ABB MEASUREMENT & ANALYTICS | ARTICLE

ABB measurement products

Monitoring emissions from incineration plants

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ABB's leading-edge analytical technology ensures high quality, excellent performances and full compliance with the international environmental regulations

Measurement made easy

Introduction

According to the study 'Waste to Energy 2013/2014'[1], nowadays there are 2,200 incinerators around the world, for a disposal capacity of approximately 255 million tons of waste per year and approximately 180 new plants with a capacity of about 52 million tons per year will be constructed by 2017. In Coolsweep's[2] report on waste, prepared by the Lombardy Energy Cluster, Europe is highlighted as the main country in terms of number of plants, recovered energy and expertise in incineration, anaerobic digestion and recovery of landfill gas.

The European Union Directive 2000/76/EC on the incineration of waste imposes strict obligations to the Member States, in the aim to minimize the negative impacts on the environment and on human health of all pollutants found in air, soil, as well as in surface and subterranean water. This Directive is a driver for the construction of technically advanced incinerators to achieve high standards in reducing emissions.

References

1 The 'Waste to Energy' – 'The World Market for Waste Incineration Plants 2013/2014'

2 Coolsweep 'D 1.2 Global Analysis of the Waste-to-Energy field'

For more information

Further details of ABB Measurement & Analytics products are available for free download from:
www.abb.com/measurement

or by scanning this code:

Fourier Transform Infrared Spectroscopy (FTIR) for emissions monitoring

Until the end of the 1990s, the emission monitoring systems for incineration plants were constructed with multiple conventional analysis systems from different manufacturers.

This caused engineering and integration problems, difficulties in measuring critical components (for example, HCl, HF, NH_3, H_2O) reliably and reproducibly, frequent maintenance intervals and limited data availability. Together, this led to a significant increase in operating costs.

Detail of incinerator plant in Vienna, Austria

It was at this time that ABB developed an emission control monitoring system with an integrated FTIR spectrometer. This solution was greeted by the world of analysis with amazement and some perplexity. The main driver that led ABB towards this ‘innovation’ was the requirement from the competent supervisory authorities that analysis systems should be able to continuously detect an increasing amount of pollutants emitted in ever smaller concentrations from incineration and other types of plant.

FTIR is a measurement technique. Fast Fourier Transform (FFT) is a mathematical operation performed on the signal obtained by interferometry to extract the infrared (IR) spectrum. All molecules in the atmosphere, including those of the pollutants, leave a ‘footprint’ in by absorbing certain infrared frequencies. The resulting infrared spectrum not only permits the molecules to be identified, but also permits their concentrations and temperatures to be evaluated. FTIR spectroscopy is a measurement technique that allows the spectrum from incoming infrared light to be interpreted. FTIR technology combines FFT mathematical analysis with the Michelson interferometer. The physicist Albert A. Michelson performed several experiments to measure the speed of light. He developed an interferometer in 1881, and in 1887, together with E.W. Morley he showed that the speed of light is independent of the movement of the reference system (the Michelson-Morley experiment is often quoted in conjunction with Einstein’s Theory of Special Relativity).

FTIR technology today is based on the development of this interferometer. FFT is a mathematical operation performed on the signal obtained by the interferometer (the interferogram) to extract the IR spectrum.

Over the years, ABB's R&D department has worked continuously to refine and improve the multi-component monitoring system, in order to obtain ever greater stability and availability of data, reduce maintenance costs and, of course, ensure full compliance with applicable national and international legislation and regulations relating to emission control.

The ABB ACF multi-component measurement system is now in its third generation and is an example of how innovative technologies enable the precise and stable measurement of concentrations in the parts per million (ppm) range. The range of application of the ACF measurement system, which is based on the FTPA 2000 FTIR spectrometer, includes complex applications for emission monitoring in domestic waste, hazardous waste and sewage sludge incinerators, and in cement plants, glass furnaces, combined-cycle power plants and co-generation plants.

The heart of the FTPA 2000 FTIR spectrometer is the Michelson interferometer; ABB technology has modified Michelson's original optical design, introducing changes that make ABB's spectrometer highly effective and unique.

An electronically controlled air injector sampling system conveys the sample gas, at constant pressure, from the sampling point to the analyzers. To avoid pressure dependencies, which could arise if a conventional diaphragm pump were used, no moving parts are used. The absence of sampling pumps, hot ovens and connecting joints ensures accurate measurements and minimizes maintenance costs.

Chimney detail of an incinerator plant

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 FTPA2000 spectrometer measures gaseous pollutants such as HCl, CO, NO and SO_2, as well as NH_3, H_2O, CO_2, HF, N_2O, NO_2, H_2CO and CH_3OH. Measurement of sample gases with a high moisture content is also possible by using a chemometric model optimized for waste incineration processes. To measure oxygen and total hydrocarbons C tot a zirconium oxide sensor and a Flame Ionization Detector (FID) respectively are integrated into the system. In this way, the three FTIR, ZrO_2 and FID measurement modules guarantee 'hot' analysis and a single sampling point for analyzing all the gaseous components.

The FTPA2000 spectrometer is manufactured in the ABB Analytical Measurements (formerly Bomem Inc.) factory in Quebec City, Canada. Since 1973, this plant has designed, manufactured and delivered one of the largest portfolios of analytical solutions in the world for laboratory, at-line and process FT-IR/FT-NIR analyzers for the oil, chemical, pharmaceutical, remote-sensing and aerospace industries. The FTPA2000 spectrometer has been integrated and certified together with the RGM11 (O_2) and Multi-FID 14 (TOC) measurement modules by ABB's Measurement Products unit in Frankfurt.

In addition to the use of conventional analog and digital interfaces, data transmission can be carried out via Ethernet, MODBUS or PROFIBUS for a simplified connection to a control system or emissions analysis computer. Moreover, remote intervention can be carried out via a telephone modem connection to minimize maintenance time and costs.

The ACF system is TUV certified according to the European Directives 2000/76/EC, 2001/80/EC and meets the quality requirements imposed by EN 14181 and EN 15267.3; MCERTS is also certified in accordance with the UK Environment Agency, U.S. EPA and ASTM standards according to U.S. EPA 40CFR Part 60 PS-15 and ASTM D6348-98, according to the CSA CAN/CSA-C22.2 No. 61010-1-04 and UL Std No. 61010-1 and GOST-R.

ABB product family for continuous gas analysis

FTIR for monitoring flue gases

ABB Flue gas purification systems, located downstream from combustion processes, ensure that the concentration of flue emissions are below the legal limits using different and complex systems for dust, acidic pollutant, heavy metal and micropollutant removal.

To adjust the dose of the reagents effectively and in a timely manner it is also necessary to analyze the flue gases upstream of treatment. In the past, Italy experimented with a number of in-situ FTIR applications, in the belief that these would provide much faster measurements and would give the operator an immediate indication of the contents of some of the pollutants in the fuel. Unfortunately, these applications were not at all successful.

The first ABB FTIR applications, configured to extract flue gases, date back to 1996. Today, there are over 50, deployed successfully even on process measurements.

The ACF analyzer, thanks to a heated measurement chamber and with a multi-reflection optical path of 3.2 m, is also considered to be the benchmark solution for monitoring flue gases and the dose of the reagents in flue gas purification systems for waste-to-energy plants. At the end of the treatment process, the flue gases are conveyed to the stack.

At the stack, two series of analyzers can be used. The first is the Automated Measurement System (AMS), which is required by legislation to verify compliance with the legal limits. The second consists of an identical series of instruments, whose measurements are incorporated into the algorithm of the system for the abatement of acid pollutants and nitrogen oxides.

It is therefore possible to switch between the two analysis systems in order to reduce plant downtime due to failures.

More than 350 installations in Italy and 1500 in the world make ACF the most referenced and reliable solution, placing ABB in first place globally in terms of emission control.

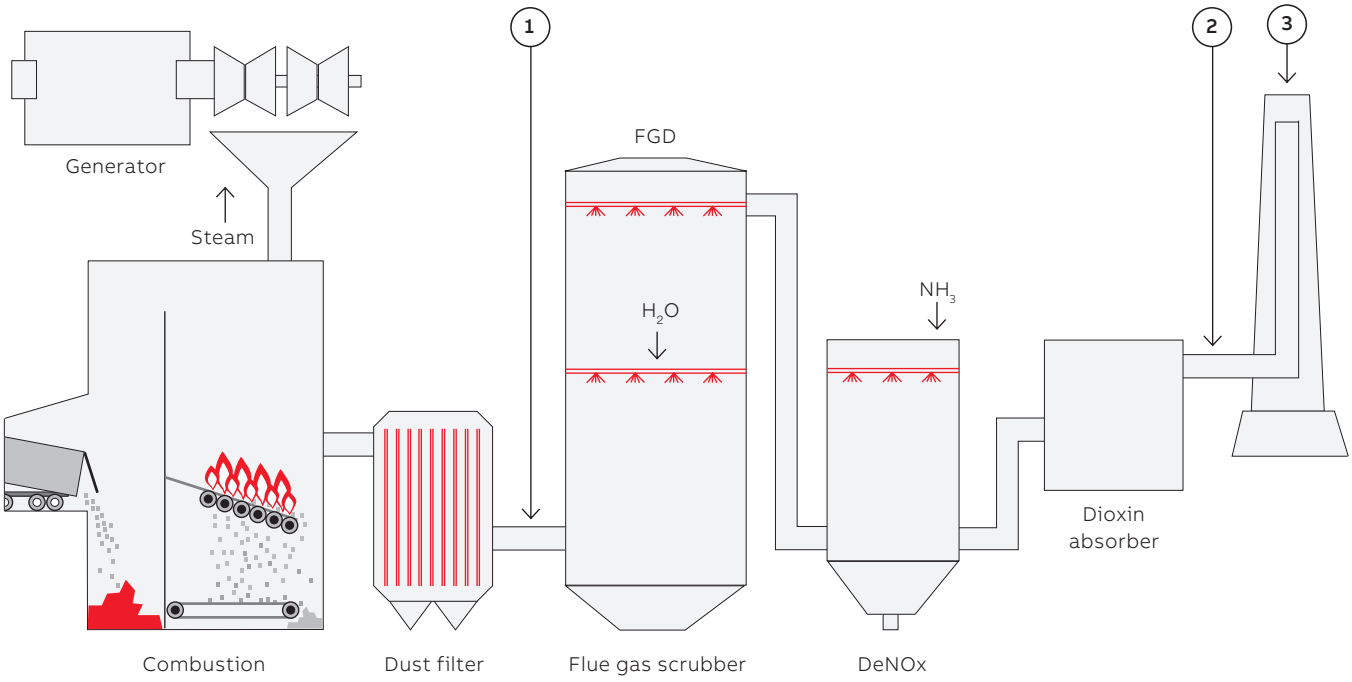
ACF is therefore an environmental monitoring system of the highest quality. It can rightly be called state-of-the-art as it has demonstrated in the field its safety features, stability, compliance with industry legislative standards and ability to detect gases at low concentrations.

Among ABB's most recent major accomplishments in Italy, are the emission monitoring system and process controls on three lines of the Acerra waste-to-energy plant, on two lines of the ACEA plant at San Vittore and on three lines of TRM's Gerbido waste-to-energy plant in Turin.

The ACF multi-component measurement system demonstrates how ABB analytical solutions are engineered and built to maximize the availability of measurements and improve the performance, operability and safety of processes while minimizing operating costs.

Choosing ABB analytical solutions means not only benefiting from the best technology, but also from the best after-sales support services that the market can offer.

Example of incinerator measuring points and solutions



Example of incinerator measuring points and solutions

Measuring point	Measuring task	Measuring components	Analyzers
(1)	Process control	CO, HCl, SO_2, NO_x	ACF
(2)	Process control – emissions monitoring backup	CO, NO_x, N_2O, SO_2, O_2,NH_3, HCl, HF, VOC	ACF
(3)	Emission monitoring	CO, NO_x, N_2O, SO_2, O_2,NH_3, HCl, HF, VOC	ACF

Key

The ABB Analytical Measurement service is unrivalled in Italy and consists of 25 Field Service technicians. These qualified ABB employees receive constant training and skills updates through specific courses given directly in the factory. All employees have expertise in the instruments and their related processes to ensure the highest performance standards and constant contact until the system is accepted: this is the Certified Support that ABB offers to its customers.

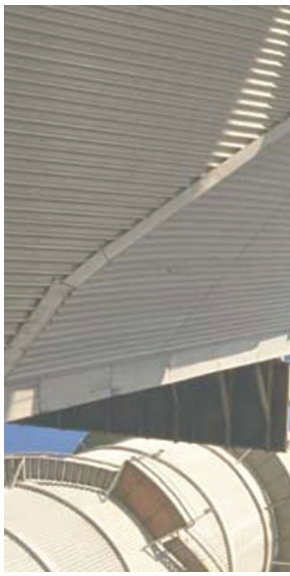
Headquarter of ABB Italy, Sesto San Giovanni – Milan / ABB Italy SpA

Article by:
Enrico Arioni, ABB SpA – Analytical Measurement

ABB Spa
Measurement & Analytics
Via Luigi Vaccani 4
22016 Tremezzina (CO)
Italy
Contact: Elisa Piacentini
Tel: +39 0344 58111
email: elisa.piacentini@it.abb.com

ABB AB
Measurement & Analytics
Norra Malmvagen 143
191 85 Sollentuna
Sweden
Tel: +46 21 32 50 00
Fax: +46 8 658 80 21

abb.com/measurement



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