

A2 LEVEL

Environmental Technology

Landfill

For first teaching from September 2014

For first award in Summer 2015



environmental
technology

Landfill



Specification Content

Students should be able to:

- discuss Northern Ireland's over reliance on landfill and the difficulties associated with locating and developing new landfill sites;
- list the major waste types and the priority waste streams identified in the Northern Ireland Waste Management Strategy; and
- describe how the key EU strategies and directives identified in the Northern Ireland Waste Management Strategy are driving improvements in waste management practice in Northern Ireland;
- explain the term 'waste management hierarchy' with reference to prevention, reduce, reuse, recycle, energy recovery and disposal;
- outline the main processes associated with waste recycling at a Materials Recovery Facility (MRF) for common domestic waste items such as glass, aluminium, paper and plastics;
- explain the process by which waste in landfill breaks down over time and identify the factors that influence the rate at which methane and leachate are produced;
- demonstrate how modern engineered landfill sites are designed to address the problems of methane and leachate production, using the terms 'dry tomb' and 'bioreactor';
- explain how the landfill tax encourages a reduction in levels of landfill as well as supporting environmental initiatives.

There are several obvious concerns about this form of waste disposal:

- Transport to site causes congestion and disruption to the local environment and is an issue for residents.
- Potential perceived smells can result from poorly managed and operated landfill sites which can have a considerable negative impact on the local environment.
- Land is being used for waste disposal purposes and has been taken out of other uses where it may be used for production e.g. agriculture.
- There is the possibility for seepage of waste into groundwater which can have a serious impact on local water supplies.
- They attract vermin with associated implications for residents.
- If organic material such as food waste and vegetation is put into a landfill site it is normally compacted and covered. In doing so it loses contact with oxygen and starts to break down in an anaerobic process which can result in the production and release of methane. This could have implications for harmful gas emission and is also flammable.
- The actual landfill site could have stability issues due to the nature of the material being disposed.

Northern Ireland tends to have an over reliance on the use of landfill as a means of waste disposal. This is however being addressed by the need for local authorities to meet EU guidelines on waste disposal.

The **Northern Ireland Waste Management** Strategy has identified and prioritised the types of waste produced.

These are;

- major waste types:
 - Municipal waste;
 - Commercial and industrial waste;
 - Construction, demolition and excavation wastes;
 - Hazardous waste; and
 - Agricultural waste.



Course Content



Landfill is a process where waste material from domestic and commercial sources is transported to a site and is dumped or

churned into the ground as a means of disposal.

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Pupil Activity

- Priority wastes under European legislation:
 - Packaging;
 - Waste Electrical & Electronic Equipment (WEEE);
 - End of life vehicles;
 - Tyres; and
 - Batteries.

The strategy document can be found at www.doeni.gov.uk/nia/wms.17.pdf

There is a wide range of legislative tools which are driving improvements in reduction of landfill use and improvements in management of landfill such as;



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EC Landfill Directive 1999/31/EC

The **EC Landfill Directive 1999/31/EC** which aims to standardise controls on the landfill of waste throughout the European Union. It also aims to reduce the amount of methane, emitted from landfill sites, by setting three progressive targets for member states to reduce the amount of their Biodegradable Municipal Waste (BMW) sent to landfill. Details on some of the legislation can be found at: www.doeni.gov.uk/nia/niwms.pdf

Waste Management Hierarchy

The Waste Management Hierarchy is a list of the options open to us in terms of the best ways to deal with waste. There are several versions of the hierarchy but all follow a similar pattern.

The best option **Prevention** sits at the top with the least preferable **Disposal** at the bottom.

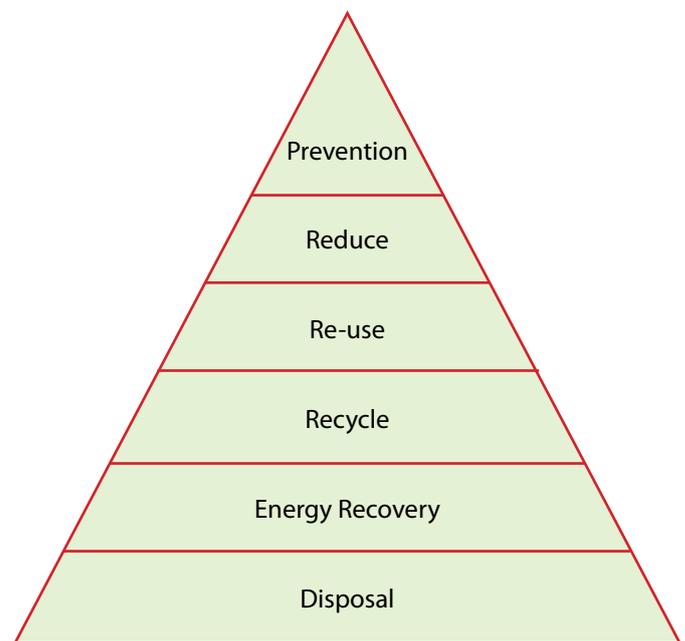
It normally comprises six options on a descending scale of preference. The six options are;

- **Prevention** – this is deemed to be the most preferable option as prevention of waste reduces all of the problems associated with its disposal;
- **Reduce** – reducing the amount of material used in

the design of products and their packaging,

- **Re-use** – design of products and systems which can be re-used;
- **Recycling** – using materials which can then be recycled for future use;
- **Energy Recovery** – making use of the energy contained within waste by incinerating it or by other processes such as anaerobic digestion or gasification; and
- **Disposal** – the least preferable option through the use of traditional landfill techniques.

It is sometimes presented as a pyramid with the most preferable option at the top descending to the least preferable.



Materials Recovery Facility

Most of us are now used to placing different types of domestic waste into different coloured bins or small containers which are then picked up by the local council as part of the normal waste collection service. We place different materials which are themselves capable of being recycled but these then have to be separated and processed at a central location known as a materials recovery facility. This uses state-of-the-art technologies to separate and prepare the various materials before recycling can take place. The main stages involved in a typical operation are;

- a quality inspection to ensure that only those materials required for recycling are moved on to the next stage of the process;
- separation of the various materials into single waste streams;
- magnets can be used to separate steel items from the others;

- glass bottles and jars are identified through a breaker screen and passed into a clean-up system for further refinement and separation by size;
- what is known as an eddy current separator can be used to remove aluminium foil and tins; and
- plastic bottles can even be separated by polymer type such as high density polythene and unwanted mixed plastic.



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Management of landfill sites

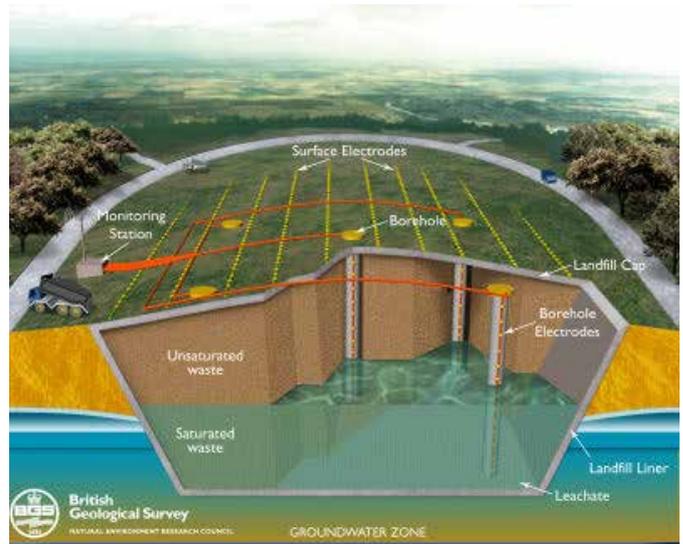
Modern landfill sites are highly engineered facilities that are located, designed, operated, and monitored to ensure compliance with government regulations. Solid waste landfills must be designed to protect the local environment from contaminants which may be present in the solid waste stream. They are not simply storage sites for waste. There are two main types known as **dry tomb** and **bioreactor**. In the dry tomb operation, waste is placed and maintained in dry conditions to minimise biodegradation and the release of leachate and gas. A major concern regarding this type of landfill operation is that the waste contained in the site may pose a risk to public health and the environment due to its long life (twenty to thirty years being typical figures) in the site which is compounded by the decomposition process being retarded. In a bioreactor landfill controlled quantities of liquid and air are added to the waste to accelerate biodegradation. The moisture content is the single most important factor in promoting the accelerated decomposition. Some installations utilise storm water and waste water to supplement the leachate to enhance the process. In this system the waste can be stabilised in a much

shorter time (five to ten years). In addition a bioreactor produces methane at a relatively early stage in the life of the landfill site and at a much greater rate than a traditional landfill.

A modern day landfill site is comprised of;

- a liner system;
- storage space for the waste usually arranged in groups or cells;
- a leachate collection system;
- a gas collection system; and
- a cover or cap.

The liner is crucial in preventing waste escaping into the local water supply or soil.



In general terms household waste contains 150 to 250 Kg of organic matter for every tonne of waste. This is capable of decomposition ultimately releasing landfill gas which itself could be used for energy purposes. With a restriction on exposure to oxygen decomposition takes place through four phases.

Phase 1 – aerobic biodegradation takes place; oxygen is gradually removed and replaced by CO₂.

Phase 2 – substances such as cellulose, proteins and fats decompose to produce substrates for further biodegradation that provide short fatty acids, CO₂ and H₂. This process can take two weeks to become established. During this phase methane bacteria begin to establish themselves in the waste.

Phase 3 – landfill gas begins to be produced in significant quantities. This phase takes three to four months to become established. The rate of gas production stabilises within two to three years.

Phase 4 – the site will produce gas over a long period of time.

Landfill Tax

Landfill Tax is, as its name implies, a tax levied by central government through Her Majesty's Revenue and Customs (HMRC) on the disposal of waste. Its sole aim is to discourage waste producers from producing so much waste that has to be disposed of in landfill.

Landfill Tax applies to all waste;

- disposed in landfill;
- at a licensed landfill site; and
- on or after 1 October 1996.



Some waste is exempt. The tax is charged by weight and there are two rates.

Inert – materials used in buildings, concrete, brick, glass soil and gravel.

Active – wood, ductwork and plastics.

The operator of the landfill site is responsible for paying the tax but this is passed on to the user such as businesses and local councils.

Landfill tax is generally regarded as a successful example of an environmental tax and is credited with assisting in the process whereby the UK has the fastest improvement in recycling rates of any EC country between 2001 and 2010.



Activity

Carry out a survey on the amount of waste produced by your household in a typical week. Estimate how much of this waste is identified for recycling, by using different bins or other means, and identify any ways in which the amount of waste produced could be reduced.

