6.4.4.2 Leachate Treatment

Under such climatic conditions that the precipitation is about 500mm/year and the evapotranspiration is more than 3 times of the precipitation, leachate is scarcely generated or is little enough to handle and treat easily (e.g., temporal storage and circulation, etc.). However, under such climatic conditions near AMSS that the precipitation is more than 1,700mm/year, leachate needs to be treated properly.

There are various ways of treating leachate and whose engineering integrity, investment costs and O&M costs are diversely different.

In Japan, as quite high levels of leachate treatment are required, treatment costs (only O&M costs) range US$20 to 50 per 1m^3 leachate treated. As for investment cost for treatment plant installation, it ranges as high as US$ 300,000 to 500,000 per m^3/day of nominal capacity of the plant.

Permissible level of treated effluent quality is not defined in the current environmental legislation. Meanwhile, the existing MIDES Nejapa landfill is currently carrying out the leachate treatment. Hence, in planning a new final disposal site, it is considered necessary to set it forth as a premise that the same level of leachate treatment as that of MIDES Nejapa landfill is required.

Therefore, the Study recommends aerated lagoon type leachate treatment for a new landfill planning, which is same as the MIDES Nejapa landfill treatment.

6.4.4.3 Conceptual Cost Estimate

In order to compare alternatives in final disposal system, it is necessary to have conceptual cost estimate.

10 municipalities out of 14 municipalities in AMSS already perform Step III in the final disposal system (i.e., sanitary landfill). Meanwhile two municipalities are at Step I (open dumping) and other 2 municipalities are at Step II (i.e., controlled dumping).

Viewing the situation of the 4 municipalities, conceptual cost estimate on:

- Sanitary landfill costs
- Additional cost incurred with longer transport distance

are carried out herewith.

a. Sanitary Landfill Costs

The figure below shows correlation between "capacity" and "conceptual unit cost[2] (per ton)" of sanitary landfill.

[2] Source: adopted from "Teechnology, Prevalence and Economics of Landfill Disposal of Solid Waste", EPA, Washington D.C. 1980

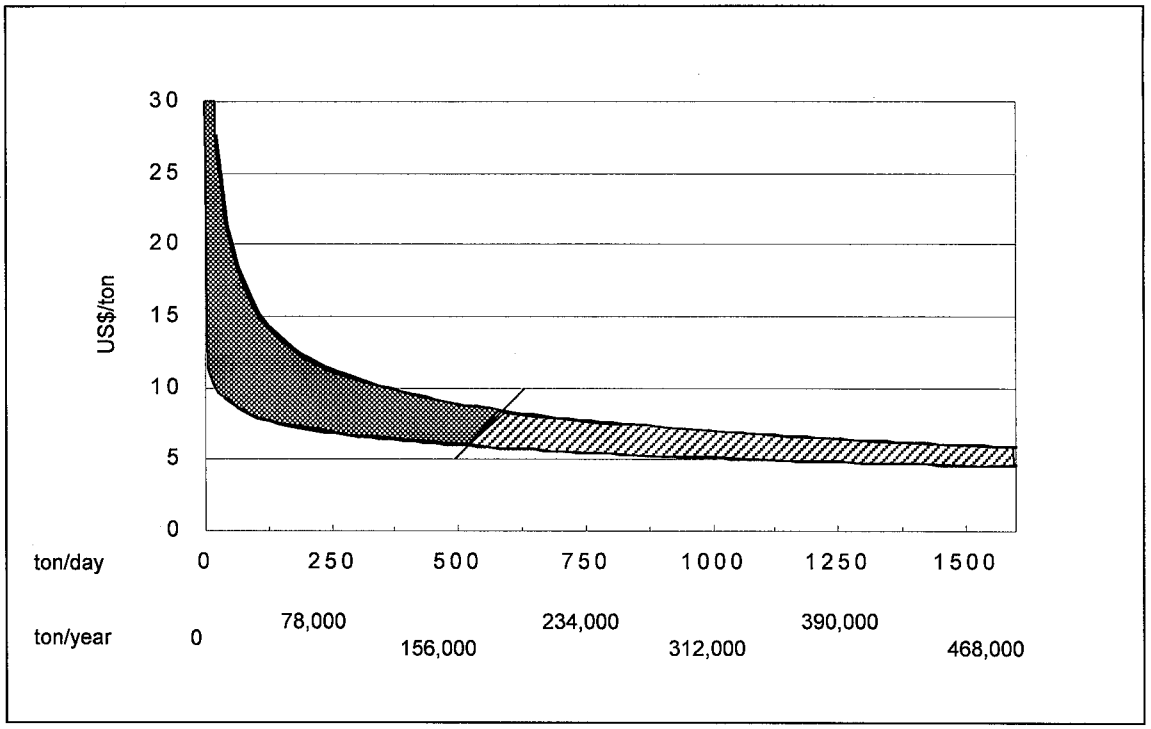

Figure 6-8: Correlation of Capacity and Unit Cost of Sanitary Landfill

The figure above implies possible unit cost of sanitary landfill depending the capacity sizes that several alternatives imply. The table below summarizes range of possible unit cost for final disposal.

Table 6-51: Correlation of Capacity and Unit Cost of Sanitary Landfill

Capacity (ton/day)	Range of possible unit cost	Mean value of possible unit cost	Remarks	Assumption (applicable alternatives)
30	US$23.5/ton to US$9.5/ton	US$ 16.5/ton		TN own use SMT own use
60	US$21.5/ton to US$8.5/ton	US$ 15/ton		TN and SMT together
100	US$ 20/ton to US$7.5/ton	US$ 13.7/ton	possible co-use of landfill by several municipalities (regional use landfill)	
150	US$ 18/ton to US$7.0/ton	US$ 12.5/ton		New ESPIGA size (assumption)
200	US$ 13/ton to US$6.4/ton	US$ 9.7/ton		
320	US$ 9.8/ton to US$5.6/ton	US$ 7.7/ton		
640	US$ 7.2/ton to US$5.0/ton	US$ 6.1/ton		
960	US$ 6.8/ton to US$ 4.6/ton	US$ 5.7/ton		
1280	US$ 6.5/ton to US$4.5/ton	US$ 5.5/ton		

b. Additional Cost Incurred with Longer Transport Distance

The figure below shows representative cost of collection and transport by collection vehicle (e.g., 18yd^3 compactor truck) with the parameter of transport distance (one-way distance). It calculates about **US$0.4/km/ton**.

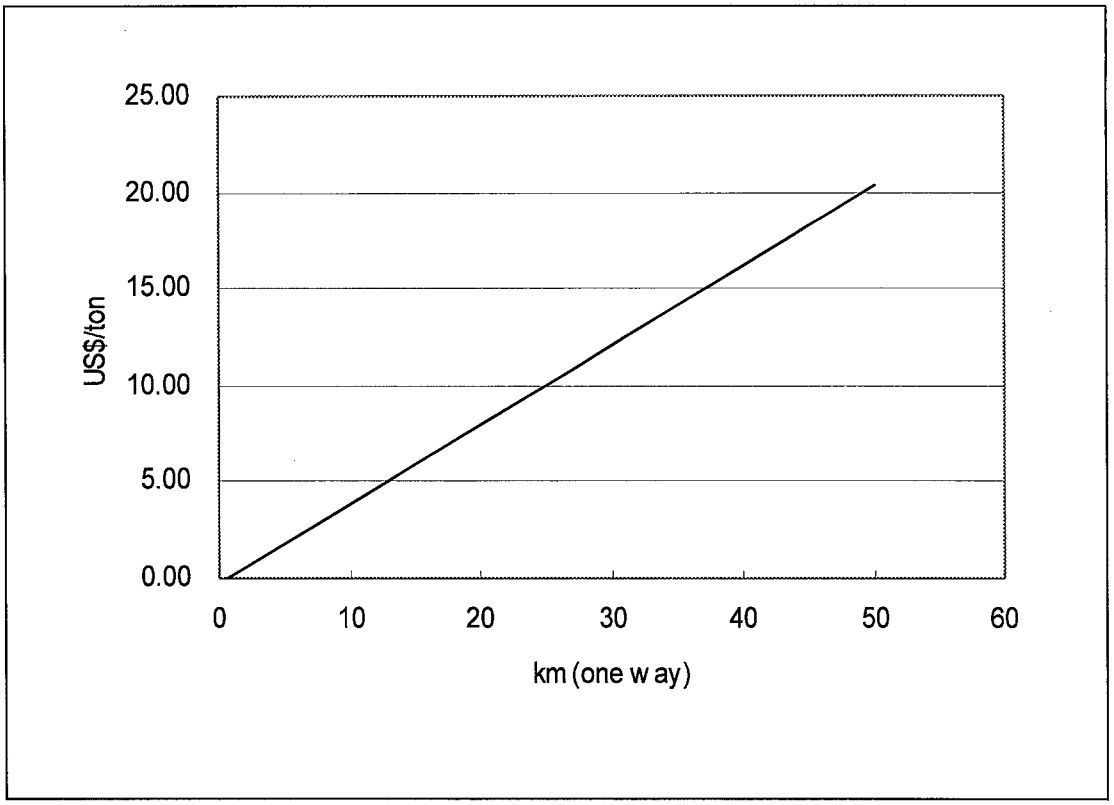

Figure 6-9: Representative Cost of Collection and Transport (18yd^3 Compactor)

6.4.4.4 Cuscatancingo and Antiguo Cuscatlan (Step II to Step III)

a. Background

Cuscatancingo and Antiguo Cuscatlán municipalities used to dispose of their waste at Mariona site, and their transport distances were about 12.2km and 42.2km respectively.

Today they bring their waste to ESPIGA site. The transport distance to the site from respective municipalities is about 35km. The transport distance to ESPIGA site for Antiguo Cuscatlán municipality becomes about **7km shorter** than to the formerly used Mariona site. On the other hand, as for Cuscatancingo municipality, it becomes about **23km longer**.

Formerly the two municipalities did not bear the disposal cost at Mariona site, however, today they pay the disposal fee to the owner of the ESPIGA site.

b. Present Problems

As the current ESPIGA disposal site is a controlled dumping site, it should be improved to a level of a sanitary landfill.

Meanwhile, it seems impossible to improve the same site as "sanitary landfill". The reasons are as follows:

- It is necessary to have impermeable liner to satisfy the current requirement[3], since the site seems to stand on a permeable ground.
- It is never practical to remove all wastes formerly buried and to place on a new S/L with impermeable liner.
- If the impermeable liner of a new S/L is placed above the formerly buried waste and the final soil cover on the former waste does not have a very sufficient thickness, the impermeable liner might possibly be broken by the waste buried that have sharp edges. Because the new S/L will add the weight burden on the impermeable liner by the waste buried above. Breakage of impermeable liner creates underground contamination by leachate. In other words, sufficient thickness of soil cover on former waste will induce relatively high cost.
- Furthermore, if the impermeable liner of a new S/L is placed above the formerly buried waste, biogas from formerly buried waste may accumulate and be pressurized below the impermeable liner. It consequently will create fatal hazard and accident.

Hence, it is recommended that a new S/L of ESPIGA be constructed at an off-set location of the current site.

c. Alternatives in Final Disposal System

It is awaited that a sanitary landfill be constructed and operated near the current ESPIGA site. Or, it is expected that the two municipalities of Cuscatancingo and Antiguo Cuscatlán participate to use MIDES Nejapa S/L or another regional S/L.

As it is aimed that until the target year 2010 both Cuscatancingo and Antiguo Cuscatlán municipalities should establish and implement the Step III (i.e., sanitary landfill) in their final disposal system, alternatives of sanitary landfill should be examined herewith.

The following should be the candidate alternatives for the examination.

- participate in MIDES Nejapa sanitary landfill
- participate in the new ESPIGA sanitary landfill
- participate in another regional sanitary landfill

Because, it is impossible for each municipality to locate candidate site of S/L within its jurisdiction area, where both are populated urbanized municipalities and sufficient land for S/L is hardly available.

c.1 Participate in MIDES Nejapa sanitary landfill

The conceptual cost estimate summarized in the table below gives additional cost in participating MIDES of about US$19.4/ton and US$7.6/ton respectively for Antiguo Cuscatlan and Cuscatancingo.

[3] The Transitory Decree on Solid Waste turned into the Special Regulation on Integral Management of Solid Waste, that appeared on the Official Gazzete on 1st June 2000.

Table 6-52: Conceptual Cost Estimation for Participation in MIDES Nejapa Landfill

Item	Cost Increased		Remarks
	Antiguo Cuscatlan	Cuscatancingo	
grade up to sanitary landfill	US$13.0/ton	US$13.0/ton	MIDES landfill fee (US$18.0/ton) minus current ESPIGA fee (US$5.0/ton)
longer distance	US$6.4/ton	- US$5.4/ton	assumed US$0.4/km/ton, present 35km to 51km for AC, and present 35km to 22km for CT
Total	US$19.4/ton	US$7.6/ton	

As for Cuscatancingo, to participate MIDES has an advantage of reducing transport cost.

c.2 Participate in the new ESPIGA sanitary landfill

The conceptual cost estimate summarized in the table below gives additional cost in participating new ESPIGA of about US$7.5/ton for both Antiguo Cuscatlan and Cuscatancingo, since no transport cost increase is envisaged.

Table 6-53: Conceptual Cost Estimation for Participation in New ESPIGA Landfill

Item	Cost Increased		Remarks
	Antiguo Cuscatlan	Cuscatancingo	
grade up to sanitary landfill	US$7.5/ton	US$7.5/ton	conceptual cost estimation (US$12.5/ton) minus current ESPIGA fee (US$5.0/ton)
longer distance	US$0.0/ton	US$0.0/ton	same distance to current ESPIGA site
Total	US$7.5/ton	US$7.5/ton	

c.3 Participate in Another Regional Sanitary Landfill

There is no information of another regional landfill at this moment.

d. Comparison of Alternatives for AC and CT

In view of the above examination on "conceptual cost estimate", the table below compares the alternatives.

d.1 Comparison of Alternatives for AC

Table 6-54: Comparison of Alternatives for AC

Alternatives for Improvement	Cost Increased (US$/ton)			Remarks
	S/L level up	Longer distance	Total	
participate MIDES Nejapa	13.0	6.4	19.4	
participate new ESPIGA	7.5	0.0	7.5	
participate another regional S/L	-	-	-	no information

It could be suggested for Antiguo Cuscatlan to select the alternative of "new ESPIGA", with an assumption of that new ESPIGA tipping fee be about US$12.5/ton.

d.2 Comparison of Alternatives for CT

Table 6-55: Comparison of Alternatives for CT

Alternatives for Improvement	Cost Increased (US$/ton)			Remarks
	S/L level up	Longer distance	Total	
participate MIDES Nejapa	13.0	-5.4	7.6	
participate new ESPIGA	7.5	0.0	7.5	
participate another regional S/L	-	-	-	no information

It could be suggested for Cuscatancingo to select either alternative of participating "MIDES" or "new ESPIGA", with an assumption of that new ESPIGA tipping fee be about US$12.5/ton.

If the MIDES tipping fee is discounted by several US$/ton, the alternative of "participating MIDES" become a competitive offer for the municipality of Cuscatancingo, which has shorter distance to the MIDES disposal site than to new ESPIGA site.

e. Recent Information on New ESPIGA Sanitary Landfill

A newspaper article regarding New ESPIGA S/L is published on 1st June 2000 (Diario de Hoy). A part of it is quoted below.

QUOTE
"The project will be executed through a public tender... ... ...
The municipalities of Cuscatancingo, Antiguo Cuscatlan, Santiago Texacuangos, Panchimalco and Zaragoza wish to build a sanitary landfill, similar to that operating in Nejapa, in the land located at La Paz. .....
Nerio stated that a Canadian company is designing a sanitary landfill project, and it will then request a credit to an international bank or the Central Government .....
There are 20 blocks (manzanas) of land available for the construction of the landfill, which is the same space utilized by the dumping site. The costs and terms on which such landfill will be executed are not defined yet."
UNQUOTE

As this project will be subject to public tender, the project information is not available for the Study.

6.4.4.5 San Martin and Tonacatepeque (Step I to Step III)

a. Background

Since long time ago, Tonacatepeque municipality disposes their waste at the open dumping site in the same municipality. It is estimated that due to mainly financial restriction on municipal budget for SWM, the municipality is and was unable to transport their waste to a distant disposal site either to the former Mariona site or to the present MIDES Nejapa site or ESPIGA site.

Considerable years ago, San Martin municipality disposed of their waste at the open dumping site at the Tonacatepeque municipality. Since such disposal was rejected by the Tonacatepeque municipality, San Martin was forced to dispose their waste at some ravine in its municipality such as San Martin #1 open dumping site where soil cover on disposed waste is hardly difficult to carry out.

b. Present Problems

Today, San Martin and Tonacatepeque municipalities dispose of their waste respectively at their own dumping site. In so doing, transport distance becomes significantly short, however, there remains problems of environmental contamination by disposed waste.

c. Alternatives in Final Disposal System

As it is aimed that until the target year 2010 both San Martin and Tonacatepeque municipalities should establish and implement the Step III (i.e., sanitary landfill) in their final disposal system, alternatives of sanitary landfill should be examined herewith.

The following should be the candidate alternatives for the examination.

- proper sanitary landfill (its own use)
- co-use sanitary landfill (by the two municipalities, as they are neighboring municipalities)
- participate in MIDES Nejapa sanitary landfill
- participate in the new ESPIGA sanitary landfill
- participate in another regional sanitary landfill

c.1 Proper Sanitary Landfill

As San Martin and Tonacatepeque municipalities generate municipal waste 26.3ton/day and 22.9ton/day respectively in 1998 and 33.0ton/day and 28.7ton/day respectively in 2010, the capacity of its own sanitary landfill should be about **30**ton/day.

In view of possibility of localizing the new disposal site, transport distance to the new site could be estimated for example 4km longer than to the present disposal site.

Table 6-56: Conceptual Cost Estimation for Proper Landfill in SMT and TN

Item	Cost Increased	Remarks
grade up to sanitary landfill	US$15.5/ton	$16.5/ton (conceptual cost for 30ton/day capacity) minus $1.0/ton (present disposal cost estimated)
longer transport distance	US$1.6/ton	assumed US$0.4/km/ton x 4km
Total	US$17.1/ton	

The conceptual cost estimate gives additional cost of about US$17.1/ton.

c.2 Co-use Sanitary Landfill by the Two Municipalities

As San Martin and Tonacatepeque municipalities generate municipal waste 26.3ton/day and 22.9ton/day respectively in 1998 and 33.0ton/day and 28.7ton/day respectively in 2010, the capacity of the two municipalities co-use sanitary landfill should be about **60**ton/day.

In view of possibility of localizing the new disposal site, transport distance to the new site could be estimated for example about **average 7km** longer than to the present disposal site, since the centers of the two municipalities are about **10km** distant (access road from trunk road assumed **2km**).

Table 6-57: Conceptual Cost Estimation for Co-use Landfill by 2 Municipalities

Item	Cost Increased	Remarks
grade up to sanitary landfill	US$14.0/ton	$15.0/ton (conceptual cost for 60ton/day capacity) minus $1.0/ton (present disposal cost estimated)
longer distance	US$2.8/ton	assumed US$0.4/km/ton x 7.0km
Total	US$16.8/ton	

The conceptual cost estimate gives additional cost of about US$16.8/ton.

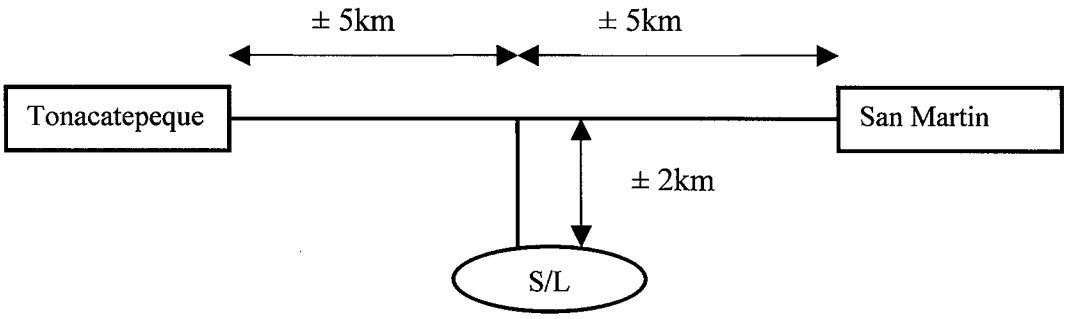

Figure 6-10: Estimated Concept of Co-use Landfill by 2 Municipalities

c.3 Participate in MIDES Nejapa Sanitary Landfill

The conceptual cost estimate summarized in the table below gives additional cost of about US$33.8/ton and US$27.4/ton respectively for San Martin and Tonacatepeque.

Table 6-58: Conceptual Cost Estimation for Participation in MIDES Nejapa Landfill

Item	Cost Increased		Remarks
	San Martin	Tonacate.	
grade up to sanitary landfill	US$17.0/ton	US$17.0/ton	$18.0/ton (MIDES landfill fee) minus $1.0/ton (present disposal cost estimated)
longer distance	US$16.8/ton	US$10.4/ton	assumed US$0.4/km/ton, 42km and 26km respectively
Total	US$33.8/ton	US$27.4/ton	

c.4 Participate in the New ESPIGA Sanitary Landfill

The conceptual cost estimate summarized in the table below gives additional cost of about US$31.5/ton and US$35.5/ton respectively for San Martin and Tonacatepeque.

Table 6-59: Conceptual Cost Estimation for Participation in New ESPIGA Landfill

Item	Cost Increased		Remarks
	San Martin	Tonacate.	
grade up to sanitary landfill	US$11.5/ton	US$11.5/ton	$12.5/ton (New ESPIGA landfill fee estimated by the Team) minus $1.0/ton (present disposal cost estimated)
longer distance	US$20.0/ton	US$24.0/ton	assumed US$0.4/km/ton, 50km and 60km respectively
Total	US$31.5/ton	US$35.5/ton	

c.5 Participate in Another Regional Sanitary Landfill

There is no information of another regional landfill at this moment.

d. Comparison of Alternatives for SMT and TN

In view of the above examination on "conceptual cost estimate", the table below compares the alternatives.

d.1 Comparison of Alternatives for SMT

Table 6-60: Comparison of Alternatives for SMT

Alternatives for Improvement	Cost Increased (US$/ton)			Remarks
	S/L level up	Longer distance	Total	
proper sanitary landfill	15.5	1.6	17.1	
co-use S/L by TN and SMT	14.0	2.8	16.8	
participate MIDES Nejapa	17.0	16.8	33.8	
participate new ESPIGA	11.5	20.0	31.5	
participate another regional S/L	-	-	-	no information

It could be suggested for San Martin to consider alternatives of "proper S/L" or "co-use S/L with Tonacatepeque".

To select other alternatives (e.g., MIDES or new ESPIGA) might not be recommended, since it will give crucial cost burden of longer transport distance. In other words, only when the tipping fee is considerably reduced by MIDES or new ESPIGA, such alternatives become selectionable.

d.2 Comparison of Alternatives for TN

Table 6-61: Comparison of Alternatives for TN

Alternatives for Improvement	Cost Increased (US$/ton)			remarks
	S/L level up	Longer distance	Total	
c.1 proper sanitary landfill	15.5	1.6	17.1	
c.2 co-use S/L by TN and SMT	14.0	2.8	16.8	
c.3 participate MIDES Nejapa	17.0	10.4	27.4	
c.4 participate new ESPIGA	11.5	24.0	35.5	
c.5 participate another regional S/L	-	-	-	no information

It could be suggested for Tonacatepeque to consider alternatives of "proper S/L" or "co-use S/L with San Martin".

To select the "c.4-alternative (new ESPIGA)" is not be recommended, since it will give crucial cost burden for longer transport distance.

If the MIDES tipping fee is reduced by about US$10/ton, this alternative becomes selectionable comparatively.

6.4.4.6 Examination of A New Landfill Requested

The conceptual cost estimate for S/L (shown in Table 6-51) indicates a wide range of possible unit cost for respective size of S/L. It is true that S/L has a wide range of possible unit cost even the size of S/L is same, because cost incurred will vary wide depending on the topographical, hydro-geological conditions etc. of the localization site and also depending on the environmental requirement that prevalent legislation demands. In other words, if there is a candidate site and the site information such as topographical, hydro-geological conditions is available, cost estimate will be more precise.

In view of the above examination presented by the Team, OPAMSS/COAMSS requested for the Team to examine S/L conceptual design and cost estimate for the candidate site in Tonacatepeque.

6.4.5 Medical Waste Management System

6.4.5.1 Outline

The Study Team in conducting the medical waste survey (MWS) investigated the status quo of medical waste management in AMSS. It consequently revealed that many medical institutions are practicing appropriate handling of medical waste following the recently published manual[4]. However, some large public hospitals and small private hospitals with small number of beds have not yet established

[4] Manual para Personal Médico y de Enfermería, Gestión y Manejo de Desechos Sólidos Hospitalarios ALA91/33

appropriate handling of medical waste, since medical waste mixed with common waste are discharged by such institutions. This section describes appropriate and optimum medical waste management systems in AMSS awaited in respective stages of the medical waste flow (from generation to final disposal).

6.4.5.2 Medical Waste Separation

a. Principles of Separation

It should be avoided to deem that all wastes generated at medical institutions be medical waste, since it is anticipated that cost burden in such cases will be huge. Wastes generated at clerical office, kiosk and dinning room/restaurants in medical institutions are generally deemed as common waste. However, if they are handled inappropriately (e.g., mixed collection with infectious waste), then at that same time such common waste should be deemed as medical waste and should be handled and treated as medical waste. Therefore, it is the most basic principle of medical waste management to separate "common waste" and "medical waste" that has a great health risk for human-being. Categories of medical waste are shown in Table 6-62.

Table 6-62: Categories of Medical Waste

Waste Category	Description and examples
Infectious waste	Waste suspected to contain pathogens e.g., laboratory cultures: waste from isolation wards: tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta
Pathological waste	Human tissues of fluids e.g., body parts; blood and other body fluids; fetuses
Sharps	Sharp waste e.g., syringes; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	Waste containing pharmaceuticals e.g., pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties e.g., waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

Source: Safe management of waste from health-care activities, World Health Organization, Geneva 1999.

b. Separation Standard of Minimum Compliance

It is difficult for all medical institutions in AMSS at first instance to introduce such integrated intra-hospital separations that some large hospitals with large number of beds are currently practicing. Hence, it should be necessary to establish the separation standard of minimum compliance that medical institutions first time introducing separation could also observe (see Annex K). Which consequently will encourage and promote actual practices of safe and secure medical waste management in future.

c. Intra-Hospital Separation

c.1 Separation at Outpatient Consultation/Treatment Room

Many outpatients visit the consultation/treatment room in short a time. An example of separation at consultation room in Japan is to locate a set of containers for respective separation categories at one place not distant from patients. A set of containers with written instruction draws patients' attention that to which container a waste in his/her hand should be deposited. Consequently collaboration by patients and medical staff for separate discharge was attained. As a matter of course, medical waste and common waste are separated at such places. A container for common waste should not necessarily be a sealed type. However, a container for medical waste, in which such as alcohol cotton to wipe blood after injection should be disposed, needs to be a sealed type in order for its isolation. Meanwhile a container for sharps (e.g., syringe) should be an impenetrable container such as used medicine bins.

In case of surgery treatment rooms for outpatients, containers for respective medical waste categories shall be placed in such rooms in order to secure separation in required categories. Meanwhile, there are some that can be categorized as common waste even though which is employed for medical actions. Therefore, training and education is needed to clarify and confirm items entailed in respective categories.

c.2 Separation at Inpatient Wards (Bedrooms) and Nurses' Stations

Most medical conducts themselves at inpatient wards and nurses' stations are same as those at outpatient consultation rooms. However, such medical conducts do not take place at one fixed place (consultation room) but at many bedside places by a tour of doctor and/or nurse. Therefore, mobile medical treatment platforms/carts should equip several containers for medical waste separation (e.g., impenetrable bin for sharps, etc.) based on the features that respective platforms/carts possess.

c.3 Separation at Operation/Surgery Rooms

All waste generated through operation/surgery shall be categorized as medical wastes. Respective medical waste shall be sealed in each operation/surgery and it would be recommended to entrust treatment/disposal of such waste for a specialized agent.

In case of medical institutions in Japan that owns a proper incinerator, tissue particles from operation/surgery are incinerated by a proper incinerator. Even in such cases, sealing of the medical waste is completely carried out.

As for blood and body fluid from operation/surgery, only at the medical institution that has sewage treatment facilities, they are disposable to specified drains. In other cases, they should be regarded and controlled as "infectious and pathological waste".

c.4 Separation at Laboratories

Blood, urine, culture, specimen recipients, tissue etc. are regarded as medical waste therefrom. It is recommended that fluids such as blood and urine be disposed at specified drains for sewage treatment or be subject to thermal treatment (e.g., autoclave) and subsequent disposal.

If other medical waste (than fluid) from the laboratory is in small quantity, to entrust its treatment as infectious waste to a specialized agency might be more economical that to sterilize by the laboratory itself.

c.5 Separation at Isolation Wards (Bedrooms)

Basic practices for separation are same as those at impatient wards. However, all medical waste from isolation wards shall be sealed on-site immediately and to deposit in special containers. Subsequent procedures could be incineration by a proper incinerator of the medical institution or to entrust the treatment/disposal to a specialized agent.

c.6 Home Treatment

In recent years, home treatment of patient becomes popular. Major medical wastes generated from the home treatment are: blood (e.g., from heamodialysis patients equipped with machines); incontinence pads; dressings; or syringes and hypodermic needles (e.g., from diabetics). If appropriate instructions are absent, those medical wastes from home treatment are discharged mixed with common wastes. As medical waste generated by one home patient is very small in quantity, medical institutions in charge of home treatment should instruct the home patient or its helper to store the medical waste temporarily in a specific container at home in order not to mix with common waste. A special container for sharps (such as hypodermic needles) shall be provided by the medical institution in charge. And at a specific time interval the containers shall be handed to the medical institution.

6.4.5.3 Containers at Medical Institution and its Management

a. Containers for Medical Waste

Medical institutions in AMSS that already practice separation utilize red-color plastic bags for medical waste and black-color plastic bags for common waste for separate collection. As for intra-hospital separate collection, for example a hard plastic container is used for sharps, a small carton box is used for separation of such as small glass, cylinders. In these practices, categories of medical waste should be clearly indicated on containers in order not to mix up nor commit an error.

At central storage area of most medical institutions in AMSS that medical waste are temporarily stored, red color plastic boxes of 30cm high X 40cm wide X 60cm long are used as standardized containers for medical waste.

To maintain those practices standardized for medical institutions in AMSS for the future is recommendable. As a reference information, features of various containers for medical waste utilized in Japan are detailed in Table 6-63.

b. Intra-Hospital Movement of Medical Waste

Movement of medical waste from respective generation sources to temporary/central storage area should be conducted by specialized hospital workers with cart or carrier destined for such exclusive use. Carts and carriers for such exclusive use should de periodically disinfected. Meanwhile, it shall be prohibited to open sealing lid/cap of container and to pour medical waste from one container to another, because it will greatly enlarge the risk of workers to be infected in so doing.

c. Central Storage and Temporary Storage at Medical Institutions

Temporary storage area in medical institutions shall be at certain fixed places. In order to lessen the storage time therein as short as possible, intra-hospital collection should be frequently carried out. Medical waste frequently collected at temporary storage area should be moved to the central storage area to store for a certain period but it should also be shorter. Since pathological wastes are perishable, they should be kept at cool storage. Such central storage shall also be disinfected periodically. The central storage area shall be controlled as the restricted area (e.g., such as fencing with entrance locks) and be clearly indicated that only authorized special workers who handle the medical waste and who disinfect area are accessible to this restricted area. Furthermore, medical waste handling procedures and cautions related with the works shall also be expressed there.

Table 6-63: Collection Container for Medical Waste

Container		For medical solid waste	For sharps
Carton board container	Structure	2 layers (Plastic bag installed inside the Carton box.)	3 layers (Inner box made of hard paper, plastic liner is on outside of the inner box, and outer box made of Carton box)
	Handling manners	Plastic bag is to be installed inside the carton box.	Most products in market are easily set up following written instructions. Some products require skills for setting up.
	Advantage	Cost is cheaper due to simple structure.	Apt to incineration treatment.
	Disadvantage	It is not apt for sharps and liquid waste.	There are few cases that syringes are penetrable (especially from the box corner).
Plastic container	Structure	• Most products in market consist of a container and an independent lid/cap. • Most products have such a sealing structure that once a lid/cap is closed that can not be opened again.	
	Shape	• Cylindrical bucket type products were prevalent in former time. Rectangular box types are popular recently.	
	Capacity	• Products of 20liter, 25liter, 40liter, 45liter, 50liter are available. • 2-4liter products also used as desktop containers.	
	Advantage	• Since they are plastic molded one-piece products, their application is wide for all categories of medical waste (e.g., for liquid waste, for sharps, etc.). • Product setup troubles are absent unlikely for the cases of carton box containers. • Sealing works are very easy.	
	Disadvantage	• Once the container is used it should be incinerated. Therefore it has an aspect of resource extravagancy. • Production of large capacity products is difficult and requires substantial cost. Consequently such products are not available.	

Source: Handbook on Infectious Waste Management: Nihon Iryo Kikaku Inc. 1993

d. Monitoring of Medical Waste Amount and Movement

It is important to monitor amount and movement of medical waste. Therefore, persons responsible for the monitoring should be nominated respectively for each sections of medical institution so that they should routinely take records for each medical waste category with such as container quantity, weight, etc.

6.4.5.4 Collection and Transport of Medical Waste

a. Separation

- It is prerequisite for appropriate collection and transport that medical wastes are source separated and deposited at appropriate containers respectively.
- To pour medical waste in another container shall be avoided.

b. Containment

- Sharps such as syringes and surgical knives shall be deposited at impenetrable hard containers in order to avoid workers injury and infection.
- Medical solid waste shall be contained in hard containers or durable plastic bags of double layers.
- Liquid or semi-solid medical waste shall be contained in hard and sealing containers to avoid leakage.
- In cases where category separation is not practiced, hard and impenetrable containers with sealing function should be employed in order to avoid leakage of liquid content.
- All containers in general should be of type that scatter or leakage of medical waste be avoided and odor emission be prevented.

c. Indication

- It is indispensable to clearly indicate on containers that medical wastes are contained.

d. Transport

- Medical waste shall be transported by a vehicle of exclusive use (not together with other waste such as municipal waste).
- As a principle, medical waste transport should be made directly to treatment/disposal facilities, i.e., intermediate transfer or storage should be prohibited. In case that medical waste intermediate transfer should be carried out, such transfer station should at least comply with the requirements mentioned above for the temporary storage area inside the medical institutions. Transfer activities in such cases should be in a manner that transfer distance be shorten for example from vehicle to vehicle.
- The transport vehicle should have such a structure that medical waste containers never fall down.
- It is preferable that the transport vehicle is cooler vehicle or freezer vehicle.
- The transport vehicle should have such a structure that the containers loaded can not be damaged even in case of the traffic accident of the

vehicle.

- If the transport vehicle is destined to carry both medical waste and new empty containers, compartment shall be of waterproof.
- The collection/transport vehicle shall be disinfected periodically.

6.4.5.5 Medical Waste Treatment

In reviewing current medical waste management system in AMSS, the Study will recommend an optimum system for medical waste treatment as a part of the M/P for the regional SWM in AMSS in order that all medical institutions in AMSS could practice appropriate medical waste management. In this context, reviews on current system and examination for the optimum system to be proposed are detailed as follows.

- As for medical institutions that are going to introduce "separation collection" from now on, the autoclave facility with small capacity could be appropriate for in-hospital treatment only for infectious medical waste. Treatment for medical wastes other than infectious wastes should be entrusted to a specialized agent.
- Because autoclave treatment does not visually enable to confirm its disinfection performance, the autoclave can not be an absolute and sure treatment method. Therefore, it is suggested that at least some of medical waste should be subject to incineration treatment. On the other hand as the current medical waste management in AMSS, there are no in-hospital autoclave facilities in AMSS and most medical institutions entrust the medical waste treatment for MIDES to disinfect by the autoclave at Nejapa disposal site where waste after treatment is landfilled. Therefore, the disadvantage of visual confirmation inability is not eminent due to the single major flow of medical waste treatment at current AMSS. In this context, this autoclave treatment at a disposal site is effective in medical waste management. However, to rely on the only one treatment system (i.e., autoclave) is not recommended because there are several problems such as follows:
  - ♦ Medical waste consists of what suited for autoclave treatment and what not suited for that.
  - ♦ In case that the only one autoclave facility has a breakdown or an accident, there is no other choice to alter the treatment of standby infectious waste.
- An optimum system for medical waste treatment should therefore consider a system consisting of plural treatment measures.
- In order to aim to treat all medical waste from all medical institutions in AMSS, the optimum system should be examined from the overall viewpoint consisting of such as collection, transport, treatment and disposal aspects. In practice, if an intermediate treatment facility is localized at more appropriate position such as at a wide premise of a metropolitan large hospital (than at the final disposal site), transportation costs will be significantly reduced. And as that consequence, a beneficial impact to lower overall costs for medical waste management could be brought about.

- In this case, in order safely to dispose treated medical waste at final disposal site, the treatment method should be such that enables visual confirmation on disinfection performance by way of clear identification of waste appearance changes (e.g., through incineration process). Medical waste incineration treatment could be feasible in AMSS with a satisfactory treatment performance where appropriate operation management and exhaust emission control on hazardous substances are implemented.
- As explained above, it is suggested that, in parallel with the currently operated autoclave treatment, medical waste incineration should be introduced to secure the appropriate and safe medical waste management.
- In addition to that, if an incineration plant is designed and operated not exclusively for medical waste but also for incinerating high calorific industrial waste, it will enable co-incineration of medical waste and high calorific industrial waste. Such facilities have merits in attaining cost-effectiveness both in the context of investment costs and O&M costs. Therefore, due attentions should be paid for present and future trends in industrial waste management in AMSS, in order to aim at establishing the optimum medical waste management system.

6.5 Alternatives for Competitive Services (Participation by Private Sector)

6.5.1 Participation by Private Sector (PPS) for Solid Waste Management

a. Introduction

In the last two decades the way of rendering solid waste management services has undergone several changes in developing countries, specially Latin America, where more than 50% of the solid waste collection systems are controlled by the private sector through diverse ways of contract-out.

It is very important not to confuse the method of **Participation by Private Sector (PPS)** with that of **Privatization**. The PPS concept regards several options, among which whether the transfer of assets to the private sector can be taken into account or not. The concept of privatization of state-owned enterprises refers to the case in which a total transfer of assets and income takes place.

It is important to understand that in municipal solid waste management, the collection is a sector in which PPS is relatively more simple than in the final disposal sector. On the other hand, the required capital investment is relatively lower with regards to other natural monopolies, which in turn causes a greater interest by small enterprises and particularly local enterprises to participate into this sector.

To allow the rendering of these services and the PPS to be successful and convenient for the users, it is necessary that the authorities and users themselves be aware that the following principles must be complied with.

Political decision

No successful PPS can be achieved without the resolute and firm support by the authorities and political leaders.

The excess of staff resulting from a political nepotism or from the pressure by unions is a problem that cannot be solved without the political support.

Financial autonomy

Financial autonomy of the activities in the service is essential if such services are to be efficiently provided and on a continuous base.

In order to provide the services in a stable and uninterrupted manner, municipal administrators need a direct access to the funds generated by the service itself.

These funds must be separated from the municipality's flow of funds.

The adoption of appropriate fees or tariffs and methods for the identification of customer and efficient collection systems, particularly for large generators and industrial and commercial customers, must be strongly promoted as the means to provide a viable and equitable financial administration.

Integral planning

Municipalities have to regard the storage, discharge, collection, sweeping haulage, transfer and final disposal within an integral planning context.

This view must incorporate all the aspects of solid waste management process, including elements such as the following: recycling, legislation, regulation and execution. This is important if any portion of the system goes to PPS, it should be able to assure that those portions by private sectors are complemented with the municipal service and are backed up by a general administration program.

Financial responsibility

A thorough knowledge of the real costs of the service rendered and the magnitude of the financing resources required to make them sustainable are the prerequisite for any PPS plan. It is essential to know the costs without subsidies in order to promote these services for both the municipality (in negotiation and assessment of contracts) and the private enterprise (to calculate expenses and markups).

Municipal responsibility

Municipalities must face PPS under a strong position. They cannot elude the total responsibility for solid waste management to the private activity, but in turn they have to establish their duties precisely in the contracts and in the careful monitoring of their performance. Otherwise, if a firm municipal control and a real competition is absent, a powerful monopoly or cartel may appear, which would result in an uncontrolled exploitation of the municipality and the public.