Waste Treatment Facilities

YOUR GUIDE TO WASTE DISPOSAL

Contents

Introduction to Waste Treatment Technologies

On average people in the UK throw away seven times their own body weight in rubbish every year. This leaflet details what happens to the waste after it has been disposed of, what treatment facilities are available to treat it and how these treatment facilities operate.

Recyclable waste

Household waste

Household waste can be classified in two ways, as recyclable waste or residual waste.

Recyclable waste is material which is separated by the householder for recycling for example paper, cardboard, plastic bottles, tins, glass bottles and jars or kitchen waste for composting.

Residual waste is the waste which is not separated for recycling and is intended for disposal.

After the waste is collected there are a number of different waste treatment techniques available to treat it.

The waste treatment techniques highlighted throughout this leaflet are all intended to help work towards recycling, recovery and diverting as much waste as possible from landfill.

Residual waste

All waste treatment facilities require planning permission from the local authority and a permit from the Environment Agency. These controls are intended to protect public and animal health, prevent pollution of the environment and protect neighbours from nuisance and possible negative impacts from the technology.

The Treatment of Recyclable Waste

There are a number of options available for managing recyclable waste, these include bulking facilities, materials reclamation facilities, reuse and recycling centres, composting and anaerobic digestion.

Inside a bulking facility

Bulking facilities

If waste is collected in street banks for example, glass, paper and cans; or is sorted at the kerbside by collection workers it will be taken to a bulking facility.

The sorted waste will be unloaded from the collection vehicle and reloaded or 'bulked' into a larger vehicle for transport to a reprocessor. Bulking facilities can be constructed quickly at low cost and are often introduced by modifying existing sites.

Bulked materials

How much do they cost?

To construct a bulking facility at an existing depot costs between £50,000 and £100,000 depending on the amount of work required.

Local issues

- There is a possibility of increased traffic and noise as more vehicles deliver and remove recyclables from the site.

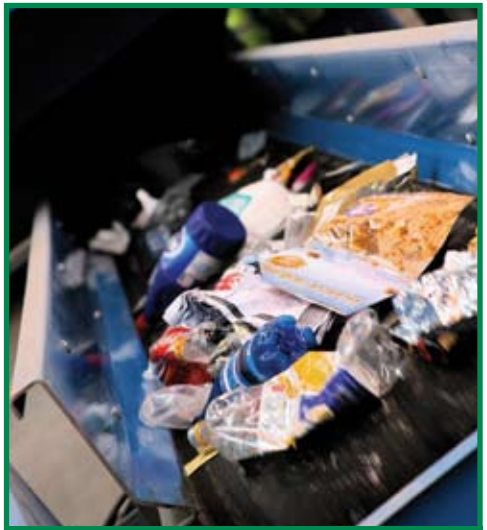
Materials Reclamation Facility (MRF)

In many areas waste for recycling is collected in a single container with many types of dry recyclable waste all mixed together. This waste is taken to be sorted at a Materials Reclamation Facility or MRF.

This facility separates the individual components of the waste using a variety of machinery and manual handling. Recyclables are deposited into a storage pit and are fed onto a series of conveyor belts to begin their trip around the facility. Each area in the MRF helps to separate one type of recyclable material from another. A typical MRF will separate recyclable materials from a mixture of paper, card, glass, plastic and drinks cans.

How much do they cost?

A MRF costs between £5 million and £10 million and takes several months to construct. The space required to construct a MRF is between 1 and 2 Hectares.



The in-feed area of a MRF

How efficient is a Materials Reclamation Facility?

Typically, 95% of the material delivered to a MRF will be recycled. Most of the material that cannot be recycled is used to generate energy or is sent to landfill. Most of the materials that cannot be recycled are items that should not have been collected for recycling.

Outside a MRF

Local issues

- There is a possibility of increased traffic and noise due to more vehicles delivering and removing recyclables from the site.
- Litter may be generated due to the spilling of stored, baled paper in the open air.

Reuse and Recycling Centres

Reuse and recycling centres are sites where local residents can bring waste to be reused, recycled or sent for disposal. Waste taken to these sites tends to be waste that cannot be collected during the weekly refuse collection because it is either too large to be collected by the normal services for example furniture; or is not normally collected for recycling in the area e.g. books. These sites will be designed to maximise the amount of waste that is collected for recycling and minimise the amount that is sent to landfill.

Recycling at a reuse and recycling centre

How much do they cost?

A reuse and recycling centre would cost between £1 million and £2 million and take three months to construct.

Local issues

- There is a possibility of increased traffic and noise due to more vehicles delivering and removing recyclables from the site.

Composting

Composting is classed as an aerobic treatment which means oxygen is used in the process.

Windrow composting

Composting is the process in which biodegradable material is broken down in the presence of oxygen by micro-organisms (organisms that are too small to be seen with the naked eye, for example bacteria). This process releases carbon dioxide and heat and generates a solid residue – compost. Producing usable compost can take up to 6 months.

There are two methods of large scale composting - windrow composting and in-vessel composting. Windrow composting (commonly used for green garden waste) takes place in the open air and in-vessel composting takes place inside a container where the moisture content, air flow and temperature are carefully controlled to optimise the process.

Windrow composting in the open air is not suitable for wastes that have been in contact with meat as it is not possible to be certain that all parts of the waste will reach the temperature required to kill agents that can cause disease in animals and plants.

In-vessel composting facility

In-vessel plants are more commonly constructed in areas where other users are sensitive to potential odours as much greater control of the emissions can be achieved than is possible with windrow facilities.

In-vessel facilities are also useful where space is restricted as they occupy a smaller area than an open windrow facility that processes the same amount of waste. Additionally, in-vessel facilities can treat compostable food waste that includes meat as the better process control means that these wastes can be safely treated. This allows a greater amount of the waste stream to be separately collected for composting.

How much do they cost?

A windrow composting operation would cost £500,000 to establish and would take about 3 months to construct. They are commonly constructed on farms or closed landfill sites.

An in-vessel compost plant would be expected to cost between £3 million and £6 million and take around 6 months to construct.

Vital statistics

Most compost plants treat between 10 and 20,000 tonnes per annum, but the optimum size is around 50,000 tonnes per annum. The land required for a facility is typically between 1 and 2 Hectares including the area used to store the compost that has been produced. Larger plants naturally require a greater area.

How efficient is windrow composting?

Approximately half of the material delivered to a compost site will be converted into carbon dioxide and water during the process. The material will then be screened to remove large particles and contaminants such as logs and branches, plastic and glass. After screening the product is recognisable as compost.

How efficient is in-vessel composting?

The products of an in-vessel composting process are the same as from an open windrow system. The land required for the facility is less as the process is more efficient although the cost of construction is considerably higher.

Local issues

- Odour is generated by the process and needs to be effectively controlled.
- Small amounts of litter can be generated.
- Noise is caused by machinery processing the waste and vehicles delivering and removing material.
- There is an increase in vehicle movements to and from the site.

Anaerobic Digestion

Anaerobic Digestion (commonly referred to as AD) is the process by which biodegradable waste is broken down in an enclosed reactor vessel (a big tank) in the absence of air to create biogas - a mixture of mostly hydrogen, methane and carbon dioxide and sludge.

The differences between aerobic treatment (composting) and anaerobic treatments include:

- The types of micro-organisms present.
- The fact that anaerobic processes require external heating to maintain the working temperature.
- Anaerobic treatments produce a biogas consisting of mainly hydrogen, methane and carbon dioxide. This biogas is commonly used to heat the reaction vessel to the required operating temperature with the surplus being used to generate electricity.
- Sludge from anaerobic digestion plants requires further composting in the open air before it can be spread on land as a fertiliser or soil improver. This material is similar to sewage sludge.

Anaerobic digestion plant

How much do they cost?

Anaerobic digestion plants cost between £3 million and £4 million and would take several months to construct. A typical plant will occupy between 0.5 and 1.0 Hectares.

Anaerobic digestion plant

How efficient is anaerobic digestion?

Anaerobic digesters convert about half of the material to biogas and water and the other half to a stabilised sludge.

Local issues

- Odour is generated by the process and needs to be effectively controlled.
- Noise may occur from machinery processing the waste and vehicles delivering and removing material.
- There will be increased vehicle movements to and from the site.

The Treatment of Residual Waste

The waste that is left after some items have been separated for recycling is called residual waste. The treatment of residual waste falls into four main categories:

Mechanical Biological Treatment (MBT)

Mechanical Heat Treatment (MHT)

Energy from Waste

Advanced Thermal Technologies (ETT)

Each of these categories includes a range of treatment techniques, all with different strengths and weaknesses. Often more than one of these techniques will be used together to treat the residual waste.

Landfill is also used to manage residual waste and is covered at the end of the leaflet.

Mechanical Biological Treatment (MBT)

MBT technologies are used to treat residual waste that remains after recyclables such as paper, plastic, glass and garden waste have been separately collected.

MBT is a general term for treatment systems that include a mechanical sorting system followed by a biological treatment facility. Systems can vary in terms of the degree of mechanical sorting and the type of biological process applied.

MBT facility

Consequently the materials sorted from the waste and the end products of the process can vary depending on the separation process employed.

MBT is predominantly a drying and volume-reducing process but can also facilitate the recovery of any remaining recyclable materials that were not separated before the waste was collected.

MBT plants are commonly used as a pretreatment before waste is sent to one of the thermal treatment technologies described below. They are often built and operated in partnership with one of the other types of plant described in this document. The biological processes are very similar to those described on pages 9 and 10 but in this case are applied to residual waste.

The material produced at a MBT plant is of a lesser quality than that produced by composting source separated wastes and so has fewer opportunities to be used on soil. It may be used in land restoration or landscaping but is unlikely to used as horticultural or agricultural compost.

Typical MBT plants have a treatment capacity of between 50,000 and 180,000 tonnes per annum and occupy between 1 and 4 Hectares.

How much do they cost?

A MBT plant would cost between £15 million and £20 million.

How efficient is MBT?

Efficiency is not an appropriate measure for comparing MBT plants with other technologies. The variety of technologies and operating parameters make it difficult to compare this technology with others. MBT plants are commonly used as a pretreatment to dry waste and produce a material that is suitable for treatment in another process such as gasification or pyrolysis (see page 20).

Local issues

- Odour is generated by the process and needs to be effectively controlled.
- Noise may occur from machinery processing the waste and vehicles delivering and removing material.
- There will be an increase in vehicle movements to and from the site.

Mechanical Heat Treatment

Mechanical Heat Treatment (MHT) techniques involve applying heat energy to the waste to reduce its volume and aid the recovery of recyclables. A typical example of a MHT process is autoclaving.

This technique is commonly applied to clinical waste but can also be applied to residual waste. It involves treating waste with steam in a pressurised container to sterilise it. Waste is processed for about an hour and the volume of waste is reduced. Metal, glass and some plastics can be recycled after treatment.

Once recyclables have been removed the remaining material can be processed to make a ‘refuse derived fuel’ (RDF) that can then be used to produce heat and electricity.

Energy from Waste

The term ‘energy from waste’ is commonly used to describe incineration processes in which the residual waste is subject to a combustion process at a temperature typically between 850°C and 1,000°C. The combustion relies on the intimate mixing of the waste stream with air (which provides oxygen) at a high temperature. The process releases heat, a mixture of carbon dioxide and steam and produces ash. Other gases and pollutants generated during the process are removed before the gas is discharged. Metals are recycled from the ash and the remainder is recycled into aggregate for use in construction.

The advantage of energy from waste plants is that waste can be treated directly upon delivery with little or no pretreatment method such as MBT to prepare the material. Compared with a MBT plant followed by gasification or pyrolysis (see page 20 for an explanation), the land requirement is also lower. Energy from waste plants must meet the same emission standards as all advanced thermal treatment facilities. A modern energy from waste plant would usually be constructed with a combined heat and power (CHP) system to provide heat and power to local residents and businesses.

Emissions from energy from waste plants are regulated by the Environment Agency and must comply with the standards set in the Waste Incineration Directive.

How much do they cost?

Energy from waste plants cost between £25 million and £70 million depending on the scale of the plant, the technology selected and land costs. Modern energy from waste plants range in size from 23,000 to 585,000 tonnes per annum and typically occupy between 1 and 5 Hectares.

How efficient is energy from waste?

Energy from waste plants typically recover about 27 percent of the potential energy that is available. Some of this energy is used to run the plant and the remainder is exported to the national power supply.

Energy from waste facility

Metal is recovered from the ash which is then used as an aggregate material in construction. If the technology includes a combined heat and power system that provides electricity and heat to local residents and businesses the efficiency rises to between 50 and 70 percent.

Local issues

- Noise may occur from machinery processing the waste and vehicles delivering and removing material.
- There will be an increase in the number of vehicles delivering waste to the facility.
- Residents may be concerned about air quality and emissions from the facility but these are effectively controlled and regulated by the Environment Agency.
- Some visual intrusion may occur due to the size of the building.

Advanced Thermal Technologies (ATT):

This term is used to describe modern technologies for treating residual waste or refuse derived fuel (RDF) in which different parts of the combustion process happen in different parts of the plant. This gives a greater control of the overall combustion process. Two types of technology are commonly employed; these are pyrolysis and gasification. The two techniques are similar but there are subtle differences in the design and operation of the plants. Pyrolysis involves heating waste in an atmosphere that has no oxygen to the point that the waste breaks down into its basic chemical parts. These simple parts can then be burnt in a separate part of the process or collected for use in the chemical industry. Gasification is very similar except that a small amount of oxygen is permitted into the reaction vessel. This allows greater control over the process and the materials that can be produced by it.

ATTs facilitate the recovery of materials including metals and possibly plastics and industrial chemicals for reuse and recycling.

Residual waste will usually be subjected to a pretreatment such as MBT that produces a more homogenous material that is suitable to be introduced to an ATT plant. This type of plant will commonly be associated with an MBT plant as described above that is required to prepare the 'fuel'.

Both systems produce a gas that can either be burned to generate heat and electricity or can be collected and used to make industrial chemicals.

Emissions from gasification and pyrolysis plants are regulated by the Environment Agency and must comply with the standards set in the Waste Incineration Directive.

How much do they cost?

These plants cost between £9 million and £50 million depending on the scale of the plant and the technology selected as well as a range of local factors. The land required for a facility is between 0.5 and 3 Hectares depending on the size of the plant and the technology selected.

How efficient is gasification/ pyrolysis?

Typically, the energy recovery efficiency of a gasification or pyrolysis plant would be 30 percent. A CHP system could be incorporated.

Local issues

- Noise from machinery processing the waste and vehicles delivering and removing material from the site may occur.
- There will be an increase in the number of vehicles delivering waste to the facility.
- Residents may be concerned about air quality and emissions from the facility but these are effectively controlled and regulated by the Environment Agency.
- There may be some visual intrusion due to the size of the building.

Landfill

Landfill remains the most common method of waste disposal in the UK. A landfill site is an engineered void space (hole) in the ground that is lined with impermeable clay and a thick plastic sheet to prevent liquid escaping.

Waste is buried in the landfill site and decomposes under controlled conditions to prevent pollution. Landfill gas containing methane is produced and collected and used to generate electricity. Liquid produced by the process is extracted and treated to prevent pollution before it is discharged. This process is similar to the way that sewage is managed.

Landfill sites are often constructed in old quarries and mines where the waste is used to fill the hole produced by extracting the minerals.

Landfill site

Further reading

www.environment-agency.gov.uk/wtd/

This document has been prepared by officers of the North London Waste Authority. The information and data presented is indicative and is intended to aid understanding.

Pictures of the MRF and bulking facilities supplied courtesy of Veolia.

Pictures of the in-vessel composting plant supplied courtesy of LondonWaste Ltd.

Pictures of the MBT and anaerobic digestion plants supplied courtesy of Clarke Energy and HAASE.

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