Part IV

Appendices

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Appendix 1 Master Plans for Solid Waste Disposal

The master plan for solid waste management shall be formulated to improve the long-term position for municipal waste disposal and each municipal and district councils is expected to make a long-term plan and then to implement it. The main points of the master plan for solid waste management are as follows;

(1) General Principle

- The master plan is formulated to improve the long term position for municipal waste disposal. Each city and town is expected to make a long term plan and then to implement it.
- In formulating the plan, it is important to consider reducing waste volume, recycling waste and its efficient usage, reducing disposal costs by efficient collection and transportation, securing landfill sites and resources. It is required to define the long-term vision concerning local Municipal waste treatment and at the same time to examine comprehensively the realistic and concrete policies. In this connection, the local authority should also examine thoroughly the policy for common treatment with neighbouring Municipalities.

(2) Basic Policy

Each Local authority should identify its basic policy for solid waste management with regard to social and economic situations in the future.

(3) Target Year

Generally a target year of 10 to 15 years after first formulating the plan is established. If necessary a mid-term year is also established.

(4) Conditions of Solid Waste Discharge

It is necessary to estimate the quality, quantity and type of municipal waste discharged within the planned treatment area (i.e. the prescribed area according to this Masterplan in the target year). In particular, regarding sanitary waste disposal, attention must be given to the progress of sewers as well as to the diffusion of septic tanks.

(5) Treatment and Disposal Subjects of Solid Waste

An understanding must first be reached regarding the types of waste and treatment/disposal currently in use and to formulate a definition of the subjects for the target year, according to the basic policy.

(6) Management and Disposal Plans

The contents of the treatment program for the target year should be established by the types of waste and treatment subjects with regard to the present situation.

a) Collection & Transport Plans

- Objectives of collection and transport (basic policy, etc.)
- Collection zone
- Quantity and method of collection and transport

b) Intermediate Treatment Plans

- Objectives of the intermediate treatment (basic policy, etc.)
- Quantity and method of intermediate treatment (including the discharged quantity of intermediate treatment waste)
- Outline of the treatment facility and its improvement plan (site acreage, treatment capacity, etc.)

c) Final Disposal Plan

- Objectives of final disposal (basic policy, etc.)
- Quantity and Method of final disposal
- Outline of final disposal site and its improvement plan (potential landfill area- the sea, swamp and marshes, mountain area and flat land; landfill acreage, landfill capacity, related facilities, etc.)

d) Recycling and Effective Utilization Plans

- Objectives of recycling and effective utilization (basic policy, etc.)
- Quantity and method of recycling and effective utilization
- Outline of the related facilities and their improvement plan

(7) Measures Required to Accomplish Management Plans

The measures pertaining to the following matters should be identified according to the types of waste in order to accomplish the treatment plan in para (6).

- Matters concerning discharge
- Matters concerning collection and transport
- Matters concerning intermediate treatment
- Matters concerning final disposal
- Matters concerning recycling and effective utilization of waste
- Matters concerning the improvement of solid wastes treatment and disposal facilities
- Matters concerning cost of solid wastes treatment and disposal

Generally the function of the landfill site should be adjustable to the changing quality and quantity of the discharged waste. The improvement plan for the landfill site should be established with attention paid to not only securing space for landfill site, but also to establishing a systematic treatment programme from the long-term view.

Appendix 2 SWM Intermediate Treatment Technologies

2.1 Physical Processing

In line with the policy considered by GOM Material Recovery Facilities to serve as both transfer stations as well as preliminary physical processing points for recyclable materials, are expected to be introduced in the near future. In addition to the sorting lines, the MRF's will be equipped with equipment for shredding, screens and magnets to remove plastic, glass and metals. As source-separation takes root, the need for manual sorting may be decreased however, the gathering of materials from various areas at the MRF centres and their physical sorting will be of benefit to the end-users who will collect these accumulated materials from the MRF centres.

Presently most of the physical processing for plastic, glass and paper is done by the end-users.

There is a pilot project for manufacturing of refuse derived fuel (RDF) in Kajang, which has a capacity of about 15t/d. There is also a project for construction of a RDF in Kajang with a capacity to receive 700t/d. RDF should be considered in line with the waste composition and the possibility to introduce source separation.

2.2 Biological Treatment

The quantity of organic material in the waste can be reduced with the use of biological technologies including composting and anaerobic digestion. Biological technologies are undertaken both in the presence and absence of oxygen. Neither process destroys the organic matter contained in biodegradable waste but they utilize micro-organisms to convert degradable organic matter into humus, known as compost.

In the compost process carbon dioxide and water are also produced. Under anaerobic conditions, methane gas is produced which can be used as a source of energy. In the case of Malaysia, conversion of kitchen waste into compost may generate sensitive cultural and religious issues which should be taken into consideration when selecting this technology. Furthermore lack of source separation and poor separation at the compost plant will result in presence of metals, glass and other unwanted materials in the compost. Therefore it is preferable to restrict to uncontaminated segregated green garden waste as this reduces the risk of end product contamination and minimizes problems of odour generation and vermin. However the reduction in organic content from the waste mass will also reduce gas generation at landfill sites as a result of decomposition, and leachate generated will generally require less treatment before discharge.

(1) Composting:

This is the process of biological decomposition of semi-dry organic waste (such as garden and vegetable wastes) by micro-organisms, under controlled aerobic conditions. The product is a nutrient rich humus like-material, commonly referred to as a soil conditioner. To be acceptable to the end-users and for ease of application the compost should be free of contaminants such as plastic, glass, and metal fragments. The composting process requires control of the feedstock (input wastes) and the product (compost) through physical, chemical and biological parameters. Standards should be developed for the end product (presently there are no standards in Malaysia). Common systems for composting are as shown in **TableIV-2-1**.

Table IV-2-1 Composting Systems

System	Description
(1) Windrow Composting	Windrows are heaps of waste, triangular in section, which are frequently turned (manually or mechanically) to maintain the correct temperature and aeration conditions. Waste is shred and placed in long rows where it is turned regularly for up to 20 weeks until the compost is considered ready for use. Windrow heights can be up to 3 meters in height and 4 meters in width. "Aerated static piles" achieve aeration by controlled pumping of air through the static pile. Mature compost may be produced more quickly and there is less land requirement, however aerated static pile composting requires higher capital costs.
(2) In-Vessel Composting	"In-vessel systems" may be drums, tunnels or boxes (e.g. roll on/off containers), and offer better process control of the composting process. The vessels usually include odour control, automated aeration and moisture regimes within the vessel, and movement of the material (e.g. using moving floors). The investment costs are higher and there is normally some need for further maturation of the processed compost from such systems, but the land requirements may be lower. Systems have been used primarily for sewage sludge composting, but many suppliers are now encouraging the merits of this technology for the composting of MSW.
(3) Home Composting	Home composting is a long established practice in many countries involving the use of special compost bins and, more recently wormeries (a container which houses a colony of worms), to break down the organic elements of the household waste stream, including kitchen waste, into nutrient rich compost. This method would generally account for only a small proportion of the total volume of material diverted from landfill, due to the small number of households that undertake composting and the low throughput of material. The adoption of pilot schemes is an option whereby households are provided with the necessary facilities. However, a major barrier to its increased use is that many householders, especially those who live in flats or are without open areas outside, do not have the space required to allow home composting. Increased public awareness and education are also required. The development of such schemes however does invoke an involvement in waste reduction initiatives among the public, and consequently can play a useful part in promoting community involvement.

Table IV-2-2 shows the advantages and disadvantages of the Composting treatment system.

Table IV-2-2 Composting; Advantages and Disadvantages

Advantages	Disadvantages
• Can contribute to climate change abatement. Little methane is produced compared to landfill. • Volume reduction 30-40% (dependant on waste components). • It is recycling – nutrients can be returned to the soil. • Well established • Relatively inexpensive. • Can handle variable waste streams more easily than Anaerobic Digestion (AD). • May be a source of fuel when dried. • Capital investment costs are lower than other technologies. • Simple (comparatively) low technology option.	• The microbial activity is exothermic, thus there is heat generated and there must be close control of aeration, temperature and moisture content • Prior sorting is required to ensure the process is effective, to reduce contamination, and to produce high quality compost. • Odours at plant or in transit. • Quality of end product is critically dependant on feedstock, and contamination can be a significant problem. Heavy metal content is generally high compared with naturally occurring soils, thus, for the domestic market, further processing is required. • Religious concerns need to be addressed in the case of Malaysia

(2) Anaerobic Digestion:

In anaerobic digestion (AD) organic waste matter is reduced into a material similar to compost, known as digestate, which can have similar applications. The main difference between the two processes is that AD is an anaerobic (oxygen free) process, whereas composting requires aerobic conditions.

AD is, however, also referred to as Energy from Waste (EfW) process because one of the by-products is biogas, which can be utilised as a fuel either on-site or converted to electricity and transferred to the national grid. AD is more suited to wet organic wastes such as sewage and foodstuffs from the household waste stream. Garden waste can also be processed but the degree of degradation varies according to the type of input, e.g. grass cuttings will degrade quicker than wood. Segregation of wastes, whether by the householder or at a material recycling facility (MRF), can significantly benefit the AD process by excluding those elements of the waste stream not suited to the process e.g. plastics, glass and textiles.

The natural biological process is artificially accelerated in a closed vessel, where bacteria are used, in an oxygen-starved atmosphere, to decompose complex organic materials. The gases, which are produced by the decomposing matter, mostly methane and carbon dioxide, are drawn off and converted into energy or used to generate steam. The purity of feed material determines the quality of end product, and the end products can be products for horticultural use or gas collection.

Ideal feedstock for AD plant is organic-vegetable origin, but waste paper, which is too contaminated to be recycled or has no market value, can also be digested. Most AD plants incorporate a number of stages including shredding, pre-digestion, post-digestion, aerobic curing and screening.

Table IV-2-3 shows the advantages and disadvantages of the anaerobic digestion system.

Table IV-2-3 Anaerobic Digestion; Advantages and Disadvantages

Advantages	Disadvantages
• Disposal volume of waste reduced by up to 60% (dependant on characteristics of feedstock) and the residue for disposal to landfill is small. • The process is a form of recycling, and has additional benefits over the alternative of open composting because it is fully enclosed, obviating nuisance caused by odours. • Greater control of gas and leachate. • Biogas produced represents about 25% of the energy content of the waste, so can be used as an on-site fuel, or to generate electricity for export off-site.	• Requires an engineered vessel to ensure anaerobic conditions. • More expensive than composting, • Can handle only limited waste streams, thus prior separation of input waste is essential. • If the feedstock is variable then it may cause operational problems • Plastics and cellulose products (such as wood and wood fibre) are not digestible

2.3 Thermal Treatment

(1) Energy from Waste

Energy from Waste (EfW) refers to waste management technologies whereby energy is captured as a by-product of the process and converted into electricity. It is usually used in the context of waste incineration (but can also be applied to anaerobic digestion and recovery of landfill gas from waste disposal sites) where, in addition to providing a supply of electricity to the National Grid, the process can also be utilised to supply district heating to neighbourhoods or other buildings in the vicinity, or to provide power to run the plant.

Incineration with energy recovery provides a means of reducing the volume of waste to a relatively inert ash and recovering the energy content of the organic waste. Different combustion processes can be used, including refuse derived fuel and combined heat and power.

Refuse derived fuel (RDF) – in this process the mainly organic fraction of the MSW (with non combustible material removed) is used as a fuel.

Combined heat and power (CHP) – This is a thermal processes involving the use of waste as a combustion fuel for power generation and steam that is used locally for heating. The combustion efficiencies in CHP plants can reach 30%.

Table A-2-4 shows the advantages and disadvantages of the generation of energy from waste.

Table IV-2-4 Energy from Waste; Advantages and Disadvantages

Advantages	Disadvantages
• The process maximises the use of available heat derived from the fuel. • Can accept a wide range of wastes. • Waste is a renewable energy resource, with consequent benefits through international non-fossil fuel obligations, and a positive response to the implications of the Kyoto Agreement as determined at the Framework Convention on Climate Change.	• Capital and operational costs are high. • Pollution control equipment is expensive. • Ash produced may require to be disposed of in a hazardous waste landfill due to heavy metal content. • Requires a sustained market for the energy generated. • Thermal treatment produces several waste streams (solid wastes as fly ash and bottom ash, gaseous emissions and discharges to water), each of which may contain pollutants that can adversely affect the health of exposed individuals in the absence of properly engineered and constructed facilities and poor operation and maintenance practices.

Thermal treatment processes include Pyrolysis, Gasification and Plasma. Pyrolysis and gasification involve the conversion of waste into energy-rich fuels by heating it under controlled conditions. However, whereas incineration fully converts the input waste into energy and ash, these processes limit conversion so that combustion does not take place directly. The waste is instead converted into intermediate products, which can further be processed for material recycling or energy recovery.

A brief description of each process is given below.

(2) Gasification

The conversion of solid waste into its gaseous components (principally hydrogen and carbon monoxide). The process involves the reaction of hot carboniferous material (the waste) with air, steam or oxygen to produce a gaseous fuel, "syngas" which is then used for electricity production in gas turbines, or in combination with heat exchangers and steam turbines. The temperatures involved are high and vary between 800°C and 1,100°C in the case of air gasification, and between 1,000°C and 1,400°C in the case of oxygen gasification. The environmental burden, often associated with "conventional" thermal treatment, is generally low, due to the contained nature of the process.

Table IV-2-5 shows the advantages and disadvantages of the gasification process.

Table IV-2-5 Gasification; Advantages and Disadvantages

Advantages	Disadvantages
• Energy efficiency is high. • Waste volume reduced by 80% – 90%. • Emissions of NOx, Sox, dioxins and furans are reduced • Capable of treating a wide range of wastes.	• Technically complex. • Generally more expensive if ash melting is included to meet higher environmental standards. • Feedstock may need to be pre-treated (homogenizing/ sizing).

(3) Pyrolysis

This process involves the thermal degradation of waste in the absence of oxygen in a sealed vessel. Organic matter is heated in closed conditions in the absence of air and subsequent volatisation produces combustible gases, a low calorific combustible char, a mixture of oils and a liquid effluent. Temperatures are in the range of 700°C to 1,000°C.

Table A-2-6 shows the advantages and disadvantages of the gasification process.

Table IV-2-6 Pyrolysis; Advantages and Disadvantages

Advantages	Disadvantages
• Maximises the recovery of various products and residues. • Waste volume reduced by up to 90%. • Potential for energy production • Capable of treating a wide range of wastes.	• Technically complex. • Generally more expensive dependent upon processes controls and equipment to meet higher environmental standards.

(4) Plasma:

Plasma is the fourth state of matter, i.e. a highly ionised gas which can be produced as a result of electric discharges. Plasma energy is produced when the ionised gas resists the flow of electric current through the gas, thus creating radiant heat that generates temperatures higher than 10,000°C. The intense heat of plasma energy is normally used in combination with pyrolysis for treatment of solid waste, the heat source being a plasma arc torch.

Heat is transferred to the waste via connection, where temperatures of up to 2,000°C are established in the waste melt. Volatile organic materials break down and reform to hydrogen-rich, simple gases such as carbon dioxide. Inorganic form a glass-like melt as they stabilize.

Table IV-2-7 shows the advantages and disadvantages of the gasification process.

Table IV-2-7 Plasma; Advantages and Disadvantages

Advantages	Disadvantages
• Very high destruction efficiency for organic materials • Waste volume reduced by up to 90%. • Potential for energy production • Non-leach able (vitrified) slag is recyclable • The plasma arc torch has no moving parts, thus operating costs may be lower than conventional incineration	• High-energy demand (electricity; about 3,000 kW) for processing, thus reducing the net amount of energy for export. • More complex design than mass burn EfW plants. • Generally more expensive than EfW plants (but modular build basis may provide greater flexibility). • Currently worldwide there are limited full-scale applications of plasma arc technology for solid waste treatment

Appendix 3 Example of Design Calculation for Leachate Treatment and Controlling Facility

3.1 Example Calculation 1

An example of calculation for capacities of leachate treatment and leachate control facilities reported in Implementation of the Semi Aerobic Landfill System (Fukuoka Method) in Malaysia: A Costing Study (Theng Lee Chong, JICA Trainee (2002)) is shown below.

Estimation of leachate volume generated from landfill sites is very important particularly for a country with very heavy rainfall annually such as Malaysia. Improper estimation of leachate volume will create serious problem for leachate overflow and subsequently cause a total failure for the entire landfill system as a whole.

The estimation of leachate volume generation can be achieved by using the following equation:

$$Q = (1 / 1000) \cdot C \cdot I \cdot A$$

Where

Q = Average leachate amount (m^3/day)
C = Leaching Coefficient
I = Average daily rainfall (mm/day)
A = Landfill site area (m^2)

For this study, the 15 hectares landfill site are assumed to be divided into 3 phases in order to keep the working space smaller and reduce the leachate generation. The size of each phases are as follows:

Phase 1 – 5.0 hectares
Phase 2 – 5.0 hectares
Phase 3 – 5.0 hectares

The rainfall data was collected from various different locations in Malaysia and the highest rainfall data within a month, which was about 850mm/month (28mm/day) was used in the calculation in order to cope with the maximum great volume of leachate especially during heavy rainfall season. Some rainfall data is attached in Appendix A.

For Phase 1, the area expected for waste is about 50,000 m^2, and the Leaching Coefficient value used was 0.5. Thus the average leachate amount generated was:

$$Q = (0.001 \cdot 0.5 \cdot 28 \cdot 50{,}000)$$
$$= 700 \text{ m}^3\text{/day}$$

During Phase 2 period, the area expected for waste is also 50,000 m^2, and the Leaching Coefficient value used was 0.5. However at this stage, the leachate generated from Phase 1 was expected with a lower Leaching Coefficient of 0.3. Thus the average leachate amount generated was:

$$Q = [0.001 \cdot (0.5 \cdot 28 \cdot 50{,}000) + (0.3 \cdot 28 \cdot 50{,}000)]$$
$$= 1{,}120 \text{ m}^3\text{/day}$$

While for Phase 3 period, the leachate generation calculated by using the Leaching Coefficient for the Phase 1 as 0.1, Phase 2 as 0.3 and Phase 3 as 0.5, i.e.:

$$Q = [\,0.001 \cdot (\,0.5 \cdot 28 \cdot 50{,}000\,) + (\,0.3 \cdot 28 \cdot 50{,}000\,) + (\,0.3 \cdot 28 \cdot 50{,}000\,)\,]$$

$$= 1{,}540\ m^3/day$$

From the calculation, it was found that the highest possible leachate generation rate is about 1,540 m^3/day at the later phase of landfilling. For the purpose of coping with overflow and overload problems, the size of the leachate ponds are usually designed about 10 times more than the estimated leachate volume so that it can be provide a sufficient retention time in the pond.

Practically, the leachate pond size at phase 2 is usually recommended at the initial stage of the landfill development, while later on another additional capacity of ponds are added in the final stage. However, in this study the design of pond was assumed to be based on capacity of 1,540 m^3/day of stage 3 where the maximum leachate volume is achieved because for the cost estimation purposes. Thus, the pond of 15,400 m^3 in capacity is proposed and with an assumed depth of 3m, the suggested area for the pond is about 5,133 m^2.

For this landfill site, leachate re-circulation system is proposed with simple primary and secondary aerations. Thus, the number of ponds required is three with the same size, with the total capacity of 46,200 m^3 and surface area of 15,400 m^2. In addition, an overflow facility is also necessary for disaster prevention.

3.2 Example Calculation 2: Example of Calculation for Scales of Leachate Treatment and Leachate Control Facilities by Rational Formula (Technical Guideline on Sanitary Landfill -Planning and Designing- (Japan, 2001))

An example of calculation for scales of leachate treatment and leachate control facilities reported in "Technical Guideline on Sanitary Landfill -Planning and Designing- (Japan, 2001)" is shown below*.

*page467-471"Ⅲ-8.5.3 Appendix: Example of Calculation for Scales of Leachate Treatment and Leachate Control Facilities by Rational Formula"

In terms of a sanitary landfill as shown in **Figure IV-3-1** below, the scale of leachate treatment facility and capacity of leachate control facility are calculated. In this section, design inflow of leachate is determined by rational formula and scale of leachate treatment facility (daily treatment volume of leachate) is computed.

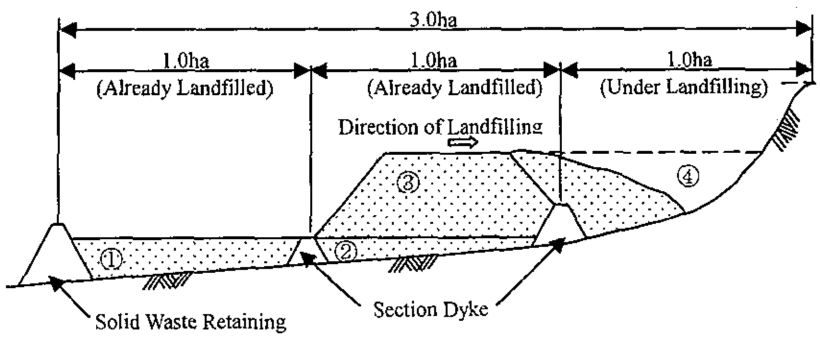


Figure IV-3-1 Cross Section of Sanitary Landfill in Mountain Areas

When designing the scale of leachate control facility, first, the capacity of leachate treatment facility is decided. Next, the scale of leachate control facility is found by water balance computation. In this method, there are two ways to find the daily leachate generation volume: one is by rational formula, and the other is by considering time lag. Hereinafter rational formula method is described.

Suppose that there is a sanitary landfill having 3.0ha landfill area located among the mountains. Water from surroundings of the landfill site is not able to infiltrate because lining facility is laid onto the landfill surface. The landfill area is divided into three sections each of which have 1.0ha area and landfilling work progresses from downstream to upper stream.

(1) Calculation of Design Inflow Q (Daily Treatment Amount of Leachate Treatment Facility)

Design inflow Q is calculated at the conditions that 1.0ha area of section under landfilling work and 2.0ha area of section already landfilled, where the most amount of leachate generates in this sectional landfill plan. Surface runoff from already-landfilled area is excluded from the landfill site.

Design inflow of leachate is calculated by following equation:

$$Q = (1/1000) * I * (C_1A_1+C_2A_2)$$

Assuming that length of landfilling period at the relevant area is 15 years, the design inflow of leachate is calculated by using the nearest 15-year data same as landfilling period.

By using past data, annual average daily rainfall [precipitation] is set as 4.6mm/day, maximum monthly rainfall converted into daily one is 7.9mm/day, leachate coefficient for the section under landfilling work is (C_1=) 0.67, and for the section already-landfilled is (C_2=) 0.40. By substituting C_1=0.67, A_1= 10,000m2, C_2=0.40, A_2=20,000m2, and I=4.6mm/day for above equation, the average leachate inflow Q=68.2m3/day, approximately 70m3/day is obtained. When substituting I=7.9mm/day instead, the maximum leachate inflow Q=117.1m3//day, approximately Q=110m3/day is obtained.

These results are shown in **Table IV-3-1**.

Table IV-3-1 Leachate Treatment Volume

Precipitation / Leachate Volume	Rational Formula	
	Annual Average Precipitation	Conversion
Average Leachate Volume	70m^3/day	–
Maximum Leachate Volume	–	110m^3/day

That is to say, daily leachate treatment volume must be set between 70m^3/day and 110m^3/day. Therefore, in following sections, daily leachate volume is set in five cases: 70, 80, 90, 100 and 110m^3/day.

(2) Calculation of Capacity of Leachate Control Facility: Vmax

1) Rainfall [Precipitation] Data for Calculation

Assuming that length of landfilling period at the relevant area is 15 years, the design inflow of leachate is calculated by using the nearest 15-year data same as landfilling period.

2) Daily leachate Inflow Q'

By using rational formula, daily leachate inflow is calculated by following equation:

$$Q_j = (1/1000) * I_j * (C_1A_1+C_2A_2)$$

while

Q_j: Daily Leachate Volume (m^3/day)
I_j: Daily Rainfall [Precipitation] from 1st of January 1985 to 31st of December 1999.
A_1: Section Area under Landfilling
A_2: Section Area
C_1: Leachate Coefficient in Section Area under Landfilling
C_2: Leachate Coefficient in Section Area

To find C_1 and C_2, first, available amount of evaporation in the relevant area is calculated by Blaney Criddle Formula using annual average of rainfall. Then, assuming that 60% of the evaporation amount is used in effectively, leachate coefficient $C_1$and C_2 are determined as C_1=0.67, C_2 = 0.6, and C_1 = 0.4, respectively.

For example, daily leachate volume is calculated when rainfall on that day is I_j = 20.5mm/day, as follows:

$$Q_5 = (1/1000) * 20.5 * (0.67*10{,}000+0.4*20{,}000) = 301.4m^3/day.$$

(3) Setting up the Maximum Volume of Control Capacity

According to the flow diagram for calculation for water balance of capacity of leachate control facility shown in **Figure IV-3-2**, the maximum volume of control capacity in each case of daily leachate inflow, where Q' = 70, 80, 90, 100 and 110m^3/day.

Maximum volume (Vmax) is a set value of capacity of leachate control facility, equivalent to each Q'.

Maximum continuous storage days (See **Figure IV-3-3**) and working ratio of leachate treatment facility during 15 years (total amount of treated leachate/(15 years * 365 days * Scale of leachate treatment facility)) are shown in **Table IV-3-2.**

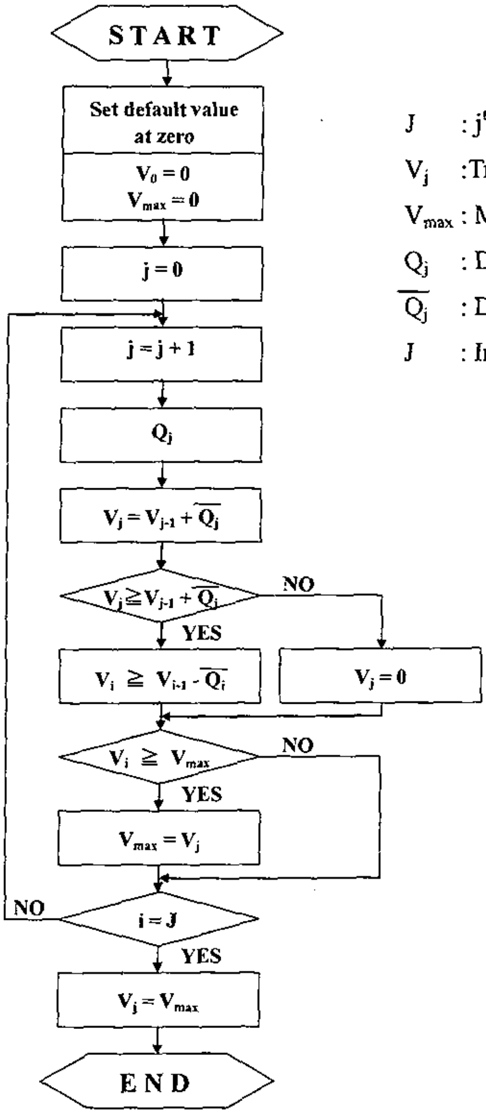
Table IV-3-2 Results of Computation [Calculation]

Q' (m^3/day)	Vmax (m^3)
70	23,147
80	13,238
90	12,538
100	11,838
110	11,138

Fluctuations of leachate control volume for Q' = 70, 80, 90, 100 and 110m3/day are shown in **Figure IV-3-3.**

Reference: 1) Structural Guideline on Sanitary Landfill in Japan

1989, Japan Waste Management Association)



Legend

J : j^{th} date

V_j :Treatment Capacity on j^{th} date

V_{max} : Maximum Treatment Capacity

Q_j : Daily Leachate Flow on j^{th} Date

$\overline{Q_j}$: Daily Treatment Flow

J : In and Out Number of Days

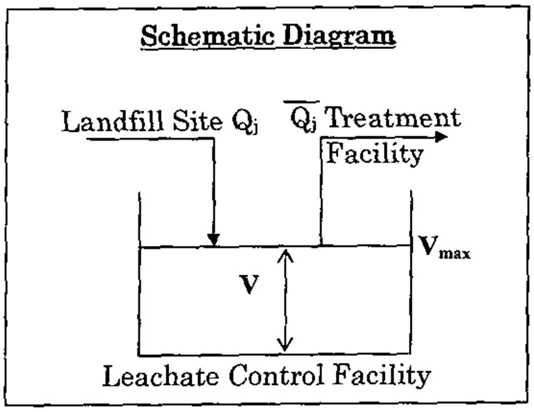


Figure IV-3-2 Flow Diagram for Calculation for Water Balance of Capacity of Leachate Control Facility

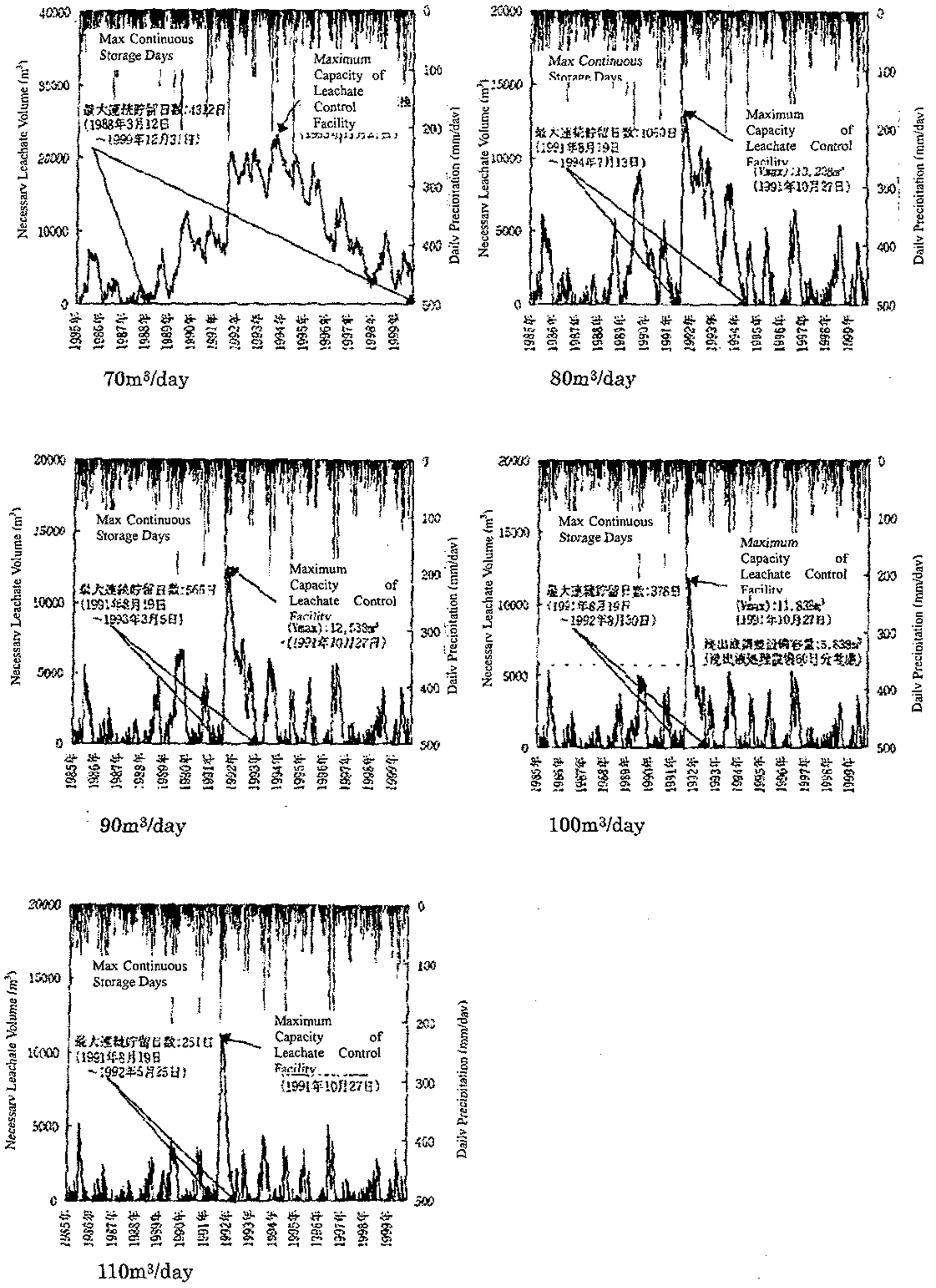


Figure IV-3-3 Fluctuation of Daily Leachate Control Volume

JICA