Pyrolysis and Gasification Factsheet

Pyrolysis and gasification, like incineration, are options for recovering value from waste by thermal treatment. The basic technology concepts are not novel but, recently, several new proprietary processes have been developed. This brief note provides an independent overview of this subject and aims to answer some of the most common questions about the use of pyrolysis and gasification to process wastes.

What are Pyrolysis and Gasification ?

Both pyrolysis and gasification turn wastes into energy rich fuels by heating the waste under controlled conditions. Whereas incineration fully converts the input waste into energy and ash, these processes deliberately limit the conversion so that combustion does not take place directly. Instead, they convert the waste into valuable intermediates that can be further processed for materials recycling or energy recovery.

PYROLYSIS
Thermal degradation of waste in the absence of air to produce char, pyrolysis oil and syngas, eg the Conversion of wood to charcoal

GASIFICATION
Breakdown of hydrocarbons into a syngas by carefully controlling the amount of oxygen present, eg the conversion of coal into town gas

Why use Pyrolysis and Gasification ?

- Increased possibilities for recycling

Pyrolysis and gasification offer more scope for recovering products from waste than incineration. When waste is burnt in a modern incinerator the only practical product is energy, whereas the gases, oils and solid char from pyrolysis and gasification can not only be used as a fuel but also purified and used as a feedstock for petro-chemicals and other applications. Many processes also produce a stable granulate instead of an ash which can be more easily and safely utilised. In addition, some processes are targeted at producing specific recyclables such as metal alloys and carbon black. From waste gasification, in particular, it is feasible to produce hydrogen, which many see as an increasingly valuable resource.

While this type of recycling is rarely economically attractive under current market conditions, these technologies do offer the scope for increasing recycling rates to achieve government targets or address environmental concerns.

- Better energy efficiency & contribution to reducing global warming

Gasification can be used in conjunction with gas engines (and potentially gas turbines) to obtain higher conversion efficiency than conventional fossil-fuel energy generation. By

displacing fossil-fuels, waste pyrolysis and gasification can help meet renewable energy targets, address concerns about global warming and contribute to achieving Kyoto Protocol commitments. Conventional incineration, used in conjunction with steam-cycle boilers and turbine generators, achieves lower efficiency.

However it is worth noting that, for technical and financial reasons, many current projects do not implement these advantages, preferring instead to use proven – but lower efficiency – methods of energy recovery.integration with composting and materials recovery

Many of the new processes fit well into a modern integrated approach to waste management. They can be designed to handle the residues from MRF and kerbside resource recovery initiatives and are fully compatible with an active programme of composting for the putrescible waste fraction.

- More flexibility of scale

Systems are being developed for a wide range of capacities. Some processes can be used as local solutions, at small scale (30,000 tonne per year), to handle the wastes generated by isolated communities, while others are targeted at large (150,000 – 500,000 tonne) regional facilities.

What types of waste can be processed ?

A very wide range of materials can be handled by gasification and pyrolysis technologies (Juniper's database lists over 50 different types of waste for which systems are available or under development). Specific processes have been optimised to handle particular feedstock (for example, tyre pyrolysis and sewage sludge gasification), while others have been designed to process mixed wastes like MSW.Today, the main applications are:

- Processing agricultural and forestry residues
- Handling household and commercial waste
- Recovering energy from residues left from materials recycling (auto-shredder residue, electrical and electronic scrap, tyres, mixed plastic waste and packaging residues)

Materials recycling and composting cannot handle mixed waste feeds – today only landfill and incineration can do this. A few pyrolysis and gasification systems can handle unsegregated MSW, although operational reliability has not yet been fully demonstrated for most of these processes.

What processes are available commercially ?

There are more than 150 companies around the world that are marketing systems based on pyrolysis and gasification concepts for waste treatment. Many of these are optimised for specific wastes or particular scales of operation. They vary widely in the extent to which they are proven in operation.

Today, about 10 companies are vying for the largest potential market, bulk disposal of MSW, though not all of these are active in all areas of the world.

Is this technology proven in operation ?

There are more than 100 facilities operating or ordered around the world, capable of processing over 4 million tonnes of waste per year. Some plants – particularly in Europe

and Japan - have been operating commercially for more than five years. However, many of the proprietary systems currently being promoted have only operated so far as small scale pilots and, in general, incineration is far more proven than pyrolysis and gasification for most applications. There have also been some noteworthy problems at particular projects over the last five years that raise concerns about operational reliability.

How do the economics compare with alternatives ?

There is a shortage of hard data on true capital cost and operating costs for 'real-world' applications (many projects have been supported by subsidies) while, in other cases, vendors have forward-priced projects to secure prestigious references. Many studies have shown that gasification and pyrolysis can be commercially feasible. But, in our experience, project costs are rarely significantly lower than conventional alternatives. Individual projects need to be considered on a case-by-case basis to determine whether the economics are viable.

Pyrolysis and Gasification for handling unsegregated MSW

Much attention has been focused on the potential for these technologies to handle the bulk disposal of household waste. Today, there are few demonstrator projects at large scale in Europe. There are several commercial sites in Japan. So the technical and economic feasibility cannot be described as fully demonstrated. Increasing emphasis upon resource recovery and renewable energy may make these processes more attractive in the medium term. The key to their widespread adoption will be successful extended operation at 'flagship' reference facilities
over the next few years.

For more assistance with projects relating to the pyrolysis and gasification
of waste, please contact Juniper on 0044 (0) 1453 860750 or email info@juniper.co.uk.