REVIEW OF BEST AVAILABLE TECHNIQUES FOR NEW WASTE INCINERATION ISSUES

Background
Technical guidance for waste incineration processes regulated under the integrated process control (IPC) regime was issued by the Environment Agency in 1996. This guidance now requires revision to address developments in technology and new considerations brought about by new legislation, notably the change from the IPC regime to the Pollution Prevention and Control (PPC) and the recent EC Directive on the incineration of waste. This work was commissioned to supplement and update current information on best available techniques (BAT) contained within existing guidance in order to assist with the development of future guidance.

The work is presented in three parts:

Part 1 Waste pyrolysis and gasification Activities
Part 2 Validation of Combustion Conditions
Part 3 New IPPC considerations

Part 1: Waste Pyrolysis and Gasification Activities
Whilst gasification and pyrolysis have been around for over a century, their application to waste treatment with the need for demonstrably sound environmental credentials is novel. In the UK, there is growing interest in the use of these technologies for the treatment of wastes and the Environment Agency is receiving a growing number of approaches from developers wishing to gain authorisations for pyrolysis and gasification of wastes.

The existing guidance notes no longer adequately cover the range of possible projects which may apply for licensing. Hence, the aim of this work is to update the current guidance to cover pyrolysis and gasification and PPC issues relevant to these technologies.

There are a wide range of process configurations under development or demonstration worldwide. The report provides an overview of the key technical and environmental issues associated with these processes, grouped according to generic process type. The nature of the different intermediate fuels such as pyrolysis oil, syngas and solid char residues are also described. Pollution control options are identified with information on performance and applicability.

Plant performance profiles are presented for the generic process types and performance benchmarks derived which represent “best practice” currently being achieved. However, there is very little published data on emissions and there are limitations with the data that is available.

There are two key conclusions from this work:
1. Based on current evidence, waste pyrolysis and gasification plants will have similar pollution potential to waste combustion plants. Claims that pyrolysis and gasification processes are inherently less polluting than conventional waste combustion processes have not yet been substantiated. In theory, there is potential for pyrolysis and gasification processes to have lower emissions of certain pollutants and relevant points are noted in the report.

2. The economic analysis shows that, based on the available data and our assumptions, pyrolysis and gasification plants cost more than similar scale waste combustion plants. There is wide variance in the available economic data. If the lowest combinations of currently published capital and operating costs for pyrolysis and gasification plants are taken, these plants can give lower gate fees than waste combustion plants. This is particularly true for smaller scale plants. As these are emerging technologies, there is scope for optimising costs to improve their competitive position.

There is significant uncertainty regarding the data these conclusions are based on and there is a need for more data that is in a consistent form. This will be essential if best available technology is to be specified.

Part 2: Validation of Combustion Conditions

The EC Waste Incineration Directives lay down minimum conditions for furnace residence time, temperature and furnace gas oxygen content. They also require that plant are subject to appropriate verification at least once to show that the minimum requirements are satisfied, even under the most unfavourable operating conditions. This report considers and assesses the available literature concerning possible monitoring methods and makes recommendations for guidance on BAT.

The study found that there are no standard methods covering this area and therefore the reviewed methods are described in some detail. The report also explains that a major obstacle concerned with validating residence times in incinerators is the lack of a comprehensive definition for this parameter. The report finds that clarification of the definition to be employed is essential to allow any verification procedures to proceed, and suggests several possible ways forward.

Design and measurement approaches are considered and the report recommends that verification should be based on measurement. The role of modelling is also considered and it is recommended that the use of techniques, such as computational fluid dynamics, should be encouraged to promote good design.

The report recommends that the minimum temperature requirements should be verified using a suction pyrometer system. Other approaches are also recommended, including shielded thermocouples, infra-red pyrometers and acoustic pyrometers, but these will need to be calibrated against a suction pyrometer and corrections applied.

Two residence time measurement approaches are recommended. The first is based on an assumption of "plug flow" and measures the residence time by monitoring the mean gas flow rate leaving the system. The second approach assumes that some stirring occurs within the furnace chamber and uses a time of flight determination. Measurement methods are recommended and described.

The use of the time of flight methodologies and the partially stirred reactor model represents the best approach, as it more closely reflects the real situation. It is recommended that these methods should be used for determining residence times in new plant. Time of flight methods could be used at some existing plant but its use could become more difficult. Consequently, it is recommended that existing plant be allowed to use the "plug flow " approach based on the mean gas flow measurement procedure.

Recommendations are given concerning the conditions to be tested, the minimum number of tests at each condition and minimum sampling times. Recommendations are also made for defining the datum for the qualifying combustion zone. The technical difficulties likely to be encountered are considered for various type of plant, including existing and new plant. Recommendations are made on where latitude should be allowed.

The capital costs associated with the purchase of monitoring equipment are reviewed. Compromises will need to be considered for much existing plant, and Regulators should accept that this would introduce additional uncertainty into any monitoring programme. It is recommended that new plant should meet the ideal monitoring port requirements laid out in the report.

Part 3: New IPPC Considerations

The study identifies the techniques that may be used to address the 'new' IPPC considerations, identifies the levels of performance that are achievable by their use, provides benchmarks, and identifies what techniques may be considered as best available techniques (BAT). These IPPC considerations include: selection of raw materials, waste minimisation, re-use, recycling and recovery of wastes; noise and vibration, energy efficiency and the risk of accidents and their consequences.

- **Raw materials**

The main use of raw materials (other than waste feedstock) are those used in gas treatment. The majority of acid gas abatement is currently achieved with dry and semi-dry processes. Wet scrubbing systems, which are generally two to four times as efficient and produce less residues than dry or semi-dry systems, are a potential option for all incinerators, though those currently in use have a high water consumption.

Most incineration installations utilise or intend to utilise ammonia or urea injection as nitrogen oxide abatement techniques. Of these, urea is the least environmentally harmful and is the easiest to handle and contain should a spillage occur. The advantage of using ammonia is that injection is easier than for crystalline urea. Both techniques are BAT if ammonia storage and use is carefully managed.

- **Materials Recycling and Reuse**

The impact of increased recycling (of the waste feedstock) on MSW incinerator performance will be minimal.

The imposed barriers to recycling of residues vary greatly from plant to plant. The majority of municipal waste incinerator operators either currently recycle the bottom ash as aggregate or are seeking to do so. Economics are the key driver for this as operators seek to avoid landfill costs and, in at least one case, create an additional income stream. APC residues from all forms of incineration plant are currently disposed in landfill, principally as special wastes. In the near future, the Landfill Directive is likely to require pre-treatment of these wastes in order to prevent mobilisation of pollutants including metal elements and chlorides.

- **Energy Efficiency**

The degree to which thermal energy can be recovered for conversion into usable heat and power varies by incinerator type. The main influence on the degree of recovery is economic, although there are also technical aspects that constrain this potential.

Due to the lack of information on energy flows within incineration plant, for existing plant the use of energy auditing is recommended as a tool for identification of key energy uses and losses from a plant and identification of savings. For new plant, the energy consumption of plant equipment and the overall process should be identified and evaluated in terms of cost and benefit at the design stage.

- **Noise and Vibration**

Most of the source of noise and vibration for incineration plant of all types are similar to those encounted in many other industrial processes, ie fans, pumps, motors, etc. and are covered in existing Agency guidance. However, several sector specific noise issues are identified.

- **Accidents and their consequences**

Many of the potential accidents or hazards associated with incineration plant also apply to other sectors, such as the movement of heavy vehicles and are covered in existing Agency guidance. Several sector specific issues are identified in the areas of waste storage, residues management and abatement failure.

This R&D Technical Summary relates to information from R&D Project P4-100 contained in the following output:

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