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Mechanical Heat Treatment of Municipal Solid Waste

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Preamble

This Waste Management Technology Brief, originally produced in 2007, is one of a series of documents prepared under the New Technologies work stream of the Defra Waste Implementation Programme. This Brief has been revised to accompany the 2013 Energy from Waste Guide while remaining a standalone document. The Briefs address the main technology types that have a role in diverting Municipal Solid Waste (MSW) from landfill.

This brief addresses Mechanical Heat Treatment (MHT). Other titles in this series include: Advanced Biological Treatment, Mechanical Biological Treatment (MBT), Advanced Thermal Treatment, and Incineration.

The prime audience for these Briefs are local authorities, in particular waste management officers, members and other key decision makers for MSW management in England but also members of the public who require more detailed information on the technologies mentioned in the 2013 Energy from Waste Guide. It should be noted that these documents are intended as guides to each generic technology area.

These Briefs deal primarily with the treatment and processing of residual MSW.

1. Introduction

Residual Municipal Solid Waste (MSW) is waste that is household or household like. It comprises household waste collected by local authorities   some commercial and industrial wastes e.g. from offices, schools, shops etc that may be collected by the local authority or a commercial company. Legislation limits (by implication[1]) the amount of mixed MSW that can be sent to landfill.

One of the guiding principles, now enshrined in law, for European and UK waste management has been the concept of a hierarchy of waste management options, where the most desirable option is not to produce the waste in the first place (waste prevention) and the least desirable option is to dispose of the waste with no recovery of either materials and/or energy. Between these two extremes there are a wide variety of waste treatment options that may be used as part of a waste management strategy to recover materials (for example furniture reuse, glass recycling or organic waste composting) or generate energy from the wastes (for example through incineration, or digesting biodegradable wastes to produce usable gases).

There are a wide variety of alternative waste management options for dealing with MSW to limit the residual amount left for disposal to landfill. The aim of this guide is to provide impartial information about the range of technologies available referred to as Mechanical Heat Treatment (MHT). These technologies are pre-treatment technologies which contribute to the diversion of MSW from landfill when operated as part of a wider integrated approach involving additional treatment stages.

The technologies described in this Brief - Mechanical Heat Treatment - have a relatively limited track record operating on municipal wastes worldwide. There have, however, been developments over the last few years as described in the track records section of this publication. The aim of this document is to raise awareness of this type of technology and present the most current information regarding their implementation.

This guide is designed to be read in conjunction with the other Waste Management Technology Briefs in this series.

Other relevant sources of information are identified throughout the document.

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[1] Targets pertain to the biodegradable fraction in MSW.

2. How It Works

2.1 Introduction

This section gives an overview of the principles of Mechanical Heat Treatment (MHT) processes, i.e. technologies that use thermal treatment in conjunction with mechanical processing. Alternative waste management technologies which use other (higher temperature) thermal treatment processes are dealt with in separate Briefs in this series: ‘Advanced Thermal Treatment’ and ‘Incineration’.

2.2 Aim of the Processes

Mechanical Heat Treatment is a relatively new term. It is used to describe configurations of mechanical and thermal, including steam, based technologies. The generic purpose of these processes is to separate a mixed waste stream into several component parts, to give further options for recycling, recovery and in some instances biological treatment. The processes also sanitise the waste, by destroying bacteria present, and reduce its moisture content.

Autoclaved waste

2.3 History of the Processes

The most common system being promoted for the treatment of MSW using MHT is based around a thermal autoclave (see Table 1). Autoclaving has been used for many years to sterilise hospital and surgical equipment using the action of steam and pressure. This technology is also in common use for the sanitisation treatment of some clinical wastes, and for certain rendering processes for animal wastes, prior to sending to landfill. However, its application to MSW is a relatively recent innovation and the commercial experience on this feedstock has made considerable strides forward in recent years and is developing in the UK at present.

A second type of MHT system is a non-pressurised heat treatment process, where waste is heated in a rotating kiln prior to mechanical separation[2].

Heat Treatment Process	Description

[2] Defra part funded a Demonstrator of this type of technology promoted by Orchid Environmental Ltd.

Type 1 – Autoclaving *Batch, steam processing in a vessel under the action of pressure.*	Waste is subjected to steam under pressure, followed by mechanical sorting and separation of the sterilised waste. This is a batch process (i.e. waste is entered into the vessel which is sealed and after treatment (~ 1 hour), discharged before a new batch of waste is loaded.
Type 2 – Continuous Heat Treatment *In a vessel, not under the action of pressure.*	Waste is dried using externally applied heat, followed by mechanical sorting and separation of the sanitised waste. In this process waste is fed and moves along the thermal vessel and through the system in a continuous fashion.

Table 1: Mechanical Heat Treatment Processes

Details of the Process

Figure 1 illustrates the various stages in the process, and some possible options for dealing with the outputs.

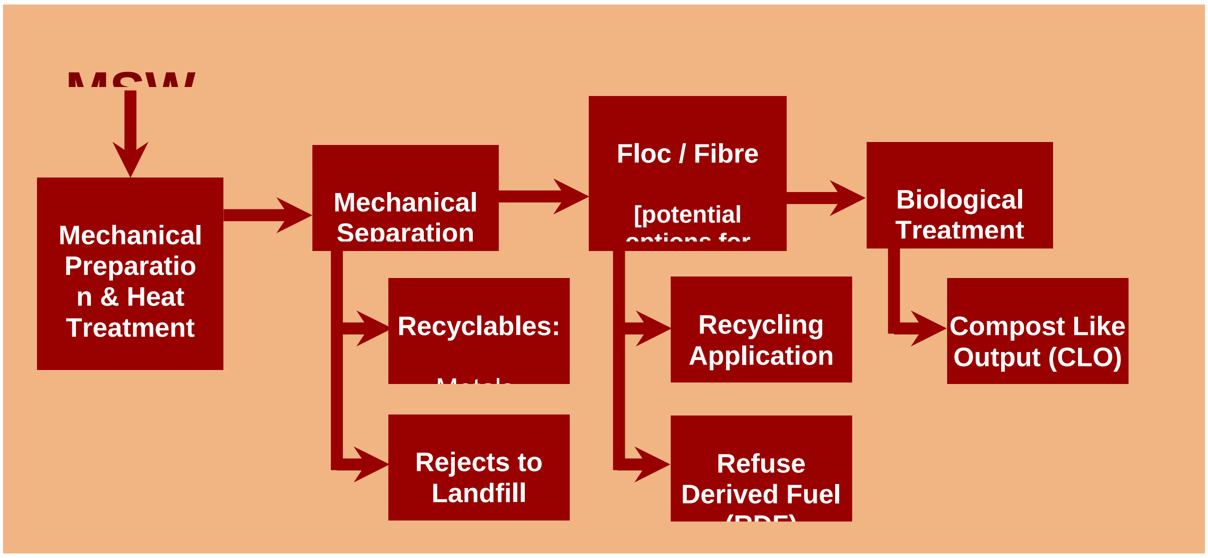

Figure 1: Mechanical Heat Treatment Schematic

2.4 Mechanical Preparation

Some processes carry out a basic initial screening process to remove any large items from the waste stream unsuitable for further processing in the system; for example, large metal objects, rubble or particularly bulky items such as carpets. Several processes shred the waste to homogenise the particle size. The waste is then loaded into the heat treatment vessel. In some systems waste is loaded into the heat vessel in a raw form, however in such instances there is usually some mechanical abrasion tool within the heat chamber (e.g. blades / helix) to break up the waste.

2.5 Heat Treatment

All MHT processes use heat and/or steam treatment, which may or may not be applied under pressure.

The treatment vessel is loaded with waste and either an autoclave or continuous process is used as follows:

- The autoclave process is a batch process, so the vessel is sealed. Steam is injected into the vessel, wetting the waste. Pressure is applied in the range of 5-7 bar, and the vessel is rotated to mix the waste. These conditions are maintained for up to one hour, after which the pressure is released, and the contents emptied from the vessel.
- An alternative heat treatment process, which usually accepts shredded waste, is a continuous process. This means the waste continuously passes through the vessel as it is treated. Water is added to the waste to give a pre-determined moisture content. The vessel is under atmospheric pressure, and

the waste is rotated as a hot air stream passes through the vessel. The residence time of the waste in the vessel is generally up to 45 minutes, after which the treated waste is removed for mechanical separation.

Process Vessels, image courtesy of Orchid Environmental

The aim of the autoclave process is to 'cook' the waste, and has the following effect on the waste:

- Biodegradable materials, including paper and card, are broken down into a fibre;
- Glass bottles and tins have their labels removed as the glue disintegrates under the action of the heat;
- Plastics are softened, and labels are removed. Certain types of plastics are deformed by the heat, but remain in a recognisable state, whereas other plastics soften completely forming hard balls of dense plastic.

The resulting outputs from this heat/steam processing are relatively clean 'hard' recyclables (tins, glass and plastics with no labels and most of the food waste removed), a mix of fibrous material from the breakdown of paper, card and green/kitchen waste constituents, and a reject fraction.

Both systems apply temperature in the range of 120-180□C, which is sufficient to destroy bacteria present in the waste. This has benefits in terms of storage, transport and handling of the outputs as they are sanitised, and are free from the biological activity that may give rise to odour problems. There is also a significant volume reduction of the waste.

2.6 Heat / Steam Efficiency

MHT processes using steam and pressure usually release the pressure in the vessel via a condenser, to trap and recycle water within the process. The depressurisation of the vessel causes most heat and moisture contained within the waste to vaporise, and so a further drying stage prior to materials separation is not usually required.

Release of waste from autoclave vessel

MHT processes operating at atmospheric pressure and using heat usually return hot gases exiting the vessel to the front end to provide some pre-heating for incoming waste. The remaining hot gases are released to atmosphere via an economiser and a condenser gas scrubbing system, which creates a liquid effluent stream.

2.7 Materials Separation

The materials removed from the MHT vessels are potentially recyclable and include glass, metals and plastics and a ‘fibre’ or floc.

MHT systems invariably utilise a number of separation techniques to extract the various recyclable components post-heat treatment. These are likely to be similar mechanical separation technologies used in Mechanical Biological Treatment systems, and are described in Table 2. A high-quality ferrous and non-ferrous metal stream, cleaned of labels and foodstuffs is always extracted for recycling. Some systems may also extract a glass / aggregate fraction, and a plastics stream for recycling. There may be small amounts of fibre / contrary material trapped within containers destined for recycling, and so whilst the recyclate is likely to be considerably cleaner than materials extracted for example from an MBT process, there may still be some quality issues for some reprocessors. As with any waste treatment process there will be a reject fraction which must be disposed of.

The fibre comprises the biodegradable elements of the waste stream (predominantly green waste, kitchen waste, paper, card). There are a number of potential options available for the remaining fibre after removal of recyclables, and these are discussed in the next section.

Separation Technique	Separation Property	Materials Targeted
Trommels and Screens	Size	Oversize – paper, plastic Small – kitchen waste, glass, fines
Manual Separation	Visual examination	Plastics, contaminants, oversize
Magnetic Separation	Magnetic properties	Ferrous metals
Eddy Current Separation	Electrical conductivity	Non-ferrous metals
Air Classification	Weight	Light – plastics, paper Heavy – stones, glass
Ballistic Separation	Density and Elasticity	Light – plastics, paper Heavy – stones, glass
Optical Separation	Diffraction	Specific plastic polymers

Table 2: Example Mechanical Waste Separation Techniques for MHT processes

2.8 Configurations

Different MHT systems may be configured to meet various objectives with regard to the waste outputs from the process (Figure 1).

The alternative objectives, depending on the system employed, may be one or more of the following:

- Separate a biodegradable component of the waste for subsequent biological processing, for example to form a low grade compost-like output;
- Produce a segregated high calorific value waste (see Box 1), potentially high in biomass, to be applied in an appropriate process to utilise its energy potential; and
- Extract materials for recycling (typically glass and metals, potentially plastics and the 'fibrous' organic and paper fraction).

Whilst a variety of treatment and mechanical separation options are offered, plant should be configured according to availability of markets for the products of the process (see section 3). It is important to retain the flexibility, for example by allowing sufficient space within buildings, to adapt the process to produce different outputs to meet the needs of the market over time.

2.9 Summary

There are two main types of MHT process, with autoclaving being the most common example. In this process waste is ‘cooked’, under pressure, breaking down the waste, destroying bacteria, and facilitating onward separation of materials. Cleaned recyclables are one of the outputs, with a sanitised fibre as the majority output. There are several potential options for further recycling/recovery of the fibre which are all dependent on availability of sustained markets and outlets.

3. Markets and Outlets for MHT Outputs

In the UK, at present, the commercial markets for some of the outputs from MHT are still relatively young. A number of organisations have developed plans to utilise the output from MHT, and there is now some UK operational experience. Plants being specified today will need to provide materials into a developing market and clearly it is prudent to install or at least maintain operational flexibility in terms of the degree and types of separation of materials that any proposed plant can achieve. The following sections summarise some key issues with regard to the markets and outlets for outputs derived from MHT processing of MSW.

3.1 Materials Recycling

Glass, Metals and Plastics

Glass and metals derived from some MHT processes have the potential to be significantly cleaner than those from Mechanical Biological Treatment processes due to the action of steam cleaning, which removes glues and labels. Metals in particular can have higher revenue value if labels / foodstuffs have been removed, and cleaner recyclables may be easier to market.

Other recyclables such as plastics may also be extracted from some systems. However, most plastic materials are deformed by the heat of the process, some to a greater extent than others, potentially making them more difficult to recycle in some instances. Appropriate plastics could be recycled, or alternatively could be blended with other secondary fuels and combusted to recover energy where outlets or markets exist.

Fibre

As with the output from most residual waste treatment facilities, the fibre from MHT processes is still classified as a waste, and as such is subject to legislative requirements concerning its handling, storage and disposal.

The main options available for the fibre output are:

- Use for its combustible properties as a fuel;
- Biologically process for use as a low grade compost-like output, or as a bio-stabilised residue for disposal; or
- Use as a raw material in recycled products.

The separated fibre contains most of the biodegradable municipal waste and is the main output of the process. Potential recycling applications for this fibre are varied, although the most common application is use as a fuel or landspreading.

Work has been undertaken to evaluate use of the fibre as a raw material for example by mixing the fibre together with crushed shale and a resin to manufacture products (e.g. composite such as floor tiles). Other options may include mixing with cement to produce building products, and washing the fibre to extract the long cellulose fibres suitable for paper-making or as insulation materials. However, the market for recycled products made with fibre from MHT processes is not yet established and is subject to on-going development.

The landspreading option is likely to require some biological processing of the fibre. Since the autoclave process is a sanitisation process that kills most of the microbes present in the waste, the fibre may need to be 'seeded' with microbes (e.g. mixed with material that has already undergone biological treatment) to accelerate the onset of the biological process. Either composting or Anaerobic Digestion techniques could be used[3]. Compost-like outputs or digestate from these processes would still be classified as a waste and therefore subject to Environmental Permitting regulations[4].

The quality of CLO produced will vary with different MHT technologies, the quality of raw waste inputs, and the method and intensity of waste preparation and separation prior to biological treatment, as well as the methods used to screen and / or wash the outputs. Subject to its quality, it may be possible to use it in the restoration, reclamation or improvement of previously developed land. This will need to be authorised by the Environment Agency (EA) under a mobile plant permit and deployment form. The deployment form is submitted by the operator and contains the site specific information to demonstrate that the CLO will be beneficial, a risk assessment, and the control measures proposed by the operator.

The use of CLO produced from mixed MSW on agricultural land is currently not permitted by the EA. If an outlet cannot be found for the CLO then it may have to be disposed to landfill. This will incur a disposal cost and any remaining measured

[3] Aerothermal Group has planning permission for a 75,000tpa, 26GWe, £15m facility at Lee Moor, Plymouth. The Advanced Anaerobic Digestion (AAD) plant will combine autoclaving and anaerobic digestion, with CLO from the process being used for nearby restoration projects at a China Clay Workings site. The site is expected to be operational in 2013.

[4] The Environmental Permitting (England and Wales) (Amendment) Regulations 2012 (SI 2012/630). The regulations replace the 2010 and previously 2007 versions which had combined Waste Management Licenses (WML) and Pollution Prevention and Control (PPC) regulations.

biodegradable content will affect local authority landfill diversion targets. Trials on the use of CLO on land have however been permitted by the Environment Agency[5].

As with any waste treatment process for mixed waste containing animal products, it will be necessary to comply with the Animal By-Product Regulations (ABPR)[6]. If the fibre from an MHT process is destined to be spread on land (which includes its use as landfill daily cover), without further biological processing, the MHT process must comply with ABPR standards. If the fibre is to be biologically processed, and the MHT process does not comply with ABPR, the biological process must be approved under ABPR. If material is destined for landfill or incineration only, neither the MHT nor the biological process need comply with ABPR. For further information on ABPR please see the 'Advanced Biological Treatment' Brief in this series.

3.2 Energy Recovery

Where MSW is sorted or treated to produce a high calorific value (CV) waste stream comprising significant proportions of the available combustible materials such as mixed paper, plastics and card, and potentially some kitchen/green waste matter, this stream is termed Refuse Derived Fuel (RDF – see Box 1).

The fibre from MHT processes may be combusted as a Refuse Derived Fuel to release the energy contained within. The fibre is typically of a fine homogenous nature consisting of broken down biodegradable matter, paper and card, providing a consistent feedstock for onward thermal combustion.

Box 1: Fuel from Mixed Waste Processing Operations

Various terms are in use to describe solid fuel arising from MBT/MHT processes in the UK, the most common being solid recovered fuel and refuse derived fuel.

A CEN Technical Committee (TC 343) has developed standards on fuels prepared from wastes, where the suite of standards uses the terminology Solid Recovered Fuel (SRF) and classify the SRF by a number of characteristics, including by thermal value, chlorine content and mercury content. The use of Refuse Derived Fuel (RDF) as a term has no strict definition and could be generated from a wide variety of waste treatment processes.

A recent development in the UK is the separation between the procurement of waste treatment processes that give rise to a fuel output and the procurement of

5 http://publications.environment-agency.gov.uk/PDF/GEHO0512BWLS-E-E.pdf

6 The Animal By-Products (Enforcement) (England) Regulations 2011 (SI 2011/881).For more information visit the Defra website at, http://www.defra.gov.uk/food-farm/byproducts/ and http://archive.defra.gov.uk/foodfarm/byproducts/documents/lowcapacity.pdf.

the market for the utilisation of the fuel generated. In these circumstances a specification of RDF/SRF would be required.

Within this Brief, Refuse Derived Fuel will be used as a term to cover the various fuel products processed from MSW.

Fibre produced by a Mechanical Heat Treatment plant is visibly different to an RDF produced by an MBT plant. The predominant difference is that RDF from an MBT plant usually contains recognisable components, including plastic, paper and card, and may also contain organic material. It is also likely to be less homogenous in nature than RDF from MHT. There may be different operational requirements regarding thermal combustion of each of these types of RDF.

However, some MHT systems are designed to process RDF to a particular fuel specification tailored to a specific market demand.

3.3 Legislative Requirements

RDF is a waste and therefore any facility using the fuel will be subject to the requirements of the Waste Incineration Directive. Electricity generated from the biodegradable fraction of waste in certain technologies is eligible for support under the Renewables Obligation (RO)[7]. Electricity recovered from the biomass component of RDF qualifies for support if it is generated in ‘advanced conversion technologies’, including pyrolysis or gasification plant (see the Advanced Thermal Treatment Brief), or in a conventional combustion facility with Good Quality Combined Heat and Power (CHP)[8]. Fuels derived from over 90% biomass in content also qualify for ROCs if burnt in a conventional boiler, ATT facility or co-combusted for power generation. Producing a fuel of this quality from MSW would require considerable refinement, which potentially could be achieved through technologies such as MHT, however the additional processing costs would need to be considered against the additional income / market benefits.

3.4 Types of Facility Accepting RDF

The process of separation and refinement of an RDF fraction from mixed waste can use significant amounts of energy. It is therefore particularly important that as much of the energy as possible stored within the RDF is captured during combustion, to

[7] DECC RO website:
www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/renew_obs/renew_obs.aspx.
[8] For further information, see https://www.chpqa.com/guidance_notes/GUIDANCE_NOTE_44.pdf

make the energy expended during separation and refinement worthwhile. A high conversion efficiency process should be used to combust the RDF. Whichever combustion route is chosen, the individual process should be examined in detail to establish its energy conversion efficiencies.

There are several options available for the thermal combustion of RDF within the UK, including: dedicated waste treat

ment plant accepting RDF as a fuel (e.g. an Incinerator or Advanced Thermal Treatment plant); or combustion in an existing industrial process.

Orchid 'Renewable Power Fuel' pellets, courtesy of Orchid Environmental

Potential Outlets for RDF

Defra has identified 6 potential outlets for RDF. The viability of some of these is dependent on addressing any technical barriers for use of the fuel, the market appetite, commercial drivers around carbon trading, renewable energy incentives and the cost of waste disposal (gate fees).

The 6 potential outlets are:

1. Industrial intensive users for power, heat or both (Combined Heat and Power, CHP).
2. Cement kilns.

3. Purpose built incinerators with power or power and heat (CHP).
4. Co-firing with coal at power stations.
5. Co-firing with fuels like poultry litter and biomass which are eligible for Renewable Obligation Certificates (ROCs see later in this section) in conventional technologies
6. Advanced thermal technologies, such as pyrolysis and gasification which are ROC eligible technologies.

RDF from UK waste treatment facilities (MBT & MHT) is already utilised at industrial facilities in the UK (e.g. cement works) replacing fossil fuels.

There is currently only one dedicated conventional combustion plant (incinerator) in the UK that uses RDF as a fuel to generate electricity[9]. Another facility which accepts prepared fuel, (generated from raw MSW delivered at the front end of the plant) which could be termed crude RDF is also combusted in Fluidised-Bed incinerators in Kent and Dundee, illustrated in Table 3.

RDF Combustion plant	Operator	K tonnes/ year
Slough, Berkshire	Slough Heat & Power	145[a]
Allington, Kent	Kent Enviropower	500[a]
Dundee	Dundee Energy Recycling Ltd	85[b]
[a] Source: EA 2010 Incineration inputs and capacity[9] [b] Source: SEPA 2010 Waste sites and capacity report[10]		

Table 3: Combustion Technology Plant Generating Electricity from RDF in England

RDF may also be utilised within some appropriate Advanced Thermal Treatment (ATT) processes, for example the Isle of Wight gasification facility exclusively accepts RDF, and the Dumfries gasifier is projected to accept a 50:50 mix of RDF and treated commercial wastes when fully operational. A suitably scaled, dedicated ATT plant could represent a part of an integrated strategy in combination with MBT/MHT. A separate Waste Management Technology Brief, in this series, is available on the subject of ATT processes.

[9] EA Permitted Waste Management Facilities for 2010 Incineration inputs data table, http://www.environment-agency.gov.uk/research/library/data/132647.aspx#England_and_Wales.

[10] SEPA List of Waste Sites and Capacities in Scotland 2010, http://www.sepa.org.uk/waste/waste_data/waste_site_information/waste_sites__capacity.aspx.

The energy use incurred in the separation of waste typically involves around 15 – 20% of the energy value of the waste. If the RDF is to be used as an energy source then a high efficiency process (e.g. Advanced Thermal Treatment or Incineration with Combined Heat and Power) needs to be used, or the RDF needs to be used as a fossil-fuel replacement fuel to establish any environmental benefit over directly combusting the residual waste in an incinerator[11]. Not all ATT or incineration processes will offer the efficiencies appropriate.

The advantage of co-combusting RDF at power stations or other large thermal processes is that the infrastructure may already be in place; a disadvantage is that the outlet for the fuel is subject to obtaining a contract of sufficient duration and tonnage, with a commercial partner.

The co-combustion of RDF is a relatively young market in the UK. Cement kilns were early entrants into the market for RDF and are now being followed by other large industrial energy users and the power generation sector which between them are likely to provide the majority of potential capacity for using RDF. There is however, competition from other wastes to be processed within industrial processes including tyres, some hazardous wastes, secondary liquid fuels etc. Consequently it is expected that there may be competition (and competitive gate fees) for acceptance of RDF in intensive energy using industries.

As a developing market there are also some potential risks in terms of the operations of large thermal facilities accepting RDF from mixed waste processing as a fuel source due to the variability of the composition of the waste. Work on standards and specifications for SRF have gone some way to address these concerns. Waste contractors are establishing relationships with the cement industry and other power intensive industries, meeting their specifications to provide a useful industrial fuel and waste recovery operation.

Renewable Energy

RDF is classified as a waste and therefore any facility using the fuel will be subject to the requirements of the Industrial Emissions Directive (IED)[12]. As with the cement industry, power stations would need to be IED compliant. Operators who combust waste would need to comply with Annex VI of the IED. This would represent a significant capital investment for the industry. However, IED only requires an

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[11] In energy balance terms the Orchid MHT process (part funded as a Demonstrator by Defra) yielded a similar overall energy balance to incineration of raw MSW, however some of the energy benefit derived from the MHT process was from recycling savings as a result of materials separation, which is higher up the waste hierarchy.

[12] The Industrial Emissions Directive (2010/75/EU), set a target for transposition no later than 6th January 2013, is a recast of seven previous directives including the Waste Incineration Directive (WID) (2000/76/EC).

operator to upgrade those facilities at a power station in which waste is handled to Annex VI standards. If an operator has more than one boiler then only one would need to be upgraded. This might make RDF a more attractive option for the power generation industry. The waste and energy generation industries are starting to work together in order to generate electricity from RDF, for example the Barnsley, Doncaster and Rotherham (BDR) PFI procurement Shanks and Scottish and Southern Energy have plans to use RDF from the waste treatment proposals at Ferrybridge Power Plant[13].

Electricity generated from the biodegradable fraction of waste in certain technologies is eligible for support under the Renewables Obligation (RO). Electricity recovered from the biomass component of RDF qualifies for support if it is generated in 'advanced conversion technologies', including pyrolysis or gasification plant (see the Advanced Thermal Treatment Brief), or in a conventional combustion facility with Good Quality Combined Heat and Power (CHP).

Up-to-date information regarding RDF and RO can be obtained from the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/renew_obs/renew_obs.aspx.

[13] See http://bdronline.co.uk/tag/3se/ for more information about the proposals and consortium.

4. Track Record

4.1 Introduction

The autoclave process has been used to treat clinical waste for many years and is a proven and effective technology for this waste. It has also been used for many years to sterilise hospital and surgical equipment. Several MHT plant are now operational for MSW derived feedstocks. Listed below are some examples of MHT processes currently in the marketplace. Table 4 lists examples of proposed, operational and trial facilities in England & Wales.

Contractor / Technology	Location	Capacity	Feedstock	Status
Aero Thermal – AAD (Autoclave and AD)	Lee Moor, Plymouth	75,000tpa	Mixed MSW	Planning permission granted. Expected operational in 2013.
Graphite Resources – Autoclave and Composting	Derwenthaugh, Near Newcastle	320,000tpa	Mixed MSW / Industrial	Operational.
Orchid Environmental – Thermal Drum	Huyton, Merseyside	80,000tpa	Mixed MSW	Trial facility from 2008 to 2011 under Defra NTDP, now closed.
Orchid Environmental – Thermal Drum	Bexley, South East London	160,000tpa	Mixed MSW	Expected operation early 2013. LWARB funding provided.
Orchid Environmental – Thermal Drum	Shotton, North Wales	160,000tpa	Mixed MSW	Planning granted in 2008. Expected operational summer 2012 at cost of £20m.
Shanks / Babcock Environmental Engineering – Autoclave and AD	South Kirkby, Wakefield	145,600tpa	Mixed MSW	Site works commenced. Planning permission granted. Permit expected in Autumn 2012.
Sterecycle – Autoclave	Rotherham	130,000tpa	Mixed MSW	Operational since June 2008. Expansion plans in place to 200,000tpa.

Sterecycle – Autoclave	Cardiff	200,000tpa	Mixed MSW	Planning permission granted.
Sterecycle – Autoclave	Harlow, Essex	240,000tpa	Mixed MSW	Planning permission granted.

Table 4: Examples of MHT Plant in England and Wales

4.2 Case Studies

AeroThermal Group Limited - Advanced Anaerobic Digestion (AAD) Technology

AeroThermal's AAD technology consists of a front-end autoclave technology with back-end anaerobic digestion designed to significantly increase the generation of biogas from the organic fraction of waste materials. The autoclave process provides for the pre-processing of organic wastes, and the separation of recyclable materials if processing mixed residual wastes. Post-autoclave, the organic fraction of the waste has been broken down and reverted back to its original cellulose form. The lignin compound of the organic fraction then is attacked and the material cell structure is changed, so the now "hydrolysed" material is well suited to complement anaerobic digestion. A traditional anaerobic digestion arrangement is then utilised to process the hydrolysed material and generate biogas.

The autoclave itself utilises "direct steam injection" (with a steam contact time of 45 minutes) and sterilises everything within the pressure vessel, which enables processing of totally unsorted municipal wastes.

AeroThermal secured its first planning permission in 2011 for a 75,000 tonne per annum facility in Lee Moor, near Plymouth in Devon known as "AAD (South West) Ltd". The plant utilises redundant kaolin settlement tanks for the AD process and existing buildings to house a two-line autoclave arrangement with electricity fed into the national grid by utilising an existing grid connection. The resulting digestate produced from the Lee Moor facility is intended to be applied for the restoration of the china clay quarry operated by Imerys Minerals Ltd at Lee Moor.

Shanks / Babcock Environmental Engineering

As part of a £750m procurement in Wakefield, expected tosigned in January 2013, Shanks/Babcock propose to build a 145,600tpa facility in South Kirkby that will combine autoclaving and Anaerobic Digestion. The facility will pre-sort waste to recover recyclables, and digest approximately 65,000tpa in the biogas facility. The new facility is expected to provide 70 new jobs. For more information on this facility, see Section 6.1 – Box 2

5. Contractual and Financing Issues

5.1 Grants and Funding

Development of MHT plant will involve capital expenditure of several million pounds. There are a number of potential funding sources for Local Authorities planning to develop such facilities, including:

Capital Grants: general grants may be available from national economic initiatives and EU structural funds;

Prudential Borrowing: the Local Government Act 2003 provides for a 'prudential' system of capital finance controls, which is covered in detail by the Chartered Institute of Public Finance and Accountancy (CIPFA) 2009 Prudential Code for Capital Finance;

Waste Infrastructure (WI) credits and Private Sector Financing: waste authorities were able to obtain grant funding from central Government to support the expenditure required to deliver new facilities.. However, there is no intention to issue new WI credits at the date of this publication;

Other Private-Sector Financing: a contractor may be willing to enter a contract to provide a new facility and operate it. The contractor's charges for this may be expressed as gate fees;

Existing sources of local authority funding: for example from National Non-Domestic Rate payments (distributed by central government)[14], credit borrowing where government credit approvals are received, local tax rising powers (council tax), and income from rents, fees, charges and asset sales (capital receipts). In practice capacity for this will be limited.

The Government is encouraging the use of different funding streams, otherwise known as a 'mixed economy' for the financing and procurement of new waste infrastructure to reflect the varying needs of local authorities. The Government Green Investment Bank is investing in waste infrastructure. This option may provide financing for appropriate projects moving forward.

[14] Except, for example, in 'Core Cities' where authorities may be eligible for infrastructure support through the application of business rates under the 'New Development Deals' and 'Economic Investment Funds' mechanisms of the Governments City Deals programme. See 'Unlocking Growth in Cities: City Deals – Wave 1', HM Government Cabinet Office, July 2012.

5.2 Contractual Arrangements

Medium and large scale municipal waste management contracts, since January 2007, are likely to be procured through the EU Competitive Dialogue (CD) programme under the Public Contact Regulations[15]. This is dialogue between an authority and the bidders with the aim of developing a suitable technical or legal position against which all the bidders can submit a formal bid. More information on CD is available from the Local Partnership website at http://www.localpartnerships.org.uk/PageContent.aspx?id=9&tp=Y.

The available contractual arrangement between the Private Sector Provider (PSP) and the waste disposal authority (or partnership) may be one of the following:

<table>
<tr><th>Design</th><th>Build</th><th>Operate</th><th>Finance</th><th>Contractual arrangement description</th></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>Separate Design; Build; Operate; and Finance: The waste authority contracts separately for the works and services needed, and provides funding by raising capital for each of the main contracts. The contract to build the facility would be based on the council's design and specification and the council would own the facility once constructed.</td></tr>
<tr><td colspan="2">A</td><td>B</td><td>C</td><td>Design and Build; Operate; Finance: A contract is let for the private sector to provide both the design and construction of a facility to specified performance requirements. The waste authority owns the facility that is constructed and makes separate arrangements to raise capital. Operation would be arranged through a separate Operation and Maintenance contract.</td></tr>
<tr><td colspan="3">A</td><td>B</td><td>Design, Build and Operate; Finance: The Design, Build, Operation and Maintenance contracts are combined. The waste authority owns the facility once constructed and makes separate arrangements to raise capital.</td></tr>
<tr><td colspan="4">A</td><td>Design, Build, Finance and Operate (DBFO): This contract is a Design, Build and Operate but the contractor also provides the financing of the project. The contractor designs, constructs and operates the plant to agreed performance requirements. Regular performance payments are made over a fixed term to recover capital and financing costs, operating and maintenance expenses, plus a reasonable return. At the end of the contract, the facility is usually transferred back to the client in a specified condition.</td></tr>
<tr><td colspan="4">A</td><td>DBFO with WI: This is a Design, Build, Finance and Operate contract, but it is procured under the Waste Infrastructure (WI) Initiative. In this case the waste</td></tr>
</table>

[15] The Public Procurement (Miscellaneous Amendments) Regulations 2011 (SI 2011/2053).

	authority obtains grant funding from Government as a supplement to finance from its own and private sector sources. The WI grant is only eligible for facilities treating residual waste and is payable once capital expenditure is incurred.

Table 5: Available Contractual Arrangement Configurations

The majority of large scale waste management contracts currently being procured in England are DBFO contracts and many waste disposal authorities in two tier English arrangements (County Councils) are currently seeking to partner with their Waste Collection Authorities (usually District or Borough Councils). Sometimes partnerships are also formed with neighbouring Unitary Authorities to maximise the efficiency of the waste management service and make the contract more attractive to the Private Sector Provider, for example the Greater Manchester Waste Disposal Authority combining nine of ten unitary authorities in the city region.

Contracts are becoming more 'output' led since contractors increasingly have to build proposals around obligated targets placed on authorities such as for recycling yields.

Before initiating any procurement or funding process for a new waste management treatment facility, the following issues should be considered: performance requirements; waste inputs; project duration; project cost; available budgets; availability of sites; planning status; interface with existing contracts; timescales; governance and decision making arrangements; market appetite and risk allocation.

A fundamentally important issue in consideration of the bankability of any waste treatment project is the acceptable risk profile of the procurement in question (i.e. risk allocation within the contract), and project risk in terms of ability to deliver the infrastructure required (planning, technology, availability, reliability and available secure markets for process outputs). There are a number of steps that may be taken by contracting authorities and waste management solution providers in order to minimise the risk profile and help in the delivery of the project as a whole. The following examples of further reading explore these issues:

- 'Rubbish to Resource: Financing New Waste Infrastructure', Associate Parliamentary Sustainable Resource Group (APSRG), September 2011, available at http://www.policyconnect.org.uk/apsrg/rubbish-resource-financing-new-waste-infrastructure.
- Local Authority funding examples http://www.defra.gov.uk/environment/waste/local-authorities/widp/pfi-projects/.
- Guidance documents on waste management procurement http://www.defra.gov.uk/environment/waste/local-authorities/widp/widp-guidance/.
- For Works Contracts: the NEC3 contracts (available at www.neccontract.com – formerly the Institute of Civil Engineers 'New Engineering Contract').

- Local Partnerships provide guidance to local authorities concerning partnership opportunities and achieving optimum service delivery and efficiencies, http://www.localpartnerships.org.uk/PageContent.aspx?id=198&tp=Y.

6. Planning and Permitting Issues

This section contains information on the planning and regulatory issues associated with MBT facilities based on legislative requirements, formal guidance and good practice.

6.1 Planning Application Requirements

All development activities are covered by Planning laws and regulations. Minor development may be allowed under Permitted Development rights but in almost all cases new development proposals for waste facilities will require planning permission.

Under certain circumstances new waste facilities can be developed on sites previously used for General Industrial (B2) or Storage and Distribution (B8) activities. In practice even where existing buildings are to be used to accommodate new waste processes, variations to existing permissions are likely to be required to reflect changes in traffic movements, emissions etc.

Under changes to the planning system introduced in 2006 all waste development is now classed as 'Major Development'. This has implications with respect to the level of information that the planning authority will expect to accompany the application and also with respect to the likely planning determination period. The target determination periods for different applications are:

- Standard Application – 8 weeks
- Major Development – 13 weeks
- EIA Development – 16 weeks

The principal national planning policy objectives associated with waste management activities are set out in Planning Policy Statement 10 'Planning for Sustainable Waste Management' (PPS 10) published in March 2011. Supplementary guidance is also contained within the Companion Guide to PPS 10[16]. Both of these documents can be accessed via the Department of Communities and Local Government (DCLG) website.

It should be noted that with the publication of the National Planning Policy Framework (NPPF) in March 2011, virtually all pre-existing Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) notes have now been replaced. However, as the Framework does not contain specific waste policies since

[16] http://www.communities.gov.uk/documents/planningandbuilding/pdf/150805.pdf.

these will be published alongside the national waste management plan for England, PPS 10 will remain in place until the new Plan is adopted.

PPS 10 places the emphasis on the plan led system, which should facilitate the development of new waste facilities through the identification of sites and policies in the relevant local development plan. Separate guidance on the content and validation of planning applications is also available from DCLG through their website[17]. Individual Planning Authorities can set out their own requirements with respect to supporting information and design criteria through Supplementary Planning Documents linked to the Local Development Framework (which is likely to be referred to as the 'Local Plan' in the future under the NPPF system). It is important that prospective developers liaise closely with their Local Planning Authorities over the content and scope of planning applications.

Key Issues

When considering the planning implications of an MHT plant the key issues that will need to be considered are common to most waste management facilities, and are:

- Plant or Facility Siting;
- Traffic;
- Air Emissions and Health Effects;
- Dust and Odour;
- Flies, Vermin and Birds;
- Noise;
- Litter;
- Water Resources;
- Design Principles and Visual Intrusion;
- Public Concern; and
- Size and Landtake.

A brief overview of the planning context for each of these issues is provided in the following pages.

Plant or Facility Siting

Mixed waste processing (such as MHT) can take place in many different buildings at a variety of locations. PPS 10 and its Companion Guide contain general guidance on the selection of sites suitable for waste facilities. This guidance does not differentiate between facility types and states:

[17] http://www.communities.gov.uk/documents/planningandbuilding/pdf/1505220.pdf.

"Most waste management activities are now suitable for industrial locations, many fall within the general industrial class in the Use Classes Order (as amended).[18]

The move towards facilities and processes being enclosed within purpose designed buildings, rather than in the open air, has accentuated this trend. The guidance goes on to state:

"With advancement in mitigation techniques, some waste facilities may also be considered as light industrial in nature and therefore compatible with residential development. In more rural areas, redundant agricultural and forestry buildings may also provide suitable opportunities, particularly for the management of agricultural wastes".

The following general criteria would also apply to the siting of new MHT plants:

- Buildings which might house MHT can be similar in appearance and characteristics to various process industries. It would often be suitable to locate facilities on land previously used for general industrial activities or land allocated in development plans for such (B2) uses;
- Facilities are likely to require good transport infrastructure. Such sites should either be located close to the primary road network or alternatively have the potential to be accessed by rail or barge;
- The location of such plants together with other waste operations such as MRFs and ATTs can be advantageous. The potential for co-location of such facilities on resource recovery parks or similar is also highlighted in the Companion Guide; and
- General concerns about bio-aerosols from biological processing may require an MHT site to be located away from sensitive receptors.

Traffic

MHT facilities may be served by large numbers of Large (Heavy) goods vehicles (LGVs) (depending on the scale of the facility) with a potential impact on local roads and the amenity of local residents. It is likely that the site layout/road configuration will need to be suitable to accept a range of light and heavy vehicles. Mixed waste processing operations are designed to split a mixed waste stream into a number of individual streams some of which are low tonnage or low bulk density. As a result traffic implications may be greater than initially considered. For a 50,000tpa capacity plant, 20-30 Refuse Collection Vehicles per day would be anticipated. This would be reduced if bulk transport systems are used.

[18] For more information on change of use classes see, http://www.planningportal.gov.uk/permission/commonprojects/changeofuse/

Air Emissions / Health Effects

Concerns regarding air emissions and health impacts for this type of facility are most likely to be linked to traffic movements, and potentially vapours from the release of pressure from the autoclave vessel. The relatively high temperatures in the autoclave vessel should be sufficient to eliminate the risks posed by micro-organisms. The facility should be designed to ensure that there are no significant releases of volatile organic compounds or particulate matter from the autoclave vessel.

Steam-raising plant would also need to be designed to ensure that there are no significant effects on local air quality, although this should not normally be problematic.

MHT processes result in the production of a fibrous material. This could be recycled or disposed to landfill as a stabilised waste material, or could be burnt as a refuse derived fuel. Combustion of RDF is subject to the stringent emission control requirements of the Industrial Emissions Directive and would result in a similar range of emissions to those from the incineration of waste, although this may well take place at a separate facility to the MHT process.

Dust / Odour

Any waste management operations can give rise to dust and odours. The control of odour from waste reception areas and from the autoclave component of MHT facilities needs careful consideration. Because MHT facilities are located within an enclosed building, potential odour emissions can normally be controlled through the building ventilation system. If there is a combustion element to the facility, odorous air extracted from process areas can be used in the combustion stage. If there is no combustion element, the process of air extraction and ventilation will nevertheless dilute odorous air. It may be necessary to disperse extracted air from an elevated point, and/or treat the air.

Bio-filtration systems, thermal systems or other thermal abatement plant can be used to control the odours in air extracted from working areas if required. The need for, and design of odour control systems would need to be assessed on a site-by-site basis.

Flies, Vermin and Birds

The enclosed nature of MHT operations will limit the potential to attract vermin and birds. However, during hot weather it is possible that flies could accumulate, especially if they have been brought in during delivery of the waste.

Effective housekeeping and on site management of tipping and storage areas is essential to minimise the risk from vermin and other pests. In some operations waste heat from the process may be passed through fresh inputs waste so temperatures exceed levels at which flies can survive. Similarly, waste storage time in some MHT plant is designed to be less than the breeding cycle of vermin such as rats.

Noise

Noise is an issue that will be controlled under permitting regulations and noise levels at nearby sensitive receptors can be limited by a condition of a planning permission. The main contributors to noise associated with MHT are likely to be:

- Hydraulic motors that drive the treatment vessel tilting mechanisms;
- The pressure generator;
- Loading vehicle and bucket moving waste around the transfer hall;
- Loading operations for the vessels;
- Vehicle movements / manoeuvring;
- Traffic noise on the local road networks;
- Mechanical processing such as waste preparation, screens, trommels and air classification; and
- Air extraction fans and ventilation systems.

Litter

Any waste which contains plastics and paper is more likely to lead to litter problems. With MHT, litter problems can be minimised if good working practices are adhered to, vehicles use covers and reception and processing are undertaken indoors.

Water Resources

Common to many new waste treatment processes the enclosed nature of the operations significantly reduces the potential for impacts on the water environment. The greatest potential for pollution to surface/ground water is linked to the arrangement for delivery of waste and the collection of processed materials. Disperse pollution to water is unlikely although wash down waters or liquid within the waste will need to be managed using an appropriate drainage system on site. Under normal circumstances the risks are very low.

Some water is likely to be used in MHT processes: either in the form of steam injected into the process; or simply adding water to the waste to a pre-determined moisture content. Hot exhaust gases from the process, usually containing water vapour, are often cited as being reused within the process, and those which are vented, do so via a condenser. This would produce a liquid effluent stream; such process water will need to be managed. As part of the permitting requirements for a facility a management plan would be required for managing process effluent.

Design Principles and Visual Intrusion

Current planning guidance in PPS 10 emphasises the importance of good design in new waste facilities, the importance of which echoed by the NPPF in relation to the design of the built environment as a whole. Good design principles and architect input to the design and physical appearance of large scale buildings and structures such as MHT plant is essential. Buildings should be of an intrinsically high standard and should not need to be screened in most cases.

Good design principles also extend to other aspects of the facility including having regard to issues such as:

- Site access and layout;
- Energy efficiency;
- Water efficiency; and
- The general sustainability profile of the facility.

Construction of any building will have an effect on the visual landscape of an area. Visual intrusion issues should be dealt with on a site specific basis and the following items should be considered:

- Direct effect on landscape by removal of items such as trees or undertaking major earthworks;
- Site setting – is the site close to listed buildings, conservation areas or sensitive viewpoints;
- Existing large buildings and structures in the area;
- The potential of a stack associated with some air clean up systems for mixed waste processing operations may impact on visual intrusion;
- Appropriate use of landscaping features (trees, hedges, banks etc.) not for screening but to enhance the setting of the facility;
- The number of vehicles accessing the site and their frequency; and
- Many of these facilities are housed in ‘warehouse’ type clad steel buildings, however use of good design techniques can help minimise visual intrusion.

Box 2 summarises the key planning issues and overall design for a proposed MHT and AD facility in Wakefield.

Box 2: Proposed Shanks-Babcock Facility, South Kirkby, Wakefield

- Facility designed to handle 145,600tpa of MSW using a single autoclave vessel combined with Anaerobic Digestion. AD expected to handle c. 65,000tpa of the input waste. A pre-sorting MRF will be used at the front end of the system to recover metals, plastics and an RDF.

- Total site footprint is 8.9ha with main Autoclave/AD building covering almost 4ha.
- Part of a total £750m PFI procurement, with contract expected to be signed between consortium and Wakefield Council in July 2012.
- Original planning approval granted in November 2008, with 'early works' started in October 2011.
- The planning application was submitted in June 2008 and permission granted in November 2008. The EIA commenced in January 2008 and was submitted as part of the planning application in June 2008. The permit was submitted in February 2012 and was confirmed as 'Duly Made' in March. It is expected to be issued in draft form in November 2012.
- The facility is to be located on what was formerly the site of the South Kirby Coal Mine. This mine was closed in 1988 and the area remediated in 2000. The village of South Kirby is located to the east of the site at 500m and the site is separated from the village by landscaping of former colliery spoil. The surrounding area is designated for commercial development and the first building has been completed which is a Training and Enterprise centre.
- The facility is to be housed within an industrial style building which is approx. 13m to eaves and 16m to ridge. The stacks will extend approximately 4m above ridge level.

For more information on the role of good design in waste facilities, please see the Defra publication 'Designing Waste Facilities: A Guide to Modern Design in Waste', which can be found at http://archive.defra.gov.uk/environment/waste/localauth/documents/designing-waste-facilities-guide.pdf.

Public Concern

Section 7, Social and Perception Issues, relates to public concern. In general public concerns about waste facilities relate to amenity issues (odour, dust, noise, traffic, litter etc.). For facilities that form part of a larger development which include thermal treatment of the RDF, health concerns can also be a perceived issue. Public concern founded upon valid planning reasons (known as 'material considerations') can be taken into account when considering a planning application.

Size and Landtake

Table 6 shows the land area required for the building footprint and also for the entire site (including supporting site infrastructure) for MHT facilities, although this is likely to vary greatly depending on the specific technology used and the quantities of waste being handled. For a number of the facilities listed existing buildings have been adapted to accommodate the MHT technology, therefore for some locations the full buildings will not be utilised.

Facility	Capacity	Buildings Area	Total Landtake
Lee Moor (MHT with AD)	75,000 tpa	9,590 m^2 (3,400 m^2 main autoclave building)	44,516 m^2
Wakefield (MHT with AD)	150,000 tpa	3,965 m^2	8,900 m^2
Shotton (MHT)	160,000 tpa	6,022 m^2	-
Harlow (MHT)	240,000 tpa	24,300 m^2	69,500 m^2
Rotherham (MHT)	<200,000tpa	2,829 m^2	~30,000 m^2
Note. All data taken from planning application documents.			

Table 6: Landtake of MHT Facilities

An average MHT plant may have a height of 10-20m. Some facilities may also have a stack if using particular air clean-up systems, potentially increasing overall height.

Environmental Impact Assessment

It is likely that an Environmental Impact Assessment (EIA) will be required for an MHT facility as part of the planning process. Whether a development requires a statutory EIA is defined under the EIA Regulations 2011[19]. Care should be taken with the difference in meaning between 'treatment' and 'disposal' when applying these regulations. An MHT facility is a waste treatment facility and is not a waste disposal installation. The existing additional guidance in DETR circular 02/99 is to be withdrawn following the publication of the new EIA Regulations; however no proposals have yet been made as to a replacement.

6.2 Licensing and Permitting

The Environmental Permitting Regulations (EPR) have been amended on several occasions[20] and combined the previously separate Pollution Prevention and Control (PPC) and Waste Management Licensing (WML) Regulations. All commercial scale MHT facilities require a permit. There are Standard Rules designed to deliver a standard Environmental Permit, which can save time and money for the operator,

[19] 'The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (SI 2011/1824).
[20] The latest amendment is the Environmental Permitting (England and Wales) (Amendment) Regulations 2012

where the rules apply to the treatment facility in question. The Standard Rules document no. 18 applies to Non Hazardous Mechanical Biological (aerobic) Treatment facilities, and would also apply to some MHT processes[21]. Where the standard rules do not apply a bespoke permit is required.

It is the scope of the proposal, in addition to local environmental circumstances, that will determine the nature and complexity of the permit, and hence the process and, to a certain degree, timescale from initiation to permit determination. Furthermore in some instances multi-operator permits are needed where for example the MHT process may be operated by one contractor and an associated AD plant (for treating the fibre from the process) may be operated by another contractor, again such aspects can add time and complexity into the permitting process.

The process of obtaining an environmental permit is an initial step in an on-going management process for delivery of the requirements of the Permit and ensuring compliance and use of Best Available Techniques. This may include reporting, improvement plans and other on-going activities. There is also a facility within the regulations for the variation of Permits. In the case of municipal waste treatment facilities, where there is a significant operational life anticipated (15 – 30 years), the option to vary may be an important one to allow incorporation of new technology or methods within the installation. In addition, the Permit may be transferred or surrendered (e.g. at the end of a projects operational life). These aspects should be appropriately considered and will involve management processes and reporting / actions as required by the Environment Agency (for example completion reports, decommissioning plans, etc.).

For more information, please see the permitting pages of the Environment Agency's site at http://www.environment-agency.gov.uk/business/topics/permitting/default.aspx.

Animal By-Products Regulation

Where waste containing animal by-products (e.g. food waste, catering waste etc.) is treated and the outputs utilised, for example to apply to land, then the Animal By-Products legislation[22] will usually apply. This legislation requires certain treatment methods and operational conditions and is explained in more detail in the Mechanical Biological Treatment Brief.

[21] For further information, see http://www.environment-agency.gov.uk/business/topics/permitting/118404.aspx

[22] The Animal By-Products (Enforcement) and Transmissible Spongiform Encephalopathies (England) (Amendment) Regulations 2011 (SI 2011/2681).

7. Social and Perception Issues

This section contains a discussion of the social and public perception considerations of MHT facilities.

7.1 Social Considerations

Any new facility is likely to impact on local residents and may result in both positive and negative impacts. Potential impacts on local amenity (odour, noise, dust, landscape) are important considerations when siting any waste management facility. These issues are examined in more detail in the Planning and Permitting chapter of this Brief. Transport impacts associated with the delivery of waste and onward transport of process outputs may lead to impacts on the local road network. The Planning and Permitting chapter of this Brief provides an estimate of potential vehicle movements.

An MHT facility may also provide positive social impacts in the form of employment and educational opportunities. Employment figures for these types of facilities would be dependent on the size of the facility and shift patterns during operation. A provision for both unskilled and semi-skilled workers as well as professionals will be required. A typical MHT plant with a capacity of 100,000-150,000tpa would provide employment opportunities for 25-75 persons depending on the waste handling requirements. This may be increased if manual picking operations are used. The plant may be operated on a shift system, for example to allow for 24 hour operations. These facilities are also likely to provide vocational training for staff. Many new facilities are built with a visitors centre to enable local groups to view the facility and learn more about how it operates.

7.2 Public Perception

Changes to waste management arrangements in local areas as a result of continually improving recycling and landfill diversion performance, often creates a higher profile for the service through the media. Many people as a result of greater publicity, targeted education and more comprehensive waste services are participating, to a greater extent, in waste reduction and recycling activities. This leads to a greater level of engagement in waste management activity. There is still, however, a significant challenge with regard to acceptance of waste management facilities. New waste facilities of whatever type are rarely welcomed by residents close to where the facility is to be located.

Public opinion on waste management issues is wide ranging, and can often be at extreme ends of the scale. Typically, the most positively viewed waste management options for MSW are recycling and composting. However, this is not necessarily reflected in local attitudes towards the infrastructure commonly required to process waste to compost, or sort mixed recyclables, or indeed to have an extra wheeled bin or box. It should be recognised that there is always likely to be some resistance to any waste management facility within a locality, despite the necessity to have the capacity to deal with societies waste.

Overall, experience in developing waste management strategies has highlighted the importance of proactive communication with the public over waste management options. The use of realistic and appropriate models, virtual 'walk – throughs' / artists impressions should be used to accurately inform the public. Good practice in terms of public consultation and engagement is an important aspect in gaining acceptance for planning and developing waste management infrastructure.

At present there is a relatively low level of understanding of the concept of MHT by the public, since it is a more recent concept and it is unclear as to the public perception of this option. It may be that, as a mixed waste processing facility, MHT will have a similar perception as that for Mechanical Biological Treatment. Alternatively, there may be a more negative perception due to distrust of 'thermal' based techniques.

The Associate Parliamentary Sustainable Resource Group (APSRG) have produced a report concerning waste infrastructure developments including 'incentivising community buy-in'[23], which provides examples of waste infrastructure development in the UK with the techniques utilised to gain public approval.

[23] 'Waste Management Infrastructure: Incentivising Community Buy-In', APSRG, February 2011. More information and download available at http://www.policyconnect.org.uk/apsrg/waste-management-infrastructure-incentivising-community-buy.

8. Cost

It should be noted that the costs of MHT systems are sensitive to the markets and outlets for recycled materials, RDF and compost-like outputs that are produced by different processes. Partnerships between MHT operators and potential users of outputs should be established at the earliest opportunity and indeed care should be taken to ensure plant can deliver materials of sufficient quality.

There is little published information on the cost of MHT facilities. Technology suppliers suggest between £25-45 per tonne operating costs for the autoclave/separation components of the process. Capital costs are estimated at around £15-20 million for a 100,000tpa facility based on media articles concerning planned facilities.

These facilities need to be viewed as large capital investments with a lifespan of not less than 10 or more usually 20 years. Any building housing MHT processes should have sufficient capacity to add new separation equipment to enable response to changing market demands for materials and fuels.

It is vital in any negotiation that a true appreciation of the cost of essential repairs and refurbishment is taken into account over the lifetime of the project. Additionally the developing markets (and risks associated with market uncertainty) for products or outputs of these processes needs to be reflected in cost models.

9. Contribution to National Targets

9.1 Recycling

Recyclate derived from a mixed waste processing plant (including MHT) of household waste qualifies as recycling, and therefore would contribute to national and local targets. Typical materials extracted for recycling from an MHT process may include glass, metals and hard plastics. The material must pass to the reprocessor (and not be rejected for quality reasons) to count as recycling. The same would also apply to glass used as an aggregate. It should be noted that some materials may have market limitations due to being derived from a mixed MSW source.

The revised Waste Framework Directive includes national targets for recycling and composting for household waste set at 50% for 2020. At present the UK (and England) are on course to meet this target.

9.2 Composting

Where MHT processes are configured to produce an organic-rich (biodegradable) stream to be further composted to produce a low grade compost-like output (CLO), this material may (but is 'unlikely to' see below) qualify as composting under Defra policy. The CLO could be utilised in applications such as landfill restoration or some bulk fill uses (provided that the appropriate engineering and quality standards are met).

These materials will only qualify as 'composted' under recycling guidance[24] if the output meet the appropriate criteria for use in the intended application. Some waste management contractors have demonstrated that there is a market for these materials, however the current guidance states the criteria for composting should be "a product that has been sanitised and stabilised, is high in humic substances, and can be used as a soil improver, as an ingredient in growing media or blended to produce a top soil that will meet British Standard BS2882 incorporating amendment no.1". It also states that it is 'unlikely that products of a Mechanical Biological Treatment process will meet this definition'. A similar policy position is likely to apply to Mechanical Heat Treatment outputs. However if the definition could be achieved then the product would contribute towards recycling and composting targets.

[24] http://www.wastedataflow.org.

9.3 Landfill Directive Diversion Performance

The European Landfill Directive and the UK's enabling act, the Waste & Emissions Trading Act 2003, require the diversion of biodegradable municipal waste (BMW) from landfill. MHT systems have the potential to divert BMW from landfill. Any outputs that are recycled, used as soil conditioner (under an exemption) or burnt as RDF and which are not landfilled will count directly towards diversion targets. The ability of MHT to meet a high level of landfill diversion will therefore depend upon the availability of markets for, and the quality of, the process outputs.

However, MHT plant may contribute to partial bio-stabilisation of waste. The Environment Agency (EA) has developed a methodology to determine the 'stability' or 'biodegradability' of any outputs from waste treatment plant which are sent to landfill. This test can be used to determine the amount of biodegradable material being landfilled.

Guidance on monitoring of MBT and other treatment processes, like MHT, for the purposes of landfill diversion targets has been prepared by the Environment Agency, http://publications.environment-agency.gov.uk/PDF/SCHO1009BREB-E-E.pdf.

As the requirements of the Landfill Directive relate to the amount of biodegradable material landfilled, the stability of materials diverted from landfill via MHT will not need to be measured.

9.4 Recovery

MHT technologies will only contribute towards recovery targets through the waste streams that are sent to an energy recovery process. This may be either RDF combusted or degraded in a thermal plant (e.g. Energy from Waste, Advanced Thermal Treatment or co-combusted in a Cement Kiln / Industrial process), or the biological stream that is processed in an Anaerobic Digestion plant.

The Government national recovery targets set in Waste Strategy for England 2007 still apply: 67% by 2015; and 75% by 2020.

9.5 Renewables

The Renewables Obligation (RO) was introduced in 2002 to promote the development of electricity generated from renewable sources of energy. The Obligation requires licensed electricity suppliers to source a specific and annually increasing percentage of the electricity they supply from renewable sources, demonstrated by Renewables Obligation Certificates (ROCs). The target is currently set at 15% by 2020. In essence, the RO provides a significant boost to the market price of renewable electricity generated in eligible technologies. The RO will close to new operators at the end of the 2016/17 financial year. Those already accredited under the RO will continue to receive their full lifetime of support until the scheme closes in 2037.

Orchid 'Renewable Power Fuel', image courtesy of Orchid Environmental

Electricity generated from the biomass (renewable) fraction of waste (including RDF) in 'advanced conversion technologies' (including AD, gasification and pyrolysis) or incineration plant with good quality heat and power is eligible for support under the RO. Therefore, facilities which combine MHT processes with conversion technologies like Anaerobic Digestion for the biodegradable fraction of waste have the opportunity to generate additional revenue under the scheme providing all qualifying requirements are met. As the value of a ROC is not fixed, the long term value would need to be assessed in detail to determine its overall financial value to the project, in addition to other renewable energy incentives available.

An MHT facility that incorporates an advanced conversion technology may also be eligible under the DECC Feed-in-Tariffs and Renewable Heat Incentive schemes. The Feed-in-Tariffs (FiTs) were introduced by DECC in April 2010 with the intention to encourage deployment of small-scale low-carbon energy generation. Anaerobic Digestion qualifies for FiTs provided energy production is below 5MW per annum. There are three financial benefits associated with FiTs:

1. Generation tariff – Payment per KW energy produced from chosen electricity supplier.
2. Export tariff – If the energy is not used on-site it may be exported to the national grid.
3. Energy bill savings – If the energy generated is used on-site.

Renewable Heat Incentives (RHI) is a £25m support scheme to provide support to the installation of renewable technologies for heat generation, implemented by

DECC. The second stage of the scheme is under development at the time of this publication, and further advice will be available on the DECC website.

Further information on the RO, FiTs and RHI can be retrieved from the following sources:

- Renewables Obligation (RO) see the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/renew_obs/renew_obs.aspx.
- Renewable Heat Incentive (RHI) see the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx.
- Feed-in-Tariffs scheme (FITs) see the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/feedin_tariff/feedin_tariff.aspx.

10. Further Reading and Sources of Information

DCLG planning guidance: http://www.communities.gov.uk/planningandbuilding/planningenvironment/.
'Designing Waste Facilities: A Guide to Modern Design in Waste', Defra, 2008: http://archive.defra.gov.uk/environment/waste/localauth/documents/designing-waste-facilities-guide.pdf.
'England's Waste Infrastructure: Report on facilities covered by environmental permitting: 2010', Environment Agency, October 2011: http://www.environment-agency.gov.uk/research/library/data/134327.aspx.
'Integrated Pollution Prevention and Control, Reference Document on Best Available Techniques for the Waste Treatments Industries, European Commission' – Directorate General Joint Research Centre, August 2006: http://eippcb.jrc.es/reference/BREF/wt_bref_0806.pdf.
Local Authority funding: http://www.defra.gov.uk/environment/waste/local-authorities/widp/ .
Local Partnerships guidance: http://www.localpartnerships.org.uk/PageContent.aspx?id=198&tp=Y.
'Review of Environmental & Health Effects of Waste Management', Enviros Consulting Ltd, University of Birmingham, Open University & Maggie Thurgood, Defra, 2004: http://archive.defra.gov.uk/environment/waste/statistics/documents/health-report.pdf.
Renewables Obligation (RO), Renewable Heat Incentives (RHI) and Feed-in-Tariffs (FiTs) guidance: http://www.decc.gov.uk/en/content/cms/funding/funding_ops/funding_ops.aspx.

‘Rubbish to Resource: Financing New Waste Infrastructure’, Associate Parliamentary Sustainable Resource Group (APSRG), September 2011: http://www.policyconnect.org.uk/apsrg/rubbish-resource-financing-new-waste-infrastructure
‘Waste Management Infrastructure: Incentivising Community Buy-In’, APSRG, February 2011: http://www.policyconnect.org.uk/apsrg/waste-management-infrastructure-incentivising-community-buy.
WRATE (Waste and Resources Assessment Tool for the Environment): http://www.environment-agency.gov.uk/research/commercial/102922.aspx.

11. Glossary

Advanced Thermal Treatment (ATT)	Waste management processes involving medium and high temperatures to recover energy from the waste. Primarily pyrolysis and gasification based processes, excludes incineration.
Aerobic	In the presence of oxygen.
Anaerobic	In the absence of oxygen.
Anaerobic Digestion	A process where biodegradable material is encouraged to break down in the absence of oxygen. Material is placed in to an enclosed vessel and under controlled conditions the waste breaks down, typically into a digestate, liquor and biogas.
Animal By-Products Regulation	Legislation governing the processing of wastes derived from animal sources.
Biodegradable	Capable of being degraded by plants and animals.
Biodegradable Municipal Waste (BMW)	The component of Municipal Solid Waste capable of being degraded by plants and animals. Biodegradable Municipal Waste includes paper and card, food and garden waste, and a proportion of other wastes, such as textiles.
Biogas	Gas resulting from the fermentation of waste in the absence of air (methane / carbon dioxide).
Composting (Aerobic Digestion)	Biological decomposition of organic materials by micro-organisms under controlled, aerobic conditions, to form a relatively stable humus-like material called compost.
Co-combustion	Combustion of wastes as a fuel in an industrial or other (non-waste management) process.

Digestate	Solid and/or liquid product resulting from Anaerobic Digestion.
Feedstock	Raw material required for a process.
Floc	A small loosely aggregated mass of flocculent material. In this instance referring to Refuse Derived Fuel or similar.
Greenhouse Gas (GHG)	A term given to those gas compounds in the atmosphere that reflect heat back toward earth rather than letting it escape freely into space. Several gases are involved, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone, water vapour and some of the chlorofluorocarbons.
Green / Garden Waste	Waste vegetation and plant matter from household gardens, local authority parks and gardens and commercial landscaped gardens.
Incineration	The controlled thermal treatment of waste by burning, either to reduce its volume or toxicity. Energy recovery from incineration can be made by utilising the calorific value of the waste to produce heat and / or power.
In-Vessel Composting (IVC)	The aerobic decomposition of shredded and mixed organic waste within an enclosed container, where the control systems for material degradation are fully automated. Moisture, temperature, and odour can be regulated; and stable compost can be produced much more quickly than outdoor windrow composting.
Local Authority Collected Municipal Waste (LACMW)	Refers to the previous ‘municipal’ element of the waste collected by local authorities. That is household waste and business waste where collected by the local authority and which is similar in nature and composition as required by the Landfill Directive. This is the definition that will be used for LATS allowances.

Local Authority Collected Waste (LACW)	All waste collected by the local authority. This is a slightly broader concept than LACMW as it would include both this and non-municipal fractions such as construction and demolition waste. LACW is the definition that will be used in statistical publications, which previously referred to municipal waste.
Materials Recycling Facility / Materials Recovery Facility (MRF)	Dedicated facility for the sorting / separation of recyclable materials.
Mechanical Biological Treatment (MBT)	A generic term for mechanical sorting / separation technologies used in conjunction with biological treatment processes, such as composting.
Mechanical Heat Treatment (MHT)	A generic term for mechanical sorting / separation technologies used in conjunction with thermal treatment processes, such as autoclaving.
Municipal Solid Waste (MSW)	LACMW plus commercial and industrial waste similar to that generated by households which is collected by commercial operators (i.e. not by or on behalf of a local authority). This is the definition which will be used by the UK for reporting against EU landfill diversion targets. It includes all waste types included under European Waste Catalogue Code 20 and some wastes under Codes 15 and 19.
Recyclate/Recyclable Materials	Post-use materials that can be recycled for the original purpose, or for different purposes.
Recycling	Involves the processing of wastes, into either the same product or a different one. Many non-hazardous wastes such as paper, glass, cardboard, plastics and scrap metals can be recycled. Hazardous wastes such as solvents can also be recycled by specialist companies.
Refuse Derived Fuel	A fuel produced from combustible waste that can be stored and transported, or used directly on site to

(RDF)	produce heat and/or power.
Renewables Obligation	Introduced in 2002 by the Department of Trade and Industry, this system creates a market in tradable renewable energy certificates (ROCs), within each electricity supplier must demonstrate compliance with increasing Government targets for renewable energy generation.
Renewable Heat Incentives (RHIs)	A long-term tariff scheme to encourage the replacement of fossil fuel heating with renewable alternatives, led by the Department of Energy and Climate Change. It opened for applications in November 2011 and currently supports renewable heat installations in business, industry and the public sector as well as district heating schemes.
Solid Recovered Fuel	Refuse Derived Fuel meeting a standard specification (CEN 343).
Source-segregated/ Source-separated	Usually applies to household waste collection systems where recyclable and/or organic fractions of the waste stream are separated by the householder and are often collected separately.