Gloucestershire County Council

Waste Core Strategy

Technical Paper WCS-G

Waste Facility Types

Living Draft

January 2008

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Contents

Section 1
Introduction

1. This report sets out information in relation to the land and operational requirements for waste treatment facilities.

2. The evidence has been collated by the Waste Planning Authority in respect of the planning requirements for various types of waste management facilities.

3. It is based upon the Office of the Deputy Prime Minister (ODPM) publication 'Planning for Waste Management Facilities: A Research Study', August 2004 and updates the information provided in Chapter 4 'Facilities and Preferred Sites' of the adopted Gloucestershire Waste Local Plan.

4. The background evidence it provides on waste facility types will support the Preferred Options stage of the emerging Waste Core Strategy.

Section 2
Waste Facility Requirements

5. This section sets out information from national, regional and local sources in respect of site requirements for different waste technologies.

National Waste Policy

6. The Government published 'Waste Strategy for England 2007' on 24 May 2007. It sets out the Government's vision for sustainable waste management. A key aim of the document is to reduce waste by making products with fewer natural resources, thereby breaking the link between economic growth and waste growth. This requires that most products should be re-used or their materials recycled. The strategy also provides support for energy from waste technologies and discusses the future of landfill. Annex E of the Government's strategy provides summary guidance on energy from waste technology.

7. Planning Policy Statement 10: 'Planning for Sustainable Waste Management' (PPS10) and its companion guide discuss the role of the regional planning body and local waste planning authorities in identifying the requirement for waste management facilities, allocating sites and areas suitable for new and enhanced waste management facilities and identifying the type of facilities appropriate for the allocated sites or areas.

8. The Companion Guide to Planning Policy Statement 22: 'Renewable Energy' (PPS22) discusses the planning and development of renewable energy schemes across England. It details technologies available to recover energy from waste using biological and thermal processes. The biological processes covered are:
   - Anaerobic Digestion
   - Sewage Gas
   - Landfill Gas

   The thermal processes covered are:
   - Direct Combustion
   - Pyrolysis
   - Gasification
   - Combined Heat and Power

Regional Waste Strategy

9. The Regional Waste Strategy for the South West 2004-2020 contains policies on the provision of facilities for waste management in waste development plans.

   Appendix D gives an explanation of the technologies included in the Regional Waste Strategy. These are:
   - Materials Recovery/Recovery Facility (MRF)
   - Mechanical and Biological Treatment (MBT)
   - Mass Burn Incineration
   - Advanced Thermal Treatment (ATT)
   - Anaerobic Digestion (AD)
   - Composting

Waste Facility Requirements

10. The ODPM have prepared a document, ‘Planning for Waste Management Facilities: A Research Study’ (August 2004), which sets out the requirements of twelve different types of waste management facility.

11. The site requirements for each type of waste facility set out in this evidence report are based on the information provided in the ODPM report.

Local Policy

12. Gloucestershire County Council adopted the Gloucestershire Waste Local Plan in 2004. This is a site-specific plan that is not process or facility specific. It contains a section which provides information sheets on waste management options currently available and subsequently provides a matrix of facility requirements for each site.

Section 2.1
Composting
(Windrow and In-Vessel)

13. Composting is the aerobic decomposition of organic waste, by micro-organisms, to form a compost or soil improver.

14. Facilities are generally either centrally run sites or community or farm operations.

Types of compost facilities:

Windrow Composting

15. This is carried out in the open using linear heaps on a hardstanding. The heaps are known as windrows and are generally trapezoid in cross-section. They are periodically aerated and blended by turning. Windrows are usually used for processing garden or 'green' waste.

16. A similar process to windrow composting is known as 'aerated pile' composting whereby a blower is used to supply air to the pile and no turning is required. *(Environment Agency 2001)*

Windrow composting (Grundon's, Beenham)

In-vessel composting

17. This is a semi-industrial process that can occur in a range of covered buildings, tunnels or containers. They usually process a mix of organic kitchen and garden waste.

In-vessel composting (Viridor, Castle Cary)

18. Composts produced by either windrow or in-vessel methods generally require a final maturation stage before the compost leaves the site. *(Environment Agency 2001)*

19. The Environment Agency has a presumption against composting facilities within 250m of a workplace or the boundary of a dwelling, unless it can be demonstrated via a site-specific risk assessment, that the bioaerosol levels are and can be maintained at appropriate levels.

Other composting facilities

20. Community composting schemes are schemes where groups of households combine their organic wastes to create larger volumes of compost.

Physical & Operational Characteristics

Site Requirements

21. The scale of operations can vary considerably from small community schemes to large-scale centralised commercial facilities. The particular size of the scheme has an impact on the appropriate siting.

22. Small facilities may only require an area of hardstanding and drainage for composting; a covered area for screening and storing materials; and a small building for equipment storage.

23. The compost is usually stored in the open. Composting facilities could be located in rural or urban fringe areas at existing landfill sites, farms, quarries, appropriate industrial sites, brownfield land or in a "redundant" agricultural building.

24. At a minimum, facilities will need a suitable impermeable hard standing and to route surface water drainage via an interceptor to meet Environment Agency requirements.

25. **[25,000 tonnes per year plant composting green waste only]**

- *Expected lifetime of facility:* 10–25 years
- *Working time:* 8 hours, 5–6 days per week[3]
- *Waste Tonnage treated:* 25,000 tonnes per year
- *Typical site area:* 2-3 ha
- *Building footprint:* Often no building is required for composting operations. Office buildings of 30 to 100m^2 may be erected
- *Building height:* 3 to 4m
- *Vehicle movements:* 20–40 refuse collection vehicles or equivalent per day.
- *Employment:* Site Manager, Assistant Manager plus three site operatives
- *Waste storage:* Up to one day's waste input, in open-air reception area. Storage of inputs from at least one day to up to one week may be required = 130 tonnes per day (during seasonal peak inputs)
- *Compost storage:*30–40% by volume of input material
- *Oversize storage:*10–20% by volume of input material

26. **[25,000 tonnes per year plant composting waste containing kitchen/catering waste covered by the Animal By-products Regulations]**

- *Expected lifetime of facility:* 10–25 years
- *Working time:* 8 hours, 5–6 days per week
- *Waste Tonnage treated:* 25,000 tonnes per year
- *Typical site area:* 1–2 ha
- *Building footprint:* Enclosed building – footprint: 25m × 30m and height: 4–5m
- *Active enclosed composting:* Windrows in an enclosed building, in-vessel units, or tunnels.
- *Windrows in building* – 2000 to 3000m^2; height 5–7m

[3] This refers to the operating hours of the site as composting is a 24 hour process.

- *Tunnels* – 1000 to 2000 m^2; height 4–5 m
- *Mobile in-vessel containers* – 3000 to 4000 m^2; height 3 m
- *Building height:* From 3m (mobile in-vessel containers) to up to 7m for housed windrows
- *Vehicle movements:* 20–40 refuse collection vehicles or equivalent per day.
- *Employment:* Site Manager, Assistant Manager plus three site operatives
- *Waste storage:* Storage of inputs from at least one day to up to one week may be required = 130 tonnes per day (during seasonal peak inputs)
- *Compost storage:*30–40% by volume of input material[4]
- *Oversize storage:*10–20% by volume of input material

27. Advantages of Composting

- Converts a significant element of the waste stream into a useful material.
- Reduces the need for peat as humus in horticulture and land restoration.
- If the standard/quality is high enough, compost can be used in agriculture and horticulture. There is a potential for a large and reliable market for the compost with a wide geographical spread.
- Composting schemes can be farm based, thus assisting farmers to diversify their operations.
- The heat generated offers opportunities for horticultural heating schemes.
- Low cost to get established, and is suitable for small-scale production.
- Community (and home) composting reduces the volume of waste that needs to be managed and reduces transport.
- In-vessel composting gives better control over the process and emissions.

28. Disadvantages of Composting

- If the source material is poorly segregated or unsegregated, residues may become contaminated with heavy metals, residual glass, plastics & other materials, although this is usually low if the material is mainly sourced from garden waste.
- Without careful management the windrow method can produce odours and emissions which can be a health hazard.
- Liquid effluent is produced which is potentially polluting.
- In-vessel composting has a relatively high cost.

[4] Can be up to a 50% reduction by weight.

Current Facilities

29. Composting is a well-proven technology with numerous facilities in the UK.

30. There are sites with extant permissions for composting across the county in all Gloucestershire districts except Cheltenham. These include:
    - Sunhill, Nr Cirencester
    - Rosehill Farm, Dymock, Nr Newent
    - Hempstead, Gloucester
    - Wingmoor Farm, Bishop's Cleeve, Nr Cheltenham
    - Former Plasmega Site, Sharpness Docks

Section 2.2
Anaerobic Digestion

31. Anaerobic Digestion (AD) is the biological degradation of organic wastes in the absence of oxygen.

32. The process takes place in a reactor under controlled conditions and as a result generates usable products:
    - **Biogas** rich in methane which can be used to generate heat and/or electricity;
    - **Fibre** (known as digestate) which is rich in nutrients and can be used as a soil improver, growing media or landfill cover depending upon the quality of the end product. This is reflective of the quality of the incoming material; and
    - **Liquor** which can either be used as a liquid fertiliser or to moisten incoming material.

AD Plant (GreenFinch)

33. AD can be used to treat most organic wastes, including sewage sludge. ABPR 2005 applies to AD plants treating kitchen waste and any other food/animal by-products.

Physical & Operational Characteristics

Site Requirements

34. Facilities can be stand-alone or be part of a larger waste management site and can vary in size from a small plant designed to treat wastes from a small village or rural area to large centralized plants designed to cope with large volumes of industrial or municipal organic wastes.

35. The plant is industrial by nature and larger sites would require a building and large upright vessel, with areas for sorting and storing different types of organic wastes. Buildings would also be required to store ancillary equipment and offices.

36. Ideally sites should be located as close as possible to the main source of the waste to reduce transport costs. Larger sites are ideally suited to industrial or brownfield locations and smaller sites can be located on farms.

37. **[Small scale plant – throughput circa 5,000 tpa]**
    - *Expected lifetime of facility*: 25 years
    - *Operational hours*: 24 hour process, wash deliveries, 20 days per month, typically 0700–1700 weekdays
    - *Waste Tonnage treated*: 417t per month
    - *Typical site area*: 0.15 ha.
    - *Building footprint*: 30m × 15m, plus 4 circular tanks of 6–10m diameter.
    - *No stack*.
    - *Building height*: 7m maximum

- *Tanks height* 10m
- *Vehicle movements*: Maximum of 4 waste collection vehicles or equivalent per day.
- *Employment*: Site Manager, plus 2 other workers.
- *Waste storage*: In smaller facilities, segregated waste may be tipped directly into a sealed conditioning tank. There is no storage of untreated waste outside the building.

38. [Centralised plant – throughput circa 40,000 tpa]

- *Expected lifetime of facility:* 25 years
- *Operational hours*: 20 days per month, typically 0830 h–1730 h weekdays and 0800 h–1300 h on Saturdays
- *Waste Tonnage treated*: 3,333 tonnes per month
- *Typical site area*: 0.6 ha
- *Building footprint*: 40 m × 25 m, plus 2 circular tanks of 15 m diameter. No stack
- *Building height*: 7 m, tanks 6 m
- *Vehicle movements*: Approximately 20 waste collection vehicles or equivalent per day. One JCB used to move waste around on site.
- *Employment*: Site Manager and foreman, plus 3 other workers
- *Waste storage*: In smaller facilities, segregated waste may be tipped directly into a sealed conditioning tank. Otherwise unsorted waste, segregated waste and residual waste may be stored in open bunkers, possibly outside.

39. Advantages of Anaerobic Digestion

- It can produce a useful soil improver that can be used in land reclamation.
- It is a process that allows good control including containment of potential pollutants.
- The process traps methane, a potent greenhouse gas and uses it as a renewable energy source, making no net contribution to climate change.
- The heat and electricity required to operate the site are generated on site by the production of the biogas.
- Odour problems usually associated with waste decomposition under anaerobic conditions can largely be contained within the enclosed vessel.
- It treats and stabilises organic materials such as kitchen waste.

40. Disadvantages of Anaerobic Digestion

- Needs and optimal mix of input material which can require a high degree of waste segregation or pre-treatment to produce a marketable residue.
- It may not be economic due to the large capital investment required.
- There is a possibility of pollution from liquid effluent and other emissions/material.
- The digestate usually requires a further treatment process such as dewatering or maturation before it can be

marketed.

- There may be costs associated with wastewater treatment of any excess liquor generated.

- Depending upon the type of anaerobic digestion process used, additional heat or a separate sanitation stage may be required.

Current Facilities

41. There are a limited number of UK examples of anaerobic digestion, but Annex E of the Waste Strategy for England 2007 states that *"the Government wishes to encourage more consideration of the use of anaerobic digestion (AD) both by local authorities and businesses".*

42. The only operating examples of AD in Gloucestershire are in association with sewage treatment and there are no current AD facilities dealing with general MSW in Gloucestershire . However, a planning application for a resource recovery park at Wingmoor Farm Bishop's Cleeve is currently held in abeyance. This proposal has an anaerobic digestion element attached to it.

43. Further information relating to anaerobic digestion can be obtained from the 2007 DEFRA Publication *Advanced Biological Treatment of Municipal Solid Waste.* [available from **http://www.defra.gov.uk/environment/waste/wip/newtech/pdf/abt.pdf**]

Section 2.3
Processing of Recyclables

(Materials Recovery Facility [MRF])

44. A Materials Recovery Facility [MRF] includes multi-stream separation facilities, recycling treatment facilities and community recycling schemes. Such a facility receives sorted or unsorted waste, which is then separated into recyclable and non-recyclable components. A MRF may store waste waiting to be processed.

Materials recovery facility (Grundon's, Beenham)

45. In the MRF, useful materials are prepared (sorted and bulked) ready for shipment to be processed into new products. Non-recoverable materials go for further treatment or final disposal. Facilities that receive unsorted wastes are sometimes referred to '*dirty*' MRFs as opposed '*clean*' MRFs which are the facilities receiving dry, mixed recyclables.

46. Small facilities may deal with one or two specific types of waste, larger facilities may sort over 30 types of material. Glass is commonly excluded from MRFs to prevent contamination from broken glass and allows for a simplified mechanical separation. It also protects the operatives at MRFs using hand sorting processes.

47. A combination of techniques are used to sort the waste in a MRF, including:
- Hand picking;
- Mechanical sorting/screening;
- Magnetic separation;
- Light and density separators;
- Air separators for paper;
- Eddy current separation for aluminium.
- MRF facilities may offer features associated with other waste management processes such as MBT (see section 2.7 later).

Physical & Operational Characteristics

Site Requirements

48. Industrial buildings and a storage area (possibly in the open) would be required.

49. A facility can range from a small-scale local recycling operation to a strategic large scale facility dealing with 5,000 to 100,000 tonnes per annum and sites of 1-1.5 hectares could be appropriate. A building of sufficient size to accommodate equipment to wash, sort, grade, crush and bale materials, as well as storage and loading facilities for recovered materials.

50. The facility should retain flexibility so that different materials from different sources can be sorted at different times to meet the changing demands of the recyclables markets.

51. Suitable urban locations could include industrial estates or warehouses or on

appropriate brownfield land. There may be benefits in reduced traffic movements if located adjacent or close to a Household Waste Recycling Centre (sometimes referred to as a Civic Amenity Site).

52. [50,000 tonnes per year facility]

- *Expected lifetime of facility*: 20 years (or linked to contract period)
- *Operational Hours*: 10 hours a day, 6 days a week. Generally 07:30–17:30 weekdays 07:30–13:00 Saturdays
- *Waste Tonnage treated*: Various – average approximately 50,000 tonnes per year
- *Typical site area*: 1–2 ha
- *Building footprint*: 70 m × 40 m
- *Building height*: 12 m
- *Vehicle movements*: 20–30 waste collection vehicles or similar per day in. 10–20 bulk transport vehicles per day out.
- *Employment*: If no hand-picking less than 10 operatives; if hand picking potentially 50 or more operatives on shift rotation.
- *Waste storage*: Some storage of unsorted waste likely in open bunkers or skips. Covered storage preferred, to limit generation of leachate. Open storage of sorted waste may be restricted due to product quality control concerns.

53. Examples of processing equipment used in MRFs

- Loaders
- Ramps
- Conveyors
- Scales
- Bag splitters
- Mechanical sort equipment
- Air classifier
- Mechanical sorting table or platform
- Air knife
- Infra red or x-ray plastics sorter
- Magnetic separators
- Trommels
- Eddy Current Separators
- Screens
- Balers
- Compactors
- Flatteners or roll packer
- Shredders
- Granulators
- Bays
- Containers
- Blowers
- Hoppers

54. Advantages of Materials Recovery Facilities

- Can operate at various scales.

- A network of facilities is required if recycling is to make a significant impact on reclaiming materials from the waste stream.

- It will ensure that collected materials are sorted and supplied to the reprocessing industry and can increase value of materials supplied to recycling industry.

- Can be added to existing waste operations.

55. **Disadvantages of Materials Recovery Facilities**

- May increase local vehicular movements.

- Impacts on the locality similar to any other industrial process.

Current Facilities

56. There are a significant number of MRF facilities in the UK. There is an operational facility at Moreton Valence in Gloucestershire and permission was granted for a facility at Wingmoor Farm, Bishop's Cleeve in 2006, but is not yet operational.

Section 2.4
Waste Transfer Station

57. A Waste Transfer Station (WTS) is a depot where waste from collection vehicles is stored temporarily prior to transportation in bulk to be recycled, composted or to other treatment and disposal facilities.

Vehicles for transferring waste

58. 'Waste Transfer Station' is a generic term used to cover operations that deal with all types of wastes, including special waste, clinical waste, inert waste, household/ industrial/ commercial waste and construction waste; and also includes different methods of transfer e.g. skip transfer, road to water and road to rail. Some stations may handle only one waste type, others may handle more, and may also include some small scale recycling.

59. Municipal Solid Waste (MSW) transfer stations usually consist of a building where vehicles deliver waste. Inert wastes may be transferred in the open.

60. A WTS is often located in association with other waste management facilities. Wastes do not usually remain in the WTS for very long, often just a few hours before onward transportation.

Physical & Operational Characteristics

Site Requirements

61. A transfer station can be a small facility serving the local community or one dealing with much larger quantities.

62. An industrial style building is normally required. Locations could be on appropriate industrial or brownfield sites provided they are of sufficient size for sorting the waste.

63. Sites should have good accessibility to receive delivery of collected waste and transfer it in bulk by road, rail or water to other waste management facilities.

64. Transfer facilities are required in both rural and urban areas to provide an integrated network across the County.

65. Facilities will need a suitable impermeable hardstanding and to route surface water drainage via an interceptor to meet Environment Agency requirements.

66. **[120,000 tonnes per annum facility]**
- *Expected lifetime of facility*: 20 years
- *Working time*: 20 days per month[5]
- *Waste Tonnage treated*: 10,000t per month
- *Typical site area*: 0.7 ha

[5] This figure is based on ODPM figures, however, it is likely that some waste transfer stations may also operate on Saturdays.

- *Building footprint*: 70 m × 30 m
- *Building height*: 12 m
- *Vehicle movements*: Significant variation depending on nature of work and mode of collection/transfer.
- *Employment*: Site manager and foreman, plus two other workers.
- *Waste storage*: Unsorted waste may be stored in open bunkers or skips, housed within a building.

67. Advantages of Waste Transfer Stations

- Appropriately located transfer stations provide a bulking up facility which can supply other waste managements centres and industries.

- Reduces transport by allowing a smaller number of larger vehicles and different transport systems to be used to transport waste over greater distances if required.

- Network of facilities will ensure that collected materials are sorted and supplied to the reprocessing industries.

68. Disadvantages of Waste Transfer Stations

- May have environmental impacts on the immediate locality.

Current Facilities

69. The use of Waste Transfer Stations is a long-standing method of waste management. There are Waste Transfer Stations well placed across the county in all districts. The locations include:

- Bishop's Cleeve
- Cheltenham
- Cirencester
- Gloucester
- Lydney
- Mitcheldean
- Moreton Valence
- Nr Weston Sub-edge
- Tewkesbury

Section 2.5
Inert Recovery & Recycling

Mobile crushing facility

70. Inert Recovery and Recycling facilities re-use, recycle and transfer inert waste. They include construction and demolition wastes and the recycling of secondary aggregates at centralised processing facilities or on site.

71. Facilities can be mobile, for example this would be appropriate for large scale demolition operations thus enabling waste to be recycled close to where it arises.

72. A range of materials such as crushed concrete, road planings, mineral wastes and some industrial wastes can be recycled and utilised as substitutes for primary aggregates.

73. Waste collection is delivered by skip or bulk vehicles for crushing, screening and grading for re-use. Unusable residues are used in landfill engineering.

Physical & Operational Characteristics

Site Requirements

74. Hardstanding is required for stockpiles of material; and locating crushing, screening and grading machinery.

75. Some elements of the operation and storage may be enclosed, but it is mostly undertaken in the open air. Suitable locations may be found in appropriate industrial areas, brownfield land, or associated with operational quarries or landfill sites.

76. Facilities should ideally be located away from residential areas.

77. **Advantages of Inert Recovery & Recycling**

- Reduces the amount of waste landfilled.
- Reduces the need for quarrying primary materials.
- Mobile facilities enable on site recycling, which reduces double handling and unnecessary transportation.

78. **Disadvantages of Inert Recovery & Recycling**

- Recycled material may not be of high enough quality and specification to meet certain uses, thus reducing its market potential.

- Noise, dust and visual intrusion can be a problem.
- Storage of materials may be unsightly.
- May generate large goods vehicle movements.
- Removal of inert materials from the waste stream can delay restoration of mineral workings.
- Reduces transport by allowing larger vehicles and different transport systems to be used to transport waste over larger distances if required.

Current Facilities

79. Inert Recovery & Recycling Sites are numerous throughout the UK.

80. In addition to the temporary mobile sites in Gloucestershire there are established sites in the county including at Moreton Valence and Gloucester.

Section 2.6
Metals Recycling Facilities

81. ‘Metal recycling facilities’ is a generic term to cover traditional scrapyards, car breakers, vehicle dismantlers, metal recycling sites and sites used for the storage of abandoned vehicles.

Metals Recycling Facility

82. Car breakers or vehicle dismantlers contribute to metal recycling and the re-use of car parts.

83. Traditional metal recycling sites are recovery and bulking up facilities which concentrate on providing metals as high quality input to the smelting industry.

Physical & Operational Characteristics

Site Requirements

84. Facilities can vary in size from small to large-scale operations. Due to their noise, unsightly and industrial character, they will require careful siting in appropriate industrial areas.

85. Modern facilities require industrial buildings able to accommodate workshops and storage space in addition to metal processing and sorting equipment.

86. Small facilities could be accommodated as part of a larger waste management facility. Where possible enclosing operations will help reduce environmental impacts.

87. Facilities will need a suitable impermeable hard standing and to route surface water drainage via an interceptor to meet Environment Agency requirements.

88. Advantages of Metals Recycling Facilities

- Allows for the efficient recovery of metals for recycling.
- Bulking up can reduce the overall number of vehicular movements.

89. Disadvantages of Metals Recycling Facilities

- Traditionally viewed as ‘bad neighbour’ development.
- May increase vehicular movements locally.
- Impacts on the locality including dust, noise, ground pollution and adverse visual impact where outside storage is involved.

Current Facilities

90. Metal Recycling Facilities are widespread throughout the UK.

91. There are numerous sites dispersed throughout Gloucestershire. These include sites at:

- Twigworth
- Bishop's Cleeve
- Cinderford
- Lydney
- Gloucester
- Cheltenham
- Nr Moreton-in-Marsh

Section 2.7
Mixed Waste Processing
(Mechanical Biological Treatment (MBT) and Mechanical Heat Treatment (MHT))

Mechanical Biological Treatment

92. MBT is a generic term used to describe hybrid technologies that use a combination of biological and mechanical steps to process waste. MBT plant can incorporate processes used in other waste management technologies.

MBT facility

93. MBTs are designed to process the residual fraction of Municipal Solid Waste (MSW) or Commercial & Industrial (C&I) waste. The biological processes can be aerobic or anaerobic.

94. The mechanical step is designed to separate materials so that greater value can be achieved from the waste and/or allow the biological process to work effectively. Mechanical processing can take place before and/or after the biological process. The mechanical process potentially has similar aspects to MRFs

95. The design of the plants are determined by the anticipated end-use of the processed materials; many were originally designed to biologically stabilise waste prior to landfilling. Other options include low-grade composted materials, production of solid recovered fuels or biogas.

96. In most cases it is normal to remove materials that have economic value such as glass, stones and metals (typically up to 10% - 15% weight).

97. If landfilled the stabilised waste can have substantially less biodegradable content than raw waste. If composted the waste is considered to be “stabilised waste” and has limited and prescribed applications.

98. If used as a fuel, it is still considered to be waste, but is upgraded to have higher energy content and less pollution burden than raw MSW or C&I waste. Additionally, it has high renewable power content and produces less carbon dioxide per unit of energy than coal. Biogas can be created if the bio-fraction is anaerobically digested. The resulting gas can be burnt to create renewable electricity.

99. Examples of mechanical or biological processes commonly used at MBT plants
- Trommel screen (available in various forms typically a tilting/rotating drum used to screen to size and density);
- Shredders;
- Refuse Derived Fuel (RDF) plant and pelletisers;
- Hand picking stations;
- Biological stabilisation;
- Ball mills;

- Other mechanical reduction techniques (crushing, pulverising etc).

*Mechanical Heat Treatment**

100. Mechanical heat treatment is a term used to describe configurations of mechanical and thermal (including steam) based technologies.

101. The most common system used in MHT is autoclaving which involves batch, steam processing of waste in a vessel under the action of pressure. Other methods involve continuous heat treatment in a vessel without the action of pressure.

Fibrecycle Autoclave

102. After recyclables have been extracted the processed organic fraction of the waste is reduced to a fibrous material that is easily sorted. Depending on the process used, the residual material can be used as a type of RDF, as a raw material in recycled products or used as a low-grade soil conditioner.

103. Glass and metals recovered after MHT may be significantly cleaner than with other processes due to the steam cleaning action.

104. Some plastics may be deformed by the process which can affect their recyclability depending upon the process and polymer type.

105. RDF produced by MHT will have different characteristics to that produced by MBT.

*All material for the section on MHT was sourced from *DEFRA (2005) Mechanical Biological Treatment & Mechanical Heat Treatment of Municipal Solid Waste*

Physical & Operational Characteristics

Site Requirements

106. Can be part of a larger integrated waste facility. Buildings look like industrial units. Minimum throughput typically 20,000 tonnes pa (although can be designed for much higher throughputs). Land take dictated by residence time; eg 85,000 tonnes pa needs >1ha; any height constraints on the building will also increase the footprint of the building.

107. **[typical 50,000 tonnes per year MBT plant]**

- *Life time of facility*: 20–25 years [Linked to contract period]
- *Operational Hours*: Potentially 24 hours 7 days (potentially less subject to plant set up nature of waste generation)
- *Typical site area*: <1–2 ha
- *Building Footprint*: 100 m × 30 m or less
- *Building Height*: 10–20 m
- *Vehicle Movements*: 20–30 waste collection vehicles or equivalent per day. Less if bulk transport vehicles used.

- *Employment*: 2/3 at any one time, shift system if 24 hour operation – (more if manual picking operations)

108. Advantages of MBT and MHT:

- Reduces the mass of waste inputted.
- Based upon a combination of existing proven techniques for treating residual fraction of MSW.
- Permits further recycling from the residual fraction.
- Enables energy content of waste to be recovered / can increase calorific value where drying takes place.
- Has the potential to divert high levels of biodegradable municipal waste and C&I waste.
- MBT has lower environmental and visual impact that thermal processes.
- Can be modular, easy to add incremental capacity.
- Highly flexible, can convert to make different products and/or accept different feeds, eg separately collected biowaste. These can be designed to be part of an integrated system.

109.Disadvantages of MBT and MHT

- Needs secure end markets to be available to deliver highest landfill diversion performance.
- Economics driven by security of end markets.
- Very limited UK plant experience.
- Traffic movements needed for input and output flows.
- Still produces a residue which may require further treatment.

Current Facilities

110.There are only a limited number of MBT/MHT plants operating in the UK, and none currently permitted in Gloucestershire. However, there is a proposal for a resource recovery park at Wingmoor Farm that is currently held in abeyance. The proposal includes an MBT element.

111.The Waste Strategy for England 2007 states that the Government is supportive of the market for solid recovered fuel (SRF) and refuse derived fuel (RDF) produced by MBT and MHT plants. It is therefore likely that these facilities will be more widely distributed throughout the UK in the future.

Section 2.8
Small Scale Facilities
(Municipal Solid Waste only)
(Bring Banks / Civic Amenity Sites / Household Recycling Centres)

112. These sites provide a facility for the delivery and sorting of household waste by the public and include bring banks and civic amenity (CA) sites (also known as household recycling centres).

113. Bring banks are containers where the public can deposit household recyclable materials.

Recycling 'bring-site' in the Forest of Dean

114. CA sites are usually provided by Waste Disposal Authorities (WDA) as places where the general public can deliver their household waste for disposal or recycling. CA sites do not generally accept trade waste.

Wingmoor Farm Recycling Centre

115. Often scope for a greater diversity of recycling activities on the site to recover materials such as metals, batteries, wood and engine oil. The centres are also a source of organic wastes for composting.

116. Wastes collected could be fed into a materials recovery facility to be assimilated with waste from other sources.

Physical & Operational Characteristics

Site Requirements

117. These sites are generally small scale dealing with householders' waste. Sites should be carefully designed to ensure that maximum recycling/recovery is achieved.

118. Facilities may be ancillary and provide 'front end' recycling to an existing waste management operation.

119. Locations for bring banks should be in high traffic areas with high visibility and secure from vandalism. However, locations should be avoided where parked cars cause congestion. Facilities also need to be located near to centres of population to maximise accessibility and ensure usage, often on the edge of town locations.

120. Sites need an area of hardstanding to site recycling bins with sufficient space and access for the manoeuvring of both householders' vehicles and collection vehicles. Facilities could be either fully or partially enclosed, and be on an impermeable surface if they will cater for oils, or other polluting liquids. Surface water drainage needs careful design, and should be routed by an interceptor.

121. **[civic amenity site]**

- *Expected lifetime of facility*: Permanent
- *Working time*: Daylight hours, every day of the year (with the exception of Christmas and New Year)
- *Waste Input Tonnage treated*: Typically between 10,000–50,000 tonnes per annum
- *Typical site area*: Less than 0.5–1 ha
- *Building footprint*: Civic amenity sites are typically open air areas of hardstanding. A mobile site office may be situated on site
- *Vehicle movements*: Public access to centre – averaging 1,000 cars per day Vehicles removing waste streams for further treatment – average 1–2 vehicles per day
- *Employment*: 2–4 workers
- *Waste storage*: In bring banks and skips – removed when full

122. **Advantages of Small Scale Facilities**

- Household waste recycling centres can be a valuable supply of source separated wastes.
- Provides the public with the opportunity to recycle their wastes.

123. **Disadvantages of Small Scale Facilities**

- Impacts on the immediate locality.
- Increased traffic movements close to site, due to public access.

Current Facilities

124. There are six main household recycling centres within the county. These are located at: Wingmoor Farm, nr Bishop's Cleeve; Swindon Road, Cheltenham; Fosse Cross, Nr Cirencester; Pyke Quarry, Nr Horsley; Oak Quarry, Nr Coleford; Hempsted, Nr Gloucester. There are also numerous bring banks located at easily accessible sites throughout the county such as car parks and supermarkets.

Section 2.9
Sewage Treatment Facilities[6]

125. Sewage treatment works are generally designed to receive a combination of domestic wastewater, certain industrial wastewater and storm water. The majority of the UK is served by sewage treatment works with a small minority relying on septic tanks and small scale package plants. More information on planning for sewage treatment facilities can be found in Technical Evidence Paper WCS-H.

Sewage Treatment Facility

126. The purpose of sewage treatment is to treat contaminated wastewater to produce a clear effluent that is free from suspended solids, toxic materials, pathogens and other contaminants. The wastewater is usually conveyed via drains and sewers to treatment works to be cleaned and reused or discharged into a watercourse.

127. In addition to the clear effluent, sewage treatment works will also produce grit, screenings and sludge.

- The grit can be used to 'grit' roads if thoroughly washed.
- The screenings are usually sent for final disposal.
- The sludge can be spread upon agricultural land or thermally combusted.

128. The treatments available are vast and will vary according to the resources available, type of sewage received and the required afteruse of the water. Most plants will generally comprise preliminary stages to remove grit and large suspended and floating matter followed by settlement tanks to separate the effluent from the sludge. The sludge will then be sent off for dewatering and further treatment such as anaerobic digestion (including energy recovery) before final disposal.

129. The next stage in the effluent treatment *(Primary Treatment)* involves settling out heavier organic material and floating material. Again, the sludge is removed for treatment and the effluent passes to the next stage of the process known as *Secondary Treatment.*

130. Secondary Treatment is a biological treatment using either filter beds or a

6 The references for this section can be found in the bibliography (Severn Trent; Porteous; Nesaratnum)

process known as *Activated Sludge Process* and further settlement takes place. At the end of the process treatment the water is either suitable for direct discharge or sent for *Tertiary Treatment*. This depends on the standard required for the particular watercourse that it is discharged to.

131. Tertiary treatment may involve a series of processes and may involve chemical treatment or biological treatment such as filters or reed beds. Some of the reasons for tertiary treatment include: removal of smaller suspended matter from the effluent; removal of hazardous chemicals and pathogens; and removal of organic matter such as pesticides or compounds affecting flavour or colour.

Physical & Operational Characteristics

Site Requirements

132. Sewage treatment facilities are generally located close to a suitable receiving body of water for discharge. The site would be ideally located away from residential areas and in a rural location close to the farms accepting the sludge for spreading on the land. Connection to the underground drain and sewer system will be required.

133. The size of the site will vary according to the type of treatments used at the site and the volume of sewage being treated. In addition to the chosen treatments, the site will need to accommodate storm tanks to allow for extra volumes of sewage in wet weather.

134. Combined heat and power plants may be attached to the sites to generate electricity from the biogas collected during anaerobic digestion of sludge.

135. Advantages of Sewage Treatment Works

- Helps to reduce the consumption of fossil fuels by the generation of renewable energy.
- Protects watercourses from pollution by making water as safe as possible before being discharged.
- Helps to improve soil structure by generating a useful soil conditioner.
- Creates a suitable product to grit roads in severe weather.
- Low impact on road transport network.

136. Disadvantages of Sewage Treatment Works

- Some technologies can be very costly.
- Can be a source of odour nuisance.
- Screenings will require incineration or disposal to landfill.
- Sewage sludge from works treating a high volume of industrial wastes may not be suitable for land application and may require incineration or disposal to landfill.

Current Facilities

137. There are sewage treatment facilities located at sites throughout the County. This involve a variety of waste treatment technologies including anaerobic digestion.

Section 2.10
Fermentation
(Ethanol / Methanol Production)

138. Fermentation treatment is confined mainly to agricultural wastes, but can be extended to pre-treated municipal solid waste to produce liquid fuel (ethanol, methanol).

139. Waste fermentation uses organisms in the absence of oxygen to break waste down into a liquid fuel and a stable solid residue, followed by distillation. The process is similar to beer and winemaking and is classed as waste to energy recovery technology.

140. There are two main bio-fuels produced, bio-ethanol and bio-diesel, which can be used substitutes for petrol and diesel, or blended with them to reduce air emissions.

Physical & Operational Characteristics

Site Requirements

141. Industrial buildings. Suitable urban locations would include industrial estates or warehouse or on appropriate brownfield land.

142. Where treatment is restricted to agricultural wastes a rural location proximate to agricultural waste arisings may be appropriate in order to minimise the distance that waste is transported.

143. Advantages of Fermentation

- Helps to reduce the consumption of non-renewable fossil fuels by producing a renewable (bio) fuel (ethanol) offering carbon dioxide neutral combustion (i.e. carbon dioxide emitted during combustion is offset by that absorbed during plant growth).

- Produces a cleaner less toxic fuel than oil-based fuels that can be used in road vehicles and in existing hydrocarbon infrastructure (e.g. internal combustion engine).

144. Disadvantages of Fermentation

- The process is still being developed and tested.

- Financial costs are likely to be higher than composting but the process is less capitally intensive than incineration.

- There are some environmental concerns surrounding increased use of ethanol, which could cause increased emissions of nitrogen oxides and volatile organic compounds.

Current Facilities

145. There is limited information available regarding this technology in relation to waste management and there are no facilities currently operating in the Gloucestershire area.

Section 2.11
Feedstock Recycling

146. Feedstock Recycling is a process whereby different types of plastic wastes are put through a chemical process known as Polymer Cracking to create petroleum feedstocks or raw materials that can be used in refineries and petrochemical plants for making new products.

147. Mixed plastics are initially processed to produce agglomerate. The agglomerate subsequently feeds depolymerisation, cracking, separation and distillation processes to yield ethylene and propylene. These chemical feedstocks may then be used to produce fibres, plastics, detergents and adhesives.

148. In the case of PVC-rich feedstocks, the polymer is decomposed at high temperatures from which hydrochloric acid is the main component recovered for subsequent re-use in the PVC production process as a raw material.

Physical & Operational Characteristics

Site Requirements

149. Industrial buildings and a storage area would be required. A building of sufficient size to accommodate a large tipping hall to deposit and load materials would be required. Suitable urban locations would include industrial estates or warehouses or on appropriate brownfield land.

150. Ideally the facility should be sited adjacent to existing petrochemicals facilities and collection/bulking operations for mixed plastic waste.

151. Advantages of Polymer Cracking

- This process would contribute to the plastics recovery rate.
- The process helps to increase the variety of plastics that are recycled into new and useful products.

152. Disadvantages of Polymer Cracking

- The low-density feedstock demands co-location between petrochemicals facilities and collection and bulking operations for mixed waste, which restricts the availability of potential locations for a facility.
- Impacts on the locality similar to any other industrial process.

Current Facilities

153. There is limited information available regarding this technology in relation to waste and there are no facilities currently operating in the Gloucestershire area.

Section 2.12
Feedstock Substitutes

154. Feedstock substitution is a process whereby mixed plastic waste is used as a substitute feedstock in blast furnaces in the iron and steel making process.

155. Mixed plastic waste is used as a substitute source of carbon to coal, oil or natural gas. The carbon in the plastic waste acts as a reagent to extract metal from iron ore.

156. The process has been adopted by the iron and steel industry in Germany. This process is classified as waste to energy recovery technology.

Physical & Operational Characteristics

Site Requirements

157. This process is connected to the iron and steel industry therefore proximity to those industries could reduce transportation.

158. Advantages of Feedstock Substitutes

- This process would contribute to the plastics recovery rate.
- Helps to reduce the consumption of non-renewable resources.

159. Disadvantages of Feedstock Substitutes

- Impacts on the locality similar to any other industrial process.
- The process is still being developed and tested.

Current Facilities

160. There is limited information available regarding this technology in relation to waste and there are no facilities currently operating in the Gloucestershire area.

Section 2.13
Fuel Substitutes

161.This process involves the use of high calorific value waste as a substitute to conventional fuels in industrial processes and power plants. This process is classified as a waste to energy recovery technology.

162.Examples of fuel substitutes include old tyres and solvent wastes used as a substitute for coal and petcoke in cement kilns and packaging waste paper, biofuels and plastics used as substitute fuel in cement kilns. Solid wastes are usually shredded.

163.Municipal solid waste can be used as a substitute for coal and to fuel incineration to achieve a more efficient burn, with less ash and emissions.

Physical & Operational Characteristics

Site Requirements

164.This process is connected to industrial processes and power plants.

165.Advantages of Fuel Substitutes

- This process would contribute to the municipal solid waste recovery rate.

- Helps to reduce the consumption of non-renewable resources.

166.Disadvantages of Fuel Substitutes

- The process is still being developed and tested.

- Environmental pressure groups have expressed concerns about releases of toxic pollution from the incineration of waste.

Current Facilities

167.There is limited information available regarding this technology in relation to waste and there are no facilities currently operating in the Gloucestershire area.

Section 2.14
Small Scale Thermal Treatment

168. Small scale thermal treatment plants have been specifically designed to accept relatively small quantities of waste. The plants are often modular and usually designed for local communities. These type of plants are less common today than they were in the early 20th Century.

169. The waste is burnt to generate heat to generate high-pressure steam which in turn generates electricity. The surplus electricity can be sold to the national grid. The surplus heat from the turbines can be used in local combined heat and power schemes.

170. Most modern small-scale plants have been designed to accept specific industrial waste streams or pre-treated homogenous feedstock or refuse derived fuel (see section 2.7), municipal solid waste (MSW) could potentially also be incinerated.

171. Where incineration without energy recovery may be permissible is for specialised cases such as treating clinical wastes in hospitals.

Physical & Operational Characteristics

Site Requirements

172. The plant will require an industrial building as the operations tend to be totally enclosed. The size of the building will depend upon the volume of waste being treated.

173. Suitable locations will usually be industrial areas, brownfield land or existing waste facilities. If surplus heat is being used for community heating schemes then the plant would need to be located close to the industrial or residential development it is supplying.

174. The plant should be located where there is suitable access for the HGV vehicle supplying the plant with waste.

175. [50,000 tonnes per year plant]

- *Expected lifetime of facility*: 20–25 years
- *Operational Hours*: Potentially 24 hours 7 days (potentially less subject to plant set up nature of waste generation)
- *Typical site area*: <1–2 ha
- *Building Footprint*: 80 m x 40 m or less
- *Building Height*: 15 m – 25 m
- *Stack height*: 40 m – 70 m
- *Vehicle Movements*: Approx 20–30 waste collection vehicles or equivalent per day. Less if bulk transport vehicles used.
- *Employment*: 2/3 workers at any one time, on a shift system if 24 hour operation.
- *Waste Storage:* Waste generally delivered to single waste reception pit within main building Conveyors can be used if part of an integrated facility. If very small facility a containerised loading system can be used.
- *Chemical Storage*: Small quantities of lime and activated carbon or urea (in solid form) used as part of air pollution control (APC).
- *Ash storage*: Generally removed daily or weekly with shovel loader into bulk vehicle or in covered containers.

- *1 Stack height determined by process characteristics and air dispersion modelling.*

176. Advantages of Small Scale Thermal Treatment

- There will be less traffic generated than with large scale thermal treatment facilities.
- If the plant is designed to allow for combined heat and power generation, the local community may benefit.
- Small scale thermal treatment plants can be set up close to the source of the waste arisings.

177. Disadvantages of Small Scale Thermal Treatment

- Some toxic ash may require landfilling.
- It may be unaffordable or not cost effective.
- The feedstock may often require pre-treatment.
- Without careful control the air emissions from incineration have potential environmental impacts.

Current Facilities

178. There are no small scale thermal treatment plants currently operating in Gloucestershire.

Section 2.15
Large Scale Thermal Treatment

Thermal treatment plant in Portsmouth

179. Large scale thermal treatment plants are designed to burn waste efficiently whilst recovering heat from the combustion. The heat is generally used to provide steam or hot water and/or generate electricity. Some of the electricity generated can be used for the operation of the plant and the remainder exported to the national grid.

180. Large Scale Thermal Treatment plants without energy recovery would not usually be acceptable except in specialised circumstances such as the destruction of clinical waste.

181. Most plants use an inclined moving or reciprocal grate design that is fed via a hopper. All combustible material is burnt and unburnt residual ash is deposited in a quench tank.

182. Although plants are capable of treating the entire waste stream, recyclable materials are generally extracted from the waste prior to incineration and ferrous and non-ferrous metals can be recovered from the residual ash after incineration.

183. The fly ash produced can be neutralised and in some cases recycled. The bottom ash can largely be recycled into an aggregate substitute for construction purposes including road building.

184. The emissions from all modern plants are strictly controlled by the Environment Agency under Integrated Pollution Prevention and Control (IPPC) regime as set up by the Pollution Prevention Control Act 1999, or by Local Air Pollution Control (LAPC) regimes under Part I of the Environmental Protection Act 1990.

185. The plants are fitted with pollution abatement systems to neutralise acidic gases and capture particulate matter. The emissions are constantly monitored and outputs displayed in real time on computer screens.

Physical & Operational Characteristics

Site Requirements

186. The plant will require an industrial building as the operations tend to be totally enclosed. The size of the building will depend upon the volume of waste being treated.

187. The site will require an area large enough to store sufficient waste to maintain the plant over weekends and holiday periods when collections do not occur.

188. The site should have good access and be located close to the source of the waste arisings to reduce transport costs. Sites can be located on appropriate industrial areas,

brownfield land and existing waste management facilities.

189. [250,000 tonnes per year plant]

- *Expected Lifetime of Facility*: 20–25 years.
- *Operational Hours*: 24 hours, 7 days per week.
- *Typical Site Area*: 2–5 ha
- *Building Footprint*: 120 m × 60 m
- *Building Height*: 25–30 m
- *Stack Height*: 60–80 m (1)
- *Vehicle Movements*: Approx 50 waste collection vehicles or equivalent per day. Smaller numbers if via bulking transfer station.
- *Employment*: Site Manager, Assistant Manager plus 10 on three shift system.
- *Waste Storage*: No storage outside main reception pit if via waste collection vehicles. Possible in sealed skips/containers if double handling system employed.
- *Chemical Storage Lime*; activated carbon; ammonia/urea.
- *Ash Storage*: Bottom Ash – 30% by weight; 10% by volume. Air Pollution Control Ash – 4% by weight.
- *Note 1: The height of the stack is determined by factors relating to the process design and in particular air dispersion modelling.*

190. Advantages of Large Scale Thermal Treatment

- Waste incineration has become a proven waste management option that is highly technical, capable of handling the volumes of waste which will remain after re-use, recycling and composting.
- It potentially provides a renewable source of energy.[7]
- It is among the most strictly regulated waste management options and the Waste Incineration Directive applies stringent emission limits to virtually all types of waste incinerator.
- There is potential for the recovery and industrial use of residues from the incineration process.

191. Disadvantages of Large Scale Thermal Treatment

- Potential environmental and visual impact of a major site is substantial.
- Some ash requires landfilling especially that which is toxic.

Current Facilities

192. Annex C1 of the Waste Strategy For England 2007, reports that around 10% of the UK's waste is incinerated with energy recovery. (Although it does not specify the plant size).

193. There is no history of large-scale incineration within Gloucestershire. However, there is a large-scale treatment facility relatively close to the northern edge of the County at Tyseley in Birmingham.

[7] The Energy White Paper (para 5.3.44, page 152) (available from http://www.berr.gov.uk/files/file39387.pdf) discusses the treatment of energy from waste under a banded Renewables Obligation.

Section 2.16
Advanced Thermal Treatment
(Pyrolysis, Gasification and Plasma Arc)

Pyrolysis

194. Pyrolysis involves the heating of organic or hydrocarbon-containing waste in the absence of air (anaerobic conditions) to produce a mixture of gaseous and liquid fuels and a solid inert residue. The production of charcoal from wood is an example of pyrolysis.

A Pyrolysis Plant

195. Pyrolysis requires a consistent waste stream such as tyres or plastics to produce usable fuel product. Feedstock waste require pre-treatment to remove bulky or inert items, and crushing or shredding to reduce particle size. The waste is then fed into the heated reactor. The waste is degraded by the heat to give a mixture of gases.

196. The products gas, burnable liquid and solids can be cooled and refined to produce a fuel product, some of which may be used to provide the heat for the process, or on-site power generation and the remainder sold.

197. Pyrolysis is typically used as a way of managing specific waste streams or pre-treated mixed waste streams such as MSW.

Gasification

198. Gasification is a thermo-chemical process involving the conversion of waste into a gas via partial oxidation (using oxygen-rich air or oxygen) under the application of heat. The majority of the waste is converted into carbon fuel-rich gases with the remaining ash residue being virtually inert.

199. The feedstock requires pre-treatment to remove bulky or inert items and reduce particle size. This can provide opportunity to add recovery or recyclate at this stage. The waste is then fed into the heated reactor and is degraded by the head to give a mixture of gases. The gas can be cooked and refined to produce a fuel product, some of which may be used to drive the process and the remainder sold for heat or power generation. The process is classed as waste to energy recovery technology.

Plasma Arc

200. Plasma Arc is an alternative heat combustion system for mixed wastes that is being developed from processes already operating in the metal refining industry.

201. The system uses plasma arc heating (energy released by an electrical discharge in an inert atmosphere) which raises the temperature of the waste to anything between 3,000-10,000°C.

202. The process is very different to combustion (incineration) in that is uses energy from the plasma to thermally convert organic waste from a solid (or liquid) to gas through a process called “controlled pyrolysis” or “controlled gasification” and avoids the need for large volumes of air to support combustion.

203. The process converts organic material into hydrogen rich gas and non-combustibles to an inert slag. The gas is suitable for generating electricity. The slag can be used as an aggregate in the construction, packaging and insulation industries.

Physical & Operational Characteristics

Site Requirements

204. Facilities tend to be medium scale (circa 30,000 tonnes per annum) to make up for the high, up front investment costs and accommodated within an industrial style building with a storage area. Where there is a desire to have a front end MRF, the minimum area required would be in the order of 4 to 5 ha.

205. Suitable urban locations would include industrial estates or warehouses or on appropriate brownfield land.

206. **[50,000 tonnes per year plant – Pyrolysis & Gasification]**

- *Life time of facility*: 20–25 years
- *Operational Hours*: Potentially 24 hours 7 days (potentially less, subject to plant set up and nature of waste generation)
- *Typical site area*: 1–2 ha
- *Building Footprint*: 60 m–60 m (to house main thermal treatment components. If pre-processing then other buildings of differing sizes will be required).
- *Building Height*: 15 m–25 m
- *Stack height*: 30 m–70 m1
- *Vehicle Movements*: 20 waste collection vehicles or equivalent per day. Less if bulk transport vehicles used.
- *Employment*:2–3 workers at any one time, shift system if 24 hour operation.
- *Waste Storage*: Waste generally delivered to single waste reception pit within main building. Conveyors can be used if part of an integrated facility. If very small facility, a containerised loading system can be used.
- *Chemical Storage*: Small quantities of lime and activated carbon or urea (in solid form) used as part of air pollution control (APC).
- *Ash storage*: Generally removed daily or weekly with shovel loader into bulk vehicle or in covered containers.
- 1 Stack height determined by process characteristics and air dispersion modelling.

207. **Advantages of ATT**

- Because these processes take place in low oxygen conditions, the volume of process flue gas produced is significantly less than from incineration. Hence gas cleaning can be more efficient.

- Generally plants will be smaller than incineration with energy from waste plants (e.g. Grate and Furnace), and so will not inhibit recycling initiatives.

- Pyrolysis has more effective energy recovery than Anaerobic Digestion or landfill gas utilisation.

- Where electricity is generated it can be used remote from the location of the facility.

- Gasification products have relatively high value and there is potential for conversion of the products to higher value materials.

- With plasma arc, since there is no oxygen available there is no oxidation phase, as a result the formation of furans, dioxins, fumes and ashes is prevented.

208. Disadvantages of ATT

- Although using pyrolysis or gasification as a means of dealing with municipal waste has commenced in some countries, the process has yet to prove itself as an economically viable and reliable means for dealing with such waste. The process for plasma arc is still being developed and tested.

- Prefers a homogenous feedstock.

- Potential for production of polluting gaseous emissions.

- Changes in calorific value of waste can cause changes in operating costs.

Current Facilities

209. This technology is still not extensive in the UK. Permission was granted in March 2007 for a small-scale gasification facility at Moreton Valence, but this has not yet been implemented. Another small facility exists just outside the County on Severnside near Bristol.

Section 2.17
Landfill / Landraise Sites including Leachate Treatment Plants and Landfill Gas Plants

(Non-hazardous, hazardous and inert)

Landfill / Landraise

210. There is a common misconception that landfill sites involve little more than burying waste in a hole and covering it up. This may have occurred historically, but today there is strict legislation covering the construction, design and long-term care for a landfill site and this involves a significant degree of engineering.

211. The term landfill generally relates to the burying of waste below ground level and landraise, also often referred to as landfill, relates to waste disposal above pre-existing levels.

212. Modern landfill sites are designed as a series of 'cells' whereby only one cell is being filled at any given time.

Landfill site (Grundons, Wingmoor Farm)

213. On completion the cells are capped with impermeable material to contain the waste, odours and landfill gases. Capping also protects the waste from vermin and controls the entry of rain and surface water to the area.

214. Landfill gas is collected and combusted to generate energy and prevent pollution and hazard problems associated with landfill gas.

215. The cells are engineered with impermeable liners to prevent leachate from reaching watercourses or aquifers. The leachate is collected in a sump from where it is removed for treatment.

216. All landfill sites must be licensed by the Environment Agency and are subject to Pollution Prevention and Control (PPC) Regulations. They are categorised according to type of waste they are permitted to accept (hazardous, non-hazardous and inert).

Landfill Gas Plants

217. Landfill gas is any gas generated from landfilled waste. The principle components of landfill gas are methane (40-60%), carbon dioxide (40-60%) and small amounts of hydrogen, oxygen, nitrogen and water vapour. Around 1% by volume may include trace organic gases.

Landfill gas plant at Frampton

218.Landfill gas production results in a number of potential risks to the environment:

- Methane is approximately 25 more potent a greenhouse gas than carbon dioxide.
- Methane is flammable at certain concentrations so there is potential for fire and explosions if allowed to accumulate.
- Landfill gas may act as an asphyxiant.
- Landfill gas has an unpleasant odour and may have potential health effects.
- Landfill gas is corrosive.

219.Landfill sites are engineered with site lining and capping systems to prevent the gas from escaping. It is then collected by a network of vertical boreholes perforated pipes drilled into the waste.

220.The collected gas is passed through a condensate trap to remove any water droplets. The gas is either burned in an engine to produce power or in a flare stack which converts methane to the less potent carbon dioxide.

221.Flare stacks tend to be used at sites that do not produce sufficient gas for energy recovery and also as a back up at energy recovery sites to be used during maintenance or breakdown of the energy generation plant. Landfill gas requires management to minimise the potential harmful effects.

Leachate Treatment

222.The liquid seeping through landfill sites is known as leachate. It contains dissolved substances from the decomposing waste.

223.Groundwater and nearby watercourses are protected from leachate by engineered landfill liners which allow the leachate to collect in a sump.

224.The leachate is pumped out of the landfill ready to be transported to the treatment plant.

225.The object of a leachate treatment plant is to attain the required standard for discharge either to sewers or controlled waters. The degree of treatment will depend on the characteristics of the leachate and the receiving water.

Leachate Treatment at Frampton

226. Leachates being discharged to sewers may only require the removal of methane whereas those discharged to waters will require full treatment.

227. The treatment plants can either be permanent, fixed plants which extend beyond the operating life of the landfill or on a temporary basis for around 6 months.

228. The type of processes involved in leachate treatment are similar to those used in sewage treatment and each plant will be individually designed according to the treatment methods involved.

229. Plants will usually include processes for removal of organic material, colour and suspended solids also processes for removing contaminants such as heavy metals and nitrogen containing compounds.

Physical & Operational Characteristics

Site Requirements

230. The scale of the site can vary according to the type of landfill proposed. Inert landfill/landraise for engineering or agricultural purposes depend upon size of the proposed development. The site should be large enough to provide void space for the proposed lifespan of the site.

231. Space is also required to accommodate all other requirements of the site, including:-

- Internal haul roads
- Offices
- Weighbridges
- Wheel cleaning facilities
- Garages and workshops
- Leachate treatment area
- Landfill gas plant.
- Litter fences
- Secured site entrance and perimeter fencing.
- Noise/Visual screens such as bunding and/or tree planting areas.

232. The siting of the landfill gas plant will preferably be within the existing boundary of the landfill site it is supporting. Ideally sites should not be closer than 250m to housing, commercial or recreational areas. The compound should be large enough to contain the flare stack and up to three engines.

233. The location of the leachate treatment plant will be dictated to be the source of the leachate and the discharge route. It can be ancillary to the existing landfill facilities. The size required will vary according to the processes used.

234. **[250,000 tonnes per year capacity] – Landfill/Landraise**

- *Expected lifetime of facility*: 5–20 years
- *Operational hours*: 0700–1730 (Monday–Friday), 0700–1300 (Saturday), Closed Sundays and Bank Holidays
- *Typical site area*: 5–50 Ha
- *Typical site volume*: 1–5,000,000 m3
- *Vehicle movements*: Approx. 50 waste deliveries a day.
- *Employment*: Site manager, environmental manager, marshall, compactor driver, plant operatives (eg. dozer/shovel drivers etc), litter pickers, ancillary staff.
- *Ancillary operations*: Landfill gas extraction and flaring/utilisation,

leachate extraction and treatment or export to sewer, minerals extraction.

- *Afteruse:* Agriculture, public open space, amenity, nature conservation.
- *Waste stabilisation period*: At least 30–50 years.

235.[2000 m3 throughput of landfill gas per hour]

- *Expected lifetime of facility*: 20–50 years.
- *Operational hours*: 24 hours a day, 7 days a week.
- *Typical site area:* 25 m × 25 m
- *Primary infrastructure*: 1 flare and/or 3 engines (~700 m3/hr each) (NB. If engines are present flares will also be included for back up purposes).
- *Power Production*: 3 MW
- *Employment*: Usually controlled by telemetry. Maintenance staff on routine call-out, as necessary.

236.[100 m3/day plant] – Leachate Treatment

- *Expected lifetime of facility*: Typically temporary e.g. 6 months – 2 years or semi permanent e.g. 15–20 years.
- *Working time*: 24 hours 7 days, subject to volumes requiring treatment. Leachate can be treated on a batch basis using balancing/storage tanks.
- *Leachate volumes treated*: According to site specific need; examples range from 30 m3/day to 800 m3/day.
- *Typical site area*: Less than 1 ha
- *Building footprint*: Various
- *Building height*: Less than 5 m – 20 m
- *Vehicle movements*: Occasional vehicles weekly.
- *Employment*: 1 or 2 operatives part or full time or plant may be fully automated.

237.Advantages of Landfill Sites

- Simple to operate.
- Relatively low cost to develop and operate.
- Able to handle a variety of wastes, including residual wastes from other processes and in variable quantities.
- Impacts are fairly localized.
- Inert landraise site can be used to improve land for engineering or agricultural purposes.
- The gas can be utilised to generate electricity as an alternative to fossil fuels. This also reduces the polluting effect of methane, does not result in a net increase to atmospheric carbon dioxide and reduces the risk of fire and explosions due to the build up of highly flammable methane.
- Leachate treatment plants enable the leachate to be treated on site to achieve the permissible levels for discharge.

238.Disadvantages of Landfill Sites

- Not considered to be a sustainable method of waste management.
- Will require aftercare and maintenance for decades after the site has close.

- Without engineering and specialist controls, landfills have major atmospheric and water pollution implications.

- As the waste degrades, the chemical composition changes increasing the potential for unknown toxic hazards.

- Requires a large area of land.

- Limited availability of suitable land.

- Limited scope for afteruse.

- Local problems may arise from odour, litter, dust, vermin and noise (in addition to the problems associated with increased traffic movements).

- Despite being designed to reduce air pollution and contributions to climate change, landfill gas plants are still a source of air pollution. They emit many of the pollutants associated with combustion, such as carbon monoxide, nitrogen oxides and particulates. These all have human health implications, most notably increases in respiratory illnesses.

- The plants can be associated with noise problems, particularly from the operational engines and engine and flare exhausts which are usually more apparent at night.

- The gas plants can be visually intrusive due to the height of the flare stack.

- There is a small risk of chemicals and untreated leachates entering water courses if an accident occurs

Current Facilities

239. Landfill is still the major type of residual waste treatment in the UK.

240. In Gloucestershire there are three large-scale landfills dealing with biodegradable waste. Two are located at Wingmoor Farm, near Bishop's Cleeve and one at Hempsted Gloucester. There are also smaller facilities at other locations within the County including at Frampton, near Moreton Valence.

Bibliography

The majority of the paper was sourced from the following two texts:

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