Monitoring Emissions from Incineration Plants

Incineration is a rapidly growing waste disposal method as well as an increasingly important source of energy. Emissions from waste incineration plants can potentially contain many harmful pollutants but with the use of modern monitoring equipment, regulatory compliance can be ensured and emissions minimised. This article from ABB Measurement & Analytics explains the options available.

> *"The increasing use of waste incineration frequently gives rise to concerns about air pollution, not least in the local community."*

Incineration plays an increasing role in the treatment of municipal waste as well as for the supply of energy. Worldwide, some 2,200 incinerators dispose of about 255 million tonnes of waste annually. By 2017, 180 new plants, with a capacity of about 52 million tonnes, are scheduled to be built. Growth is particularly strong in Europe where, due to the ban on landfilling untreated waste, large numbers of waste incinerators have been built in recent years, with many more under construction.

Incinerators reduce the waste volume by about 95 percent, dramatically cutting the space needed for disposal. The recoverable energy is just under 3 MWh per tonne of municipal waste, of which some 25 percent can be converted into electricity and the remaining 75 percent can be used for district heating.

Waste incineration produces more pollutants than a natural gas-fired plant, but less than a coal-fired plant. The flue gases can contain high levels of particles, heavy metals, dioxins, furans, sulphur dioxide and hydrochloric acid. Incineration also produces CO_2, about one tonne per tonne of waste, but because much of the waste is biological, incineration is often classed as renewable energy.

A number of techniques are used to ensure the pollutants are reduced to within permissible limits. For instance, plants are equipped with a high-temperature zone where gases are heated to a minimum of 850°C for at least two seconds to ensure the breakdown of dioxins.

A flue gas purification system, located downstream from combustion processes, ensures that the concentration of emissions are below the legal limits, using various systems for removal of dust, acids, heavy metals and micro-pollutants. The resulting emissions are made up of fine ash in the flue gas, with varying amounts of organic and inorganic matter, which depend on the composition of the waste and the incineration process.

Directive Demands Control

In the European Union, the Industrial Emissions Directive (IED) 2010/75/EU, imposes strict obligations on the member states to ensure that continuous emissions monitoring systems (CEMS) are used to monitor flue gas. These systems must meet EN14181, the CEN standard for quality assurance of automated measuring systems in stacks.

The Directive applies to a range of different types of incinerators, in addition to the municipal waste facilities already mentioned. These include incinerators processing hazardous chemical or clinical waste, which may be owned and operated by specific waste producers or may serve multiple clients on a contract basis. It also includes co-incineration plants such as cement works, which burn waste as a fuel, as well as advanced technologies such as gasification and pyrolysis.

All the incineration plants that fall under the Directive are required to keep track of a variety of contaminants in their emissions, including carbon dioxide, oxygen and water vapour, total organic carbon, hydrogen chloride, hydrogen fluoride, dust and oxides of both sulphur and nitrogen. These are in addition to a wide range of specific chemical species that might be considered a possible risk in a particular installation. The monitoring must be continuous, providing average readings every half hour and each day.

With the use of modern instrumentation, emissions to the air can be effectively controlled and documented

In the event of a measurement fault, operators must act fast to remedy any malfunctions in their monitoring equipment, because the Directive gives them just four hours to fix the problem before they must reduce or shut down their operations.

As well as ensuring regulatory compliance, data from emissions monitoring technology can provide valuable feedback on plant performance, enabling plant operators to optimise efficiency and operational control, resulting in better energy recovery.

CEMS Techniques

In a traditional system, monitoring is carried out by extracting a small sample of flue gas, using a pump, into the CEMS system via a sample probe. In some systems, the sample is diluted with clean, dry air, typically in a ratio 100 to 1, to make samples that are hot, wet or sticky more manageable. The sample is then transported through a sample line, or umbilical, to a manifold where individual analysers can extract samples. A data acquisition and handling system receives the signal output from each analyser and collects and records the emissions data.

An alternative method is hot dry extraction or direct CEMS. Here, the sample is not diluted but is carried along a heated sample line into a sample conditioning unit. The sample is filtered to remove particles and then dried, before entering the sampling manifold. One advantage of this method is that it enables measuring of the proportion of oxygen in the sample. As dilution systems mix the sample with clean air, these cannot measure oxygen.

Infrared analysis

A more modern approach is to measure the flow of all pollutants at a single point. Fourier transform infrared spectroscopy (FTIR) analyses the spectrum from incoming infrared light. The infrared

Contact Details:
Gary Egerton
ABB Limited
Howard Road, Eaton Socon
St Neots, Cambridgeshire, PE19 8EU
Tel: 01480 488328
Fax: 01480 213339

spectrum enables identification of the molecules as well as concentrations of substances. An electronically controlled air injector sampling system conveys the sample gas, at constant pressure, from the sampling point to the analysers. To avoid pressure influencing the sample, which could happen with a conventional diaphragm pump, no moving parts are used. Adjusting all sampling, transport and gas measurement elements to a constant temperature of 180 °C ensures that the chemical and physical properties of the sample are maintained while avoiding possible alterations due to condensation. The absence of sampling pumps, hot ovens and connecting joints ensures accurate measurement and minimises maintenance costs.

This technology can also be used to improve the effectiveness of the flue gas purification system by analysing flue gases after combustion and again after treatment. The result is used to adjust the addition of reagents used in the processes.

Summary

The increasing use of waste incineration frequently gives rise to concerns about air pollution, not least in the local community. However, this article shows, with the use of modern instrumentation, emissions to the air can be effectively controlled and documented.

ABB has a wealth of expertise in the design, manufacture, supply and service of instrumentation and monitoring equipment for waste incineration. For advice on the best solution for your application, please call 0870 600 6122 or email enquiries.mp.uk@gb.abb.com ref: 'waste incineration'.

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