

GASIFICATION

Residual Waste Treatment Technologies



Introduction

The key aspect of gasification is that it is done in a low-oxygen atmosphere thus avoiding direct combustion. Gasification is the controlled combustion of waste at temperatures up to 1400°C¹ producing a synthetic gas known as syngas which can then be used to generate electricity and/or heat. Gasification can reduce the volume of waste by up to 90%². Gasification is a relatively new technology for the treatment of MW. There are currently no gasification plants treating MW in Scotland; however there is a fully operational (but not full scale) demonstration plant in Bristol that combines both Gasification and Pyrolysis³. Gasification can be combined with a range of other waste treatment technologies.

Inputs

Gasification can treat MW and other waste types including commercial and industrial waste, and clinical waste.

Process

Waste is collected and delivered to the site where it is pre-treated to remove non-combustibles such as glass and metal, remove excess moisture, and sometimes shredded to a uniform size⁴. It is then fed into the gasification reactor where it is burnt. The unburned residue, or bottom ash, from the non-organic fraction of MW is stabilised and is deposited into a quench tank. Magnets remove any ferrous metals from the ash for recycling and the remaining ash may be recycled for use in construction. The combustion process also produces carbon which is transformed into syngas. This can be used at the plant to generate electricity and/or heat, or can be refined, using a system of scrubbers and cleaners, to produce a highly efficient gas which can be further scrubbed of pollutants for combustion on-site or transported to other energy generation sites. Gasification plants are able to operate at less than 100% of capacity and do not need to run 100% of the time, as start-up periods are relatively short⁵, so there is flexibility when there is a decline waste availability.



Outputs

1 tonne of MW produces approximately⁶:

- 150–300kg of ash residue for use in construction or landfill;
- 20kg of hazardous waste to landfill; and
- Syngas.

¹ Office of the Deputy Prime Minister, *Planning for Waste Management Facilities: A Research Study* 2004. p.121.

² Yassin, L, (2006). *Energy Recovery From Waste: A Case Study*, Changing the Face of Waste Management, 12th–16th June, Paignton. The Chartered Institution of Wastes Management.

³ ODPM. p.131

⁴ Department for the Environment, Food and Rural Affairs, "Advanced Thermal Treatment of Municipal Solid Waste", 2005. p4. available at www.defra.gov.uk/environment/waste/wip/newtech/pdf/advancedthermaltreat.pdf.

⁵ www.wasteresearch.co.uk/ade/efw/gassification.htm

⁶ www.mbt.landfill-site.com/Pyrolysis___Gasification/pyrolysis___gasification.html

Impacts	Details
Scale	A plant treating approximately 50,000tpa would have a site area of approximately 1-2ha with a maximum building height of 25m. The stack height will depend upon the requirements for air dispersion, but may range from 30-70m ⁷ .
Siting	Unlike large thermal treatment facilities gasification proposals are likely to offer the opportunity to consider wider locational options in mixed use areas. Preference should be given to areas allocated for business use or traditional commercial/industrial urban area. Compatible with more intensive class 4 & 5 activities under the Use Classes Order. Existing waste sites should also be considered. ⁸
Transport	A plant treating 50,000tpa would require approximately 20 waste collection vehicles per day ⁹ . Mitigation measures to regulate traffic flows can also be introduced, such as routing away from inappropriate roads, residential areas, and schools.
Noise	Noise will be generated by plant operations and traffic. However, PPC regulations require that noise is limited. Mitigation measures to minimise noise can be effectively applied.
Air Emissions	Very little research has been undertaken in the UK on the air emissions associated with gasification systems. Research that does exist suggests that, in comparison with other forms of thermal treatment, emissions are comparable, if not lower ¹⁰ . There may be a minor increase in pollution due to the increase in traffic.
Dust, Litter & Odour	There is very little practical experience of such facilities to determine whether these issues will be significant. However at well run facilities this should be minimised.
Health	There is no clear evidence of health impacts, although some plant employees have experienced skin and respiratory problems. See www.defra.gov.uk/ENVIRONMENT/waste/research/health/index.htm for more information of health impacts.

Regulation

- EU Landfill Directive (99/31/EC) requires a reduction in the amount of BMW to landfill (www.sepa.org.uk/wastemin/legis/landfilldir.htm). The Directive also requires Member States to set up a national strategy for the implementation of these targets.
- Integrated Pollution Prevention and Control Directive (96/61/EC) was created to prevent or minimise emissions to air, water and soil, as well as waste (www.sepa.org.uk/ppc/legislation/index.htm).
- Waste Incineration (Scotland) Regulations (SSI 2003 No170) introduced strict regulatory controls and set minimum technical requirements for waste incinerators (www.scotland.gov.uk/Publications/2003/10/18328/27648).
- Public Participation Directive (2003/35/EC) requires that the application and decision document for a waste treatment installation permit must be made available to the public for their comment (www.sepa.org/ppc/ppd/index.htm).

Further Information

Introductory:

www.defra.gov.uk/environment/waste/wip/newtech/pdf/advancedthermaltrat.pdf
www.sepa.org.uk/pdf/nws/guidance/thermal_treatment.pdf

Intermediate:

www.environment-agency.gov.uk/wtd/679004/679021/679065/?version=1&lang=_e
www.foe.co.uk/resource/briefings/gasification_pyrolysis.pdf
www.mbt.landfill-site.com/Pyrolysis___Gasification/pyrolysis___gasification.html
www.environment-agency.gov.uk/wtd/679004/679021/679065/?lang=_e

Detailed:

www.defra.gov.uk/ENVIRONMENT/waste/research/health/index.htm
www.wasteresearch.co.uk/ade/efw/gassification.htm
www.communities.gov.uk/pub/713/PlanningforWasteManagementFacilitiesaresearchstudyPDF1908Kb_id1145713.pdf

⁷ ODPM. p124.

⁸ ODPM. p123.

⁹ *ibid.* p.124.

¹⁰ Hogg, R. (2006). *Energy from Waste by Pyrolysis and Gasification*, Changing the Face of Waste Management, 12th-16th June, Paignton. The Chartered Institution of Wastes Management. p.5.