CHAPTER 6 HUMAN RESOURCE DEVELOPMENT AND R&D

This chapter will discuss how the government can develop official and private sector human resources in the field of SWM. Also, it will deal with how the government can strengthen R&D for SWM technology and its evaluation.

This chapter consists of the following six sections.

6.1. Need for Human Resource Development and R&D
6.2. Strategy for Human Resource Development and R&D
6.3. Development of Professionals and Administrators related to SWM
6.4. Establishment of SWM training courses for HRD
6.5. Research and Development
6.6. Institutions for HRD and R&D

In Section 6.1 and 6.2, principles of human resource development and R&D are explained.(See section 6.3 for more details.)

6.1 Need for Human Resource Development and R&D

1) Preparing for Future Challenges: Human Resource Development for SWM

The nation's capacity to handle SWM can be represented by concerned laws and institutions, and these are described in Chapter 1 and 2. The SWM institutions of local governments and businesses are explained in 3 and 4, which include how to prepare SWM institutions and arrangements. Every system needs an executive manager, and its subsystems need operators. Unless they all are in cooperation, the system is not workable. Therefore, it is necessary to set up a system, namely laws and institutions concerning SWM, and to develop human resources. Technical know-how is essential for the management and operation of SWM.

2) The Need for High Level Recognition of the Problem

Human resource development is a serious issue in any field of Morocco. In discussing this matter, social factors should be taken into account. A huge gap between the social elite and other people exists. In this gap there is the limited middle class. The lack of human resources for middle management has often been a problem. Middle class workers will not have a motivation to get a degree if they do not have much say in decision-making and will not enjoy upward mobility.

The elite does not seem to be familiar with practical knowledge generally. Without this knowledge, they will be unable to direct their subordinates. This knowledge is also necessary to understand opinions of the laborers. Managers of poor understanding will direct their workers nowhere.

As understood so far, the obstacle to the development of middle managers is not primarily the absence of training but the existence of such social conditions. It follows that SWM training should be focusing on top managers rather than middle managers.

Examining the differences between a private company and a public institution will help to better understand this issue. Why does a private company generally function more efficiently than a public institution? One reason is that a private company's top managers understand what is taking place down the line and can give the right directions. Also, a private company can enforce discipline among the workers. Top managers must educate their workers to respect the discipline; otherwise, business performance will turn out to be unsatisfactory, which will put the manager's effectiveness into question.

A public institution, generally, has everything against it, including inadequate understanding of top managers, no discipline, and indifference on the part of subordinates.

If an operation is not going well, who is to be blamed, the top managers or the subordinates? In public institutions, it is often the subordinates, but in private companies, it is not. Instead, it is the top managers who take the responsibility. This is a decisive difference between the two types of organization.

One of the Guidelines' target groups are municipal SWM managers. The officials at the top level should evaluate their efficiency. They also have to evaluate the functioning of their organization.

What decision should the officials make if the evaluation turns out to be low? The decision is already clear.

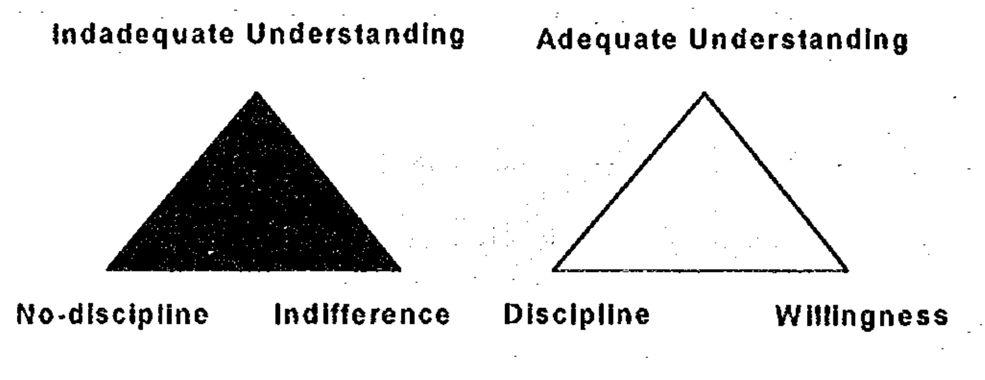

Figure 6.1-1 Fundamental Differences between Adequate and Inadequate Understanding for SWM

Remark: First, adequate understanding of managers is indispensable. Then, discipline and willingness are necessary to form a triangle.

As a management proverb has it, when the top remains the same so does the bottom.

This is also true in private companies. If the industrial waste treatment of a business is not done properly, is it the responsibility of its top managers, factory managers, or operation chiefs? The top managers of good quality will claim it is theirs and will admit their misjudgment due to lack of knowledge on SWM. As shown in the figures above, changes in understanding at the top level are important.

Again, **when the top remains the same, so does the bottom.**

3) Necessary Development of Different Layers of Human Resources

Successful SWM will not come into being just by counting on changes in understanding by top managers in local government and business. This is because an organization does not function with its head only. The organization needs SWM management staff who precisely understand directions from the top and have know-how to implement the directions, and to supervise SWM operators and workers.

Separate layers of top managers, SWM managers, and middle managers should be formed.

4) Development of Leading Experts and Researchers and Necessary R&D Arrangements

Many leading individuals are in action in the various fields of Morocco such as water and electricity supply, construction, and medical treatment. There are, however, no such people in the area of SWM. Experts and persons who transfer expertise to others exists in all types of field. A group of such people must be formed for SWM. Otherwise, top managers, SWM managers, and operation managers cannot develop. The experts can be found among administration officials, professors, researchers in public bodies, and private consultants. Developing the group is a hard task. The individuals must acquire knowledge of SWM and make it practical through the application of the knowledge. There must be opportunities for them to carry out R&D.

5) Role of the Government

Development of human resources for SWM is indispensable in Morocco to properly implement SWM. Who should be responsible for this development? And how?

Basically, bodies responsible for SWM, namely local governments and businesses, are also responsible for developing human resources. At present, this responsibility will not be fulfilled by just leaving it to the managers of the bodies, or to universities or special courses.

The government should take a leadership role to help local governments and businesses to develop human resources as has already been done for water supply, sewerage, roads, and medical treatment. In practice, the following should be done:

1. Offering training programs for developing human resources for SWM
2. Providing opportunities for R&D related to SWM

When the government plays a leading role in human resource development and R&D, it is making an investment in advance into the country's social infrastructure, which is essential for Morocco to improve her SWM.

6.2 Strategy for Human Resource Development and R&D

1) Basic Policies

Human resource development and technological R&D in the field of SWM are investments Morocco's future. The accumulation of human resources and technology comprises the social infrastructure. Morocco is now at the starting point of this accumulation. The situation in ten years' time will be totally different depending on whether development is done with a plan or without plan.

The government is expected to have the following basic objectives:

(1) Human Resource Development

First of all, Morocco needs to produce a specialist SWM group in order to expand human resource development. Improved understanding of top managers is also important since such changes are essential to develop subordinates. Based on the above consideration, the government should set the following goals.

- Development of specialist experts in SWM
- Promotion of adequate understanding of top managers of local government and businesses concerning SWM
- Education of SWM managers and operators of local governments and businesses concerning SWM expertise

(2) Research and Development

An urgent issue of SWM in Morocco is environmentally-considered disposal site development and the treatment of hazardous industrial waste. Morocco also needs to make use of the environmentally sound technology, which is being developed in Europe, to implement competitive abilities of Moroccan enterprises. Therefore, the government is advised to set the following objectives.

- Development of disposal technology that is applicable in Morocco, and an ability to evaluate the technology
- Research on technology of industrial waste treatment, and application of the technology
- Development of clean technology such as waste control and recycling

2) Strategic Development of Human Resources and R&D

a. Staged Development

In any field, stages that must be undergone are the development of expertise, creating bases under these leaders, and diffusion of the bases. The government should implement its administration along with the staged development.

It is necessary to set the first five years for development of the base. After the five years, the bases can be dispersed. Reviewing the contents of the plan and reorganization of the arrangements should be done every five years. The government should create an action plan and implement it.

First 2 to 3 years:	Early stage (preparation period)	Development of experts
Next 3 to 5 years	Development of bases	Development of technology and expertise
5 to 10 years	Dispersion period	Implementation, evaluation, and preparation for the next step

b. Development of Experts through National Projects

The government should start by developing leading experts in SWM. They, however, cannot develop their staff to fulfill this task without opportunities which are to be offered by the government. These opportunities include formulation of a national project, establishment of a research committee, training abroad, etc. The leaders will not develop without such opportunities.

c. Establishing Training Courses and their Arrangements

The government must set forth SWM training courses for local governments and businesses. The courses should be divided into three classes, namely those for top managers; senior managers including engineers; and middle managers who supervise collection and treatment operations.

The senior and middle manager classes should be linked with a system of qualifying the trained managers as SWM managers and operation managers of treatment facilities. This linkage will add some authoritative status to the training courses.

Training courses for municipal waste can be offered by MoI at existing training centers.

Concerning industrial, hazardous, and infectious waste, institutional arrangements for the training courses should be established mainly by MoE since the courses will contribute to environmental pollution control. MoE should cooperate with MoI&C and MoH to establish these arrangements.

d. Establishment of Arrangements for R&D

In establishing arrangements for R&D, issues must be narrowed down according to their priorities. Top priority issues will be the preparation of standards for necessary treatment facilities and of methods of environmental impact assessment. A second priority relates to standards for the treatment of industrial hazardous waste for environmental pollution prevention, and a manual of treatment technology. A third priority will be attached to the development of private industry and R&D in the area of clean technology, with special reference to the European market.

The government must set up arrangements in which specialists can research these priority issues. A national environmental research institution should be created in the future. For the time being, the government is expected to start a research committee consisting of professors and consultants. It is necessary for the government to endow the responsibility of a task force to the committees. In return for their participation, the group members should be able to enjoy the opportunities of participating in future SWM development.

e. Development of an Evaluation System

The government must make public both the annual and cumulative performance of its human resources development and R&D.

Follow-up is always necessary to be familiar with the effects that human resource development and R&D have brought about. The follow-up need not necessarily be done by the section of human resource development, and it should have some linkage with regulations and auditing concerning regional SWM. This evaluation system would help the government reward local governments and businesses which achieve excellent performance in SWM. The managers so recognized would be appropriate trainers in the SWM training courses.

Evaluation of R&D should preferably be made by a committee superior to the task force committee; namely a national waste committee.

6.3 Development of Professionals and Administrators related to SWM

1) It is necessary to develop at least 10 to 20 SWM specialists.

Leading experts in the field of SWM should be the following individuals.

- SWM professionals in the following fields:
  1 SWM laws and institutions
  2 Management of local government's SWM
  3 Technology of disposal sites
  4 Intermediate treatment technology
  5 Hazardous waste management
  6 Environmental impact assessment related to SWM

- Supervising Administrator of SWM

Professionals can be found among government officials, academicians, and consultants. The government is expected to train private professionals since it will not be able to find the necessary talent only among governmental officials. As it is necessary to have at least 3 or 4 individuals in each field, the government must develop 10 to 20 professionals. The government should appoint some officials to become professionals. Although the government cannot appoint private professors and consultants in the same way, it can list their names as members of the government's internal committee, so that lasting cooperative relationships can be built up.

These professionals are expected to be the first trainers in the SWM training courses.

A supervising administrator is an official of the following quality: an official who has supervised the location and operation of treatment facilities to secure proper SWM of municipalities and businesses from an environmental point of view; or a official who possesses expertise in supervising tasks. Only the professionals or individuals with expertise can fulfill the tasks of an administrative supervisor.

2) Governmental Provision of Opportunities for Developing Professionals and Administrative Officials

The government should develop leading experts by establishing a concrete task forces. The government is expected to give expected leaders the following opportunities:

1. Participation in setting up a national special committee, such as a committee for discussing laws, for preparing disposal standards and for preparing technical standards
2. Participation in SWM related projects launched by the government in preparation of a pilot project; or in an evaluation committee
3. Participation in assessment of the location of treatment facilities for local governments and businesses
4. Priority for participation in training programs in foreign countries
5. Participation in SWM projects assisted by foreign countries
6. Offering of and participation in seminars assisted by foreign countries

Through experience with these opportunities and with making concrete outputs, the leaders will be able to form practical knowledge out of what they have learned in the textbooks. These individuals must improve their knowledge with practical experience instead of merely theory. Acquiring such practical knowledge is the only way to be a leading expert.

The supervising administrator will regulate treatment facilities and industrial hazardous waste management. It is realistic that the administrative officials from central ministries and agencies give training to other officials after they themselves acquire the practical knowledge through the above opportunities.

These supervisors will be able to accumulate experience by handling practical issues. By the feedback of their experience to the central committees, they will be able to communicate with professionals and improve their knowledge

6.4 Establishment of SWM Training Courses for HRD

1) Establishing Three Training Courses for Municipal, Industrial, and Infectious Waste

The government should offer different SWM courses for municipal, industrial and hazardous waste because each course will target different trainees. Another course on infectious waste of medical institutions should be offered.

Targeting the different classes of managers, three courses should be offered; namely,

1. Top managers
2. Senior managers
3. Middle managers

Training for senior and middle managers will be almost the same in their contents; therefore, the two courses can be arranged into one course. According to the three types of the waste and another three types of the managers, there will be nine courses.

Since top managers have only limited time, their courses will be at most one-day courses. For senior and middle managers, at least two weeks will be necessary but the precise time will be subject to the program of the courses.

When these courses are offered every year, approximately two months must be reserved for the courses on each type of waste.

2) Training Courses in Municipal Waste

a) Training Subjects

The following table 6.4-1 shows necessary subjects in a municipal SWM course.

Table 6.4-1 **Subjects for Training Cources in Municipal Waste**

Subjects	Top Managers	Senior Managers	Middle Managers
1. Introduction to Environment and Sanitation	A	A	B
2. Waste, Environment and Sanitation	A	A	B
3. Waste, Laws and Systems	A	A	B
4. General Management Theory	A	A	C
5. Management System		A	C
6. Evaluation and Diagnosis		A	A
7. Preparation of Improvement Plan for Waste Collection		A	A
8. Technology for Operational Management of Waste Collection		B	A
9. Collection Equipment		A	A
10. Maintenance of Collection Equipment		B	A
11. Surveying Waste Quality and Quantity		B	A
12. Selection of Disposal Sites		A	B
13. Disposal and Treatment Technology		A	A
14. Disposal Site Planning Technology		A	B
15. Site Operation Technology		B	A
16. Environmental Impact Assessment		A	C
17. Technology for Environmental Pollution Prevention		A	C
18. Recycling		A	C
19. Use of Private Contractors and Contractual Procedures		A	C
20. SWM Cost Management		A	C
21. Information Management and Reporting		A	A
22. Disciplines of Crews		B	A
23. Safety Protection		B	A
24. Enlightenment of Citizens		A	A

Remark: A: Subjects to be learned mainly, B: Subjects to be learned,
C: Subjects in general to be learned

b. Top Manager Class

Top managers include chairpersons, vice chairpersons, and secretariesgeneral of local governments. Since there are 248 urban communes and 3 officials will attend the courses from each commune, a total of 744 top managers will be trained. They do not have to finish their courses at one time because they have a certain period of time until the next election.

Courses for top managers should include the following subjects:

1. Roles for achieving SWM
2. Actions that the managers must take
3. Appropriate directions to subordinates

The training courses will include the following.

1. Fundamental knowledge about SWM and environmental issues
2. SWM Principles and legally defined responsibility of local governments
3. Methodology for SWM management
   - Making the organization more efficient (including subcontracting with the private sector)
   - Methodology for improving collection, and development of appropriate disposal sites
   - Preparing indicators and evaluation methods

c. Senior Manager Class

Officials of the senior manager class will be engineers of urban communes and communities. Since there are the total of 267 urban communes and 14 communities, the courses will have total 281 engineers. For efficient training, the course should have 30 to 40 attendees at one time. Given that the course takes place once a year, it will take 7 to 10 years to train all the 281 engineers. Therefore, priority should be given to the engineers of large communes that are facing serious SWM problems.

The training course will place its focus on management systems and planning technology. On the management system, participants will learn the meanings and preparation methods of evaluation indicators concerning SWM service output and workers' productivity; and methods of systematic analysis to deduce the solutions based on the obtained evaluation. The planning technology is for collection and for disposal sites. It especially includes a technology to examine optimum collection methods and to evaluate the feasibility of new disposal methods.

Field observations should be programmed into training courses concerning the improvement and development of collection and the operation of treatment facilities. The government should create some hypothetical cases since there are at present no real examples that can be used.

d. Middle Manager Class

Middle managers include section chiefs for waste collection and supervisors of final disposal, and most of them are from communes and communities. The number of trainees for this course will be 281, the same as senior class.

Since middle managers are working on practical aspects of SWM, the course will be targeted at operations management technology. The subjects of this course will be almost the same as those for the senior manager class, but more focus will be on practical training. The attendees will be trained in practical applications. SWM operations should receive special attention in the course.

3) Training Courses for Industrial Waste, Hazardous Waste, and Infectious Waste

a Training Subjects

Basic elements of the training courses for industrial, hazardous, and infectious waste will be the same as the course for municipal SWM. Technical aspects, on the other hand, differ due to the special characteristics of hazardous and infectious waste. Institutional arrangements for these types of SWM differ greatly from those of local governments.

Hazardous waste calls for different types of treatment according to the type of waste. Therefore, those concerned must have knowledge about various materials and many types of treatment technologies. They also must be proficient in the improvement of production processes since the generation of hazardous waste is closely related to the production process.

Table 6.4-2 in the next page shows main subjects.

Table 6.4-2 Subjects of Training Courses for Industrial and Hazardous Waste

Subjects	Top Managers	Senior Managers	Middle Managers
1. Introduction to Environment and Sanitation	A	A	B
2. Industrial Waste, Environment and Sanitation	A	A	B
3. Industrial Waste, Laws and Systems	A	A	B
4. Definition of Industrial Waste	A	A	A
5. General Management Theory	A	A	C
6. Internal Arrangements	B	A	C
7. Hazardous Chemical Materials	B	A	A
8. Disposal Standards for Hazardous Waste	B	A	A
9. Procedures concerning Location of Treatment Facilities	C	A	C
10. Technology for the Management of Waste Generation Process	C	A	C
11. Clean-Process Technology	C	A	C
12. Recycling Technology	C	A	C
13. Technology for the Management of Waste Quantity and Quality		B	A
14. Site Selection for Hazardous Waste Disposal		A	B
15. Hazardous Waste Disposal Sites		A	A
16. Hazardous Waste Disposal Planning		A	B
17. Technology for the Operation of Hazardous Waste Disposal		B	A
18. Technology for the Treatment of Hazardous Waste		A	A
19. Treatment Facilities for Hazardous Waste and Their Operation		B	A
20. Environmental Impact Assessment		A	C
21. Technology for the Prevention of Environmental Pollution (air and water pollution)		A	C
22. Storing and Collection Containers		B	A
23. Collection Methods and Safety		B	A
24. Collection Equipment and Maintenance		A	A
25. Use of Private Contractors and Contractual Procedures		A	C
26. SWM Cost Management		A	C
27. Information Management, Book Keeping, and Reporting		A	A
28. Disciplines of Crews		B	A
29. Safety Protection for Operation		B	A
30. Public Relations		A	A

Remark: A: Subjects to be learned mainly, B: Subjects to be learned,
C: Subjects in general to be learned

b. Top Manager Class

The top manager class of courses on industrial, hazardous, and infectious waste is targeted at the top managers of business and hospitals. Minimum knowledge about hazardous chemical waste should be learned in this class. The attendants must understand the internal arrangements of SWM.

The participants should learn the necessity for establishing concerned laws early by examining the current and future conditions of legal regulations.

c **Senior Manager Class**

In the senior manager class, attendees would be SWM managers of factories and hospitals. The managers need the most comprehensive knowledge about SWM. They should be taught how production management and SWM can be integrated and must understand that the prevention of waste generation is a way to reduce the utilization of material resources.

d **Middle Manager Class**

In the middle manager class, attendees are mainly operation managers of treatment facilities in factories and hospitals. They will mainly learn technologies for operation of treatment facilities. Although the facilities themselves are easy to operate, the managers must have basic knowledge about the materials to be treated at their facilities. The course must offer knowledge about the operation of environmental protection facilities, safety protection, and maintenance of the treatment facility.

6.5 Research & Development

1) Meaning of Governmental R&D

The national government may for the time being have to take a leadership role in R&D concerning SWM, because incentives are not strong for local government or private business investment related to SWM due to the absence of institutional SWM regulations. The market for treatment facilities has not yet been formed since the needs for the waste treatment are weak. Therefore, the circumstances are not friendly for private investment to R&D.

Legal regulations will generate demand for waste treatment facilities. These regulations will bring about an environment-related new market. Generally, environmental investment is expenditures for the social costs and is not privately profitable; however, it can be profitable in terms of social efficiency and generation of employment when costs are internalized in the market.

2) Items of R&D

Morocco's R&D related to SWM should be linked with the nation's needs for SWM. The government must create a number of institutional standards and guidelines in order to strengthen solid waste administration. These standards are for landfilling, and disposal site technology, and guidelines are for treatment methods of hazardous waste, etc.

For institutional standards, guidelines, and advanced research, the following themes can be listed for R&D.

1. **Waste Disposal**

- Geology of Morocco and hydraulic information database
- Disposition models of waste and generation model of leachate
- Treatment methods of leachate
- Structure of disposal site bottom line
- Methods and effects of gas collection pipe
- Effects of seepage control by compaction and cover soil
- Leachate analysis
- Environmental impact of leachate generated from small disposal sites.
- Risk assessment for disposal sites
- Disposal standards for landfilling waste

2. **Municipal Waste Treatment**

- Research on intermediate treatment technology
- Guidelines for composting facilities
- Incineration technology and environmental control

3. **Hazardous Industrial Waste**

- Types and generation processes for hazardous waste
- Data base of information on toxicity, etc. of hazardous waste
- Methods of analysis of hazardous compositions
- Technology for reducing hazardous waste generation
- Improved technology for cleaner processes generating no hazardous waste
- Recycling of hazardous waste
- Treatment technology for hazardous waste
- Facility standards for hazardous waste disposal
- Disposal standards for hazardous waste
- Disposal of hazardous waste and its risks
- Environmental control in the intermediate treatment process

4. **Others**

- EIA for treatment facilities
- Recycling
- Soil pollution control
- Socio-economic effects of waste control
- European trends in clean technology development
- Methods of environmental auditing
- International trends in research

The above R&D themes are just to list a few, and there can be more detailed themes. Priority should be put on research that will be a basis for standards to strengthen institutional regulations. Another priority should be given to the accumulation and data base of the most important information so that the government can give concrete instructions to local governments and businesses.

6.6 Institutions for Human Resource Development and R&D

1) Development of a Training System by the Government

In the following paragraphs, an administrative system related to solid waste will be briefly explained since Chapter 2 mentions the subject in detail. The following three systems can be listed for human resource development:

1. Use of MoI's training system concerning municipal waste
2. Establishment of MoE's training system concerning hazardous waste and environmental control
3. Use of medical institutions' training centers concerning infectious waste

Although MoE does not have its own training center, it can offer the training courses at a third party's facility The MoE should start the training courses and build up its capacity for training.

MoE should have at least two specialized staff to study human resource development.

2) Development of R&D System by the Government

There is no SWM research done in Morocco, with a few exceptions in universities. In a practical sense, a R&D system does not exist in the country, so one should be created. The government is advised to form a committee consisting of researchers, consultants, etc. in order to prepare standards concerning waste disposal. At least, budgets for studying research papers should be allocated to the committee. It is necessary to take advantage of any technical assistance offered by foreign countries particularly if such budget allocation is not available. The committee needs to have full cooperation from MoPW researchers since it will need civil engineering, hydraulic, and geological expertise.

In the future, it will be essential for MoE to have its own environmental research institute. Research especially in the field of environment should be led by the government. Research should be done not only for purely academic purposes, but also for purposes linked with administrative control. This research institute should be also used for developing the existing laboratory system and making this system able to offer training programs.

One of the main research subjects of the research institute should be on the environmental impact caused by disposal of hazardous as well as other waste and the prevention of the impact.

3) Establishment of Association of SWM Experts

In the future, researchers and specialists in the field of SWM will develop further professional expertise. Also, SWM services will be offered very actively in urban areas, and the SWM market for private businesses will develop. When this future arrives, the government will be able to encourage SWM experts to establish an association of SWM experts for better communication among them.

CHAPTER 7 NATIONAL SUPPORT

7.1 Public Education

7.1.1 Need for Public Education

1) State of Awareness in the Field of SWM

Lack of environmental awareness among citizens and those persons who have responsibilities in the field of SWM is a factor that leads to low quality management and puts pressure on the environment.

The following can be regarded as being the source of such weakness:

- The effects of solid waste management on health and environment are not clearly understood. Reasons are the lack of studies and the scientific difficulty of showing relationships between waste, environment and health;
- So far, no environmental disasters have occurred in Morocco;
- Problems of the urban environment are new for the people. Relationships between consumption and environment, an essential issue for SWM, are not clearly understood.

For individuals, the SWM sector is basically perceived as a cleansing service rather than as an environmental service. Generally, those who clean houses and private areas are women. Public areas are considered to be under the full responsibility of the municipal service, for which people pay taxes.

In most cases, NGOs have not organized themselves in the area of environmental protection, apart from those that have been involved in municipal cleansing. Environmental awareness of NGOs can thus be considered as an essential objective of education.

2) Need to Increase Awareness and Community Participation

The lack of public participation in SWM is perceived by municipalities as one of the most crucial problems in improving SWM conditions in Morocco. The need for more participation is clear. Expected benefits are decreased cost of management, less pressure on the environment, better quality of urban life, and avoidance of popular resistance to siting of waste disposal facilities. SWM efficiency will increasingly be determined by waste minimization efforts, which means an increased role of the people to separate waste materials at source. People's participation is required for improving the quality of the waste collection service.

Economic development means increasing pressure on the environment. In case of environmental disruption, a good communication policy will help to avoid social unrest. The need to heighten public awareness is considerable if people are to accept environmental policy objectives. Environmental projects like new waste disposal sites will be easier to implement if people understand the issues and take part in the decision-making process. Community participation is usually understood as being as much a learning as a measure of participatory democracy.

The need to make the decision-makers and the elected representatives aware of the importance of SWM, but also about the usefulness of public awareness, has been underestimated. Increasing awareness can however be the result of indirect factors such as the exchange of information between the communes, the creation of good conditions for the public awareness, and the motivation of the local associations. The Communication and Training Directorate of the Ministry of Environment has a very important role to play in the development of such factors.

3) Need for Central Government Support for Public Education

One crucial role of the Ministry of Environment is to increase awareness of environmental responsibilities given to line ministries, in order to make the coordination process feasible and efficient. Such a requirement would not be feasible without focusing awareness development both on citizens and on local actors.

It seems that local authorities consider that Ministry of Environment has not yet adequately supported their efforts for educating people about environmental issues relating to solid waste.

Setting up intermediary bodies between the communes and the Ministry of Environment is a need, if an higher motivation of communes and a better technical support to them is expected. Urban communes need popular educational materials, with easy use, appropriate to the population targets, and whose production may be too much expensive for them, like it is for video tapes for example. The Communication and Training Directorate of the Ministry of Environment should take the initiative to make its activities known by the public and the communes, and to develop its ability of answering the questions raised by the communes about public awareness. Maintaining the contact between this Directorate and the cultural and environmental local NGOs should be considered as an important task for the good development of awareness activities at local level.

7.1.2 Definition of Public Education

Public education means education of citizens, consumers, persons involved in communication and education, and professionals of the SWM sector. Sensitization of private enterprises is not of concern. Public education is a generic term which includes, besides school education, heightening of public awareness, and some communication activities. Information and participation are both tools and results of the education process.

Public education in the field of SWM basically aims at strengthening the participation of people and improving waste management conditions. Thus, education in the field of solid waste cannot be limited to environmental education strictly speaking. It should also provide awareness and understanding of the decision making process for projects, particularly regarding environmental issues. The purpose of such education is not only to make people aware of what are the possible environmental effects of SWM projects, but also to make them aware of their possible role in order to improve the quality of projects at the planning stage. Environmental education should be understood as including civic education issues.

7.1.3 Scope of Public Education

Public education for sustainable management of solid waste must be understood as a multi-objective process with the following aspects:

- Sanitary education, which is already conducted by the Ministry of Health; present improvements in sanitary education must be encouraged;
- Civic education, which aims at introducing mechanisms of the decision making process, and citizens' responsibility towards environmental protection;
- Environmental education, which is almost a new activity in Morocco.

In Morocco, only the sanitary education has been the object of very important efforts. Environmental education is one missing element of awareness activities in the field of SWM, and this is understandable since the waste problem is primarily a problem of hygiene and cleanliness.

However, the environmental dimension of awareness heightening for solid waste is important because:

- aspects like nuisances to the quality of the living environment are taken into account;
- it provides understanding of the effects on the natural environment;
- it provides understanding of the health effects of waste generation through contamination of environmental resources such as water;
- the environmental dimension of education is interdependent with the concept of sustainable development.

Environmental education in the field of SWM, including the collection, transport and disposal steps, should focus on the following issues:

- natural ecosystems;
- natural resources;
- people's communities;
- SWM workers;
- living environment;
- health.

In terms of communication messages, the following points certainly need attention within environmental education programs regarding focusing on SWM:

- management and environmental conditions for solid waste disposal
- linkages between consumption products and waste materials
- urban, industrial, and medical waste categories
- diffusion of mineral / organic substances and germs within the natural environment and living organisms

7.1.4 Goals of Public Education

Public education in the field of SWM encompasses waste issues and has the following goals.

1) Improvement of SWM

- to increase the participation of citizens in municipal campaigns and definition of policy objectives;
- to increase the participation of people in waste collection activities;
- to make the citizens aware of their own responsibility for cleanliness of the city;
- to improve the public image of SWM workers;
- to keep people informed about waste related issues;
- to minimize health and environmental risks associated with SWM.

2) Environmental Awareness

- better understanding of environmental issues and their linkages with consumption and production patterns;
- understanding environmentally sound behavior;
- sense of environmental responsibilities;
- increased environmental awareness of NGOs and communities;
- concept of eco-citizenship and sustainable development;
- understanding the role of the SWM sector in achieving a better quality of the urban environment.

3) Community Participation

- to develop a sense of participation (and responsibility);
- to increase the use of existing participation tools;
- to increase participation of people in the decision- making process;
- to develop the capacity of the population and institutions to communicate with each other;
- to develop skills of associations to create initiatives and assess their needs;
- to strengthen the initiative of communes in education efforts;
- to obtain the participation of associations in awareness activities.

7.1.5 Development of Public Education Support

The importance of environmental education is clearly perceived and several actions have been set up to deal with the problem at the central government level, including a program for educating of teachers, establishing partnerships with NGOs, and reporting on communication tools. These actions are essential in order to deal with the urgent needs.

The following measures could improve public education support in Morocco:

- Evaluation and implementation of an education policy in the field of SWM;
- Public diffusion of environmental information;

- Production and exchange of educational materials;
- Development of social communication.

1) Public Education Policy

There are already many efforts to educate people about SWM. Better organization of these efforts would help to improve the results. The evaluation of education policy objectives in the field of SWM could be part of the larger process of establishing a national strategy for environmental education. In the short term, urgent needs could be identified through the commission in charge of culture, information, communication and education, within the CNE. However, education in the field of solid waste implies a larger representation of the agencies concerned with solid waste, health, environment, and education. NGOs should be involved. Such commissions should be established at regional level. Education programs at the municipal level should be planned and implemented as part of the SWM improvement plans.

Since the Ministry of Health has already developed and is improving education programs about health and hygiene issues, Ministry of Environment should focus on aspects which are typically environmental, namely environmental resources, quality of life and environmental nuisances. Social communication issues must be considered by the Ministry of Environment as well. These issues are detailed below.

The output of an education program as part of SWM improvement plan should be an action program strongly involving provincial delegations of the Ministry of Environment and Ministry of Health. The Ministry of Environment must provide environmental information and expertise to the Ministry of Health for more complete education materials about solid waste.

2) Diffusion of Information

Diffusion of information related to solid waste from the Ministry of Environment to the local agencies and from municipalities to the people must be increased. Besides necessary institutional improvements for achieving this objective, the following procedures can be used:

- regular publication of notes about environmental measures and the state of the environment;
- better exchange of information between local and central levels, through existing provincial commissions for environment;
- better exchange of information between concerned agencies at the central level;
- exchange of information at the international level in the field of environmental education;
- information for NGOs.

3) Production of Educational Materials

The production of educational materials should involve local as well as central agencies. At the central level, one person at the Ministry of Environment should be in charge of contacts with the Ministry of Public Health in order to keep up-to-date with existing materials and cooperate to improve these materials.

The following areas could constitute the objectives of cooperation:

- joint production of materials to cover environmental and health issues;
- use of the local network of the Ministry of Health for diffusing environmental messages for SWM;
- better use of the existing technical equipment and creation of competence to develop new educational materials.

The following priorities must be considered:

- inventory of existing materials produced at the national and local levels, and promotion of the best ones;
- preparation of methodological guides addressed to municipalities for carrying out education programs adapted to specific SWM objectives.

The video meets a real expectation on the part of local decision-makers as a tool for the promotion of public awareness in streets, on the one hand, and as a tool of public debate, on the other. The use of video a street attraction is difficult to be considered by the communes due to its high costs. The Ministry of Environment should therefore consider two types of assistance for the development of such awareness tools. The first type of action is to produce environmental series in the form of slides, and specially about solid waste. The second type of action could be to provide screening materials in view of video or slides shows on big screens.

4) Development of Social Communication

Public education and more specifically public awareness heightening will not be efficient if not reinforced by institutional improvements in the field of social communication. Social communication is a main priority for preparing suitable conditions for the development of community participation. Education in the field of solid waste can be regarded as an activity that will create needs for improving the existing means of social communication relating to the necessary choices between development and environmental protection.

Several priorities can be defined in order to heighten the quality of social communication procedures:

- strengthening the participation of people in decision-making procedures, through measures like more representation in commissions, more representation in planning stages, more direct consultation with concerned people, and partnership with NGOs;

- better use of environmental NGOs, which means an increased role of these NGOs together with measures to encourage their strengthening;
- public participation within the procedure of environmental authorization, like in connection with EIA studies for example;
- providing the capacity and institutional arrangements at the local level for communication in the field of environment.

7.2 Privatization

7.2.1 Privatization as Means of Improving Service Efficiency and Adequacy

Privatization of waste collection/transport and street sweeping services is very common in many cities of the world. Cities using contractors for waste treatment (incineration) and disposal are also increasing in number.

In Morocco, SWM costs will continue to increase with the increasing demand for 1) expansion of coverage of waste collection service, and for 2) application of higher environmental standards (controlled landfill) to disposal sites.

Privatization may be the best and shortest way to achieve the following two objectives of SWM services:

1. Increase in service efficiency
2. Increase in service adequacy

Many cities in the world use SWM contractors because their service has proved to be more efficient than services directly provided by cities. Generally, the cost of using contractors for waste collection and street sweeping service is about 30 % less than the cost when these services are provided directly by municipalities. Such cost saving can be used either to reduce local government expenditures, or to provide other services, including upgrading of solid waste operations.

7.2.2 Sources of Differences in Efficiency

Service efficiency can be best measured in terms of the unit cost of service (for example, cost of one ton of waste collected). The unit cost is estimated by dividing collection costs (numerator) by waste quantity collected (denominator). It is generally found that the difference in unit costs between contractors and communes derives from the difference in the denominators rather than from the difference in the numerators. In short, contractors tend to collect more waste by using the same equipment and manpower. The difference in the waste collection quantity derives from, for example, the difference in the number of trips a collection crew makes per day. Because the communes' workers spend much time on sorting recyclable materials on the streets, they typically make two trips per day to a disposal site. The number of trips can increase to three if the communes' workers were not engaged in the sorting activities. The increase of trips from two to three is a major contribution to the overall increase in efficiency.

A private contractor will have to pay higher salaries to collection worker to prevent them from engaging sorting activity. But higher payment may be worthwhile if they can collect more waste by making more trips.

An operations manager of a contractor has an incentive to increase service efficiency as his salary is much correlated with his performance. Contractors are given an incentive to be efficient as they will be out of business (replaced by other contractors) if otherwise.

In the case uncollected waste exists in a commune, a SWM manager of the commune will typically claim that more equipment and manpower are necessary to collect it, while a good contractor would think about the possibility of increasing collection efficiency, for example, by improving truck maintenance and increasing truck utilization rates. This is a source of difference in the efficiency.

7.2.3 Government Support Needed

The Ministry of Interior has a policy of promoting the privatization of SWM service. In 1995, the ministry organized a big seminar jointly with USAID to promote privatization in this sector. As part of continued efforts, it is recommended that the Moroccan government should take the following actions:

1. Encourage local governments to introduce accounting practices by which they can estimate SWM costs
2. Provide a standard contract document
3. Assist local governments to evaluate tenders offered by contractors
4. Encourage local governments to privatize SWM services through periodic seminars and workshops

Many Moroccan urban communes think that the use of contractors for waste collection is not feasible because it is more costly. The Moroccan local governments need to convince themselves that the privatization is beneficial before deciding on the privatization. The best way to convince themselves is to understand the real costs of SWM services provided by the communes, and compare the costs with prices offered by some contractors. The best indicator the commune should use for comparison is the unit cost of the service such as the cost of collecting one ton of waste. Chapter 3 of Book 2-Part 1 (Municipal Guidelines) shows the method of estimating a unit SWM cost.

7.2.4 Privatization of Treatment and Disposal Services

In recent years, privatization of treatment (for example incineration) and disposal has been increasingly common in the world. In France, about one half of incinerators and landfill sites are privately owned.

In many cases, private companies offer higher levels of service than communes do. If private companies' environmental standards are found to be less than required by the law, the regulatory authority can suspend the company's operations. For communes which have lower standards, suspension of disposal service provided by communes is not possible because they usually have no alternative places for waste disposal. Due to this situation, environmental standards of privately owned disposal sites can be well regulated by the authority.

For privatization of treatment and disposal services, it is necessary for local governments to develop 1) well defined contract conditions and specifications as well as 2) technical capacity to monitor and evaluate contractors' performance at the commune level.

In addition, the central government needs to develop a regulatory framework (law and responsible regulatory agency) discussed below:.

7.2.5 Establishment of Regulatory Framework

The government should establish a regulatory framework to regulate contractors when the market for SWM services grows. The regulatory framework consists of 1) a law concerning privatization of SWM services, and 2) a regulatory agency which is authorized to issue permissions to companies to operate SWM services. This regulatory framework is needed particularly to control waste disposal contractors to ensure that they attain certain environmental standards required.

A good regulatory framework ensures:

1. fair competition in the market
2. achievement of environmental standards required by law

The government should 1) decide which ministry should be responsible for setting such regulatory framework, and 2) study on a future regulatory framework desired. Chapter 2 discusses regulatory framework desired.

7.2.6 Guidelines for Urban Communes and Communities on the Privatization

Guidelines for urban communes and communities on the privatization of SWM services is shown in Chapter 5 of Book 2-Part 1. The guidelines cover the following topics:

1. Need to know the costs of SWM services provided by urban communes and communities
2. Method of estimating cost efficiency
3. Form of privatization
4. Procedure and activities needed for privatization
5. Important aspects considered in designing contracts
6. Government support

7.3 Information Services

7.3.1 Serving as Information Center

In Europe and Japan, technologies applicable to SWM have been constantly developing because there are large markets demanding for technologies. Moroccan local governments generally do not have good access to information on SWM.

It is advised that:

1. both the Ministry of Interior and Ministry of Environment (MoE) should serve as an information center, and make available SWM information to local governments, and

2. MoI will take care of waste collection/transport mainly and, while MoE will mainly take care of waste disposal, which affect the environment.

Information on the following topics may be useful to urban communes and communities:

1. Collection and transport equipment
2. Sanitary landfill
3. Industrial and hazardous waste management
4. Hospital waste management
5. Intermediate treatment including compost and incinerator
6. Recycling and sorting technologies, in particular those for industrial waste and waste exchange
7. Public education including materials (video, leaflets) prepared by MoE or local governments
8. Guidance on privatization (including a standard contract document)
9. Consultants and engineers in the SWM sector
10. Training opportunities
11. Data and statistics on Moroccan SWM (See note below)

Note:
The information system explained in Chapter 4 will enable to collect and data on SWM

7.3.2 Consultation Ability

It is advised that both MoI and MoE should have SWM experts who can provide some consulting services for local governments.

Collection of information is not enough to serve as an information center of SWM. Study of collected information is necessary to present information in such a manner as to be useful for local governments. Information on technology would be more useful if it is accompanied with an evaluation of the technology (Note: Some Moroccan cities have implemented composting, most of which resulted in failure. The government should evaluate the results of composting so that information on the results can be made available for interested local governments, without which the same mistakes may be repeated in other cities.)

MoE's research function as proposed in Chapter 6 will strengthen its consulting ability.

In Morocco, there are some communes which are superior to others in a specific aspect of SWM; for example, a truck maintenance or cleaning campaign. The successful experience of a Moroccan commune would be very useful and relevant to other communes with similar conditions. MoI and MoE should identify communes or communities which have successful experience in some aspects of SWM so that such experience can be shared by other communes.

Both MoI and MoE should organize seminars for local governments to facilitate the exchange of experience and information among themselves.

ANNEX EXAMPLE OF TECHNICAL GUIDELINES FOR CONSTRUCTION AND OPERATION OF FINAL DISPOSAL FACILITIES FOR MUNICIPAL WASTE

Introduction

Adequate final disposal sites for municipal waste are for maintaining a sanitary environment in urban areas. Location, construction, and operation of the facilities should not adversely affect the surrounding environment.
The primary responsibility for construction and operation of final disposal sites for municipal waste belongs to local governments. Moroccan laws rule that local governments are responsible for risks to environment when they construct and operate their facilities or contract out disposal activities at privately owned disposal sites.

Local governments must prevent negative impacts to environment and groundwater when constructing and operating final disposal sites. Preventive measures must meet technical standards for controlled landfilling sites, which are to be set by MoE.

Construction of all disposal sites should meet the MoE's standards. The MoE should be able to stop the construction of disposal sites that do not meet the standards, and issue orders to modify their construction plans. The ministry should also be able to order the sites to be improved or to stop their operation.

Technical standards for controlled landfil sites consist of a) objectives, definitions, and the scope of application, b) disposal standards for municipal waste, c) standards for selecting the location of disposal sites, d) landfill standards for disposal sites, e) facility standards for controlled landfill sites, and f) operation standards for controlled landfill sites. These standards need to be developed for they are at present tentative and cover only the basic elements of these standards.

There must be detailed operational guidelines for applying the technical standards. The guidelines can be issued in the form of technical manuals for construction and operation of a controlled landfill site after experimenting with model sites.

1. Objectives, Definitions, and the Scope of Application

1.1 Objectives

Local governments must use properly operated disposal sites to eliminate environmental risks. Technical standards are to guide local governments to properly construct and operate disposal sites.

1.2 Definitions

"Local government" refers to the commune, urban community, or municipality.
"Municipal waste" is the waste that a commune or municipality collects, or that local governments agree to accept at municipal waste disposal sites.

"Industrial and other wastes" are non-municipal wastes. "Special waste" is separately defined in MoE's relevant standards.

"Controlled landfill site" is a disposal site that meets facility and operation standards. "Disposal site facility" refers to any facilities at disposal sites.

1.3 The Scope of Application

Technical standards are applied to municipal or private disposal sites for municipal waste. Standards for industrial waste should be established separately.

2. Disposal Standards for Municipal Waste

Local governments should follow the following standards.

- Waste should not be scattered or spilt.
- Preventive measures should be taken against offensive order, dust, smoke, and noise.
- Rats, mosquitoes, flies, and other insects should be controlled.
- Enclosing fences should be placed around disposal sites to clearly show the border of the site.
- Leachate should be controlled when risks are expected in the river or groundwater nearby.
- A layer of disposed waste should be 2 m to 3 m thick, and cover soil of 30 cm to 50 cm should be applied to each waste layer.
- Cover soil should be applied to the whole disposal area when closing the site.

3. Standards for Selecting the Location of Disposal Sites

Disposal sites should not have any adverse effect on the surrounding living environment and water resources. Construction sites should be carefully selected to avoid any conflict of interest concerning land ownership.

- Disposal sites should be constructed at least 200 m away from residential areas.
- Springs and wells are not used for drinking in less than 1 km downstream of disposal sites
- Disposal sites should be at least 200 m away from any river that is managed by MoPW.
- Disposal sites should not be constructed in natural environments where plants and wildlife are observed; in environmental conservation areas; or in lagoons along the coast.
- Disposal sites should be constructed at least 3 km away from airports
- Disposal sites should not be constructed in public or military sites.

4. Standards for Landfilling at Municipal Waste Disposal Sites (Tentative)

In principle, controlled disposal sites for municipal waste should accept only officially defined municipal waste.

When local governments agree to accept non-municipal waste at their disposal sites to protect the environment, the authorities must confirm that the waste is free from risks to the environment and operation of the site.

The following are safety standards for landfilling.

- Testing solutions for waste samples and water should not contain as amount of heavy metals (etc.) 10 times larger than the amount of those regulated by drinking water standards. (Substances regulated by the standards will be defined separately. Methods of analysis of the substances will be described in detail separately.)
- Waste to be disposed of at municipal disposal sites should not be explosive, liquid, or infectious.

The following are operation standards.

- Plastic waste should be crushed into pieces so that it will not interfere with the operation of heavy machines.
- Demolition waste should be crushed into pieces so that it will not interfere the operation of heavy machines.

Infectious waste can be accepted at municipal disposal sites under certain conditions until a treatment plant is constructed. (Such conditions will be described separately.)

5. Facility Standards for Controlled Landfill Sites

a. General Standards

All disposal sites should meet the following general standards.

- Enclosing fences should be placed around disposal sites.
- Embankments should be constructed around disposal sites to prevent waste out-flowing.
- Buffer zones should be reserved as necessary.
- Rainwater drainage systems should be equipped around disposal sites to control incoming rain water from outside the disposal sites.
- Approach roads between public roads and disposal sites should be paved.
- A gate should be located at the entrance of disposal sites.
- A truck scale should be installed at the gate of disposal sites. (Installation of a truck scale can be optional at a disposal site whose served population is less than 50,000 persons.)

- On-site roads should be established.
- A site office should be located at the gate of the disposal site.
- A truck washing zone should be provided at the disposal sites as necessary.
- Lighting facilities should be equipped at disposal sites as necessary.
- Water sprinklers should be installed at disposal sites.

b. Standards by Types of Disposal Sites

Following are facility standards according to the size and economic conditions of disposal sites.

Following are facility standards for disposal sites whose area is smaller than 10,000 m^2 and landfilling capacity is less than 50,000 m^3.

- The top layer of base ground of a disposal site should be stripped, and earth compaction should be conducted in order to improve permeability of the base ground.

Following are facility standards for a disposal site whose area is larger than 10,000 m^2 and landfilling capacity is greater than 50,000 m^3.

- The base ground of disposal sites should have impermeability, taking into consideration geological factors and hydrological conditions of groundwater. Infiltration coefficient should be smaller than 10^{-5}.

Tentative standards for this type of disposal site (basic standards) should be as follows.

- Clay layer of 0.5 m should be laid over the base ground of disposal sites. (Clay layer is optional when the base ground meets the standards mentioned earlier concerning impermeability.)
- A leachate collection system using packed gravel should be provided in order to maintain site operation as necessary
- Gas venting pipes should be installed as necessary.
- A leachate recirculation system should be employed, and leachate should not be discharged to the outside of disposal sites.
- A leachate control pond should be located for storing leachate to maintain site operation in excessively heavy rain.

Standards to be required in the future (advanced standards) are as follows.

- A Clay layer or artificial liner 1 m thick should be applied to the base ground of a disposal site. (If a disposal site meets the above-mentioned standards concerning permeability, such lining is not necessary.)
- A leachate collection system using perforated PVC pipes should be installed in order to control leachate.
- Gas removal facilities should be installed every 50 m.
- A leachate recirculation control facility should be installed to avoid the discharge of leachate to outside the disposal site. Leachate control pond should be located to store excessive leachate due to excessive rain. When discharging leachate to outside the disposal site, leachate must be treated with aeration, etc. (Standards for water quality of leachate to be discharged should be established based on an

environmental impact assessment.

- Monitoring wells should be installed.

6. Operation Standards for Controlled Landfill Sites

Operation standards for controlled landfill sites are as follows.

a. Following are operation standards for a controlled landfill site whose area is smaller than 10,000 m^2 and landfilling capacity is less than 50,000 m^3.

1) **Heavy machines and equipment**
- Bulldozer
- Backhoe
- Other machines, if necessary

2) **Landfilling Operation**
- The fill-up method should be used for landfilling operation.
- Cover soil should be prepared.
- Cover soil should be applied at least twice a week.
- Cover soil of 30 cm - 50 cm thick should be applied to waste layers when they become 2m - 3m in depth.
- Water sprinklers should be used to prevent out-flowing of waste on windy days.
- Cover soil must be applied when waste starts to burn.

3) **Management of Site Operations**
- Site operations should be recorded daily.
- Waste haulers that do not belong to a commune or community must have official permission to use the facility.
- In-coming trucks must be recorded.
- Waste haulers without official permission should be controlled.
- Entry to disposal sites should be restricted and controlled.

4) **Closure of Disposal Sites**
- Cover soil should be applied to the whole area used as a disposal site when closing a site.

b. Following are operation standards for a controlled landfill site whose area is larger than 10,000 m^2 and landfilling capacity is greater than 50,000 m^3.

1) **Heavy Machines and Equipment**

The number of the following machines and equipment should be determined in accordance with the amount of waste disposed of.

- Bulldozer
- Backhoe
- Wheel Loader

- Dump Truck

2) **Landfilling Operation**

- Fill-up method should be employed for landfilling operation.
- Cover soil should be prepared.
- Cover soil should be applied daily.
- Cover soil of 30 cm - 50 cm thick should be applied to waste layers when they become 3 m in depth.
- Water sprinklers should be used to prevent out-flowing of waste on windy days.
- On-site roads should be constructed, taking into consideration the weight of collection trucks in accordance with landfilling operation.
- Out-going collection trucks should be washed to remove waste and soil

3) **Treatment of Leachate**

- Collected leachate should be periodically recirculated into the disposal site.
- Leachate should be purified when being discharged outside of a disposal site.

4) **Management of Site Operations**

- Site operations should be recorded periodically.
- Waste haulers that do not belong to a commune or community must have an official permission to use the facility.
- The amount of waste transported to a disposal site should be measured with a truck scale.
- Waste haulers without official permission should be checked.
- Entry to disposal sites should be restricted and controlled.
- Water quality of monitoring wells should be analyzed. (Analysis items and monitoring frequency should be defined separately.)
- Contents of leachate should be monitored when it is discharged to the outside of a disposal site. (Analysis items and monitoring frequency should be defined separately.)

5) **Management of Post-closure Disposal Site**

- Site management should be continued until sites are ultimately closed.
- Cover soil of 1 m thick should be applied to the whole area of the disposal site when closing a site.
- The final cover soil should be able to prevent the inflow of rain water into waste layers beneath.
- Gas venting pipes should be installed in grid beneath the final cover soil, if required. (This system should be applied only to advanced landfilling sites.)
- Gas venting pipes should be maintained until ultimately closing disposal sites.
- Leachate should be recirculated or treated even after closing a disposal site until ultimately closing a site.

6) Ultimate Closure of Disposal Site

- A disposal site can be ultimately closed when the sinkage of the sites comes to a stop and the quality of leachate meets relevant standards. (Such standards should be set separately.)

Guidelines for National Level Policies and Actions for Solid Waste Management

Part 3
Industrial and Hazardous Waste

Exchange Rate (as of July 1997)

1 Dirham = 0.115 US dollars = 13 yen

Abbreviation List

BMH	Municipal Health Service
CNE	National Council for Environment (Conseil National de l'Environement)
CRE	Regional Council for Environment (Conseil Régional de l'Environement)
DAHIR	Law, Decree, or other legal document signed by the King
DH	Dirham
EU	European Union, E.E.C
FEC	Fond D'Equipement Communal Communal Fund for Equipment
GDLC	General Department of the Local Government, MoI
HCS	Haul Container System
MoA	Ministry of Agriculture
MoC&I	Ministry of Commerce and Industry
MoE	Ministry of Environment
MoEM	Ministry of Energy and Mines
MoH	Ministry of Health
MoI	Ministry of Interior
MoPW	Ministry of Public Works
NP	National Promotion
ONEP	National Office for Drinking Water
SWM	Solid Waste Management
USE	Under Secretariat for Environment, MoI
Veh.	Vehicle

Final Report
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Book 1-Part 3

THE STUDY ON THE NATIONAL GUIDELINES FOR SOLID WASTE MANAGEMENT FOR THE KINGDOM OF MOROCCO

INTRODUCTION

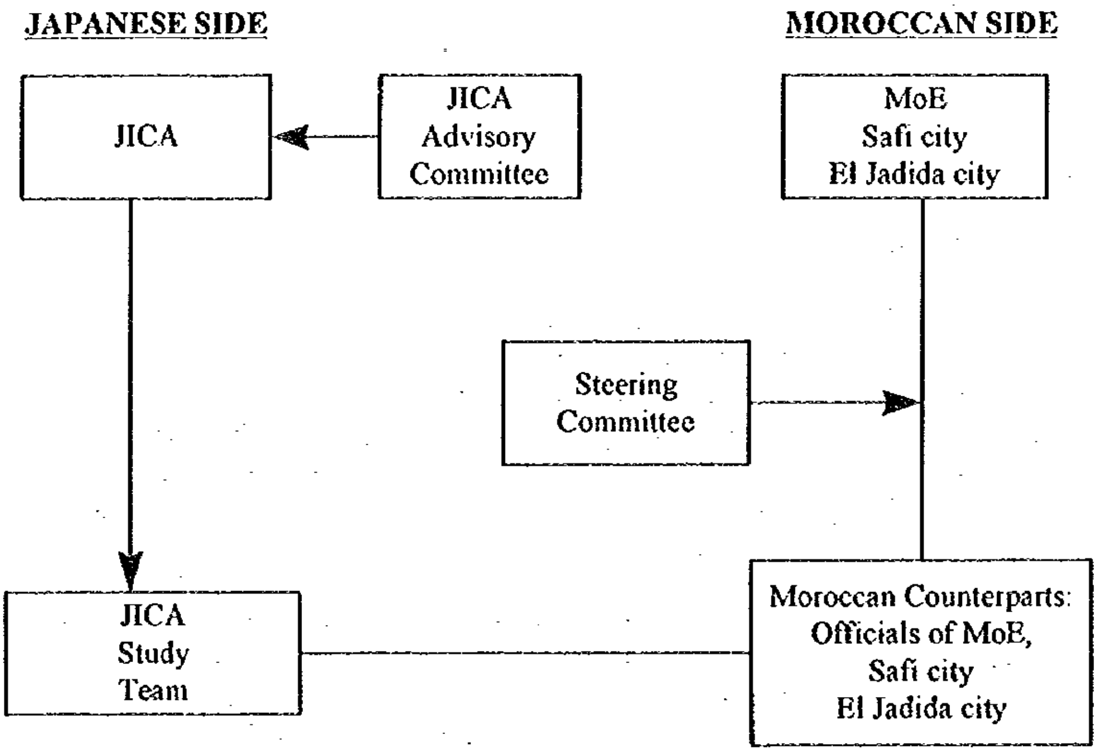
1. Objectives of the Study

The objective of the Study is to strengthen the capacity of solid waste management at both national and local levels. This study has been executed by Japan International Cooperation Agency (JICA) based on the request from the Government of Morocco. JICA commissioned the study to a joint venture comprising EX Corporation and Yachiyo Engineering Co., Ltd. The joint venture has organized a study team comprising of 11 specialists. The Study has been conducted jointly by Japanese consultants and their Moroccan counterparts.

The study period was about 18 months from January 1996 to July 1997. The Study is divided into two phases, the first phase being from the beginning up to September 1996, and the second phase being from October 1996 till the end. The objective of the first phase study is to formulate the guidelines and action plan for solid waste management at both national and local levels. The objective of the second phase is to apply the guidelines formulated and check their applicability. Two cities, i.e. Safi and El Jadida were selected for the second phase. The Study team in collaboration with the counterparts in Safi city have formulated a plan for improvement of solid waste management. In addition, we have implemented a public education campaign (demonstration project) aiming at strengthening citizens' understanding and cooperation concerning city cleansing. We have also formulated a plan for improvement of disposal of solid waste for El Jadida. It is expected that the plans will serve as a model for other local authorities in Morocco.

2. Study Organization

The study organization is shown in the figure below. This study has been conducted jointly by the Study Team led by Mr. Ohno and the Moroccan counterparts, i.e. officials of Ministry of Environment, Safi city and El Jadida city. A key counterpart agency on the Moroccan side is the Ministry of Environment. For the smooth execution of the study, the Moroccan side formed a steering committee comprising of representatives of the Ministry of Environment, Ministry of Interior, Ministry of Health, Ministry of Public Works, and Ministry of Commerce and Industry. Mrs. Layachi, Director, Department of Observation, Study and Coordination, Ministry of Environment served as chairman of the steering committee. On the Japanese side, an advisory committee was formed for the study. Dr. Masaru Tanaka, Director, Department of Waste Management Engineering, the National Institute of Health, served as chairman of the Advisory Committee.



MoE: Ministry of Environment

3. Reports

This study has produced the following reports:

1. Inception report
2. Progress report (1)
3. Interim report
4. Progress report (2)
5. Draft final report
6. Final report

The final report consists of the following Books:

Book 1 Guidelines for National Level Policies and Actions for Solid Waste Management
- Part 1 National Strategy
- Part 2 Laws, Institutions, and Finance
- Part 3 Industrial and Hazardous Waste
- Part 4 Infectious Waste

Book 2 Guidelines for Improvement of Solid Waste Management for Urban Communes and Communities
- Part 1 Management and Institutions
- Part 2 Technical Guidelines

Book 3 National Action Programs for Solid Waste Management

Book 4 Solid Waste Management Plans for Safi and El Jadida
- Part 1 Solid Waste Management Plan for Safi
- Part 2 Waste Disposal Plan for El Jadida

Book 5 Summary

Book 6 Supporting Report : Current Conditions of Solid Waste Management in Morocco

Book 7 Data Book: Appendices to Solid Waste Management Plan for Safi

Book 8 Japanese Summary

All the Book except for Book 8 has been prepared in English and French.

4. Guidelines for National Policies and Actions for Solid Waste Management (Book 1)

The Guidelines consists of the following four parts:

- Part 1 National Strategy
- Part 2 Laws, Institutions, and Finance
- Part 3 Industrial and Hazardous Waste
- Part 4 Infectious Waste

CHAPTER 1 INTRODUCTION

1.1 Background

There are no legal controls relating to industrial and hazardous waste management in Morocco. The absence of control has resulted in pollution of the Sebou river and damage to the environment around Casablanca and Mohammedia.

It seems that Morocco is following the same path that industrialized countries mistakenly took in industrial waste management. Time will surely come when Morocco has to change its course.

Morocco has already decided to start free trade with Europe after ten years, which means that Moroccan enterprises will enter the global economy. This also means that they will have to respect European environmental standards.

Based on this background, it should be understood that legal controls in industrial and hazardous waste should be established immediately.

1.2 Objectives of the Guidelines and Scope of Application

These guidelines are intended to be used as reference material relating to the objective of strengthening national level administration for industrial waste management. The guidelines are just to promote discussion since they are created under tight time constraints.

The field of industrial and hazardous waste is more broad and complex than that of municipal waste. Besides, information on industrial waste management is lacking. Although the Study may not cover the whole field of industrial and hazardous waste, sufficient information for discussion will be obtained from the Study.

This report is primarily aimed at officials in Morocco who are responsible for SWM.

1.3 Structure of the Guidelines

The Guidelines consist of nine chapters including an introduction. Chapter 2 refers to general characteristics of industrial waste and existing industrial waste management, about which little information exists in Morocco.

Chapter 3 addresses principles for industrial waste management that are relevant for Morocco and presents a necessary legal framework. The definition of industrial waste, which is not covered in Chapter 1 of Book 1-Part, is also discussed. Chapter 4 discusses an administrative system necessary for the control of industrial waste. Chapter 5 explains institutions for SWM in business establishments. Chapter 6 conveys the general theory of industrial waste treatment technology. Chapter 7 presents general information on waste prevention and recycling. Chapter 8 deals with the necessity of promoting private treatment for industrial waste. Chapter 9 discusses economic tools for promoting investment in environmental control by business establishments.

CHAPTER 2 SOURCES OF INDUSTRIAL WASTE AND EXISTING INDUSTRIAL WASTE MANAGEMENT

2.1 Sources of Industrial Waste

1) Manufacturing Industry in Morocco

Manufacturing industry as a whole has been slowly increasing its share of GDP (Gross Domestic Product). It was 16.8 % in 1980, 17.7 % in 1990, and 18.6 % in 1994. The relative importance of various industries remained without any significant change in the five years up to 1993. The largest sector is the food industry, which accounts for 34 % of manufacturing, chemical and metal industry accounts for 31 %, and machine-related industry 17 %.

Food, apparel, and chemical fertilizer industries are active exporters. Although exports of machine-related industry have not been doing well, exports of electric appliances have been growing rapidly, and further growth is expected.

In terms of location, approximately 60 % of the total amount of production takes place in the Central region. Manufacturing industry is concentrated in Casablanca and Mohammedia.

2) Types of Industry and Sources of Industrial Waste

Characteristics of manufacturing industry are as follows in terms of waste.

a. Food Processing Industry

There are many factories producing sugar, vegetable oil, and dairy food in Morocco. These factories generate waste such as waste oil, rinsing water, and waste diatomite. Most waste is organic.

b. Textiles and Tanning

Dyeing and tanning factories generate liquid waste. Tanning factories also generate tanning slag.

c. Paper Processing Industry

Paper manufacturing factories generate a large amount of liquid waste.

d. Machine and Equipment Industry

Although assembly factories are dominant, some of them internalize production of components. There are factories manufacturing electronic equipment components where electroplating waste water, and waste solution, etc. are generated.

e. Metal and Metal Commodities

Steel mills are located in Nador and Casablanca. There are also factories for machine components, surface treatment, and plating. These factories generate hydrochloric acid in pickling processes, alkali liquid waste in oil removal, and waste solutions.

f. Chemical Industry

Factories producing phosphoric fertilizer and phosphoric acid are dominant in the chemical industry. There are also caustic soda factories whose waste contains mercury. Paint manufacturing and pharmaceuticals factories are active in Morocco.

g. Others

Condensers used by electricity and railway companies seem to contain PCB. There is no information on the present use of asbestos. Lead battery waste is generated in auto workshops. Liquid waste is generated in photo developing houses.

2.2 Present Industrial Waste Management

Details of present industrial waste management have not yet been revealed. Waste management at a few factories was found by joint research of MoE and JICA Study Team, but this uncovered only a part of the whole picture.

This section refers to results of the research and describes issues in SWM in factories based on the research results.

2.2.1 Present Industrial Waste Management

a. Chemical Fertilizer Factories

In phosphoric acid producing processes, gypsum is generated from phosphorous ore as a by-product. This by-product is currently discharged into the sea. Although gypsum is recycled as a construction material in Japan, no such recycling is conducted in Morocco.

In phosphate refining, arsenic, cadmium, and sulfide are generated and seem to be landfilled in factory sites.

Fluorine acid containing polluted steam is also generated.

b. Caustic Soda Factories

There are caustic soda factories in Morocco. The process of producing caustic soda includes electrolysis of nutrient salt solution. In the filtration process to refine resolved brine, brine mud is generated, containing mercury. In both processes, used rinsing water is generated, containing mercury. When the water is treated, sludge generated from the treatment process contains mercury.

In surveyed factories, brine mud is landfilled untreated in the sites, and waste water is discharged into the sea. Waste water containing mercury is notorious worldwide for causing Japan's Minamata disease.

c. Inorganic Chemicals Industry

Inorganic chemicals are inorganic pigment, reagon, etc. Materials for the chemicals are Pb, Cr, Cd, As, CN, etc. Although they are generally in small amounts, these materials are contained in waste from the factories. Waste generated in this industry can be estimated by studying the type of factories.

d. Organic Chemicals Factories

There are factories producing paint, pharmaceuticals, agricultural fertilizer, and petrochemistry in Morocco. In paint factories, pigment dust containing hazardous waste is scattered, and waste solution is generated after washing reaction tanks.

In pharmaceuticals factories, toxic materials will not be generated as waste, but pharmaceuticals that are not sent to the market will become waste.

The petrochemistry industry has not been studied enough; however, generally speaking, organic mud is generated in a large amounts where waste water treatment facilities are located,. The catalyzing process, which is used in the industry, causes waste catalysis.

e. Iron and Steel Industry

In iron and steel making factories, slag is generated. In the surface treatment process, sulfuric acid and hydrochloric acid are generated. In the hot dip coating process, dross containing zinc is generated. Inorganic mud is usually generated from inorganic waste treatment.

f. Nonferrous Metal Industry

In factories refining zinc, cadmium, lead, etc., dross and slag are generated from these materials. Dust is also generated, containing hazardous waste.

g. Factories equipped with Electroplating or Surface Treatment Facilities

In the process of electroplating using zinc, lead, chromium, and solder, repeatedly used metal plating wastewater is generated. Where used rinsing water is treated, sludge will be generated. It is, however, not clear if there are treatment facilities for used metal plating wastewater in Morocco.

h. Factories Manufacturing Electric Motors and Equipment

Factories exist for producing dry battery and sophisticated machine or etching materials for semi-conductors, and using hazardous materials. Although the amount of rinsing solutions is not found, the generation of the used rinsing solution is a fact. Treatment of the waste solution is not known.

i. Paper Recycling Factories

When bleaching used papers, liquid waste is generated. Sludge will be generated after treating the waste. In Morocco, the waste is discharged untreated into ponds to be dried away by solar heat.

j. Tanning Factories

Since dichromate is used in the tanning process, liquid waste is generated from the rinsing process. Slag is also generated from the shaping process. A tanning factory in Casablanca discharges liquid waste into the sewerage system, but there is not information on the destination of slag.

k. Others

There has not been any full study concerning the treatment of waste such as lead batteries, liquid waste from photo developing, and PCB, which is used in condensers or as insulating oil.

2.2.2 Issues in Industrial Waste Management

Further research should be conducted for details of present industrial waste management in Morocco, but issues that the survey has revealed include the following

- Since there are virtually no regulations for emission gas and waste effluent, pollutants that can be classified as industrial waste are released into environment.
- There are many cases where industrial waste is disposed of in factory sites.
- There are no disposal sites adjacent to factories for industrial waste generated in the factories. Private treatment providers are not active.

The question naturally arises as to where industrial waste is disposed of in Morocco. Most pollutants are released into the environment as emission gases or waste effluents. Solid waste that needs treatment is dumped in factory sites. This type of landfilling causes soil pollution and will raise problems in the future. Europe, USA, and Japan are currently struggling with such problems, Morocco should not follow suit.

To summarize results of the survey, liquid and solid wastes are generally released into the environment without proper treatment. Releasing waste into the environment is not illegal in Morocco unless it directly damages the surrounding area.

Industrialized countries have experienced this situation, but it is not the path that Morocco should take.

Morocco also must start industrial pollution control for another reason. Dumping into environment will not be allowed when Morocco engages in free trade with European countries.

CHAPTER 3 PRINCIPLES AND LEGAL FRAMEWORK

3.1 Principles

Business establishments are responsible for preventing environmental pollution caused by waste from their production activities. It is now generally accepted that pollution control at source is more effective than end-of-pipe treatment. This will secure a more effective use of resources and keep the overall pollutant load low.

Based on this trend, basic SWM principles aim firstly at waste prevention to minimize potential pollution and secondly recycling. Waste inevitably generated even after the first and second activities should be properly treated and disposed of.

Many enterprises have started respecting these principles in industrialized countries, and this trend is spreading worldwide. There are two reasons why this is so. Firstly, the more enterprises discharge pollutants, the more they are being required to pay for environmental control. Secondly, enterprises with effective use of resources are more likely to remain competitive in the coming era of global competition.

Since Morocco is seeking membership of the EU, she should require domestic enterprises to adhere to these principles.

As proposed in the National Strategy for SWM, Morocco should implement the principles of industrial waste management as follows:

"Firstly, clean production processes and technology should be introduced to minimize the use of hazardous materials. Secondly, waste generated should be recycled. Finally, waste that needs to be disposed of should be neutralized or stabilized to prevent damage to the environment."

3.2 Definitions of Industrial and Hazardous Waste

1) Legal Definition

Although waste generated from industrial activities is named "industrial waste" in general, it is not a legally valid definition. Industrial waste is legally defined in accordance with management responsibility and disposal standards.

The European definition of industrial waste is shown below.

Municipal Waste	General Industrial Waste	Hazardous Waste

Figure 3.2-1 European Definition of Industrial Waste

Municipal waste is similar to household waste, although generated in factories, and can be accepted in municipal disposal sites.

Hazardous waste is waste that should not be handled according to normal disposal standards and, its treatment and disposal are specially defined by law.

The remaining part of waste according to the above box is industrial waste. It is legally possible to landfill industrial waste unless specifically prohibited.

2) Definition of Hazardous Waste

Among legal definitions of industrial waste, hazardous waste is not fully and equally defined even in industrialized countries. Since the Basel Convention is subscribed to by many countries, the definition adopted in the convention can be regarded as a worldwide standard definition. Morocco has subscribed to the convention and should respect its definition.

In the Basel Convention, waste is regulated by two classifications, namely "waste generation process" and "waste containing specified hazardous content." The first includes 18 types of waste generation process and the latter 29 types of materials. (See appendix. Originally shown in an attachment to the Convention.)

As defined in the first clause, article 1 (a) of the Convention, waste that does not possess "hazardous characteristics" is not regulated. Hazardous characteristics are explained in an attachment to the Convention. They are shown below. (See appendix for more details.)

1. Explosive
2. Flammable liquid
3. Flammable solid
4. Self ignitable materials or waste
5. Materials or waste that cause flammable gas when reacting with water
6. Oxidizing
7. Organic peroxide
8. Acute toxicity
9. Infectious
10. Corrosive
11. Materials or waste that generate toxic gas when reacting with air or water
12. Toxic (delayed or chronic toxicity)
13. Ecotoxic
14. Materials or waste that have the potential to generate materials with any of the above characteristics

Being similar to the definition in the Basel Convention, definition of hazardous waste in Europe is made according to two aspects; generation processes and waste with hazardous characteristics. There are 40 types of generation processes and 51 types of hazardous substances. The types of hazardous substances include more than those listed in the convention. Definition of hazardous waste in EC requires setting criteria for waste where it is difficult to judge whether or not it is hazardous or toxic.

In the USA, the RCRA (Resource Conservation and Recovery Act) defines hazardous waste. Procedures for defining hazardous waste are shown in the following flowchart.

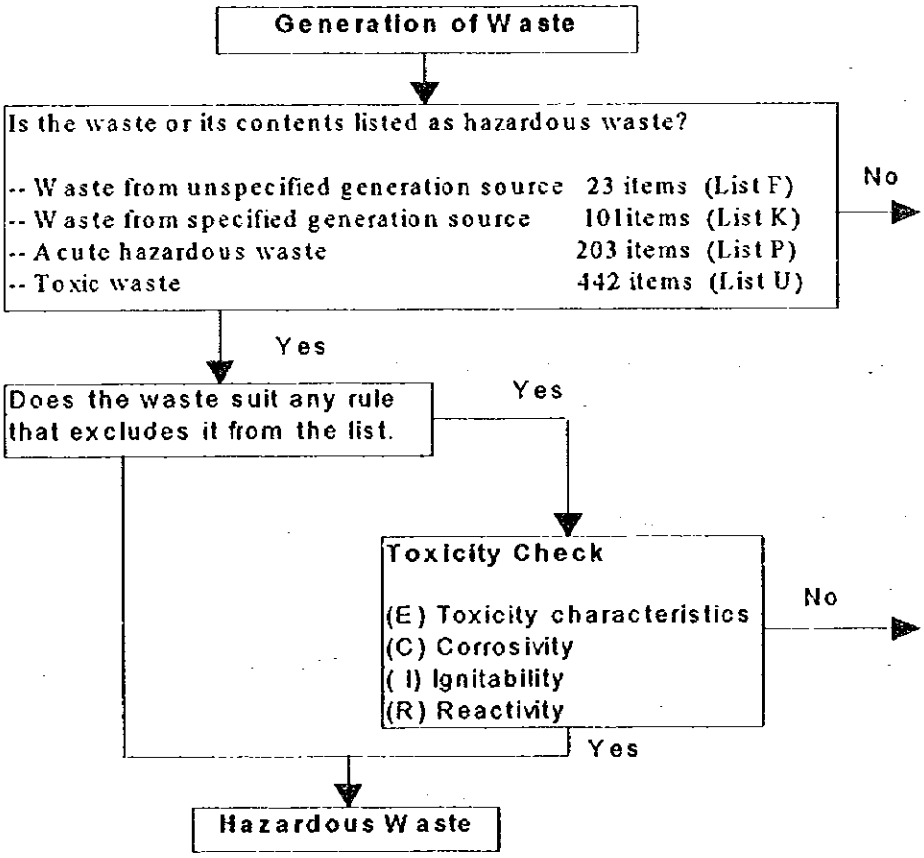


Figure 3.2-2 Defining Hazardous Waste

In terms of toxicity characteristics, hazardous materials or waste are those that score more than 1/100 of EPA criteria for drinking water in elusion test. Regarding corrosiveness, hazardous materials are those that corrode iron 6.35mm/year under certain conditions or solutions whose pH value is equal to or smaller than 2, or equal to or greater than 12.5. In respect to ignitability, liquid is defined as hazardous if its ignition temperature is 60 degrees centigrade or lower. Explanation of other definitions is omitted in this section.

Specially controlled industrial waste is divided into four categories according to Japan's definition.

1. Highly flammable waste oil (volatile oil, kerosene, and light oil)
2. Acid and alkali (pH 2 or less, pH 12.5 or more)
3. Infectious waste
4. Specified hazardous industrial waste

Specified hazardous industrial waste includes the following.

1. Waste oil containing PCB, or materials contaminated with PCB
2. Waste such as asbestos, etc.
3. Slag, dust, waste oil, waste acid, waste alkali, and sludge that are generated from specified factories and contain specified hazardous substances, or those treated

It is a feature of the Japanese definition that factories generating hazardous waste are specified.

Specified hazardous substances are defined as follows.

1. Mercury or its compounds
2. Cadmium or its compounds
3. Lead
4. Organic phosphorous
5. Hexavalent chromium or its compounds
6. Arsenic
7. Cyanide compounds
8. PCB
9. Organic chloride compounds (Vinyl chloride, Vinylidene chloride, polyethylene chloride compounds)
10. Copper, or its compounds
11. Zinc, and its compounds
12. Fluoride
13. Trichloroethylene
14. Tetrachloroethylene
15. Beryllium, or its compounds
16. Chromium, or its compounds
17. Nickel, or its compounds
18. Vanadium, or its compounds
19. Dichloromethane
20. Carbon tetrachloride
21. 1.2-dichloroethane
22. 1.1-dichloroethlene
23. Cis-1.2-dichloroethlene
24. 1.1.1-trichloroethane
25. 1.1.2-trichloroethane
26. 1.3-dichloropropene
27. Thiram
28. Simazine
29. Thiobencarb
30. Benzene
31. Selenium, or its compounds

Criteria for specifying treated waste as hazardous waste are defined by law, and landfilling criteria are applied for specifying hazardous solid waste. There are separate criteria for waste potassium acetate.

Morocco is just about to examine which definition should be applied. For the moment, the country should employ the definition in the Basel Convention. It seems difficult to set criteria for toxicity at present due to insufficient institutional arrangements for analysis. It would be practical to introduce the criteria used in Europe.

It is most important for Morocco to know what hazardous waste is. Therefore, it would be practical to define the type of waste generated from specified factories.

For example, the following definition is practical.

- electroplating waste water (waste acid)
- mercury mud in producing caustic soda, and sludge from wastewater treatment
- organic chlorine solution such as tetrachloroethylene, etc.

It is easy for both administrative and management sides to define hazardous waste. While these definitions are tentatively used, it is practical to develop legal conditions related to SWM.

The OECD has classified waste in detail by using lists, which were used to provide ideas for the Basel Convention. (Decision of the council: concerning the control of transfrontier movements of waste destined for recovery operation; "92, 39/Final, 30, March, 1992.")

3.3 Disposal and Facility Standards

Disposal methods include landfilling and discharge into water bodies (rivers and sea).

It is necessary to define waste that cannot be landfilled without treatment. Waste such as waste acid or alkali, and waste oil should be excluded from landfilling in general. Waste acid or alkali can be discharged into water bodies after neutralization treatment to satisfy discharge standards.

Intermediate treatment should be applied when landfilling waste such as waste oil, waste acid or alkali, dust, and sludge.

It is necessary to take characteristics of waste into consideration when conducting landfilling. Stabilized materials can be disposed of by landfill where groundwater pollution control is not available. It is necessary to apply very strict standards to hazardous waste disposal sites that accept final disposal waste that does not satisfy certain safety standards.

There are three levels of landfilling sites according to the characteristics of waste accepted.

Stabilized materials can be disposed of in "stable disposal sites" that are not equipped with leachate treatment facilities. Hazardous waste should be disposed of in "isolated disposal sites." All other waste should be disposed of in "controlled disposal sites" that are equipped with leachate treatment facilities.

Stabilized materials are plastic, concrete debris, etc. Hazardous waste is waste that does not satisfy criteria for landfilling. Hazardous waste can be judged by measuring the density of leachate from mixing waste and water. The criterion density is 10 to 30 times stricter than that of drinking water, taking the risk of pollution of drinking water into account.

Table 3.3.1 Landfilling Criteria

Alkyl mercury compounds	Not detectable	Carbon tetrachloride	0.02 mg/l or less
Mercury, or its compounds	0.005 mg/l or less	1.2-dichloroethane	0.4 mg/l or less
Cadmium, or its compounds	0.3 mg/l or less	1.1-dichloroethlene	0.2 mg/l or less
Lead, or its compounds	0.3 mg/l or less	Cis-1.2-dichloroethlene	0.4 mg/l or less
Organic phosphorous, or its compounds	1 mg/l or less	1.1.1-trichloroethane	3 mg/l or less
Hexavalent chromium, or its compounds	0.3 mg/l or less	1.1.2-trichloroethane	0.06 mg/l or less
Arsenic compounds	1.5 mg/l or less	1.3-dichloropropene	0.02 mg/l or less
Cyanide compounds	1 mg/l or less	Thiram	0.06 mg/l or less
PCB	0.003 mg/l or less	Simazine	0.03 mg/l or less
Trichloroethylene	0.3 mg/l or less	Thiobencarb	0.2 mg/l or less
Tetrachloroethylene	0.1 mg/l or less	Benzene	0.1 mg/l or less
Dichloromethane	0.2 mg/l or less	Selenium, or its compounds	0.3 mg/l or less

Sample solution is composed of total 500 ml of sample and solvent whose weight-volumetric sample is 10 %.

Elusion standards are set in Germany as well, as shown in the Table 3.3-2.

Table 3.3.2 Landfilling Criteria in Germany

pH	4-13	Mercury	0.1 mg/l or less
Electrical conductivity	100,000μS/cm or less	Tin	10 mg/l or less
TOC	200 mg/l or less	Fluoride	50 mg/l or less
Phenol	100 mg/l or less	Ammonia	1,000 mg/l or less
Arsenic	1 mg/l or less	Chloride	10,000 mg/l or less
Lead	2 mg/l or less	Cyanide compound that easily dissolve	1 mg/l or less
Hexavalent chromium	0.5 mg/l or less	Sulfide	5,000 mg/l or less
Cadmium	0.5 mg/l or less	Nitrite	30 mg/l or less
Copper	10 mg/l or less	AOX	3 mg/l or less
Nickel	2 mg/l or less	Contents dissolved in water	10 Gravitric %

See Book 1-Part 2section 5.4 for disposal standards.

3.4 Institutions and Responsibility for Treatment

It is recommended that factories to be regulated by law should be specified. These are factories that generate or may generate hazardous waste. It is practical to specify factories according to the processes they use instead of actual waste generation. (Processes that generate hazardous waste in Japan are listed later as examples.)

The following tasks should be obligatory for specified factories.

- Report on hazardous waste generation and management to the government
- Placing SWM managers in factories generating hazardous waste
- Report on and approval for hazardous waste treatment facilities
- Employing operation managers for treatment facilities
- Filing operation records for treatment, and report

Factories may establish treatment facilities for non-hazardous industrial treatment facilities. Report on and approval for their location should be obligatory when they exceed a certain size.

It is recommended that reports from specified factories should be linked with inventory system.

3.5 Collection and Transport

Collection and transport standards should be satisfied when collecting and transporting waste. (See Book 1 Part 2 section 5.4 for details.)

Collection and transport service should be contracted out to only authorized contractors. Special authorization should be given to contractors for collection and transport of hazardous waste.

3.6 Contracting Out Treatment and Disposal

Private contractors of hazardous waste treatment and disposal must have authorization from a public institution. A system for authorized disposal operations has recently been introduced in many industrial countries to control movement of waste whose treatment and disposal are contracted out. In Germany, the USA, and Japan, hazardous waste is controlled by this system. In Japan, it is named the "manifest system."

The structure of the system is shown below.

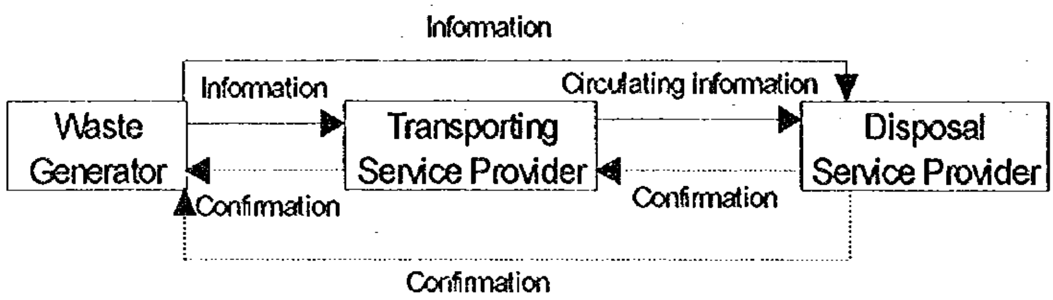


Figure 3.6-1 Manifest System

Information that waste generators present to transport service providers must convey the following information.

1. Types and amount of waste
2. Contractor's name, company's name, and address
3. Date of issue
4. Name and address of person contracted out
5. Name and address of source factories for waste
6. Name of person presenting the information
7. Name and address of office that is the destination of waste

3.7 Treatment Service Providers

Service providers who construct intermediate treatment or final disposal facilities and conduct treatment service must have authorization for activities and installation of the facilities.

Providers must employ and report on SWM managers and operation managers.

CHAPTER 4 ADMINISTRATIVE SYSTEM AND INSTITUTIONS FOR INDUSTRIAL WASTE

4.1 Controls of Disposal Activities

Business establishments tend to neglect proper waste treatment when there is no control of disposal activities. So administrative control is necessary.

When hazardous waste may damage the environment, priority should be given to monitoring hazardous waste treatment and disposal in addition to actual facilities for waste treatment and disposal. Priority should be based on environmental impact and administrative monitoring costs. In practice, items to be monitored should be selected in order of urgency.

Monitoring in Morocco can be conducted for the following items.

1. Proper disposal activities of business establishments according to disposal standards (which can be called disposal criteria before being legally defined.)
2. Mixed storage of hazardous and other waste
3. Proper equipment and operation of treatment facilities
4. Filing detailed treatment records

Monitoring the above points can be done by on-site inspection. Monitoring officials should check storage, treatment, and disposal facilities, and take samples if necessary. They also should check if the facilities satisfy technical standards and confirm reported data by comparison with existing facilities.

When problems are found during the inspection, instructions should be given to the factories. In case improvement as instructed is not confirmed, an official order for improvement should be issued, and an operation stop order can be issued when the improvement order is not followed. Violation of an operation stop order should result in a criminal law suit.

Control of disposal activities is possible only when legal definitions are prepared for disposal standards, authorized monitoring, and penalties for violators. Controls cannot be currently conducted in Morocco, since there are no laws defining controls.

Until laws are introduced, it will be more important for the government to build up cooperative relationships with businesses and instruct them on proper SWM instead of emphasizing control. Therefore, it is recommended that the government should examine SWM issues jointly with businesses prior to sending instructions to businesses.

4.2 Measures for Controls

1) Legal Measures

Measures for controls need to be legally defined, and they should include the following.

1. Report on hazardous waste generation
2. Report on and approval of location of treatment facilities
3. Report on SWM managers and operation managers
4. Report on completion of waste disposal
5. Report on operation records of treatment facilities
6. Report on analysis of hazardous characteristics of waste
7. Approval for collection and transport
8. Approval for treatment and disposal

Effective control will be possible by defining the above tasks for business establishments. Penalties are also a form of legal control, but imposing penalties should be a last resort.

2) Development of an Inventory System

A database system should be formed for hazardous waste. The system should require generators of hazardous waste to report to the government details of hazardous waste generated. With operation of this system, the government will be able to prepare policies and plans for hazardous waste control measures and make instructions regarding priorities. (See Book 1-Part 2 section 4.2 for more details.)

4.3 Assisting Measures for Business Establishments

Business establishments are expected to invest in SWM measures, and it will be a governmental role to promote such investment.

Measures for promoting SWM investment by business establishments include the following.

- Provision of information
- Assistance to human resource development
- Economic incentives
- Assistance to joint research of business establishments

It is important to provide information on treatment and disposal methods conducted in the EC so that businesses can be prepared for a unified market with the EC. It is recommended that industry should be made aware of the benefits that introduction of clean technology will bring them. (See Book 2-Part 2 and Book 3.)

Human resource development and economic incentives are mentioned respectively in Chapter 6 and Chapter 9 of Book 1-Part 2.

Research conducted jointly by businesses is very meaningful for developing a database system within industry. Joint research has been already started by MoI&C.

It is recommended that administrators should build cooperative relationships with business establishments. The government should develop model factories in SWM.

Business establishments that establish SWM institutions and conduct proper SWM should be rewarded.

The government should encourage businesses to conduct environmental auditing. It is also recommended that those who do so should be invited to seminars to promote efficient SWM elsewhere.

4.4 Institutions

In order to implement administrative action, institutions should be arranged for;

1. policy preparation and legal development
2. direct instructions and regulation of factories
3. management information for hazardous waste
4. analysis to judge hazardous waste
5. provision of information, and
6. training.

The laboratory of MoE can be used as an institution to define what is hazardous waste. Since it requires budgets for purchasing chemicals and maintenance parts for analysis, hazardous waste analysis will have to be made obligatory by the industries concerned.

Institutions for regulation and training should be located close to factories. (See Chapter 2 of Book 1-Part 2 for more details.)

The remaining institutions should be established in central ministries and agencies. (See Book 1-Part 2 Chapter 2 for more details.)

CHAPTER 5 INSTITUTIONS FOR SWM IN BUSINESS ESTABLISHMENTS

5.1 Importance of Institutions

Generally speaking, proper SWM is only conducted in companies in which specific responsibilities for SWM are established. In the USA, EC, and Japan, there are advanced factories that have introduced environmental auditing and procedure more than administrative controls require. Establishment of SWM institutions in business establishments generally means less administrative controls, and therefore small administrative expenditures. Therefore, the government should encourage business establishments to set up their internal SWM institutions.

5.2 Internal SWM Rules and Institutions

It is important to clearly define SWM managers and operation managers in business establishments.

It is necessary to prepare internal rules for SWM as follows.

1. Principles for solid waste treatment and disposal in business establishments
2. Definitions of hazardous and other waste
3. Appointment of SWM managers, and their tasks
4. Preparation of treatment and criteria
5. Operation managers, and their tasks
6. Procedures to contract out treatment
7. Location of a committee for auditing

It is necessary for SWM managers to prepare criteria for disposal and manage internal SWM. Criteria for disposal should include the following.

1. Types of waste, and especially treatment and disposal standards
2. Methods of temporarily storing hazardous and other waste at source, and location
3. Methods of collection and secondary storage of hazardous and other waste, and storage location
4. Methods of waste treatment and disposal by waste type
5. Operational conditions for treatment
6. Methods of contracting out
7. Methods of recording treatment performance
8. Methods of measuring waste quantity
9. Methods of analyzing waste quality

SWM managers should be responsible for contacting regulatory agencies, preparing reports on internal treatment performance, securing budgets for internal SWM, creating plans for treatment facility investment, and educating other workers.

Operational managers should be obliged to record operation performance for they are responsible for conducting SWM based on disposal criteria. They should prepare operation record sheets (especially for hazardous waste).

5.3 Installation of Treatment and Disposal Facilities

It is necessary to construct appropriate facilities to conduct waste treatment and disposal. Internal treatment by business establishments is not economical when the amount of waste generated is small. On the other hand, in establishments that generate a large amount of waste, it will be economically reasonable to install treatment facilities. The government should instruct large establishments to be models for installation of treatment facilities.

It is a problem in Morocco that there are few private companies that can treat waste in their factories. This implies that SWM regulations are not strict in the country. (See Chapter 8 for details.)

Contents of treatment facilities are explained in Chapter 7.

CHAPTER 6 DISPOSAL AND TREATMENT METHODS FOR INDUSTRIAL WASTE

6.1 Disposal

1) Waste Disposal

Industrial and hazardous wastes must be disposed of safely and securely because of the nature of the waste. And the environmental protection measures necessary to decrease the adverse impacts on the surroundings and living environment should also be considered carefully.

Generally, non-hazardous industrial waste and hazardous waste can be divided into three categories, from the viewpoint of disposal, as follows;

- Wastes which can be disposed of directly at the disposal site. (stable waste and most types of non- hazardous industrial wastes are included in this category)
- Wastes which can be disposed of at the disposal site after specific treatment, such as harmlessness, stabilization and volume reduction. (most types of hazardous wastes are included in this category)
- Wastes which are prohibited from being received at the disposal site (some types of hazardous wastes, such as waste acid, waste alkali, etc.)

Waste disposal systems may be divided into three types; Type-A, Type-B and Type-C, depending on the type of waste, and specific characteristics, such as decomposability, danger, etc. Hazardous waste should be disposed of at Type-A (strictly controlled), decomposable industrial waste at Type-B (controlled), and stable industrial waste at Type-C (least controlled) facilities, respectively. Table 6.1-1 shows types of disposal systems and classification of disposable industrial waste for each type of disposal system.

Table 6.1-1 Classification of Disposal System and Disposable Industrial Waste

Type of disposal system		Waste to be disposed
Type -A	Strictly controlled type (Isolated landfill)	Hazardous waste; such as cinder, dust, sludge etc. which contains harmful substances
Type -B	Controlled type (Leachate controlled landfill)	Non hazardous industrial waste; such as waste oil (only tar pitch), waste paper, waste textile, animal/plants residues, animal waste, dead animals, cinder, dust, sludge and slag
Type -C	Least controlled type (Leachate non-controlled type)	Stable waste such as waste plastic, rubber scrap, metal scrap, waste glass and ceramics, demolition waste

Disposal standards for each kind/type of industrial waste and hazardous waste in Japan are shown in Table 6.1-2.

2) Disposal Facility and Operation

To ensure sanitary, secure and efficient disposal of industrial waste and hazardous waste, proper disposal facilities and operation methods must be established. Standards of disposal facilities and operating methods for three types of disposal systems; that is, Type-A, Type-B and Type-C, will be described in this section.

At the disposal site for industrial waste and hazardous waste, daily landfill control is indispensable to prevent environmental effects, such as offensive odors, breeding of vectors and insects, outflowing of toxic substances, contamination of public water bodies and groundwater etc.

Detailed standards for disposal facilities and operations for industrial waste and hazardous waste will be shown in Table 6.1-3. Conceptual drawings of each type of disposal system are shown in Fig. 6.1-1, Fig. 6.1-3 and Fig. 6.1-4.

a. Strictly controlled type (Type -A)

As the waste subject to strictly controlled disposal is hazardous waste which is harmful for human beings and nature, the waste should be disposed of at places which are completely isolated from vulnerable natural environments, such as public water bodies, groundwater etc., to prevent negative environmental impacts on the surrounding areas and ecology.

So as to isolate the disposal site from such natural environments, external periphery separation facilities made of concrete will be required. On the other hand, where the disposal area/ block is more than 50 m2 or one block capacity is more than 250 m3, internal separation facilities made of concrete are also required.

A double liner system for hazardous waste disposal, introduced by the U. S. Environmental Protection Agency (EPA), can be an alternative to this strictly controlled type. A schematic diagram of double liner system is shown in Fig. 6.1-2.

For operation and maintenance of disposal facilities, periodical environmental monitoring, such as groundwater quality in the peripheral area etc., should be required.

b. Controlled type (Type -B)

Controlled type disposal should be facilitated with the following to prevent adverse environmental impacts caused by leachate, gaseous products etc. which are produced during the process of waste decomposition and effluent.

- Retaining walls, dams and other facilities to store the wastes
- Liner facilities to prevent groundwater contamination
- Conduits and other leachate collection facilities
- Leachate treatment plant
- Gaseous products removal facilities, etc.

Meanwhile, facility standards of this "controlled type (Type -B)" for industrial waste disposal shall be the same as that of municipal waste disposal of "sanitary landfill -B (Type -4)". For details of sanitary landfill -B systems, refer to chapter 6 of Book 2-Part 2.

c. **Least controlled type (Type -C)**

The least controlled type of waste is stable waste; such as waste plastic, rubber scrap, metal scrap, waste glass and ceramics, demolition wastes etc. which do not decompose, and do not produce any leachate or gas. Main facilities required for least controlled type disposal are the following;

- Retaining walls, dams and other facilities to prevent outflowing the waste
- Enclosure around disposal site, etc.

Table 6.1-2 (1) Disposal Standards for Industrial Waste and Hazardous Waste

<table>
<tr><th colspan="2">Industrial Waste</th><th colspan="2">Industrial Waste</th><th>Hazardous Waste</th></tr>
<tr><td colspan="2" rowspan="2">Common Standards</td><td colspan="3">1. Necessary measures should be taken to prevent scattering and outflowing of the waste
2 Necessary measures should be taken to prevent offensive odor, noise and vibration caused by landfill siting and/or operation.
3. Erection of enclosure around the disposal site, and notice board indicating that the subject site is a industrial disposal site.
4. Necessary measures should be taken to prevent the growth of rats, mosquitoes, flies or other harmful insects at disposal site.
5. When the disposal site is closed, the surface of the wastes shall be covered by soil, so as to secure living environment.</td></tr>
<tr><td>6 Stable industrial waste can be disposed at spaces in underground
7. Necessary measures should be taken to prevent disposing of unstable industrial waste at "least controlled disposal site".</td><td>6. Necessary measures shall be taken to prevent leachate from polluting public water bodies and groundwater.</td><td>6. The disposal site should be isolated from public water bodies and groundwater.</td></tr>
<tr><td rowspan="7">Individual Standards</td><td>Cinder</td><td colspan="2">Treatment is not necessary * Controlled type</td><td rowspan="2">1. Contain Hg
A. should be adopted "Standard 1" (except solidification)
(adopted) * Controlled type
(not adopted) * Prohibited to dispose
B. If not adopted "Standard 1" in above A, should be adopted by solidification
(adopted) * Controlled type
(not adopted) * Stricdy controlled type
2 Contain Cd, Pb, Cr^{6+} or As
Shall be adopted "Standard 1"
(adopted) * Controlled type
(not adopted) * Stricdy controlled type
3. Necessary measures should be taken such as wrapping etc to prevent scattering waste to air</td></tr>
<tr><td>Particulate matter (Dust)</td><td colspan="2">Necessary measures should be taken such as wrapping etc. to prevent scattering waste to air * Controlled type</td></tr>
<tr><td>Sludge</td><td colspan="2">"Landfill reclamation" * Controlled type
a Incineration - Cinder and Dust
b. Dehydration less than 85% moisture content * Controlled type

"Water aver reclamation"
a Inorganic matter sludge
Treatment is not necessary * Controlled type
b. Organic sludge
Incinevation - Cinder and Dust * Controlled type</td><td>1 Contain Hg or CN
A should be adopted "Standard 1" (except solidification)
(adopted) * Controlled type
(not adopted) * Prohibited to dispose
B If not adopted "Standard 1" in above A, shall be adopted by solidification
(adopted) * Controlled type
(not adopted) * Stricdy controlled type
2 Contain Cd, Pb, O-P, Cr^{6+}, As, PCB, TEC or PEC should be adopted "Standard 1"
(adopted) * Controlled type
(not adopted) * Stricdy controlled type</td></tr>
<tr><td>Waste acid
Waste alkali</td><td colspan="2">* Prohibited to dispose</td><td>* Prohibited to dispose</td></tr>
<tr><td>Waste oil</td><td colspan="2">A. Waste oil (except Tar pitch)
Incineration - Cinder and Dust * Controlled type
B Tar pitch
Treatment is not necessary * Controlled type</td><td>Incineration - Cinder and Dust * Controlled type</td></tr>
<tr><td>Slag</td><td colspan="2">Treatment is not necessary * Controlled type</td><td>Contain Ha, Cd, Pb, Cr^{6+} or As
Shold be adopted "Standard 1"
(adopted) * Controlled type
(not adopted) * Stricdy controlled type</td></tr>
<tr><td>Waste paper
Waste wood
Waste textile</td><td colspan="2">Treatment is not necessary * Controlled type</td><td></td></tr>
</table>

Table 6.1-2 (2) Disposal Standards for Industrial Waste and Hazardous Waste

	Industrial Waste	Industrial Waste	Hazardous Waste
Individual Standards	Rotting waste Organic sludge Animal/plant residues Animal waste Dead animals etc.	a Incineration (ignition loss shold less than 15%) - Cinder and Dust * Controlled type b When, mix ratio of rotting matter is less than 40%, waste layer should be less than 3m and approx. 50cm cover soil When, mix ratio of it is more than 40%, waste layer should be approx. 50cm and approx. 50cm cover soil * Controlled type	
	Construction waste	Treatment is not necessary * Least controlled type	
	Waste plastics	a. Incineration - Cinder and Dust * Controlled type b. should be no more hollow waste, and waste diameter should be less than about 15cm by Crushing, shredding, melting furnace etc * Least controlled type	
	Rubber trash	a. Incineration - Cinder and Dust * Controlled type b. Waste diameter should be less than about 15cm by Crushing, shredding etc * Least controlled type	
	Metal/Glass/Ceramic trash	Treatment is not necessary * Controlled type	
	Waste PCB etc		Incineration and incinerator residue should be adopted "Standard 1". * Controlled type
	PCB pollutant		a. Eliminate PCB b. Incineration and incinerator residue should be adopted "Standard 1" c When, above a or b cannot be applied because of conditions of PCB pollutant, other methods established by Chief Secretary of Environmental Agency in Japan should be adopted Should be adopted "Standard 1" by above treatments a, b or c (adopted) Waste plastics * Least controlled type Metal trash * Least controlled type Waste paper * Controlled type Cinder * Controlled type
	Infectious waste		* Prohibited to dispose of
	Waste asbestos		a Necessary measures should be taken to prevent scattering waste to air, with double wrapping by waterproof material or solidification b Necessary measures should be taken to prevent dispersing waste in disposal site, specificblock/place should be adopted * Controlled type

Source : "Solid Waste Handbook", Japanese publication, 1996

Remarks,

(1) "1 2 3. –" : should be adopted all items

(2) "a. b." : can be selected for one of them.

(3) "Standard 1" is judgment standard for industrial waste types, established by the Prime Minister's Office in Japan

(4) Above from Table 6 1-3

Table 6.1-3 (1) Facility and Operation Standards for Industrial and Hazardous Waste

No.	Description	Landfill sites for industrial waste		
		Type-A	Type-B	Type-C
I. Structural Measures				
1	Enclosure around the landfill site to prevent entry of the people	O	O	O
2	Notice board indicating that the area is a waste landfill site	O	O	O
3	Land-slide prevention measures (when required)	O	O	O
4	Subsidence prevention measures (when required)		O	O
5	Retaining walls, dams and other facilities to prevent out-flow of waste		O	O
6	Water leakage prevention measures to prevent contamination of underground water by leachate		O	
7	Conduits and other leachate collection facilities to gather leachate effectively		O	
8	Leachate treatment facilities to ensure the quality of discharged water conforms to standards of the Water Pollution Control Law		O	
9	Stormwater drainage system to prevent inflow of surface water into landfill site		O	
10	External periphery separation facilities (made of concrete with thickness of 15 cm or more with compression strength of 250 kg/cm^2 or more)	O		
11	Internal separating facilities (made of concrete with thickness of 10 cm or more with compression strength of 250 kg/cm^2 or more)	O		
II. Operation and Maintenance Measures				
1	Measures should be taken so as not to allow the waste to scatter or flow out.	O	O	O
2	Measures should be taken prevent offensive odor from being dispersed to the exterior of the landfill site	O	O	O
3	Measures should be taken to prevent occurrence of fire, and the facility should be equipped with fire fighting facilities including fire extinguishers	O	O	O
4	Sprinkling of chemicals and other measures should be taken to control rats, mosquitoes, flies and other harmful insects	O	O	O

Table 6.1-3 (2) Facility and Operation Standards for Industrial and Hazardous Waste

5	Measures should be taken to prevent people from entering the site	O	O	O
6	Notice boards should be easily observable, and clear	O	O	O
7	Retaining walls, dams and other facilities should be periodically inspected, and necessary measures should be taken if there is a fear of damage to them		O	
8	Water leakage prevention measures should be periodically inspected, and necessary repairs carried out immediately		O	
9	Monitoring of the quality of ground water in the peripheral area should be carried out	O	O	
10	Measures to prevent inflow of rainwater should be taken, if the leachate collection facilities are not equipped	O	O	
11	Operation and maintenance of leachate treatment facilities should be carried out so as to satisfy the effluent standards with periodical inspection of the functioning of facilities and periodical examination of the effluent quality		O	
12	Removal of soil, sand and other measures for stormwater drainage and other facilities should be taken as required	O	O	
13	Ventilating equipment should be provided for discharging gases		O	
14	Soil covering with the thickness of about 50 cm should be made, and on completion of landfill to close the site		O	
15	Records of operation and maintenance should be kept for five years		O	
16	Closing of the landfill site should be made, taking necessary measures to prevent scattering and outflow of wastes, contamination by leachate and occurrence of fire	O	O	O
17	Stagnant water in the landfill site should be discharged before commencement of landfill	O		
18	External periphery separating facilities and internal separating facilities should be periodically inspected, and measures should be taken if there is a fear of occurrence of damage and outflow of leachate	O		
19	The landfill site should be closed with covering which satisfies the requirements equivalent to those for external periphery separating facilities on completion of landfill	O		
20	The covering states in preceding items above shall be periodically inspected, and necessary measures shall be taken if there is a fear of occurrence of damage to them	O		

Source: "Solid Waste Handbook", Japanese publication, 1996

Type-A: Strictly Controlled Type (Isolated landfill)
Type-B: Controlled Type (Leachate controlled landfill)
Type-C: Least Controlled Type (Leachate non-controlled landfill)

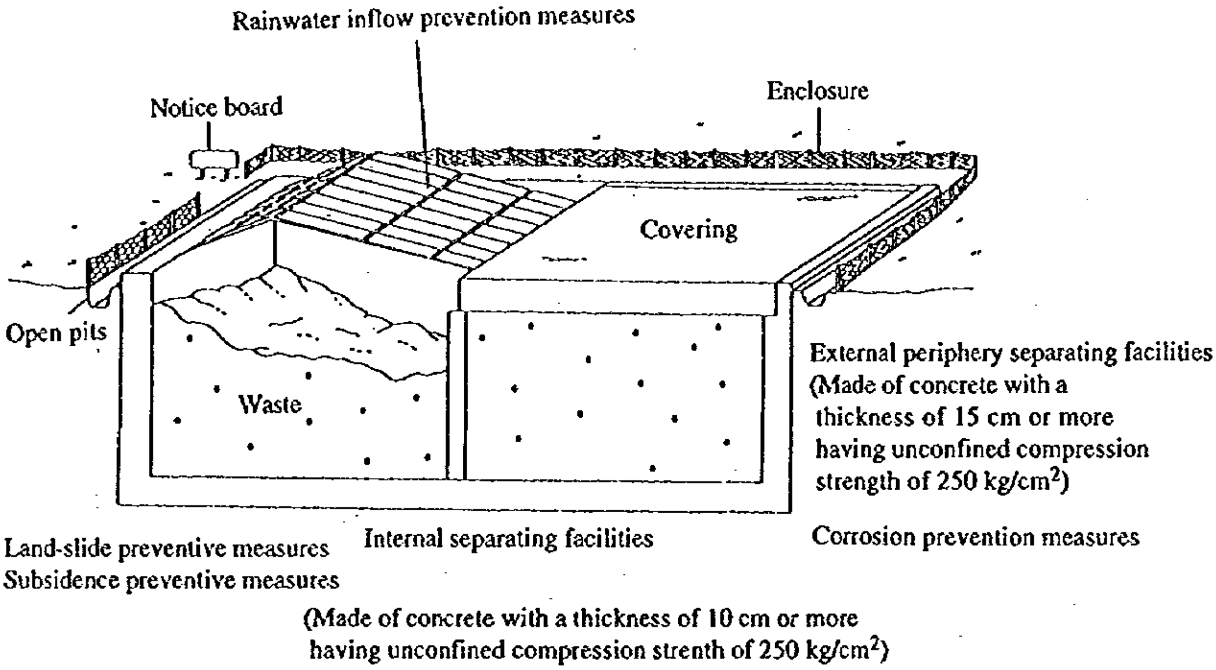


Fig. 6.1-1 Disposal Site for Industrial Waste (Type-A)

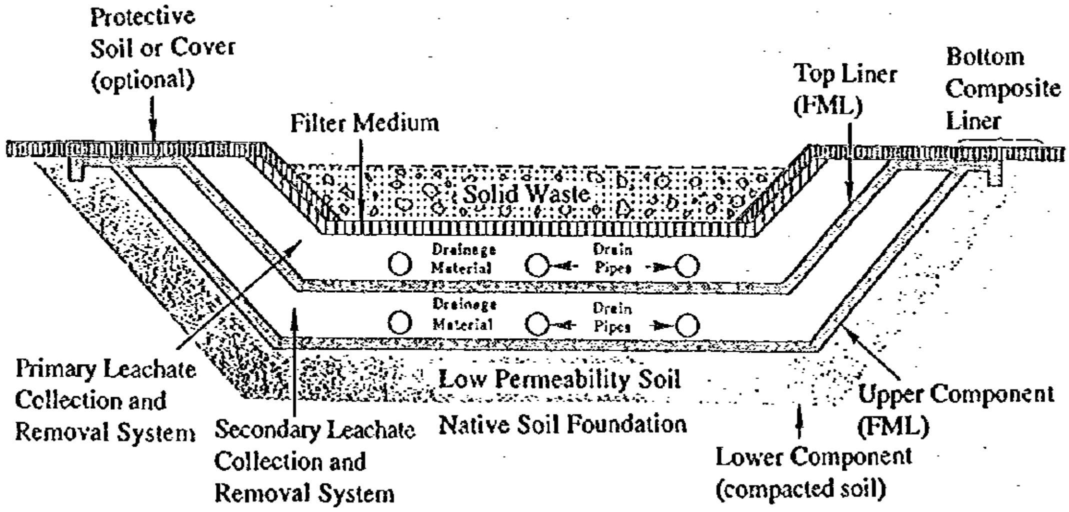


Fig. 6.1-2 Schematic Diagram of Double Liner System (by US E.P.A)

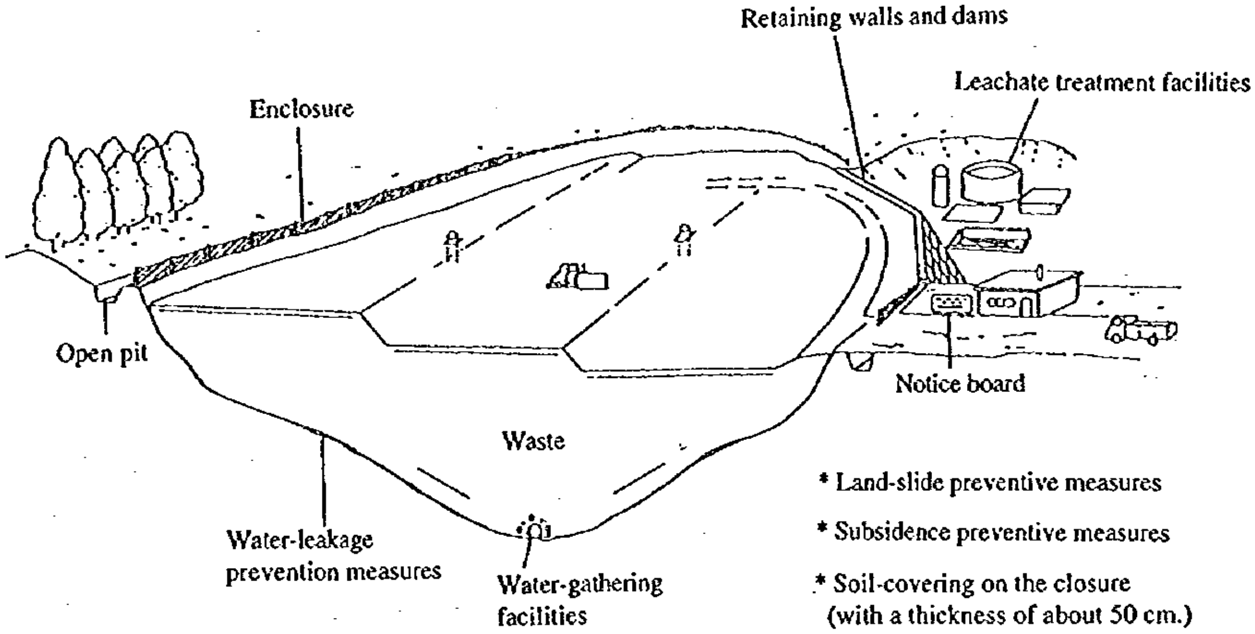


Fig. 6.1-3 Disposal Site for Industrial Waste (Type-B)

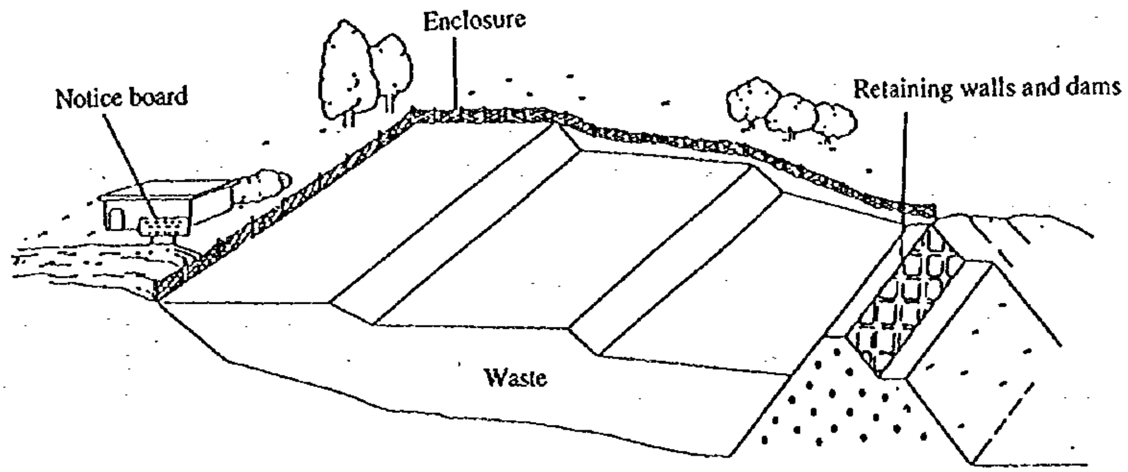


Fig. 6.1-4 Disposal Site for Industrial Waste (Type-C)

6.2 Treatment

1) General

It is necessary to treat some kinds of industrial waste and hazardous waste before disposal, so as to prevent environmental effects and protect the living environment. The main objectives of waste treatment are; harmlessness, stabilization, volume reduction and recycling. For required treatment methods of each type of industrial and hazardous waste, refer to Table 6.1-2. In this section, treatment methods of sludge, waste oil, waste acid and waste alkali are introduced.

2) Sludge

Generally, waste consists of three components; that is, moisture content, combustibles and non-combustibles. Among these, combustibles can be described as organic matter and non-combustibles as inorganic matter.

As sludge contains a high moisture content, the most important treatment is to get rid of moisture content, so as to perform stabilization and volume reduction. Decomposition of organic matter should be the second treatment for sludge.

Therefore, the main treatment system flow for organic sludge is; thickening - dehydration - drying - incineration, and for inorganic sludge is; thickness - dehydration - drying.

In addition, sludge which contains toxic substances, heavy metals etc.; such as Hg, CN, Cd, Pb, Cr^{6+}, Ag, PCB, TEC or PEC, must be carefully treated.

3) Waste Oil

Basically, incineration should be adopted for the treatment of waste oil (except tar pitch) before disposal. However, as characteristics of waste oil vary, incineration methods should also vary.

On the other hand, it is recommended that resource recovery and recycling of waste oil shall be done before incineration as much as possible, then only residues produced during these recycling processes shall be incinerated. For example, lubricating oil should first be produced by distillation of waste oil, then the residue can be incinerated.

In case of incineration, the following effective utilization of waste oil is recommended;

- As waste oil has high calorific value, it should be mixed with other waste which has low calorific value, to achieve efficient combustion.
- Oil which can be obtained by oil-water-separation treatment, can be used as supplementary fuel for incineration, and remaining water can be used as furnace temperature control.

4) Waste Acid and Waste Alkali

Waste acid and waste alkali must be prohibited from disposal at the disposal site, because of their liquid nature, (see Table 6.1-2). In principle, waste acid and waste alkali should be discharged to public sewerage after necessary treatment, such as alkali & acid neutralization, submerged combustion, pyrolysis, or hydrolysis etc.

6.3 Storage, Collection and Transport

1) Operators

The collection and transport of industrial non-hazardous and hazardous wastes should be the responsibility of the generators. It will probably make more economic sense for the generators to seek the service of professional transporters. In the case of hazardous wastes the generator should only deal with certified transporters. However it should be clearly understood by the generator that hiring of a transport operator does not in anyway release the generator from the responsibility of safely transporting the waste to the necessary disposal facility.

Generators should seek transporters that have the following qualifications;

- vehicles and equipment that are suitable for the wastes to be transported
- technically qualified management and labor to ensure safe transport of the waste
- a clean record in terms of accidents, worker injuries and vehicle/equipment breakdowns
- a sound and stable business

On their part, the transport operators should, as a minimum;

- select suitable equipment so as not to allow waste to scatter during transport, discharge leachate, emit bad odors, or make excessive noise
- properly manage operation and maintenance so as to decrease potential accidents, vehicle breakdowns on the road, etc.
- clearly understand the nature of the waste being transported and the risks incurred in mishandling the waste
- with regard to hazardous waste transport, strictly maintain a record (manifest system) showing the type and amount of waste hauled, origin, destination, and other necessary particulars
- ensure the safety of their workers by explaining the risks involved in mishandling hazardous wastes and providing them with the necessary safety uniforms, training, and supervision

2) Collection and Transport Vehicles

Industrial wastes are produced in liquid, sludge, powder or solid forms. Table 6.3-1 shows general examples of suitable vehicles according to the form of waste to be collected and transported. Table 6.3-2 then gives more details of vehicles by type of waste and vehicle. In addition to the presently widely used dumpers and armroll vehicles it appears necessary to consider introducing other vehicle types such as suction vehicles and vehicles equipped with mechanical equipment to load and unload the waste in a safe manner.

Table 6.3-1 Suitable Vehicles by Form of Waste

Type	Vehicle Type	Example/System	
Liquid	Suction veh.	Vacuum car	
		Sludge suction truck	
		Powerful suction truck	
	Tank lorry	Gravity type	
		Pump operated type	
Sludge	Suction veh.	Sludge suction truck	
		Powerful suction truck	
	Dumper	Leak proof box type	
Powder	Suction veh.	Suction type	
	Bulk veh.	Discharge type	Screw type
			Air type
Solid	Dumper	Earthworks dumper	
		Garbage truck	Lift attached
			Covered box
			Crane attached
	Mechanical collection type	Rotation type	
		Compression type	
		Rotating box type	
	Haul container veh. type (HCS)	Arm type	
		Crane type	
	Container horizontal load		
	Flat bed veh.	Lift attached	
		Crane attached	
	Van type	Lift attached	

Source: "Solid Waste Handbook", Japanese publication, 1996

Table 6.3-2 Suitable Collection and Transport Vehicle by Type of Waste

Vehicle and Waste types	Suction		Tank	Dumper			Mech. Collection			HCS
	vacuum	sludge	Lorry	water proof	earth	gar-bage	rota-tion	comp-ression	rotating box	
A. COMBUSTIBLE										
- Waste Paper					O	O	O	O	O	O
- Waste Wood					O	O	O	O	O	O
- Waste Textiles					O	O	O	O	O	O
B. PARTLY COMBUSTIBLE										
- Plants residue					O	O	O	O	O	O
- Animal residue					O	O	O	O	O	O
- Composite resins					O	O	O	O	O	O
- Tar, pitch	O	O	O	O						
- Oils	O	O	O	O						
C. SLUDGE FORM (DIFFICULT TO BURN)										
- Waste acid	O	O	O	O						
- Waste alkali	O	O	O	O						
- from metal industry	O	O	O	O						O
- from non-metal ind										
o solid	O	O		O	O	O				O
o low water content	O	O		O		O				O
o high water content	O	O	O	O						
- Animal manure	O	O		O						O
D. NON COMBUSTIBLE SOLIDS WITH RECYCLING POTENTIAL										
- Cars					O	O				
- Metal scrap					O	O				O
- Glass waste					O	O	O	O	O	O
- Scrap					O	O				O
E. SOLID NON COMBUSTIBLE SANITARY LANDFILLED WASTE										
- Ash					O	O				O
- Lime					O	O				O
- Demolition waste					O	O				
- Earth					O					
F. HOUSEHOLD WASTE										
- Putriscible matter					O	O	O	O	O	O
- Bulky wastes					O	O		O		O

Source: "Solid Waste Handbook", Japanese publication, 1996

3) Storage and Transfer

Storage and transfer activity refers to the temporary storage of industrial waste in a suitable container and at a suitable facility up to the time it is transported to the disposal facility. This activity is sometimes required to increase collection and transport operation efficiency.

Careful attention should be given to the siting and operation of the transfer facility. Among the items that need to be considered are the following;

- The transfer facility should be located at a site where it poses no negative environmental impacts on the surroundings
- Access to the facility should be strictly controlled with a signboard stating the facility name and activity type
- The storage areas should be located indoors or with a hanging roof to give protection against rainfall or direct sunlight
- Compartments or storage spaces should be defined for different waste types and partitioned, with concrete waterproof floors
- A drainage system should be erected for rain water
- Vehicle weighing facilities at entrance and exit points and washing facilities at exit points should be installed

Table 6.3-3 indicates some items that need to be considered based on the form of waste to be stored.

The selection of adequate containers for the storage of the industrial wastes at transfer stations should be carefully done to safeguard against leakage during handling and increase loading/unloading efficiencies. It is also necessary to consider packing some types of wastes at the generation points before collection. In Japan containers are generally categorized into two types, those for multiple purposes and those specially made for solid waste. Drums are usually made of metal and can be either closed and sealed with small openings, or have a detachable cover. The drums may be chemically treated for storage of acid and alkali wastes. Plastic drums are also available. Specific solid waste containers can also be made to suit the loading/unloading specifications of the collection vehicles. Stationary containers may be 1 - 2 m^3 while hauled containers may be as large as 10 to 15 m^3. Lift-up bottom-emptying containers are those lifted by cranes and emptied into the collection vehicles by opening the bottom of the container. Table 6.3-4 lists suitable containers based on types of waste.

Table 6.3-3 Important Actions Relating to Storage by Form of Waste

Stored waste	Actions
A. Liquid	• Store in a labeled container • Place containers on waterproof flooring
B. Sludge	• To prevent flow, store within partitioned areas on waterproof flooring • Provide drainage facilities for the rain water • Consider ease of loading/unloading when designating space for long term storage, alternating space between long and short term storage, and cleaning space when empty
C. Solid	• During heavy loading/unloading, water facilities should be provided to prevent scattering of fine waste • Erect sight prevention walls when near residential buildings • Where collection trucks and loading/unloading operations will cause noise, vibrations and traffic problems, suitable operation hours should be studied • Consider the ease of loading/unloading when designating storage space for long term storage, alternating space between long and short term storage, and cleaning space when empty
D. Hazardous	• For asbestos, infectious, liquid and sludge wastes the following considerations are important: • Wastes should be placed in adequate sealed and labeled containers • Partitioned compartments should be prepared and type of waste designated for each compartment, and clearly stated on a signboard • Flooring of the storage areas should be waterproof concrete

Source: "Solid Waste Handbook", Japanese publication, 1996

Table 6.3-4 Types of Storage Container

Containers and Waste Types	Ordinary Container							Specific SW Container			
	Drums				Plastic drum, cont.	Oil barrels	Flex-ible cont.	statio-nary cont.	lift up, bottom empty cont.	large cont.	infec-tious waste cont.
	open drum		clos-ed can	chem. can							
	no cover	cov-ered									
Combustible waste	O	O								O	
Sludge		O								O*	
Oil		O	O			O					
Acid				O	O						
Alkali				O	O						
Plastics	O	O					O	O	O	O	
Animal residue		O						O		O	
Rubber	O	O					O	O	O	O	
Metal scrap	O	O								O	
Glass, ceramics	O	O					O	O	O	O	
Slag		O					O				
Dust		O					O			O	
Infectious waste											O

Source: "Solid Waste Handbook", Japanese publication, 1996