideally speaking, one fourth of the total volume of the landfill site should be assigned for cover soil. Therefore, a large volume of cover material is needed and the cost of transporting the material for some distance will be quite significant.

h. Landfill Area Is of Sufficient Size

It is also necessary to ensure that the area proposed for the landfill should be utilized for a number of years. This is because the construction costs of landfill facilities, which include approach and access roads, leachate collection and treatment facilities, drainage system, guard house, etc. will be approximately the sameexpense of the area of its landfill site. If the landfill has a short life because the area is small, this will mean that capital investment cost to build new landfill will increase.

Technical Guidelines for Design of Landfill Site

1) Landfill Disposal Concept

The aim of solid waste disposal is to immediately remove solid waste from urban community and reduce its volume, making it stable and hygienic. In choosing the process of proper treatment and disposal, not only the geographical area should be considered but also the financial situation and the level of technology within the organization responsible for solid waste management. This management process can usually be divided into three processes such as collection/transport, intermediate treatment and final disposal. Basically landfill disposal is the only final disposal process which finally restores solid wastes to the nature.

The purpose of landfill disposal is to stabilize the solid waste and to make it hygienic through proper dumping of waste and use of natural metabolic function. Therefore, it is important to have a practical method of disposal which can be decided upon by regional conditions and organizational situation. In making this decision, it is important to take into account the type, form, composition of wastes, location of landfill site, regional, hydrological and climatic condition.

In planning the final disposal, it is necessary to determine the types and volume of waste for landfill and to formulate an effective masterplan for solid waste management based on the actual needs of the region. The final disposal plan should also be formulated in such a manner as to be organic with the collection or hauling plan and intermediate treatment plan.

2) General Requirements for Landfill

a. Definition of Landfill

"Landfill" means a waste disposal site used for the controlled deposit of the waste onto or into the land, and the landfill system has been prepared many facilities and equipments to protect the surround secondary pollutions from the site.

"Landfill" consists of eleven basic contents as follows:

1. Considered location;
2. Planned access road from service areas;
3. Fencing sufficiently to prevent free access to the site;
4. Considered landscaping;
5. Identification and information boards must be provided;
6. Control of access and information;
7. Water control and leachate management;
8. Protection of soil and ground water;
9. Gas control;
10. Monitoring system;
11. Control of stability.

b. Basic Contents

1. Considered location

The location of a landfill must take into consideration requirements that is shown as "Technical Guidelines Regarding Location Landfill Site".

2. Roads and service area

(1) Access to a landfill shall be planned in such a way that it creates minimal hindrance to existing public road.
(2) The landfill shall be equipped so that dirt originating from the site is not dispersed onto public roads and surrounding land.
(3) All the roads are service areas within the boundary of the landfill must be built and maintained to comply with the water control and soil and ground water protection measures required for the site itself.

3. Fencing

The landfill shall be surrounded by fencing sufficient to prevent free access to the site. The gates shall be locked outside operating hours.

4. Landscaping

Measures shall be taken in order to reduce the visual impact of a landfill, in particular when easily visible from residential areas, recreation area and roads.

5. Site identification and information

(1) At the entrance of a landfill an identification and information board must be provided displaying the following information:

- name and class of the site;
- name of the owner and or operator;
- licensing identification;
- operating times;
- contact and emergency telephone numbers;
- authority responsible for the operating permit and control of the site;

(2) The additional information must always be available to be public on request:

- type of wastes for which the site has received an operating permit;

6. Control of access and operation

(1) An appropriate system for control of access must always be provided at the entrance of the site.

(2) All waste delivered shall always be controlled on its

- origin
- type of characteristics
- quantity weight or volume
- the appropriate identification

(3) The system of control and access to each facility should contain a programme of measures to detect and discourage illegal dumping.

(4) During operation hours, a suitability qualified person in charge of the landfill operations must always be present.

7. Water control and leachate management

a. Appropiate measures shall be taken in order to control surface and or ground water entering into the landfiled waste.
b. All water or leachate emanating from the landfill shall be collected by means of an efficient drainage system, so as to ensure that no water accumulates at the bottom of the site, unless, though an environmental impact assessment, it is determined that collection is not required.
c. Contamined water and leachate collected from the landfill shall be treated to the appropriate standard required for its discharge.

8. Protection of soil and groundwater

(1) A landfill must meet the necessary conditions, naturally or artificially achieved to prevent pollution of the soil or groundwater

(2) The non-saturated geological formations constituing the substratum of the landfill base and sides shall satisfy the following permeability and thickness requirements. Maximum values of the permeability coefficient, k (m/s), for a substratum thickness of three meters measured under conditions of water saturation:

- Landfill for hazardous waste: $k = 1.0 \times 10^{-9}$ m/s
- Landfill for municipal and nonhazardous wastes and for other compatible wastes: $k = 1.0 \times 10^{-9}$ m/s
- Landfill for inert waste: k = no limit value

9. Gus control

(1) Appropiate measures shall be taken in order to control the accumulation and migration of landfill gas.

(2) Landfill gas shall be collected and properly treated and preferably used in such a way as to minimise damage to or deterioration of the environment unless by an environmental impact assessment it is determined that collection is not required.

10. Nuisances

Measure shall be taken to prevent arising from the landfill through:

- emission of odours and dust
- wind blown materials
- noise and traffic
- birds, and vermin and insects
- formation of aerosols

11. Control of stability

To provide for stability of the mass of waste and associated structures, particularly in respect of avoidance of slippages, the emplacement of waste on the site shall take place under suitable system of quality assurance.

Anexa 6

Acordul Mutual al Rezidenţilor din Judeţul/Comuna propusă în care se realizează Dezvoltarea Rampelor Finale de Depozitare ale Deşeurilor.

1. Achiziţionarea terenurilor

Achiziţionarea terenurilor se va desfăşura în mod legal şi rapid de către autorităţile relevante începând cu Primăria Municipiului Bucureşti, cât de curând posibil sau cel puţin în acelaşi timp cu începerea derulării programului de dezvoltare a rampelor finale de depozitare. Achiziţionarea terenurilor se derulează respectând fazele necesare şi procedurile legale ce se bazează pe legile existente din domeniu cum ar fi Constituţia României din 1991, şi în mod special articolele din Administraţia Locală (Secţiunea 2), Legea Fondului Funciar Nr. 18 din 19 Februarie 1991, Legea Nr. 33 din 1994 privind Exproprierea pentru cauza Utilităţii Publice, etc.

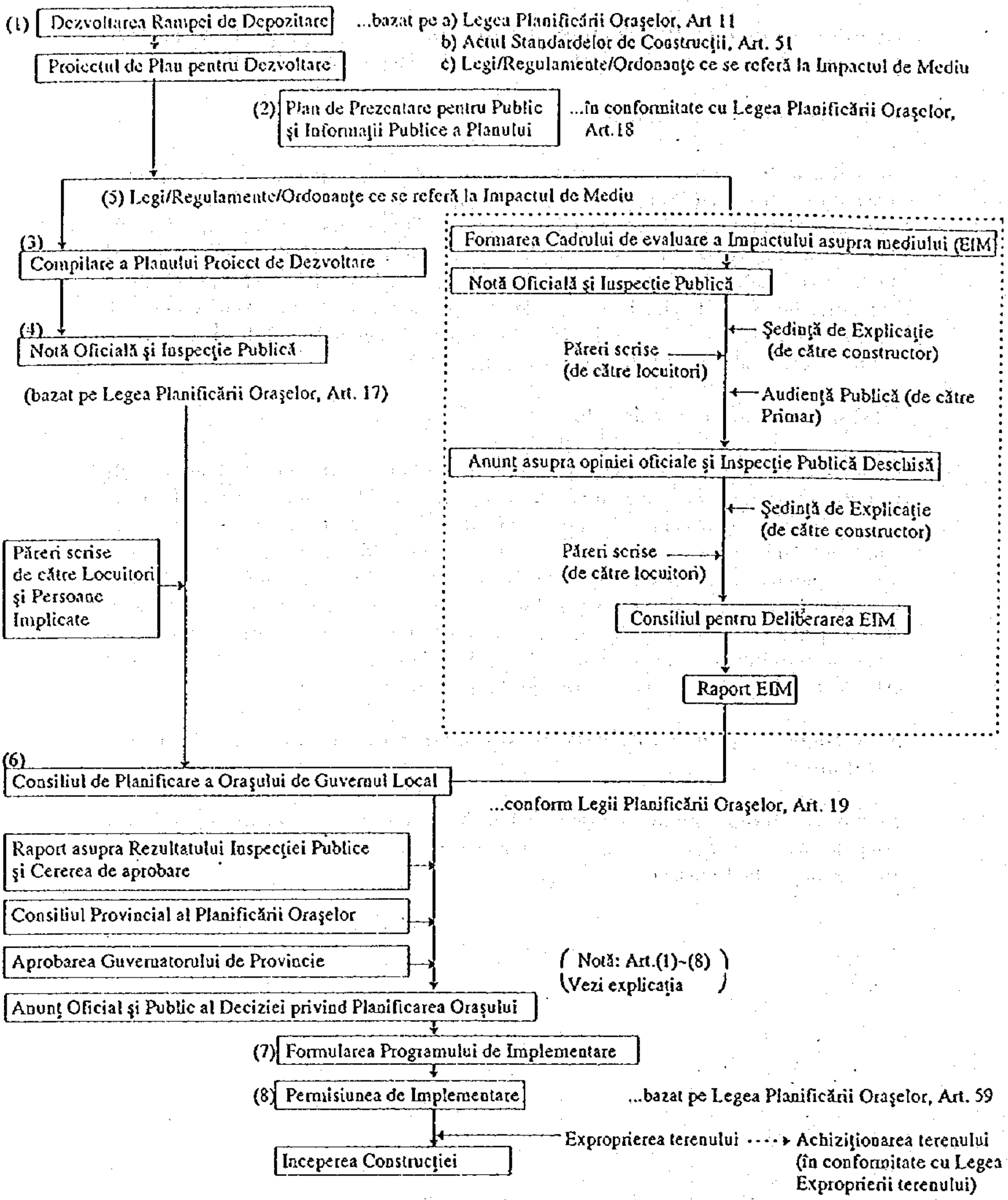
2. Consimţământul rezidenţilor

Pentru a evita problemele neanticipate referitoare la terenuri, se cere ca autorităţile responsabile pentru dezvoltarea amplasamentului să obţină în plus în mod paşnic consimţământul mutual al rezidenţilor care locuiesc în Judeţul/Comuna respectiv(ă), pe lângă derularea procedurilor menţionate mai sus privind exproprierea pentru cauza utilităţii publice. În lumina situaţiilor existente şi/sau condiţiilor terenurilor în raport cu rezidenţă, trebuie reverificat dacă consiliile relevante reprezintă cetăţenii cu adevărat în această privinţă. Anunţuri oficiale şi/sau inspecţii publice sunt considerate ca fiind esenţiale în cadrul programului de dezvoltare, chiar dacă actul declarării utilităţii publice este clar specificat în Capitolul 2, Articolul 11 al Legii 33 din 1994.

3. Exemplu de program de dezvoltare a rampei finale de depozitare în Japonia

Numai ca referinţă, figura ce urmează indică stadiile parcurse pentru dezvoltarea rampelor de depozitare în Japonia, dar legile şi normativele descrise nu neapărat se aplică situaţiei din România.

Cazul unei Rampe de Depozitare Finală a Deșeurilor în Japonia



EXPLICAȚIE

(1) Facilitățile pentru tratarea deșeurilor sunt reglementate de către Actul Standardelor asupra Construcțiilor și Legea Planificării orașelor, după cum urmează.

Facilitățile sunt stipulate ca fiind Facilități Urbane în Articolul 11 din Legea Planificării Orașelor,iar Amplasamentele clădirilor particulare folosite pentru piețe en-gross, etc., sunt date de Art. 51 din Actul Standardelor asupra Construcțiilor.

În principiu, decizia asupra planificării orașului este dată de guvernul local.

(2) Întâlnirile au ca scop prezentarea planificării orașului către public precum și observații ale cetățenilor asupra acestei planificări, și constituie o procedură în luarea deciziei în conformitate cu Legea Planificării Orașelor, Art. 16, pentru ca opiniile cetățenilor și ale altor persoane implicate (proprietari de teren, etc) să fie reflectate în planul de proiect a dezvoltării urbane.

(3) Un proiect al planificării orașului va fi transpus și pe hartă luând în considerare opiniile cetățenilor precum și ale persoanelor interesate ce au fost făcute la întâlnirile publice.

(4) Decizia va fi determinată de inspecția publică asupra planificării orașului și va fi luată de Guvernul Local conform Legii Planificării Orașelor, Art. 17. Opiniile scrise asupra planului vor fi prezentate Guvernului Local de către cetățeni și/sau persoanele implicate dacă doresc să prezinte astfel de opinii.

(5) Implementarea Evaluării Impactului de Mediu (EIM) va determina planificarea orașului după cum stipulează ordonanța din 6 Iunie, 1995 a Directorului General al Directoratului Orașului din cadrul Ministerului Construcțiilor. Procesul EIM este dat în grafic.

(6) Planul orașului va fi decis la aprobarea Guvernatorului Provincial după ce Consiliul Planificării Orașului deliberează opiniile cetățenilor și raportul (rapoartele) EIM, conform Legii Planificării Orașului, Art. 19.

În cazul în care o planificare a orașului stipulează ca facilitățile urbane să fie instalate într-un alt oraș, ajustări vor fi suficient necesare pentru un plan relevant acestor guverne locale, datorită faptului că instalarea facilităților va avea efecte asupra orașelor.

(7) O notă oficială precum și un anunț public vor fi date, bazate pe decizia planificării orașului imediat ce decizia va fi luată și furnizorul va formula un program de implementare.

(8) În conformitate cu Legea Planificării Orașelor, Art.59, implementarea programului de planificare a orașului va începe cu activitatea de achiziționare a terenului, etc, bazat pe aprobarea Guvernatorului Provincial a programului aplicat de Guvernul Local.

JICA