Al-Karkh University of Science

College of Energy and Environment Sciences

Environment Science Dept.

WASTE MANAGEMENT

Third level
Second Semester

Hind A.Ahmed
MSc. Environmental Engineering

Waste Management (practical)

What is waste?

- Is everything that no longer has a use or purpose and needs to be disposed.
- Also called as rubbish, trash refuse, garbage and junk.

Sources of Waste:

1. Domestic
2. Industrial
3. Commercial
4. Agricultural
5. Construction
6. Mining

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Waste management

Waste management is the collection, transport, processing, recycling or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

There are many waste types defined by modern systems of waste management, notably including:

1. Municipal Waste includes household waste, commercial waste, and demolition waste.
2. Hazardous Waste includes Industrial waste.
3. Bio-medical Waste includes clinical waste.
4. Special Hazardous waste includes radioactive waste, Explosives waste, E-waste.

Solid Waste Management

Solid waste management: A systematic administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment and disposal of solid waste.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Classifications of solid waste:

Solid waste can be classified into two categories by its characteristics. These are:

Organic solid waste: Wastes that are generally biodegradable and decompose in the process of which emits offensive and irritating smell when left unattended.

⇒ Putrescible wastes e.g. Garbage

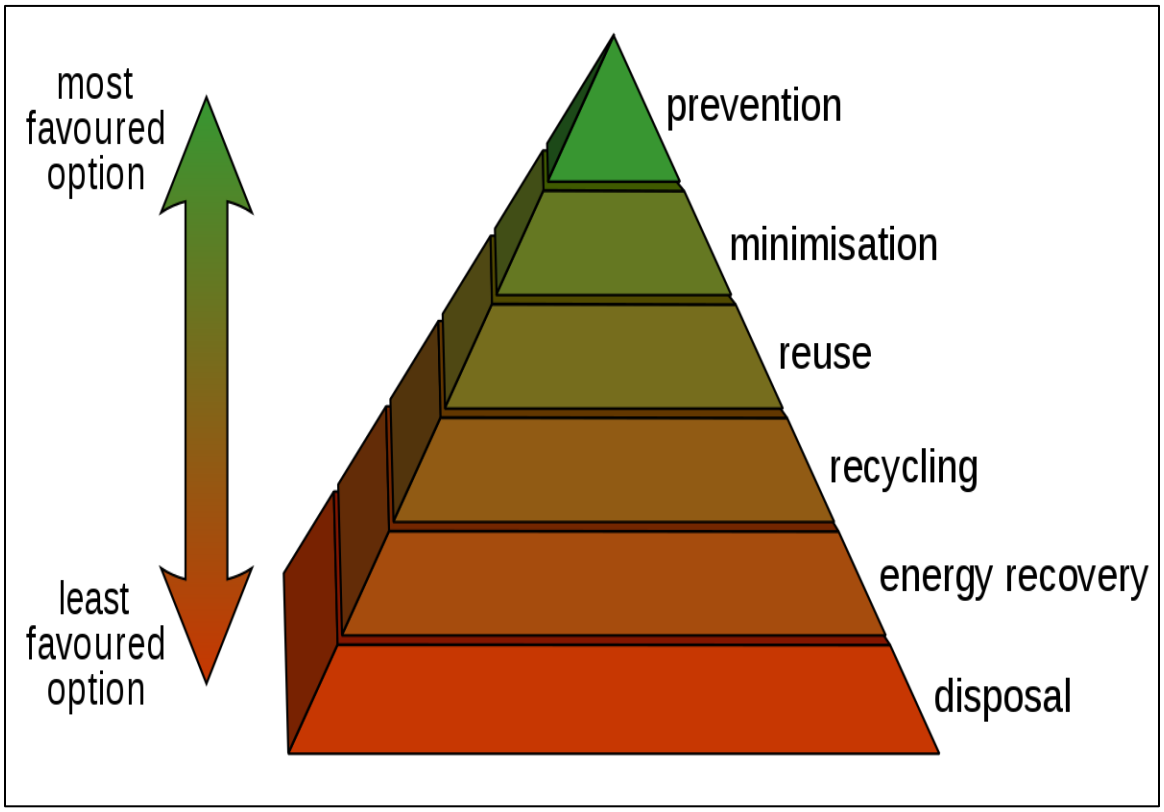
Inorganic solid waste: Solid matter that does not decompose at any rate This category of waste matter may be combustible depending on the type of the nature of the material they constitute.

⇒ Non-putrescible wastes e.g. Rubbish

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

WASTE MANAGEMENT HIERARHY



4R of Solid Waste Management

1. Reduce
2. Reuse
3. Recycle
4. Recovery

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

REDUCE

- Reduce the amount of unnecessary packaging.
- Adopt practices that reduce waste toxicity

REUSE

- Consider reusable products.
- Maintain and repair durable products.
- Reuse bags, containers, and other items.
- Sell or donate goods instead of throwing them out.

RECYCLE

- Choose recyclable products and containers and recycle them.
- Select products made from recyclable materials. * Compost yard trimmings, food scraps and other biodegradable wastes. * Do not burn.

Hind A.Ahmed
MSc Environmental Engineering

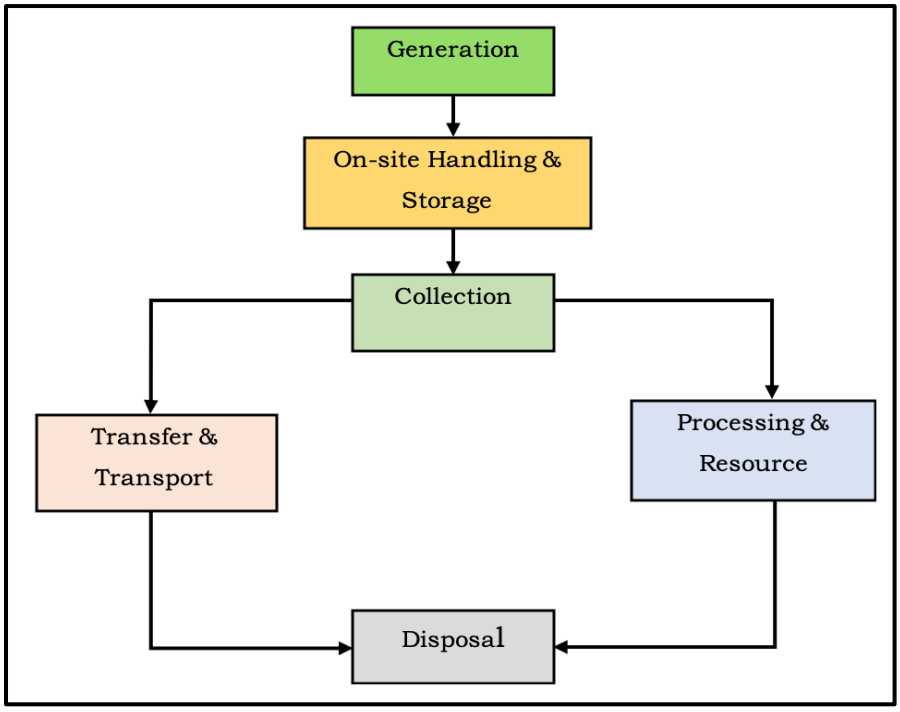
Waste Management (practical)

RECOVERY

- Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion and landfill gas recovery.

Functional Elements of solid waste management system:

There are six functional elements in the activities associated with the management of solid wastes from the point of generation to final disposal site.



Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Description of the six main functional elements of solid waste management system:

1. ***Waste generation***: those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal.
2. ***On-site handling, storage***, and processing: activities associated with the handling, storage, and processing of solid wastes at or near the point of generation.
3. ***Collection***: those activities association with the gathering of solid wastes and the hauling of wastes to the location where the collection vehicle is emptied.
4. ***Transfer and transport***: Those activities association with (1) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (2) the subsequent transport of the wastes, usually over long distance, to the disposal site.
5. ***Processing and recovery***: Those techniques equipment and facilities used both to improve the efficiency of the other functional elements and to recover useable materials, conversion products, or energy from solid wastes.
6. ***Disposal***: Those activities associated with ultimate disposal of solid wastes.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Methods of Waste Disposal

Garbage accumulation has never been much of a concern in the past, but due to globalization and industrialization, there is a need for a more efficient waste disposal method. Following are some of the methods that are used today.

1. Landfill

In this process, the waste that cannot be reused or recycled are separated out and spread as a thin layer in low-lying areas across a city. A layer of soil is added after each layer of garbage. However, once this process is complete, the area is declared unfit for construction of buildings for the next 20 years. Instead, it can only be used as a playground or a park.

2. Incineration

Incineration is the process of controlled combustion of garbage to reduce it to incombustible matter such as ash and waste gas. The exhaust gases from this process may be toxic; hence, it is treated before being released into the environment. This process reduces the volume of waste by 90 per cent and is considered as one of the most hygienic methods of waste disposal. In some cases, the heat generated is used to produce electricity. However, some consider this process, not quite environmentally friendly due to the generation of greenhouse gases such as carbon dioxide and carbon monoxide.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

3. Waste Compaction

The waste materials such as cans and plastic bottles are compacted into blocks and sent for recycling. This process prevents the oxidation of metals and reduces airspace need, thus making transportation and positioning easy.

4. Biogas Generation

Biodegradable waste, such as food items, animal waste or organic industrial waste from food packaging industries are sent to bio-degradation plants. In bio-degradation plants, they are converted to biogas by degradation with the help of bacteria, fungi, or other microbes. Here, the organic matter serves as food for the microorganisms. The degradation can happen aerobically (with oxygen) or anaerobically (without oxygen). Biogas is generated because of this process, which is used as fuel, and the residue is used as manure.

5. Composting

All organic materials decompose with time. Food scraps, yard waste, etc., make up for one of the major organic wastes we throw every day. The process of composting starts with these organic wastes being buried under

layers of soil and then, are left to decay under the action of microorganisms such as bacteria and fungi. This results in the formation of nutrient-rich manure. In addition, this process ensures that the nutrients are replenished in the soil. Besides enriching the soil, composting also increases the water

Hind A.Ahmed
MSc Environmental Engineering

retention capacity. In agriculture, it is the best alternative to chemical fertilizers.

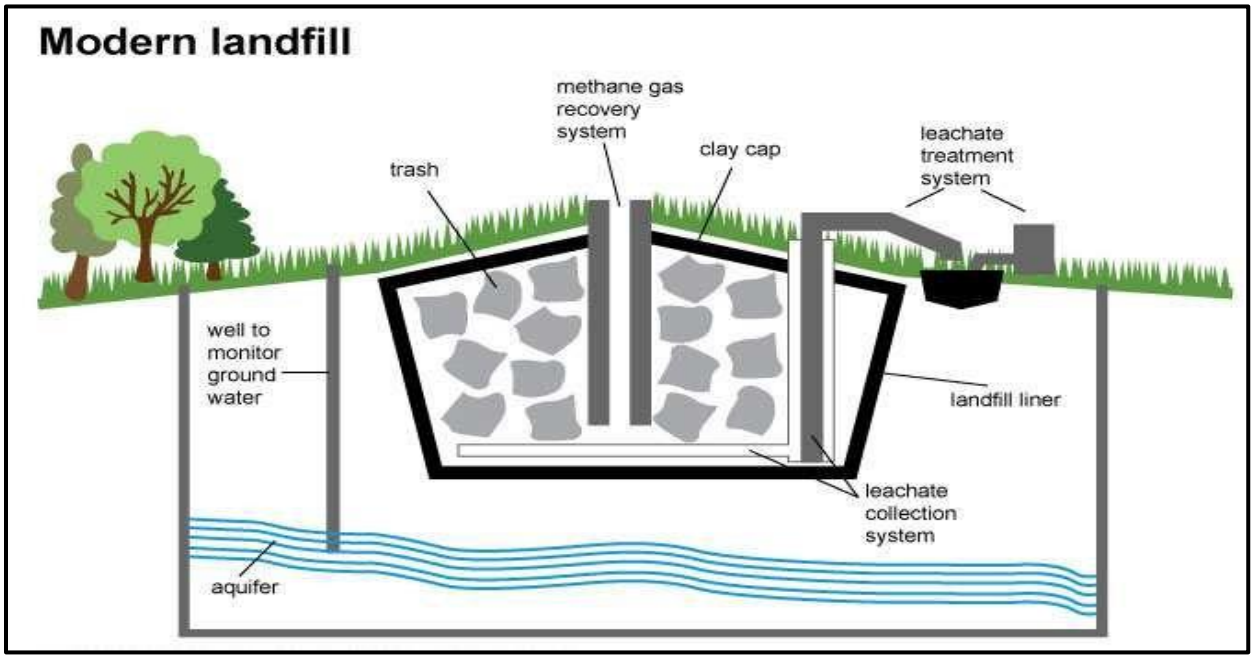
6. Vermicomposting

Vermicomposting is the process of using worms for the degradation of organic matter into nutrient-rich manure. Worms consume and digest the organic matter. The by-products of digestion, which are excreted out by the worms, make the soil nutrient-rich, thus enhancing the growth of bacteria and fungi. It is also far more effective than traditional composting.

Waste Management (practical)

Modern Landfill

Modern landfills are well-engineered and managed facilities for the disposal of solid waste. Landfills are located, designed, operated and monitored to ensure compliance with federal regulations. They are also designed to protect the environment from contaminants, which may be present in the waste stream. Landfills cannot be built in environmentally sensitive areas, and they are placed using on-site environmental monitoring systems. These monitoring systems check for any sign of groundwater contamination and for landfill gas, as well as provide additional safeguards. Disposing waste in landfills is one part of an integrated waste management system.



Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Why are landfills necessary?

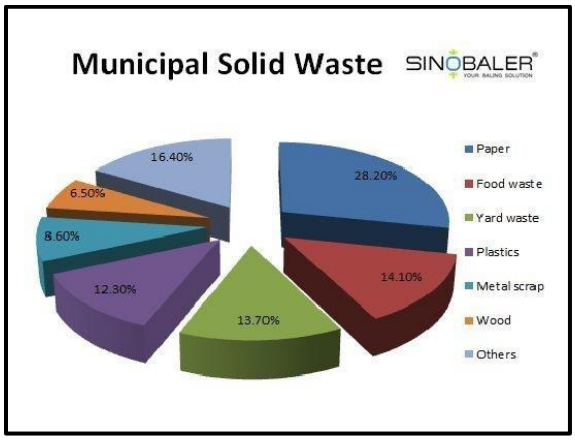
Landfill meets a critical infrastructure need – to deal with the residual waste produced by businesses and households. This waste is expected to grow as the population increases, and with current consumer behaviors. Even with improved recycling rates, there is still general waste (anything that cannot be recycled) to be managed safely and effectively.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Types of landfills: -

1. ***Municipal Solid Waste Landfills (MSWLFs)*** : Specifically designed to receive household waste, as well as other types of nonhazardous wastes.

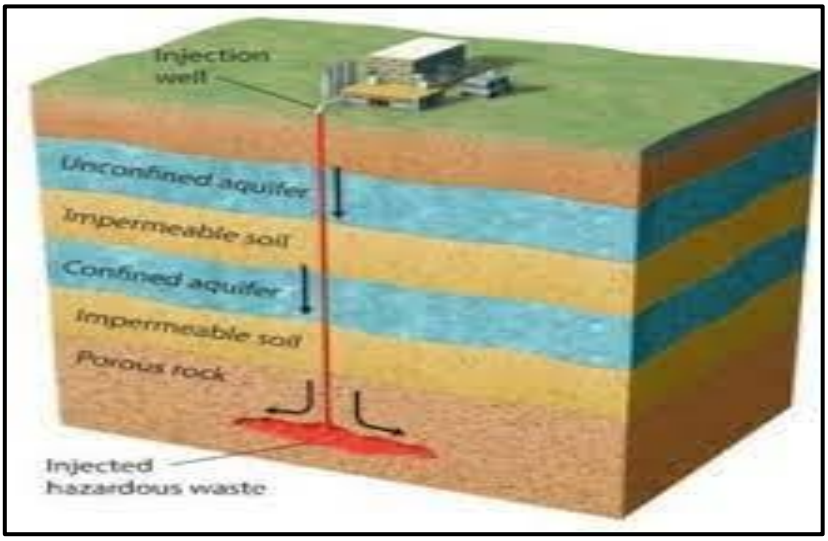


Hind A.Ahmed
MSc Environmental Engineering

2. ***Industrial Waste Landfill:*** Designed to collect commercial and institutional waste (i.e., industrial waste), which is often a significant portion of solid waste, even in small cities and suburbs.

Waste Management (practical)

3. ***Hazardous Waste Landfills:*** Facilities used specifically for the disposal of hazardous waste. These landfills are not used for the disposal of solid waste.



Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Landfill Sites

A) To prepare the land before waste is deposited, several layers of linings are installed to seal up the base. Before beginning to deposit waste, this process has to be verified independently for quality assurance. The process is:

1. A regulating layer is laid down to smooth out the surface.
2. A layer of clay is then put down to provide an impermeable material to help prevent liquid from escaping.
3. The third layer is a plastic liner
4. Geotextile is then placed over the plastic.
5. A fifth layer of gravel is then installed.
6. A layer of geotextile is the last stage of preparing the base.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

B) All waste from the local area (e.g your general waste bin), is brought to the site and tipped into the specially created cells. A compactor rolls over the waste to squash it and fill the space efficiently, to create a level surface.

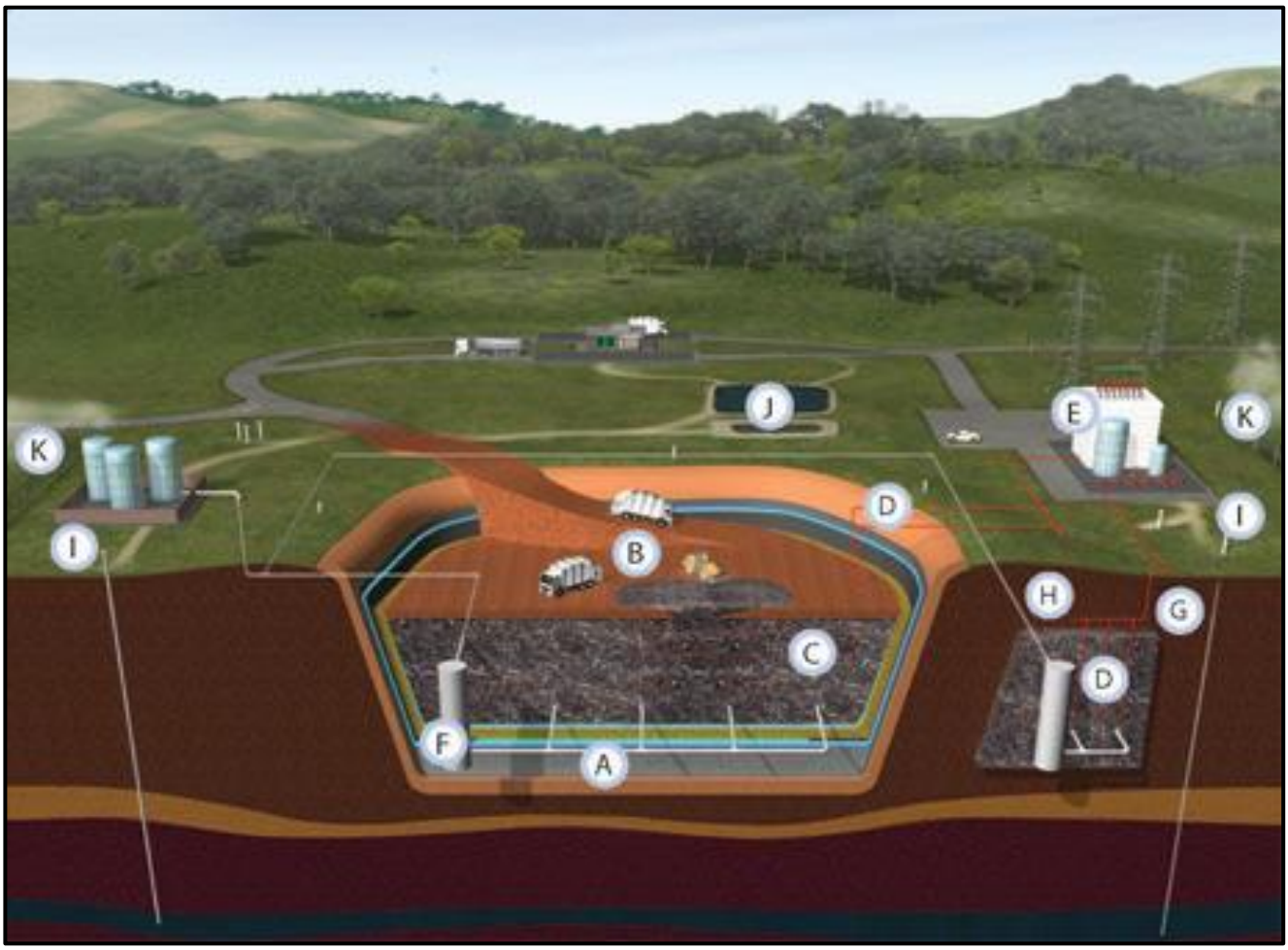
C) Each cell is built up with waste stage by stage. At the end of each stage, it is covered with inert soils or a special matting that helps to prevent odours and keeps the waste in place until more waste can be placed on top to complete the cell.

D) Gas extraction wells are inserted into the cell to allow the gases that are created as the waste breaks down to be captured to generate electricity.

E) The gases are pumped to a turbine house where they generate electricity for the National Grid.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)



F) When water falls onto site it runs through the waste and collects solids and liquid. This liquid is called leachate. Leachate runs to the bottom of the cells where it is collected in a sump and pumped to storage tanks before it is taken off site to be treated before disposal.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

G) Each cell is filled with waste until it reaches a certain agreed level. Then the area is capped with a permanent plastic cover before we begin work to restore the land.

H) Restoration involves creating several layers above the waste to seal in what is below and protect what will grow above using a combination of high tech linings, subsoils and topsoil's. The idea of this is to bring that land 'back to normal' to encourage nature and wildlife back to the area.

I) Monitoring bore holes are located on and off site to allow us to ensure the quality of ground water in the vicinity of the site.

J) Surface water ponds can be found on the site. As surface water runs off the landfill site it is collected in the ponds to allow any soil particles that may have been collected in the process to settle before the water is allowed to discharge off site.

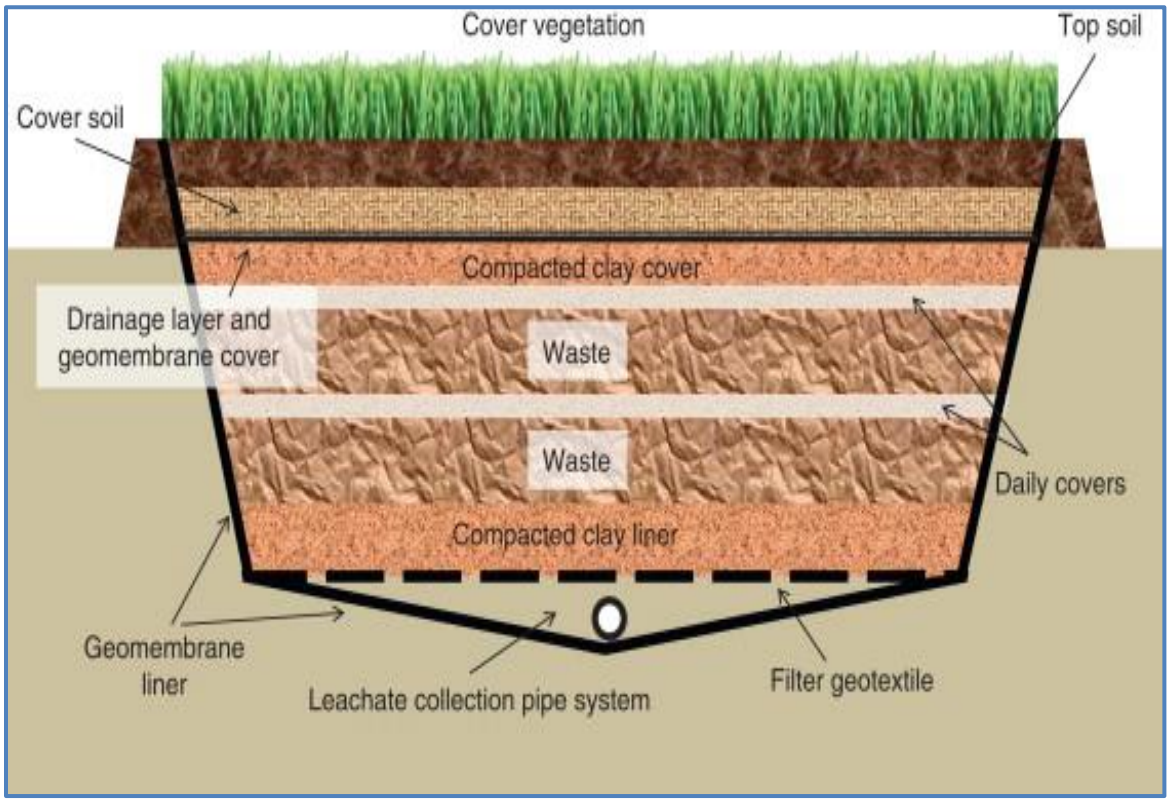
K) Around the perimeter of the site there is a de-odorizing system installed along the fence. This helps to capture airborne odors and neutralize them before they leave the site.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

What happens when a landfill reaches capacity?

When a landfill reaches full capacity, it is limited, and rehabilitated, to be turned into green spaces such as parks and community grounds. These will be maintained for up to 30 years after capping. Depending on waste type and volume, landfills take many years to reach maximum capacity. Then a landfill is capped with a final layer of cover material, clay and vegetation. This cap layer forms a barrier, keeping odors in and rainwater out. The site is planted to suit its future use when it will be restored for recreation or light cultivation.



Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Why are landfills harmful for the environment?

Landfill sites are ugly. And it's not just the eye sore of increasing piles of waste that's the problem, landfills are landfill sites are bad for wildlife, nature, environment and global warming major source of pollution, and there are many negative issues associated with them. Rubbish buried in landfill breaks down at a very slow rate and remains a problem for future generations.

The three main problems with landfill are toxins, leachate and greenhouse gases. Organic waste produces bacteria, which break the rubbish down. The decaying rubbish produces weak acidic chemicals, which combine with liquids in the waste to form leachate and landfill gas.

There are some secondary side effects as well: nauseous odors, unpleasant views, rat and seagull infestations, which create their own, waste problems.

Hind A.Ahmed
MSc Environmental Engineering

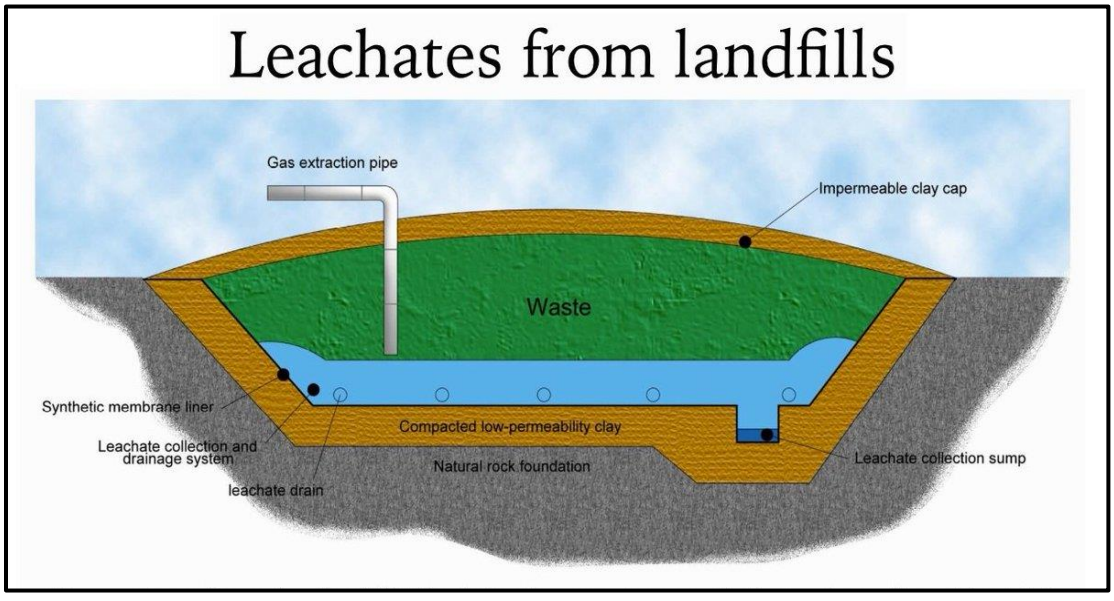
Waste Management (practical)

1. Toxins

Many materials that end up as waste contain toxic substances. Electronic waste is an example. Waste such as televisions, computers and other electronic appliances contain a long list of hazardous substances, including mercury, arsenic, cadmium, PVC, solvents, acids and lead. Over time, these toxins leach into our soil and groundwater, and become environmental hazards for years.

2. Leachate

Leachate is the liquid formed when waste breaks down in the landfill and water filters through that waste. This liquid is highly toxic and can pollute land, ground water and waterways.



Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

Landfill contains vast quantities of substances that are harmful to the environment. Plastics such as PVC and other materials leach toxic chemicals as they break down.

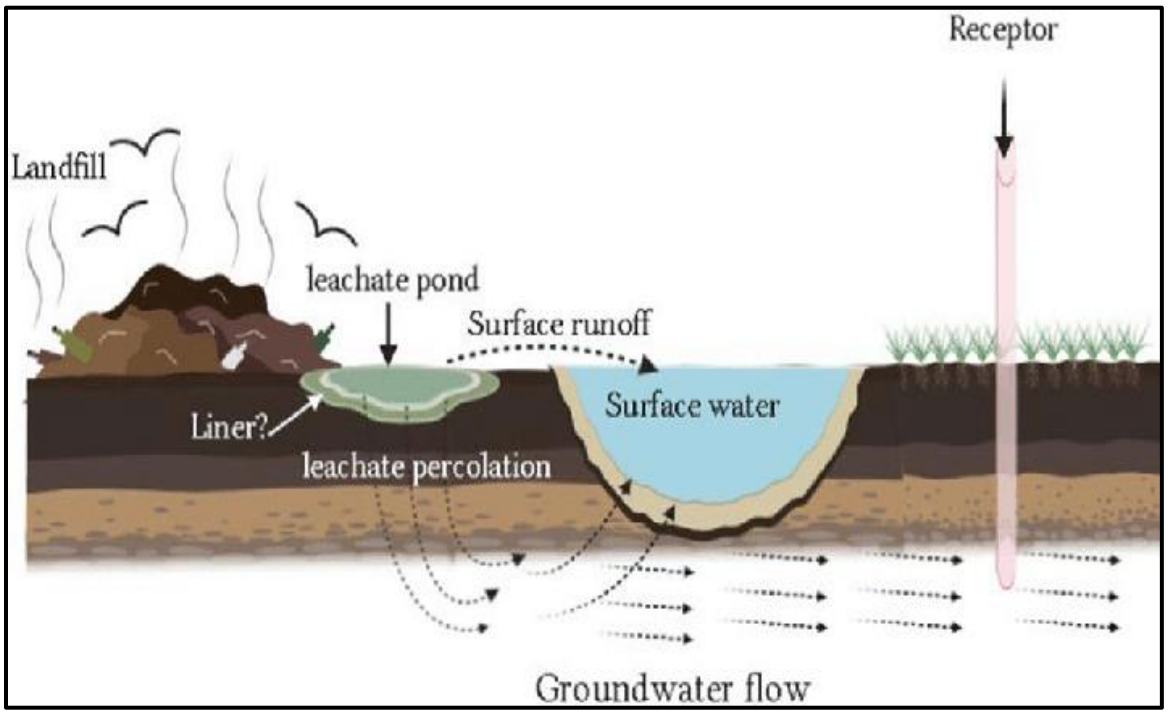
E-waste is the fastest growing waste segment in the developed world. Even though it is the most toxic everyday waste stream of all, most of it ends up in landfill. Electronic waste is loaded with heavy metals, solvents, and acids.

It takes a year or more to fill each landfill cell, during which time the contents are naturally exposed to rainfall. Rainwater filtering through the landfill dissolves and flushes 5-7 percent of the toxins with it to create a foul smelling liquor, known as leachate, which contains ammonia and various toxic salts.

Depending on rainfall, a single landfill site can easily produce several Olympic sized swimming pools of leachate each year. Leachate is carefully collected and recirculated into the landfill cells to prevent contamination of land, groundwater and waterways. Some leachate is reabsorbed when passed back into landfill, but the rest filters through again, picking up more toxins with each pass.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)

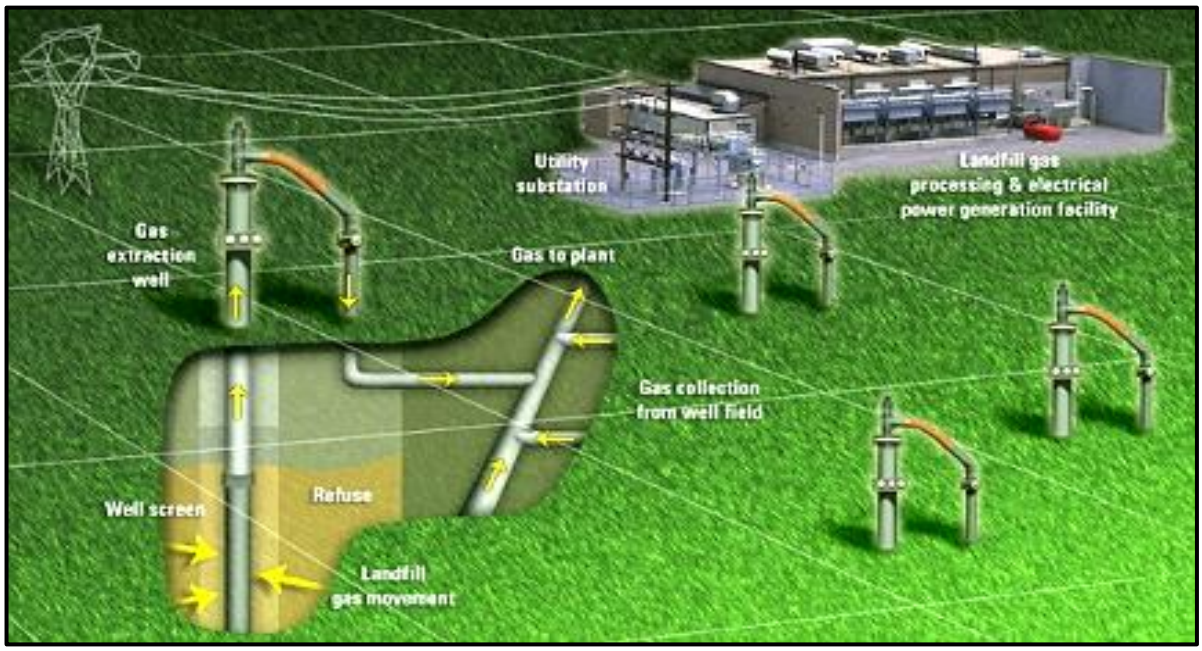


3. Greenhouse gas

Greenhouse gas production is perhaps the biggest environmental threat posed by landfills.

When organic material such as food scraps and green waste is put in landfill, it is generally compacted down and covered. This removes the oxygen and causes it to break down in an anaerobic process. Eventually this releases methane, a greenhouse gas that is about 25 times more potent than carbon dioxide. Landfill gas comprises 35-55% methane and 30-44% carbon dioxide. Methane is also a flammable gas that can become dangerous

if allowed to build up in concentration. The implications for global warming and climate change are enormous. Composting your food scraps and green waste in a compost bin can eliminate many of these problems.



Waste Management (practical)

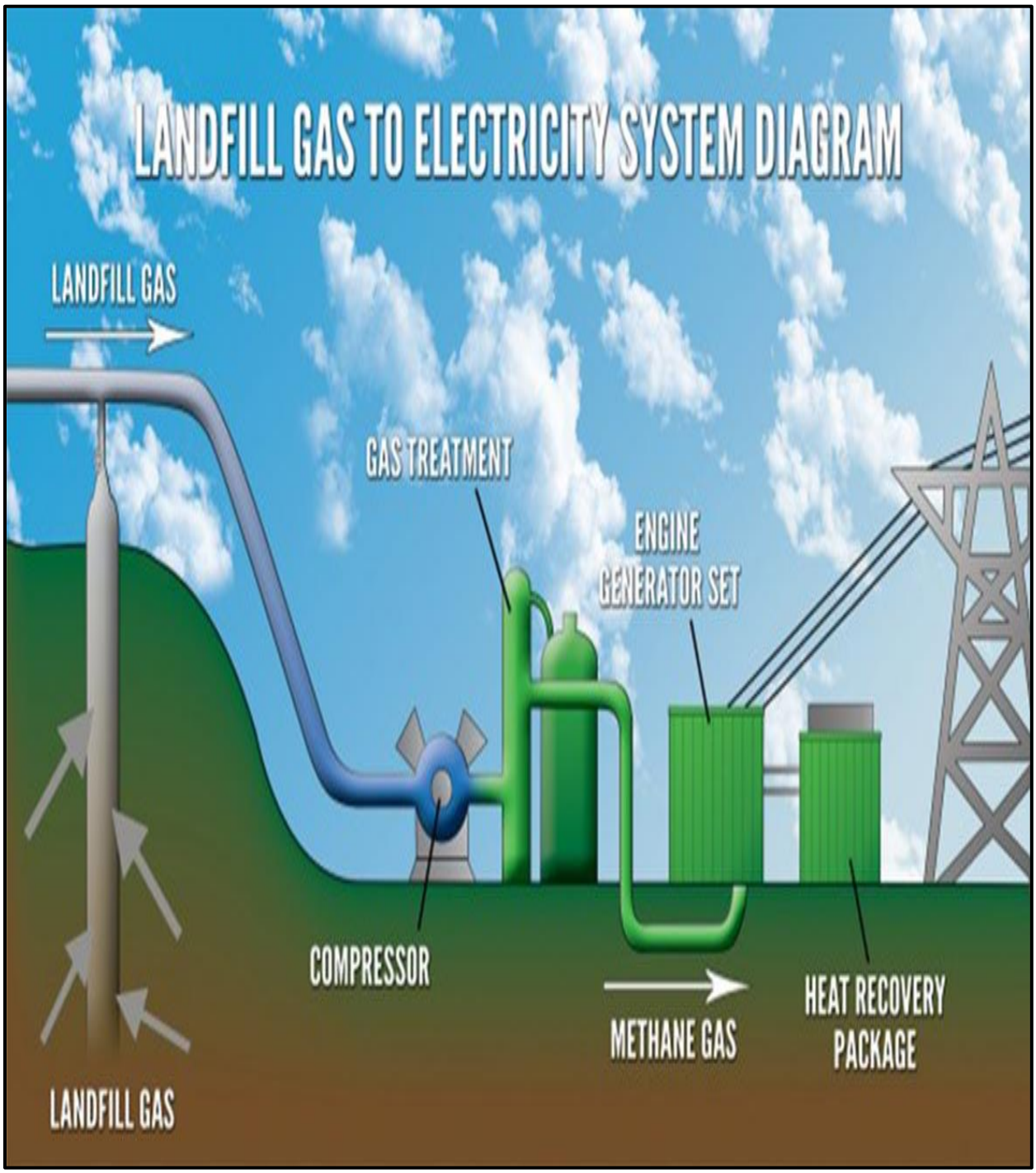
Within the first 20 years of emission, methane's greenhouse effect is far worse somewhere between 84 and 100 times more potent than carbon dioxide. In addition, when it comes to moving the needle on greenhouse gas emissions, what really counts is what happens over the next 10 – 20 years.

So ***how much methane is produced by a typical landfill site?*** A huge amount. In fact, enough to fuel a power station.

For example, a landfill that serves a population of half a million, generates nearly 1.7 million cubic metres of methane each month. Usually 85% of this gas is captured and fires a generator which provides electricity to about 10,000 homes. While plant operators and governments often choose to describe landfill gas power as renewable energy generation, it's certainly not a sustainable, or environmentally friendly form of generation. When burned, methane produces carbon dioxide – just like oil and coal.

Hind A.Ahmed
MSc Environmental Engineering

Waste Management (practical)



Hind A.Ahmed
MSc Environmental Engineering