Municipal Solid Waste (MSW) Management

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Municipal Solid Waste (MSW) Management

1. Solid Waste Management Planning History in Lebanon
2. Sources, Composition, and Properties of Solid Waste
3. Physical, Chemical and Biological Properties of MSW
4. Sources, Types and Properties of Household Hazardous Wastes
5. Collection Transfer and Transport of Municipal Solid Waste
6. Waste Handling and Separation, and Storage at the Source
7. Treatment of Municipal Solid Wastes
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Existing Solid Waste Management Practices in Lebanon

There has been a series of national waste management plans, but approach adopted to proceed with solid waste disposal is incomplete.

Since then, and during the last 35 years, Lebanon experienced different SWM plans, they are the following:

1. **Emergency Plan for SWM dated 1997,**
2. **Master Plan for SWM dated 2006,**
3. **Waste to-Energy Plan dated 2010, and**
4. **EU-OMSAR Program**

1. Solid Waste Management Planning History in Lebanon

In 1982: Master Plan for Solid Waste Management , Camp Dresser & McKee Inc., with Khatib and Alami, project funded by the UNDP and executed by WHO.

The study evaluated solid waste problems and options for Lebanon, and presented proposals for development of solid waste collection, transfer, processing and disposal systems, through the year 2000.

Municipal Solid Waste Management in Lebanon had two plans (1997):
1. Greater Beirut Emergency Plan
2. World Bank Solid Waste/Environmental Management Program (SWEMP) (Started 1998)

Emergency Plan for SWM (1997-2015)

This Emergency Plan provided a framework for SWM in Beirut and most of Mount Lebanon (Kesrouan, Metn, Baabda, Aley, and Shouf) excluding the caza of Jbeil.

Greater Beirut Emergency Plan (December 1996) consisted of:

1. Development of waste collection, and street sweeping
2. Two sorting plants,
3. One composting of sorted MSW with high biodegradable organic content,
4. Storage for sorting all bulky and recyclable materials,
5. Landfill site for the disposal of inert and bulky materials and
6. Landfill site for the disposal of sorted MSW

World Bank Solid Waste and Environment Management Program (SWEMP) comprised the following:

1. Construction and operation of controlled sanitary landfills,
2. Construction and operation of transfer stations,
3. Rehabilitation of the old dumps replaced by the new landfills, and
4. Provision of the equipment needed for waste collection and street cleaning

Implementation of SWEMP project was limited to the following:

1. Completion of the construction of one sanitary landfill in the caza of Zahle,
2. Its operation, procurement of related solid waste management equipment and
3. Rehabilitation of the Zahle and Byblos dumps.

Implementation stopped in Dec. 2003 due to the following:

1. Refusal by the majority of municipalities to build landfills as a solution for solid waste treatment,
2. Refusal of neighboring to accept that a landfill will be constructed in their vicinity,
3. Absence of institutional, legal, and financial systems for solid waste management,
4. Conflicting responsibilities
5. Lack of accountability

Table 1: Municipal Solid Waste Management Master Plan (2006)

Service Area	MSW Generation (t/d)	Sanitary Landfills				Sorting Plants	
		No	Proposed Location	No	Proposed Location	No	Proposed Location
North Lebanon & Akkar	712	1	Srar	1	Srar	1	Srar
Bekaa & Baalbeck-Hermel	425	2	Zahleh & Tebeh	2	Zahleh & Tebeh	2	Zahleh & Tebeh
South Lebanon & Nabatiyeh	626	2	Bsaffour Shakraa Barashit	2	Bsaffour Shakraa Barashit	2	Bsaffour Shakraa Barashit
Beirut & Mount Lebanon	2300	1 or 2	Jieh (Dahr Mghara) or Khreybeh	1 or 2	Jieh (Dahr Mghara) or Khreybeh	1 or 2	Jieh (Dahr Mghara) or Khreybeh
Lebanon	4,063	6-7	-	6-7	-	6-7	-

Waste-to-Energy Plan (2010)

1. Consider the WTE in large cities by considering waste as a source of energy.
2. Implement the 2006 Plan in the remaining parts of the country by also considering the WTE option.
3. Engage the private sector and facilitate its involvement in various SWM stages through turnkey or different options.
4. etc.

Beirut Crisis Proposed Plan (9/9/2015)

Phase 1:

1. Use the MSW treatment of Saida to receive 250t/d of the SW of Beirut
2. Rehabilitate Srar dump in Akkar (1500t/d) and establish a sanitary landfill in El-Masnaa, Eastern Mountain Chain (1,500t/d), both for 1st 6 months then, teach will receive 1000 t/d
3. Open Naameh SL for 7 days only.
4. Minister of Agriculture will follow up this file with the Minister Council

Phase 2: Rehabilitate and Use the Bourj Hammoud and Ras El-Ein Dumps

MOE Plan for SWM (17 August, 2017)

1. Source reduction, reuse and sorting at the source
2. Street sweeping, collection and transport
3. Separation and recycling
4. Biological and thermal treatments
5. Sanitary landfilling for residues

Policy, Legal and Administrative Framework

- No well-defined national policy on waste management, and no specific regulations regarding the treatment of waste.
- Administratively, the local municipality in coordination with Ministry of Interior and Municipalities (MIM) is responsible for MSW management at a local level.
- At a global level, the Council for Development and Reconstruction (CDR) in consultation with MIM, and the Ministry of Environment (MOE), is the ultimate responsible authority for the development and implementation of a national policy to manage MSW disposal

2. Sources, Composition, and Properties of Solid Waste

2.1. Sources of Municipal Solid Waste

A. Residential and Commercial

- Residential: Generated by me and you: Organic (combustible) and inorganic (non-combustible), food, paper, garden trimmings, glass, white goods, waste oil, spent cans of insecticide, etc.
- Commercial: stores, restaurants, hotels, car repair: paper, plastic.

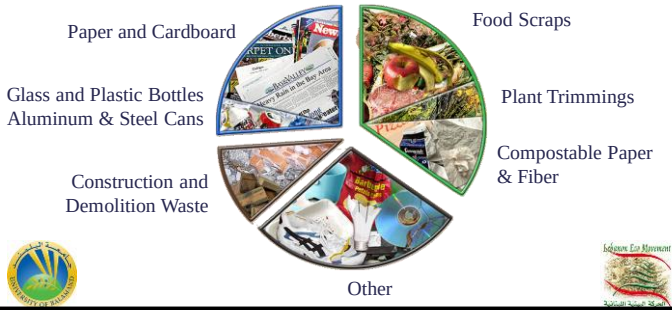
2. Sources, Composition, and Properties of Solid Waste

B. Institutional and others

- Generated by government buildings, schools, prisons and hospitals.
- Does not include medical wastes which are typically incinerated and manufacturing wastes from prisons.
- Construction and Demolition. Road repair, sewer jobs, renovations: wood, concrete, steel, shingles, electrical parts.
- Municipal Services. Street cleaning, parks, catch basins: trimmings, food, paper, sweepings, dead animals, abandoned vehicles.
- Treatment Plant Sludges

2.2 Composition of Solid Waste

Composition describes the individual components that make up solid waste



2.3 Properties of Municipal Solid Waste

- Organic
- Inorganic
- Putrescible
- Combustible
- Recyclable
- Hazardous
- Infectious

3. Physical, Chemical and Biological Properties of MSW

3. 1 Physical Properties of MSW

A. Specific Weight (lb/yd^3), (kg/m^3)

B. Moisture Content (Wet-weight relationship). It varies from 15-40%, use 21%, food and yard wastes very high-70%; paper, plastics and inorganics very low-3%.

C. Particle Size and Distribution: It is considered for recovery of materials, pre-processing antecedent to classification or sorting process.

D. Field Capacity (FC): Amount of moisture that can be retained in waste sample subject to the downward pull of gravity. Water in excess of FC will flow out of waste as leachate.

- 50-60% for un-compacted, commingled waste from residential and commercial sources.

E. Permeability (hydraulic conductivity) of Compacted MSW: Measures the movement of gasses and liquids in landfills.

3.2 Chemical Properties of MSW

A. Proximate Analysis includes the following tests:

- Moisture
- Volatile combustible matter
- Fixed carbon (combustible residue after volatile matter is removed)
- Ash (weight of residue after combustion in an open crucible

B. Ultimate Analysis of SW Components

- Determination % of Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Sulfur (S), and ash.
- Chance to calculate chemical formula, which will be used in many chemical and biological reactions.

C. Energy Content of SW Components

- It is potentially critical element in incineration and can be measured or calculated.

D. Essential Nutrients

- Theoretically they are critical elements in composting.

3.3 Biological Properties of MSW

- Volatile Solids (VS), ignition at 550°C is often used as a measure of the biodegradability of the organic fraction.

- Odors typically result from the anaerobic decomposition of the organic fraction.
  - Sulfate is reduced to sulfides and the to H_2S.
  - Organic compounds containing a sulfur radical can lead to the formation of methyl mercaptan and aminobutyric acid.

- Breeding of flies takes 9-11 days.

4. Sources, Types and Properties of Household Hazardous Wastes

4.1 . Sources, Types and Quantities of Hazardous Wastes in MSW

- Residential: cleaners, paint, nail polisher remover, antifreeze, photographic chemicals, pesticides.

- Commercial: solvents from dry cleanings, oil from automotive.
- Leftover portions of these products are called household hazardous waste (HHW)

- Hazardous waste is typically 0.1% (0.01-1% range) by weight of MSW. 75-85% residential sources.

4. Sources, Types and Properties of Household Hazardous Wastes

4.2 Properties of Hazardous Waste

A. General

- Wastes are hazardous to humans if such wastes:
  - Are non-biodegradable or persistent in nature
  - Can be biologically magnified
  - Lethal
  - Cause detrimental cumulative effects
- Safety-related problems:
  - Corrosivity
  - Explosivity
  - Flammability
  - Ignitability
  - Reactivity

- These products, if mishandled, can be dangerous to your health and the environment
- Health-related problems
  - Carcinogenicity
  - Infectivity
  - Irritant
  - Mutagenicity
  - Toxicity
  - Radioactivity
  - Teratogenicity (Causes abnormal formations)

- Municipalities usually go with:
  - Ignitability
  - Corrosivity
  - Reactivity
  - Toxicity
  - Carcinogenicity

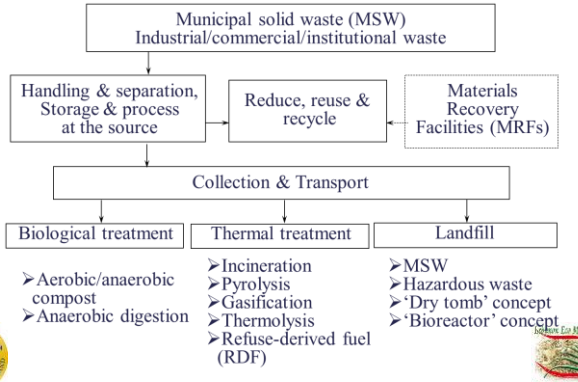
Proper Handling

- Best way to handle HHW is to reduce the amount initially generated by giving leftover products to someone else to use
- Set up collection programs to prevent HHW from being disposed of in MSW landfills and combustors to ensure their safe disposal in facilities designed to treat or dispose of hazardous waste

Benefits

- **Proper HHW Management**
  - Reduction and recycling of HHW conserves resources and energy that would be expended in the production of more products
  - Reuse of hazardous household products can save money and reduce the need for generating hazardous substances
  - Proper disposal prevents pollution that could endanger human health and the environment

Integrated Municipal Solid Waste Management



5. Collection of Municipal Solid Waste

- Waste collection and transport are the most publicly visible aspect of MSW.
- Consumes approximately 10-20% of municipalities total operating budge per year.
- High public visibility and high cost of waste collection makes it an important area for agencies to improve performance.
- Collection service should be reliable, efficient and expeditious with the use of compactors trucks and proper routes development.
- Development and implementation of collection schedules.
- Certain types of wastes are still being collected in some communities using unconventional methods.
- Collection are made at curbside.

5. Collection Options of Municipal Solid Waste

MSW collection is currently provided in three different forms:

- Municipal collection operated by municipalities,
- Private haulers delivering collection services under contract with the municipalities, and
- Private haulers operating under contract with individual households

Collection and Transportation (….continue)

Choice of waste collection containers and vehicles is influenced by a range of factors such as:

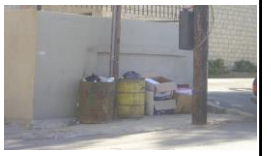
- Nature of waste
- Sorting at the source
- Topography (windings, steep hills)
- Road network (width and quality of streets),
- Frequency of collection
- Population density,
- Distance to treatment/disposal site
- Containers capacity: 250 L, 660 L, 1100 L, etc.
- Trucks capacity: $5m^3$, $10m^3$ or larger.

Glass and Plastic Bottles Aluminum and Steel Cans

Food Scraps and Plant Trimmings

Others

Used Containers in some Lebanese Municipalities



Types of Collection Vehicles

- Packer trucks (to increase density of MSW and mass of collection, compacted density ~900 lb/yd^3)
  - Rear loading
  - Side loading
  - Front loading
  - Manual loading
  - Mechanical loading
  - Chassis specified by volume (e.g., 20 yd^3)


- Roll-off trucks (container left at site)
- Truck for collection of recyclables



Waste Transport Trucks in some Lebanese Regions




Type of Roads in some Lebanese Villages




Alternative	Advantages	disadvantages	Favoring conditions
Once per week or less	Less expensive less fuel	Stored waste can create odor & vector problems	Cold to moderate climate
Twice per week	Reduces litter & storage requirement	More expensive ,more fuel	Warm climate
More than twice per week	Reduces litter & storage requirement	More expensive more fuel	Dense population

Collection and Transport

Waste generation at source

Storage at source

Local transport

Central treatment facility

Long-distance transport

Transfer

Transfer

- In cases where the processing and disposal sites are near the collection area, the collection vehicle also hauls the full load to the site. Need to balance size to minimize number of hauls versus maneuverability needed for collection
- As distances increase the solid waste engineer should consider transferring the waste to a larger vehicle (e.g., semi trailer, rail car, barge)

6. Waste Handling and Separation, Storage & Processing at the Source

6.1 Handling

- Handling: activities associated with MSW **before they are placed in a collection container**
- Source recovery is one of the most effective ways to recycle: aluminum cans, newspaper, plastic soda and milk bottles.

Low rise bldg < 4 stories; medium rise 4-7 stories; high rise > 7 stories

A. Low Rise

- Single family detached and attached
- Single family detached
  - separate recyclables at Material Recovery Facility (MRF), not at the home
  - variety of storage containers and mixed waste: plastic bags, 32 gallon galvanized or plastic, cardboard boxes
  - 90 gallons containers equipped with wheels, mixed waste

B. Low and Medium Rise

- Basement storage by residents and moving of container by maintenance personnel.
- Large outdoor containers, located in special areas that are emptied mechanically by collection truck.

C. High Rise Apartments

- Porters pick up the waste at the apartment door.
- Wastes are taken to the SW area by tenants
- Chutes on each floor (12-36")
- Use 1-2lbs/tenant/day

Figure 23.8
Source separation in the kitchen—the first step in a strong recycling program.

D. Commercial and Industrial Facilities

- Commercial - removed from work area by wheeled containers and transported via service area to disposal / processing area. Compaction would not be unusual.

B. Types of Storage Containers

- For residential containers, manually collected, the max. weight should be 40-65lbs as not injure the collector.
- 32 gallons galvanized or plastic is the most common.
- Temporary and disposable containers such as cardboard boxes, plastic bags and paper bags are common.

- **Low rise**: trend towards 1 man collection crews with vehicles with mechanical, articulated arms and 90 gallon containers,
- **Low and medium rise**: dumpsters, portable or not, galvanized or plastic
- **High rise:** more proned to have processing equipment: compaction, shredding, baling.
- **Container Locations**: side or rear of house, alleys, common location identified for that purpose.

Solid Waste Processing

- Objectives of Processing include
  - Volume reduction (baling, shredding, incineration (also mass reduction))
  - Size reduction (shredding, grinding)
  - Component separation (hand sorting, screening, magnetic separation, air classification)
  - Resource recovery (composting, energy recovery, materials recovery)

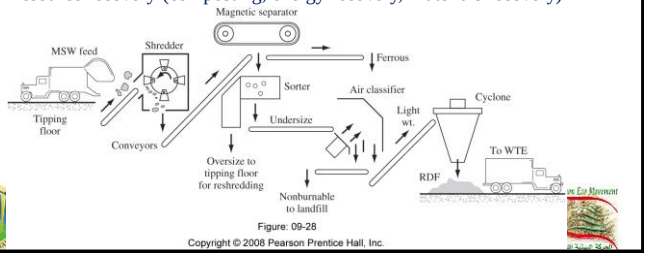


Figure: 09-28

Waste Physical Treatment

- Central separation
  - Mechanical separation / Manual separation
- Size reduction (Crashing,compaction)
- Compaction

Mechanical Separation Based On Size, Shape, Magnetic Properties,

Biological Treatment

1.Aerobic Treatment (composting)

- ✓Open windrows
- ✓Static piles
- ✓In Vessel Composting
- ✓Rotating drum
- ✓Bio-drying





2.Anaerobic composting


Comparison of specific composition of MSW in several countries

%					Components
Lebanon	Cairo	Sweden	France	U.S.A.	
55	59.5	12	24	22.5	Organic materials
15	15.75	55	29.6	42	Paper
15	1.9	6	4.2	8	Plastic & Metals
5	1.8	15	3.5	6	Glass
10	14.9	-	2.4	10.5	Others

7. Treatment of Municipal Solid Wastes

Four Scenarios for Solid Waste Treatment

Scenario 1

Unsorted untreated MSW → Landfill disposal

Scenario 2

Unsorted untreated MSW → Landfill disposal with landfill gas recovery

Scenario 3

Unsorted untreated MSW → Mechanical pre-treatment (MRF) → Recyclable fraction → Recycling

Four Scenarios for Municipal Solid Waste Treatment

Scenario 4

Unsorted untreated MSW → Mechanical pre-treatment (MRF)

- Residual fraction → Landfill disposal with landfill gas recovery
- Recyclable fraction → Recycling
- Biogenic fraction → Anaerobic digestion

Composting: Two Types of Decomposition

- Aerobic – Biological decomposition of organic substances in the presence of oxygen
- Anaerobic –Biological decomposition of organic substances in the absence of oxygen
- Composting is the controlled biological decomposition of organic matter, such as food and yard wastes, into humus, a soil-like material
- Composting is nature's way of recycling organic wastes into new soil used in vegetable and flower gardens, landscaping, and many other applications

Types of Composting

- Aerobic and Anaerobic Decomposition
- In-Vessel Composting Processes (Enclosed Aerated Static Piles; Agitated Beds and Vessels; Rotating Drums

Technology	Range of Area Requirement (acre per dry ton per day)
Turned windrow	0.51 – 0.67
Aerated static pile	0.27 – 0.54
In-vessel reactors	0.39 – 0.56

Composting Technology Selection Based on:

1. technological feasibility,
2. economic costs, and
3. social and environmental impacts.

Composting Benefits

- Reduces waste requiring disposal;
- Saves limited landfill space;
- Reduces the risks of leachate and methane production in landfill;
- Turns waste into a valuable resource;
- Provides a nutrient-rich soil amendment;

Constraints on Composting

From an overall perspective, the constraints related to composting can be summarized in following points:

- Inadequate attention to the biological process requirements.
- Over-emphasis placed on mechanized processes.
- Poor feedstock which yields poor quality finished compost, for example heavy metal contamination.
- Lack of vision and poor marketing for the final compost product.
- Sensible preoccupation by municipal authorities to first concentrate on providing adequate waste collection.
- Inadequate pathogen and weed seed suppression.
- Nuisance potential, such as odors and rodents.
- Land requirements though being often minimal can be a constraint.

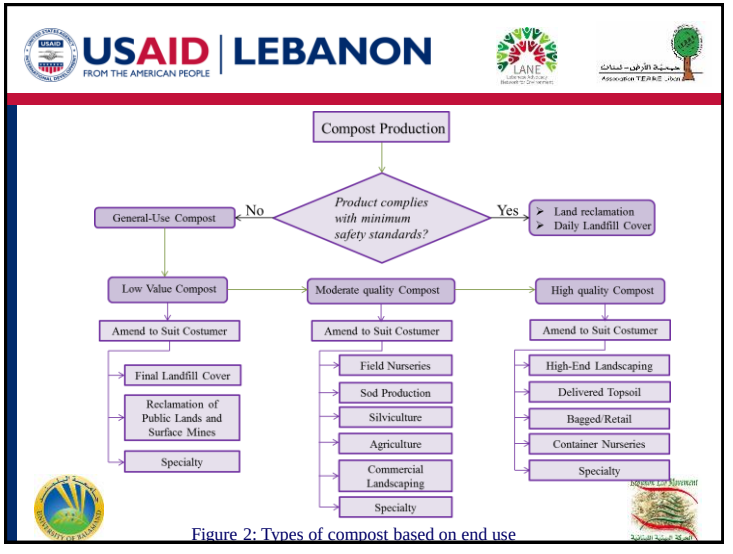


Figure 2: Types of compost based on end use

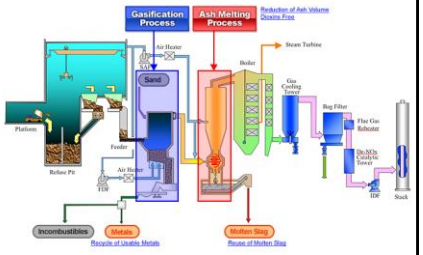
Mechanical Biological Treatment (MBT)

- Using mechanical and biological processes to separate / prepare mixed waste into usable fractions and / or render it more 'stable' for deposit into landfill
- Covers a wide range of processes
- Cited as an alternative to incineration
- Requires markets / other waste processes for outputs
- Of the problems in this technology:
  - Technical problems in operation
  - Low/No market for solid fuel

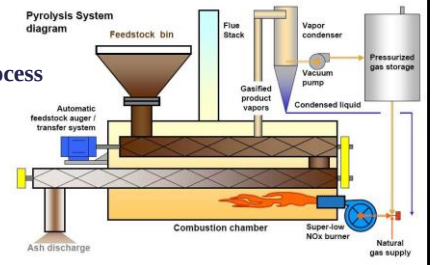
WTE Technologies

- Gasification
- Pyrolysis
- Hydrolysis
- Composting
- Mechanical Biological Treatm
- Biogas

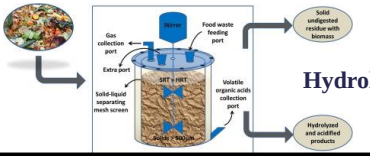
=> **Incineration / Mass Burn**



Pyrolysis Process



Hydrolysis Process



Incineration

It is the combustion of waste in a controlled manner in order to destroy it or transform it into:

- less hazardous
- less bulky
- more controllable constituents.

Incineration may be used to dispose of a wide range of waste streams including municipal solid waste (MSW), commercial, clinical and certain types of industrial waste.

Incineration is generally the second more frequently selected method of waste management after landfilling. Disposal is a major concern of incineration because landifill space is becoming scarce. Incineration of MSW with energy recovery can be viewed as an attractive alternative to landfilling in many situations.

Principles of Municipal Solid Waste Incineration

- Incineration can be viewed as the flame-initiated, high temperature air **oxidation of organic matter**.
- Incineration can only destroy organic compounds, but not inorganic (mineral) compounds – which end up as residual ash. Because waste must be oxidised nearly completely (99.99% destruction and removal capacity is required) a large excess of air is used to ensure the sufficient oxygen to do the job.
- **Emissions from waste incinerators** include unburned organic wastes, products of uncomplete combustion or by–products of combustion, heavy metals, acid gas, ash and others. They can be controlled by modern air pollution control equipment to very low rates.
- Incineration has advantages and disadvantages when compared with other methods of waste treatment, so it is not always the preferred choice.

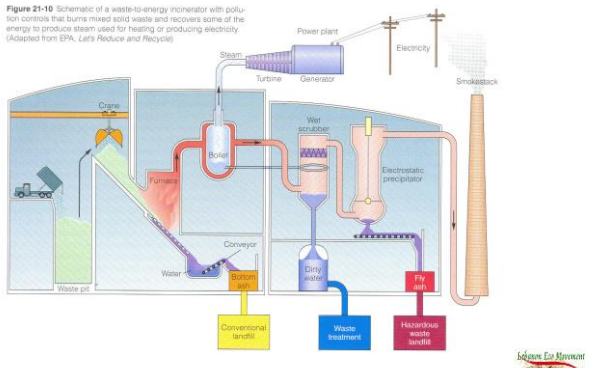


Figure 21-10 Schematic of a waste-to-energy incinerator with pollution controls that burns mixed solid waste and recovers some of the energy to produce steam used for heating or producing electricity. (Adapted from EPA, *Let's Reduce and Recycle*)

Advantages of Incineration

- Volume and weight reduction of waste (up to 90% of volume and 75% of weight of materials going to landfill).
- Destruction of some wastes (e.g. combustible carcinogens, pathologically contaminated materials, toxic organic compounds).
- Destruction of organic components of biodegradable wastes which when landfilled directly generates landfill gas (LFG).
- Recovery of energy from organic wastes with sufficient calorific value.
- Replacement of fossil fuels for energy generation with consequent beneficial impact in terms of greenhouse effect.

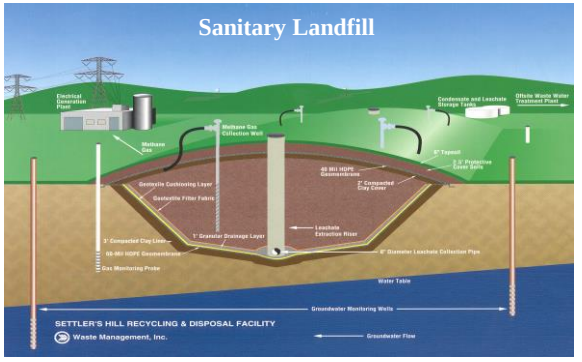
Disadvantages of Solid Waste Incineration

- High capital investments requires longer payback period than final disposal to landfill.
- Because of high capital costs, the incinerator must be tied to long-term waste disposal contracts.
- Incinerator is designed on the basis of certain calorific value for the waste. Removal of materials such as paper or plastics for recycling and resource recovery reduce the overal calorific value of the waste and consequently affect incinerator performance
- Incineration proces still produce a solid waste residue that requires management and final disposal
- Burning matter does not destroy it. Burning it converts it into another form and redistributes it in the air, land and water

9. Sanitary Landfill of MSW and Residual Matter

- Waste disposal by landfill is an essential part of any waste management system.
- There is always a significant fraction of the waste stream that cannot be treated and waste treatment process residue that require disposal by landfill.
- With careful planning, design, construction and operation, landfill can be a safe, cost-effective and environmentally acceptable means of MSW final disposal.
- Countries are challenged to put sanitary landfills in place that provide an acceptable degree of environmentally health and safety protection at an affordable cost.
- Landfill sites are black boxes, with unknown biological and chemical processes.

Sanitary Landfill



9. Sanitary Landfill of Municipal Solid Wastes and Residual Matter

During the evaluation of the final disposal sites, the following criteria were considered:

- Geological conditions
- Hydro-geological situation
- Urban Situation, settlement in the site vicinity (1km distance), ownership and land use
- Protected fauna and flora as well as other important cultural and historical areas
- Climate
- Waste management, logistics and traffic aspects
- Technical and financial feasibility for treatment
- Socio-economic characteristics

MOE Landfill Selection Criteria

Siting	Distance between Boundary and Residences	1,000 m
	Maximum height	300 m above sea level
Capacity	Area	30,000 – 50,000 m^2
Location	Not within agricultural or forestry area	
Water Supply	Distance away from river and perennial Stream	50m

EU Landfill Selection Criteria

Siting	Distance between Boundary and Residences	500 m
Distance And Capacity	Direct Haul	30 – 45 minutes
	Haul and Transfer	≤ 120 minutes
	Minimum Capacity	10 years
Ground Water	10 year High Level	≥ 1.5 m below
	Soil Permeability	≤ 10^{-6} cm/sec
	Away from area susceptible to flood	
Water Supply	Distance between perimeter of Landfill and Well	500 m
	Distance away from perennial Stream	30 m

Sanitary Landfills

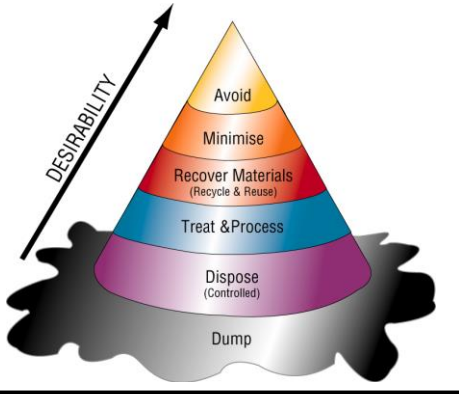
Advantages

- No open burning
- Little odor
- Low groundwater pollution if sited properly
- Can be built quickly
- Low operating costs
- Can handle large amounts of waste
- Filled land can be used for other purposes
- No shortage of landfill space in many areas

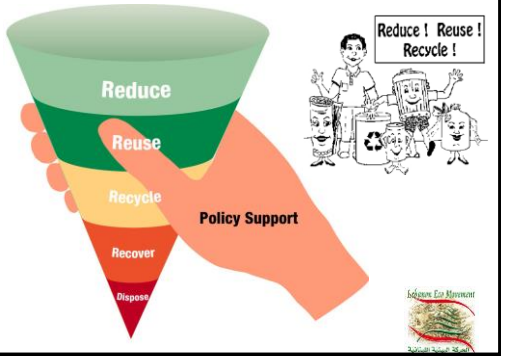
Disadvantages

- Noise and traffic
- Dust
- Air pollution from toxic gases and trucks
- Releases greenhouse gases (methane and CO_2) unless they are collected
- Slow decomposition of wastes
- Output approach that encourages waste production
- Eventually leaks and can contaminate groundwater

Our Involvement



Support competent ministry plan and all of us to make it a success



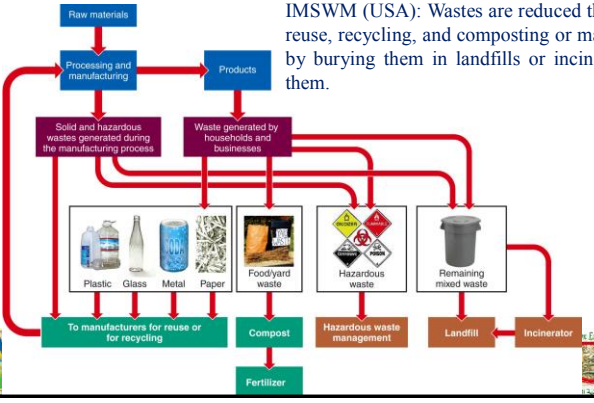
Key MSWM Problems Facing Lebanese Cities, Towns and Villages

- Lack of resources (financial, technical, administrative, institutional and human)
- Inadequate of environmental regulation and enforcement
- Inadequate of awareness and public education
- No incentives for source reduction and segregation
- General public attitude to waste management
- Absence of mandatory standards for waste reduction
- Efficiency and coverage of collections systems is not 100% in all areas
- Vehicles have high cost for local municipalities
- Technological interventions
- Most landfills do not meet basic environmental controls, and uncontrolled burning is common practice
- Increasing demand for landfill space is not met

Strategic Aspects

Political	Financial
Institutional	Economic
Social	Technical

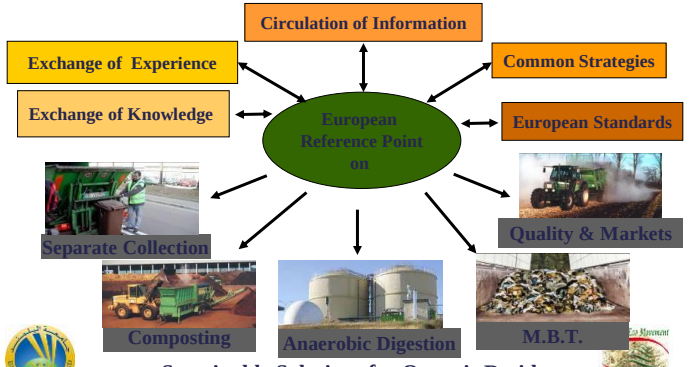
10. Case Studies from Different Countries



IMSWM (USA): Wastes are reduced through reuse, recycling, and composting or managed by burying them in landfills or incinerating them.

10. Case Studies from Different Countries

European Compost Network



Sustainable Solutions for Organic Residues

Germanys Waste Policy

- Waste avoidance has became a central policy target,
- High readiness in the society for separating and collecting of waste,
- High quotas on recycling,
- Multi way packaging is promoted,
- Strong legal emission-limits for waste incineration
- ***No more untreated waste in landfill sites since June 2005 (directive under green government).***
- ***Pyrolysis and gasification: High costs with poor results, these technologies are not reliable yet!***

- Appropriate solid waste treatment method has to be selected, keeping in view the following objectives:

1. Should be economically viable
2. Should not create a health hazard
3. Should not cause adverse environmental effects
4. Should not result in unpleasant sight, odor, and noise
5. Should not overoptimistic assessment of technical institutional and financial feasibility along with technical skills and available operation and maintenance.

- ***Be realistic about viability and practicability of MSW treatment technologies and cautious about committing to large investments***.
- ***We need to move away from waste disposal to waste management***

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➢

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FROM THE AMERICAN PEOPLE
LANE
Waste
does not know political colours; it is simply our common problem which has to be solved.
THANK YOU!
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