Best Available Technique Assessment

Arbour Growers Limited
Lady Arbour Farm, Eardisley, Hereford, HR3 6NU

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Brief

This report is prepared in support of a variation of an existing Environmental Permit under the Medium Combustion Plant Directive (MCPD) for new plants at Lady Arbour Farm in Hereford.

Summary

The “Best Available Technique (BAT) Reference Document for Waste Incineration” (Industrial Emissions Directive 2010/75/EU – Integrated Pollution Prevention and Control – Final Draft issued December 2018) document was used to identify equipment and systems, currently considered to be BAT for the incineration of wastes.

The site proposes to use a mixture of virgin and non-virgin wood chip, as per the Poultry Permit Variation guidance. However, as there is not BAT for virgin wood chips, this document is only applicable for covering the non-virgin wood fuel and for fulfilling the request of the Intensive Farming Poultry Permit Variation (Form Part C2.5, question 2a).

Thermal Treatment Systems – Grate Incinerators

Grate Incinerators are considered a BAT technique, and, for this application, the bed of the biomass boilers constitutes a moving grate combustion system. Wood is introduced into the combustion chambers in a completely controlled manner to ensure an even supply of fuel and therefore a high combustion efficiency.

The PLC based control system monitors oxygen levels within each of the combustion chambers and adjusts the speed / movement of the grate to maintain oxygen levels within set parameters known to result in highly efficient combustion (generally 6% to 12% O_2).

In order for the grate to feed evenly, wood must be supplied into the boilers in both phases with a fuel feeder. This is, again, automatically controlled by the PLC controller. Fuel is fed in by into augers through toploader bays, which are speed controlled. As oxygen levels increase, fuel delivery is also increased to provide more fuel for incineration and therefore increase the demand for oxygen. If oxygen levels drop then the feed auger slows, reducing fuel input and reducing the demand for oxygen, allowing oxygen levels within the combustion chamber to increase.

In order to maintain efficient combustion, ash within the combustion chamber must be regularly removed. An automatic system is utilised that augers the ash from under the grate and into the bottom ash discharger.

Oxygen levels within the combustion chamber are also controlled by the PLC control system, utilising primary and secondary air fans. The primary air fan is used to provide the bulk of O_2 demand, with the secondary air fan operating when oxygen levels are dropping towards the lower limits, pre-set during the commissioning exercise for the boilers.

Incineration temperature, residence time and oxygen content are therefore all controlled by the PLC control system.

Finally, the design (size and shape) of the grate (and therefore combustion chamber) is such as to ensure sufficient residence time within the boilers to ensure sufficient reaction time for gases prior to being emitted up the flue.

Several other systems on the market are considered as BAT. However, none of these are considered to be any more efficient that a moving grate design and, as they generally cost more, although considered to be BAT, can be discounted in this situation, being less cost effective than a moving grate system.

There are many other techniques highlighted as being BAT. These include Nitrogen Plasma arcs and AC Plasma systems. However, of these, a grate incinerator system offers sufficient performance at the lowest capital expenditure and should therefore be considered BAT in this situation.

Energy Efficiency Techniques

A further important aspect of BAT is energy recovery and energy efficiency. The Justsen boiler has been tested to be 89% efficient by utilising the following techniques within its design.

Recovery of energy from hot flue gases. During the combustion process, the majority of heat is transferred into the flue gases. Heat is recovered from the flue gases prior to emission to air, so that local heat demands can be met. The flue gases are passed through various heat jackets and pipe heat exchangers several times, designed to extract as much heat as possible. Over-cooling of the flue gas is avoided as this may result in corrosive acid gases being produced, leading to a dramatic reduction in the useful life of both the boilers and the flues.

Boilers & Heat Transfer. This boiler utilises a series of tubes (or tube bundles) within the boiler casing to transfer heat from the combustion gases into the water circulatory system designed to deliver heat into the greenhouses. A pump is used to circulate water around the boiler casings.

Optimal corrosion protection is designed into the boilers by ensuring that the flue gases exit the flue cowls at a sufficiently high temperature to avoid production of excessive corrosive fluids within the flue system.

Combustion air preheating. There is no pre-heating of the air prior to combustion. As the moisture content of the wood chip is agreed to be within certain limits prior to delivery, air preheating is not necessary as the fuel is already sufficiently dry.

Flue gas condensation. Condensation within the flue, resulting in corrosive fluids being produced, is controlled by maintaining the temperature of the flue gases, and also that of the return water which is used to cause condensation of the flue gases in a controlled manner.

Flue gas recirculation. A proportion of the flue gas is recirculated back into the combustion chamber to reduce the necessity of secondary air feed (at a significantly lower temperature).

Flue Gas Cleaning

A Justsen multicyclone filtration system provides flue gas cleaning capabilities to reduce dust / PM emissions sufficiently to meet emission limit values stipulated by MCPD legislation.

Cyclone. A multi-cyclone provides the flue gas cleaning capability, to reduce dust and PM emissions. There is also a ceramic ‘brake’ ring that retains gases within the combustion chamber to reduce carbon monoxide sufficiently to meet emission limit values stipulated by MCPD legislation.

Flue Gas Sampling. Only Virgin and clean non-virgin wood fuel will be used site. Therefore, annual extractive testing will be a sufficient level of emission control to ensure ELVs for all parameters stipulated as part of the poultry permit legislation will be met (250 mg/m^3 NO_2 and 50 mg/m^3 PM) and therefore BAT (See Emissions Monitoring document). The Oxides of Nitrogen levels produced by the boiler under normal operating conditions are sufficiently low enough to meet both the permit requirements, as evidenced with the supporting Extractive Testing report for a site with the same boiler and abatement installed; this one running off Grade A wood chip only; therefore we can expect emissions to be the same or better on the mixed fuel.

Alternatively, more expensive technologies that are available can, in this case, be considered as unnecessary, economically unviable and therefore not BAT.