# Waste Incineration

Standard Note: SN/SC/4876
Last updated: 30 October 2008
Author: Edward White
Section Science and Environment Section

This note provides a short overview of the issues surrounding the incineration of waste. The Library research paper Waste Incineration from 2002 provides further detail.

## Contents



## 1 Regulation

The incineration of waste is covered the EU Waste Incineration Directive. The aim of this Directive is to minimise the impact of negative environmental effects on the environment and human health resulting from emissions to air, soil, surface and ground water from the incineration and co-incineration of waste.

The requirements of the Directive have been developed to reflect the ability of modern incineration plants to achieve high standards of emission control more effectively. It covers virtually all waste incineration and co-incineration plants.

The Waste Incineration Directive is being implemented mainly through the existing permitting requirements of the Pollution Prevention and Control (England and Wales) Regulations 2000 ("the PPC Regulations"). The Pollution Prevention and Control (England and Wales) Regulations 2000 (the “PPC Regulations”) were introduced under the Pollution Prevention and Control Act 1999 and build on existing systems. The PPC Regulations have been

gradually replacing the pollution control regime set up under Part I of the Environmental Protection Act 1990. This transitional process will be completed by the end of 2008.

There are 18 municipal waste incinerators in England and Wales. Until the end of 2005, these plants were regulated under the previous regime of Integrated Pollution Control (IPC) and were also subject to the Municipal Waste Incineration Directives. From 28 December 2005, these plants became subject to the new Integrated Pollution Prevention and Control (PPC) regime and the Waste Incineration Directive (WID). The WID requires compliance with much tighter limits than the previous regime.

The regime operates on the principal that installations must operate using the best available techniques for reducing pollution. Guidance notes on the regulations are available on the Defra website:

http://www.defra.gov.uk/environment/ppc/regs/index.htm

### 1.1 Enforcement

PPC and WID Monitoring requirements require pollutants like hydrogen chloride (HCl), sulphur dioxide (SO2), oxides of nitrogen (NOx), carbon monoxide (CO), and particulate matter (PM) are measured continuously and are reported as half hourly and daily averages. Other pollutants like cadmium and thallium (Cd&Tl), mercury (Hg), other heavy metals, hydrogen fluoride (HF), dioxins, volatile organic compounds (VOCs) and ammonia (NH3) are measured quarterly. Operators are required to inform the Environment Agency of any breach of the permitted emission limits within 24 hours.

In case of a breach, the Environment Agency take appropriate action in accordance with their Enforcement and Prosecution Policy. The powers available include enforcement notices and works notices (where contravention can be prevented or needs to be remedied), prohibition notices (where there is an imminent risk of serious environmental damage), suspension or revocation of environmental licences, variation of licence conditions, injunctions and the carrying out of remedial works.

## 2 Emissions

A Defra report from 2004 on, Environmental and Health Effects of Waste Management, noted a decline in emissions of dioxins:

> Emissions of dioxins and furans per tonne of waste from incineration are higher than from other options, with other processes burning waste gases having lower emissions. Emissions from incineration in the UK have changed dramatically, with a 99.8% reduction in emissions since 1990. This was brought about following limits imposed in European Commission directives. We gained a better understanding of the factors

> which result in dioxin and furan emissions, and developed improved ways of stopping them being formed, and removing them from flue gases.[1]

A report on the epidemiological evidence on adverse health effects caused by incinerators was compiled by the Environment Agency in 2005. It states:

> There are only a small number of epidemiological studies on populations around incinerators and the results of these are typically inconsistent and inconclusive. Based on current epidemiological evidence, it is difficult to establish causality, particularly once confounding factors such as socio-economic variables, exposure to other emissions, population variables and spatial/temporal issues are taken into account. In reality, most data on the possible health effects of incinerator emissions are derived from risk assessments, which are routinely used to evaluate both direct and indirect carcinogenic and non-carcinogenic risks. Whilst such assessments can help public health professionals identify chemicals of concern, they struggle to evaluate the level of risk at the concentrations actually emitted into the environment. [2]

## 3 The incineration process and energy from waste

Incineration of municipal solid waste (MSW) with energy recovery is a process that involves several stages:

a. Waste delivery, bunker and feeding system

The fuel properties of MSW will depend on several factors, including the composition and moisture content. Wetter waste with a higher organic content requires greater energy input to reach the correct combustion temperatures. Waste with a high metal content will also be less combustible. Pre-sorting and mixing of waste to increase its homogeneity and to remove any recyclable portion can influence combustibility.

b. Furnace

The most common form of incineration of MSW is mass burn. This involves a series of furnaces into which the waste is fed and where temperatures are in the region of 850°C to 1200°C, the optimum temperature being 1100°C. The waste remains in the furnace for 45 to 70 minutes to ensure complete combustion. There may be auxiliary burners as part of the

---

[1] Defra and others, *Review of Environmental and Health Effects of Waste Management*, 2004, Extended summary p16
http://www.defra.gov.uk/environment/waste/research/health/index.htm

[2] Environment Agency, Health Impact Assessment of Waste Management: Methodological Aspects and Information Sources, February 2005:
http://publications.environment-agency.gov.uk/pdf/SCHo1205BIMG-e-e.pdf

furnace to ensure that temperatures are maintained. The solid fraction of the combusted waste, the bottom ash, is removed via conveyor belt and collected for disposal or further use.

c. Heat and Energy Recovery

The temperature of gases leaving the furnace is in the range of 800-1100°C. Gas temperatures must be no higher than 250-300°C to ensure pollution removing measures are carried out efficiently, therefore gases have to be cooled. This is done by using them to heat water which can then be used within the incinerator, or externally in community heating systems. The resulting steam can also be used to drive turbines and generate electricity. Most modern incinerators include some form of energy recovery or combined heat and power (CHP) in their design. CHP is simply that both electricity and heat is collected for use from the incineration process. CHP is particularly suited to facilities which are close to new housing developments or industrial parks where a heating scheme can be incorporated at an early stage of construction.[3]

In 2000, MSW incineration generated around 1,400 gigawatt hours (GWh) of electricity. This was 0.4% of all UK electricity production and compares to 946 GWh from wind power, 5,108 GWh from hydroelectricity and 2,188 GWh from landfill gas. When energy used to generate heat is included MSW incineration provided 0.2% of total UK energy supply.[4]

d. Pollution Control

Cooled gases and the airborne fraction of the ash (fly ash) are passed through several filters and precipitators designed to remove a large proportion of particulate and gaseous pollutants, before being released into the atmosphere.

Incineration plants without energy from waste capabilities will not have stage c in the above process.

The term energy from waste can also include pyrolysis and gasification:

- Pyrolysis involves heating waste in the absence of oxygen at temperatures of 400-800°C. The heat breaks down complex molecules and resultant gases are then passed into a combustion chamber where they are heated (in the presence of oxygen) at temperatures around 1250°C. The process produces a liquid oil which is used as a fuel.

[3] Incineration, Environmental Services Association, viewed 11 October 2004. http://www.esauk.org/waste/incineration/plants.asp

[4] Digest of UK energy statistics*, Department for Transport,* 2001

- Gasification involves heating wastes in a low-oxygen atmosphere to produce a gas with a low energy content. This gas can then be burned in a turbine or engine.

Appendix 3 of the 2004 Defra report deals with the scope for electricity generation. There are several options, so I think it best to leave you with a link to the appendix rather than to summarise it:

http://www.defra.gov.uk/environment/waste/research/health/pdf/health-report10.pdf .

## 4 Waste Strategy 2007

The Governments Waste Strategy was set out in Waste Strategy for England 2007, from May 2007. The strategy sets out a number of measures to create incentives increase the generation of energy from waste. These are set out from page 76 of the Strategy and begin:

> Recovering energy from waste which cannot sensibly be reused or recycled is an essential component of a well-balanced energy policy, and most of our European competitors already pursue this vigorously. Denmark, for instance, derives 3.6% of its electricity supply from municipal waste.
>
> Recent sharp increases in energy prices, and continuing instability in a number of supplier countries, underline the importance of maximising energy recovery from the portion of waste which cannot be recycled. This means using the most efficient technology for the job, and recovering heat as well as electricity where practicable. The Government's Energy White Paper, published May 2007, places energy from waste in a wider energy policy context.
>
> The Renewables Obligation Certificates system provides support for electricity produced from the biomass content of waste treated in gasification, pyrolysis, anaerobic digestion and good quality combined heat and power plants. Energy from waste plant are also exempt from the Climate Change Levy, recognising the renewable fraction of waste.[5]

A progress report on the Waste Strategy was published in July 2008. It notes small increases in the incineration of waste in England. Further information is available in the Library Note, Waste and recycling statistics, SN/SG/2728.

[5] Defra, Waste Strategy, 2007