European Commission

New Solutions in Energy Utilisation

WTE-ISLE

Waste Management in Island Communities: Strategy to Integrate Waste-to-Energy Policies

5th Framework Programme of the European Commission, DG-TREN

ENERGIE

Project information

The present publication has been produced in the framework of the project **Waste Management in Island Communities: Strategy to Integrate Waste-to-Energy Policies (WTE-ISLE)**, funded by the 5th Framework Programme of the European Commission, DG-TREN. The aim of the project is to promote sustainable energy production from Municipal Solid Waste (MSW) and support the integration of energy from waste into insular energy systems.

Why focus on islands?

Waste management is a challenge for all communities, insular or not, but islands have unique characteristics that influence their choices of sustainable waste management options. For instance:

- The **availability of land** is usually very limited and its value is high enough to discourage extensive reliance on landfilling of waste.
- Islands are by nature isolated from the mainland and usually need to develop **self-sufficient solutions** for waste management and energy supply.
- Population in most cases presents large seasonal fluctuations attributed to **tourism**, that affect waste and energy planning.
- Material recovery and recycling is not always feasible since, at least in small islands, there is **no market** for recycled materials.

Under these conditions, **energy recovery from waste** seems to be a reasonable option in the waste management strategy of insular areas.

What is energy recovery?

Thermal treatment with energy recovery is one of the options prescribed by the European Commission in its waste management option hierarchy. It has higher priority over landfilling but lower priority over waste prevention and reuse/recycling.

The most developed and widely deployed form of energy recovery from waste is mass burn incineration. It is used throughout the world for the treatment and disposal of municipal solid waste. Other types of incineration, i.e. fluidized bed, rotary kiln, cement kiln, are more appropriate for smaller scale treatment of sewage sludge, clinical and hazardous waste. Pyrolysis and gasification are considered 'advanced' ways of thermal treatment.

Waste management hierarchy

Prevention
Reuse
Recycling
Energy Recovery
Disposal

Waste-to-District Heating in Shetland Islands

Shetland Islands lie over two hundred miles north of Aberdeen in the centre of the North Sea and Atlantic Ocean oilfields. The modern waste-to-energy plant built there, aims to act as a centre of excellence in the management and processing of municipal and offshore waste.
Waste is delivered to the plant and stored in a reinforced concrete bunker. Waste is mixed within the bunker with an overhead crane to standardise the quality of waste fed to the incinerator. The incinerator is comprised of a three-section moving grate and is designed to process 26,000 tonnes of waste per annum.

Waste is burnt at around 1200°C, producing 7 MW of energy. The flue gases are maintained over 850°C and passed through a boiler where they heat water at 115°C. The hot water circulates into a closed-loop district heating network which currently supplies heat to houses, commercial and industrial premises, as well as the Lerwick hospital and swimming pool.
The plant operates a comprehensive environmental pollution abatement system, which comprises cyclones, electrostatic precipitators and fabric bag filters for particles, wet scrubbers for gases, a wastewater treatment plant for liquid discharges, and use of the bottom ash for landfill cover and road construction. This system ensures compliance with current and anticipated environmental standards.

An eye on technology

Incineration

Mass burn incineration refers to the combustion of unsorted mixed waste on a moving grate. On a worldwide basis it is the second most preferred option for waste management after landfill. It involves heating of the waste to an average temperature of 850°C in the presence of air for sufficient time to allow for the destruction of organic matter. Usual throughputs are in order of 10-50 tonnes per hour.

Fluidised bed incineration involves burning the waste in a bed of sand or other inert material, which is fluidized by air. Fluidised bed incinerators can burn a variety of wastes including MSW, hazardous waste as well as gaseous and liquid wastes. They require rather uniform size of waste input and they cannot operate over 850-950°C. Commercial application has not been proven in all cases.

Rotary kiln incineration comprises burning waste materials in an inclined rotating chamber, at temperatures between 900 and 1100°C, while gas products receive secondary treatment at 1400°C.

Rotary kilns and their variations (i.e. cement kilns) are used for the treatment of solid and liquid waste, especially hazardous and industrial waste.

Gasification

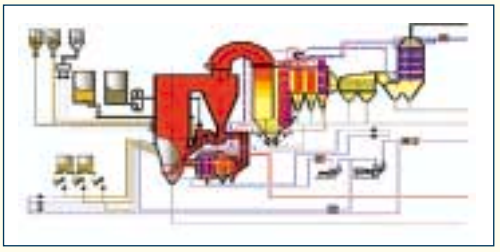
Gasification is the partial oxidation of waste in the presence of air, oxygen or steam and at temperatures between 800 and 1400°C. The process generates a gaseous product with significant fuel value, together with tar and ash. When optimized for the production of gas, gasification can achieve conversion efficiencies of up to 87%. Several pilot gasification plants have been built around the world but the process is not fully proven on a commercial scale.

Pyrolysis

Pyrolysis is the thermal decomposition of waste in the absence of oxygen, at temperatures between 400 and 800°C. The products are carbonaceous char, liquid and gaseous fuels, the percentage of which in the final product depends on the operating temperature. Given that pyrolysis is endothermic, i.e. requires heat to be supplied in order to proceed, the energy gains are marginal and the major advantage is the recovery of useful materials. The process has not been commercially proven for municipal solid waste treatment.

Co-combustion of waste and coal in Sardinia

In Sardinia, Italy, an initiative has been undertaken since 1998 concerning the design and installation of a demonstration plant for co-combustion of coal and municipal solid waste. The aim of the initiative is to provide a sustainable solution to the waste disposal problem and at the same time to reduce emissions from coal combustion. The plant has the capacity to treat a complex feed stream consisting of 98,500 tpa of MSW, 7,000 tpa of dry sludge and 26,000 tpa of coal. Power production rises to 12 MW of electricity.



The plant operates a waste pre-treatment facility, which involves crushing of waste and separation of metals and inerts, drying and bio-stabilisation of sludge and grinding of coal before the materials enter the combustion chamber. Combustion takes places in a circulating fluidised bed with the addition of limestone. The energy in the fuel is used to produce superheated steam, which drives the steam turbine of the plant. Electricity is fed to the national grid.

Flue gases undergo scrubbing while solid wastes consisting of ash, fuel treatment remainings and scrubbing by-products are rendered harmless and disposed of to the landfill. The plant complies comfortably with local environmental regulations.

Why use thermal treatment for our waste?

Apart from being recommended by the EU as an acceptable waste management option, thermal treatment with energy recovery has a number of important advantages when applied to MSW:

- Helps reducing the volume (by up to 90%) and weight (up to 75%) of the waste that goes to landfill sites and thus prolongs their life;
- Destroys the organic component of biodegradable waste which, when landfilled, would generate landfill gas and increase greenhouse gas (GHG) emissions;
- Destroys toxic or hazardous waste, or makes them more suitable for disposal in normal landfills;
- Recovers useful energy from waste thus reducing the need to import non-renewable fossil fuels and cutting down emissions to the environment.

Furthermore, investments on thermal treatment with energy recovery from waste in islands will have beneficial effects on local economic development and employment.

But is it safe for our health and environment?

Waste incineration has been the focus of increased public concern in the past, due to its environmental performance and specifically emissions of air pollutants and solid residues. This was one of the reasons that many waste incinerators had to close down during the 90s.
This is now past! The new EU Incineration Directive, already in force for new developments, sets the strictest ever emission limits for thermal treatment facilities. The industry has responded accordingly by improving design and investing in operation modifications that prevent pollutant emissions rather than applying end-of-pipe solutions. Overall emissions from municipal waste incinerators nowadays compare well with gas power stations, which are generally considered one of the cleanest power production technologies.
Adding to the above, incineration contributes to our struggle to reduce GHG emissions, since:

- It avoids the release of methane and other emissions from the decomposition of organic material that, if not incinerated, would end up in landfills
- It generates lower CO_2 emissions than coal, oil or gas when used for the production of electricity

Even if it is not strictly a 'renewable' energy source, as some people claim, its environmental performance as an alternative energy source, and its contribution to security of supply combine to make it more attractive than fossil fuels

Power production from waste in Isle of Wight

In 1987 the Isle of Wight Council constructed a waste derived fuel plant (WDF) that produced fuel pellets from collected MSW and an amount of selected commercial waste. These pellets were provided to an adjoining power generation plant that generated electricity for export into the national grid. Recently the plant has been converted into a Resource Recovery Facility (RRF) that produces a partially densified 'floc' fuel from the same feedstock as was processed by the WDF plant but also produces additional fuel from wastes that were un-processible through the existing WDF plant pelletisation system. This increases the throughput and effectiveness of the plant, and hence diverts more waste from landfill.

In normal operational circumstances the RRF would accept around 60,000 tonnes of MSW and selected commercial waste per annum and produce 30,000 tpa of fuel. Under constant production, the generation of 2.2MW of power has been achieved to date of which 0.3MW is used by the power plant and 0.5MW used by the RRF.
Environmental considerations are given special emphasis. The pollution abatement system - comprising a rocking grate, an economiser with lime injection and a back filter - is 99.99% efficient in removing contaminants.

Integrated waste management in Mallorca

Mallorca has been experiencing a constant increase of MSW produced for the last decade. To tackle this situation, an integrated policy for reduction, reuse and recycling of MSW has been instigated. At the heart of this policy lies the Son Reus incineration with energy recovery plant. The plant has a total thermal capacity of about 90 MW and is able to process about 88 tonnes of MSW per hour.
The plant is integrated into a well-functioning waste collection and transfer system. Non-recyclable waste from municipalities is collected in lorries and transported to transfer stations where it is unloaded in hermetically closed containers and compacted. Transfer stations incorporate modern environmental considerations: there is no manual handling of waste, no contact with the external environment, any leachate is collected and treated and visual intrusion is minimized. Waste containers, when full, are transferred to the Son Reus plant for treatment.
Thermal treatment with energy recovery at the Son Reus plant is able to reduce the volume of waste treated at 8% of the original volume. About 75% of the remaining material (6% of the total) is slag consisting of re-usable metals and material used for road construction. The rest 25% of the remaining volume (2% of the total) is sent to landfills after stabilization. The energy produced is equivalent to supplying 45,000 homes.

What about implementation risks?

At the end of year 2000, there were 304 incineration facilities operating across Europe producing some 49.6 TWh of electricity and heat per year. On average they treat 177,000 tonnes of waste per year. The experience gained from building and operating these facilities is valuable and greatly reduces the risks for the development of new projects. Specialist firms have been developed which offer the whole range of services, from consultancy to project design, optimization and implementation.
Nevertheless, there are some basic principles that island authorities should have in mind before engaging themselves in similar developments:

- Energy recovery from waste requires significant capital investment and has long payback periods. Long-term waste disposal contracts are required to ensure that the raw material will remain available to support full time operation;
- Incinerators are designed on the basis of specific throughput and calorific value of waste. We cannot alter these parameters at a later stage (i.e. by introducing another waste management option such as recycling of paper or plastics) without affecting their performance;
- The economic performance of such a project depends much on the exploitation of the energy generated. As a result, medium to long-term energy planning is necessary to ensure successful implementation.

Co-incineration of waste and biomass in Guadeloupe

In the French island of Guadeloupe a biomass-fired power plant is located near a sugar plant. The power plant is designed to operate on the co-incineration principle using sugar cane ("bagasse") as its main fuel and coal as supplementary fuel. The quantities of bagasse and coal used depend on the availability of bagasse, which is season dependant. The plant is expected to switch to using MSW as supplementary fuel during 2003.
The plant is equipped with two identical thermal power lines. The steam produced by co-incineration is used both for electricity production (about 74 MW) and to cover the thermal needs of the sugar plant. The plant consumes 200,000 tonnes of bagasse and 130,000 tonnes of supplementary fuel per annum, producing about 370 GWh of electricity. Only about 20% of this energy comes from the vegetal waste.
The plant currently covers 7% of the electricity consumption of the island .

Energy recovery from waste is only one of the available waste management options and should be examined in the context of an integrated waste management plan. Such a plan should be long-term and also address other options, such as waste prevention at source, reuse/recycle, composting, etc, in order to arrive at an optimum mix.

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- Transenergie, France (representing Martinique and Guadeloupe)
- Regional Energy Agency of Crete, Greece
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- Tirme S.A., Spain (representing Mallorca)
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