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Waste Planning

Energy from waste: How the Gasplasma system works

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As well as being able to convert refuse into power and empty out existing landfill sites, releasing the land for reuse, the Gasplasma process offers a significant benefit: its by-product is a building material, not a waste.

Advanced: Gasplasma's test facility in Swindon

A process called Gasplasma combines two well proven technologies in a unique combination to convert waste into a very clean, hydrogen-rich synthesis gas (syngas).

Municipal solid waste (MSW) is first sifted to remove any oversized objects and grit. A materials recycling facility (MRF) recovers any metals, glass and hard plastics and the residue is shredded and dried to make refuse-derived fuel (RDF).

Then, a fluidised bed gasifier transforms the organic materials in the RDF into a crude syngas containing tars and chars by heating the RDF to around 800ºC in a reduced-oxygen environment.

The crude syngas is passed into a separate, secondary plasma converter. The heat from the plasma arc – in excess of 8,000ºC – and the ultraviolet light of the plasma "crack" the crude syngas to create a clean syngas, whilst the inorganic elements of the crude syngas and the bottom ash from the gasifier are vitrified into an aggregate called Plasmarok.

The syngas is used in a power island to generate renewable energy. Residual heat is recovered from the process to be used in CHP mode within the process itself as well as for other users in the vicinity.

Power for 15,000 homes, from refuse

The power island, consists of reciprocating gas engines or gas turbines, and can generate renewable power for 15,000 homes. Enough residual heat is also recovered for 700 homes.

The process offers high energy efficiency, the production of an environmentally benign aggregate material, minimal generation of secondary residues and very low emissions. The MRF enables recovery of recyclates and the production of a consistent quality fuel. The technology is based on a combination of proven operating sub-systems and well-established process chemistry.

The plasma converter stage is able to achieve effective and energy-efficient cracking of the complex tars and char products in the crude syngas exiting the gasifier. It is these contaminants which have been the major obstacle for deployment of gas engines and turbines in waste gasification, which is necessary to achieve higher electrical generating efficiencies. The standard facility is designed to handle around 150,000 tonnes of waste per year which creates 90,000 tonnes per year of RDF. This offers a community-based solution for sustainable waste management and an opportunity for local CHP schemes.

Gasplasma plants are significantly cheaper to build and operate than the traditional method of energy recovery from waste, incineration. Most of the equipment will be manufactured off-site, so it can be installed in 18 months compared to 24–30 months for an incinerator which requires a substantial amount of on-site fabrication work.

The Gasplasma plant has other advantages in that Plasmarok can be sold, whereas other technologies including gasification and incineration have to process their inorganic material in the form of bottom ash in order to be able to dispose of it.

Finally the Gasplasma plant is more efficient in electrical production than other technologies, which gives a further advantage in operating revenues from electrical sales and renewable obligation certificates.

The process uses standard components, all of which are currently used all over the world.

A full-scale plant is around 10,000m2 (the size of 1.5 football pitches). It can fit into a standard warehouse, similar to those used for out-of-town retail parks. The stack is 10m above the eaves of the building. Emissions are minimal and within the EU Industry Emissions Directive. This means a plant can be constructed, unobtrusively, on the edge of a town, taking household waste from that town and supplying power and heat in return.

A Gasplasma plant can accept the waste from a town of 250,000 people. The technology can be supplied in multiple units to process higher quantities of waste.

However, the process is able to use a much wider variety of wastes. The crucial thing about any waste is its calorific value (CV). Advanced Plasma Power (APP), which developed the process, conducts extensive tests on all wastes and fuels presented by prospective clients at our UK demonstration facility, the most sophisticated of its type in Europe.

The tests examine the CV of the waste and the quality of the syngas produced. A design can then be developed for the process using this fuel source.

Recuperation of landfill sites

Landfill mining is a new concept in waste management. The waste in landfills has often been placed in controlled cells. For landfill mining it is extracted from more than one cell and blended to ensure a standardised quality. This creates a consistent fuel so the process gives a predictable level of output.

The waste is then turned into RDF as described above.

Landfill tax in the UK is currently £56 per tonne and is set to increase by £8 a year until at least 2014. This is to discourage new waste going into a landfill sites. Although there are no incentives to mine waste from old landfill sites, revenue from a UK landfill mining project could come from the value of recyclable materials like metals, glass and plastics, power and heat sold to the grid, renewable obligation certificates and incentives for selling renewable heat.

The prospects for landfill mining will depend significantly on the value of the reclaimed land.

Projects include Europe's largest paper mill, at Skogn in Norway; APP is also working with Grundon to install a plant at a site in Perth, in Scotland, Group Machiels on its enhanced landfill mining project and with some of the UK's largest waste management companies.

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