1. Standards and Approvals

The Gasmet CEMS has the MCERTS approval (UK) and TÜV (13. and 17. Implementing Order for coal- and waste fired plants) approvals for continuous emission monitoring. The MCERTS and TÜV approvals are based on the measurements that were done during 1999. The Gasmet FTIR analyzers also comply with the requirements of US EPA Method 320 - Vapor Phase Organic & Inorganic Emissions by Extractive FTIR. There is also a specific Method 321 for monitoring HCl in Cement plants.
Please note that the US EPA does not approve any systems per se – the systems is either compliant with the method or not. Gasmet Technologies Oy has also ISO 9001 certified Quality Management System. Please find copies of these certificates as attachments to this document.

2. Applications

The Gasmet CEMS allows up to 50 compounds to be measured simultaneously. Compounds can be easily added or removed from the analysis application by simple software adjustments that can be performed by the user in the field. In an FTIR analyzer, the identity of an unknown compound(s) is determined from the residual spectrum. The Gasmet user can always rely on the factory for full application support. The Gasmet Technologies' reference library of 300+ compounds is provided to users in the form of continuous application support; this together with the simplicity of altering the analysis settings makes the instrument very flexible and cost effective.

In normal emissions monitoring application there are approximately 10 - 15 compounds (depending upon final instrument configuration) that will be monitored. Typically, these include H2O, CO2, SO2, CO, NO, NO2, (NOx), N2O, NH3, HCl, HF, CH4, C2H4, C2H6, C3H8, C6H14, CH2O. The Gasmet CEMS monitors all of these compounds continuously. That is, the entire spectrum is scanned ten times per second and an average calculated from this is reported for each (user selectable) sampling period.

The Gasmet CEMS can also measure TOC (Total Organic Carbon); compounds are measured individually and can also be added together by the software to produce a figure for total TOC. This is a major benefit since it makes unnecessary to have an additional analyser such as a FID (Flame Ionization Detector). FID analysers require additional maintenance and also need a carrier gas (usually Hydrogen) and Oxygen (zero air) to function. Moreover, an FID does not give any information on the proportions of different hydrocarbons in the sample gas.

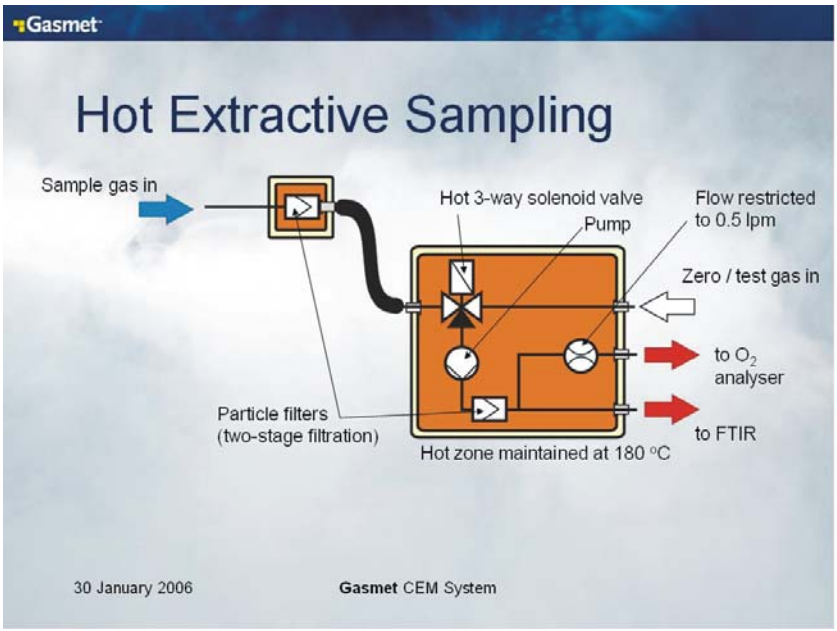
The Gasmet FT-IR stores the results of the entire spectrum; this is a major benefit since the raw data is available for post processing. Using this feature, we are able to identify compounds that the instrument was

not configured to report during the sampling period. In essence, the sample spectra and the analysis results are two separate things with an FTIR – analyzer like the Gasmet.

This feature has shown its value in a number of different applications, especially in process control. The advantage the plant operator is that should there be variations in the fuel supply, changes of fuel type or quality, Gasmet has the flexibility to post process the data and quantify emission levels of compounds not being reported in real time.

3. Installation

The Gasmet uses a hot & wet sample extraction system. The sample is drawn from the stack and passes through heated sample probe, heated lines heated pump to the heated sample cell. Particulate matter is removed from the sample but not moisture. This ensures that we are measuring a representative sample of the flue gas, not a dried or diluted version. Therefore we can also reliably measure water soluble compounds such as HF, HCl and NH3. Furthermore, this system significantly reduces maintenance - all that is required is filter cleaning and or changing as needed depending upon the dust burden in the stack.



Gasmet CEMS is an entirely modular construction; meaning that each system is built to exact customer requirements. For example, the sampling system can be constructed to suit different applications areas such as cement kilns by using sample probes that have been specifically designed for higher dust concentrations; there is also a back-flush option that ensures that minimizes the possibility of dust building up in the system. The Gasmet CEMS is also easy to install with each component fitting into a standard 19" rack, and often the existing ports / flanges on the stack can be utilized for installing the sample probe without modifications. It is also a simple procedure to add additional analyzers (e.g. H2S, H2, O2) to the system. The measurement data from these analyzers can be imported to the Calcmet – software and displayed on the screen. The Gasmet CEMS can also be supplied to Ex-Zone 1 specification (Eex II p T3).

4. Operation & Maintenance

The Gasmet CEMS requires little maintenance; Gasmet Technologies' scheduled service program calls for one annual service. This annual service includes the water vapour recalibration. In addition to that, the user should of course regularly make the visual check as instructed in the CEMS Operating Manual.

One additional benefit worth mentioning is the remote control feature that comes standard with the Gasmet CEMS. Every Gasmet CEMS is equipped with a modem and PC Anywhere – software. Thus the local distributor or Gasmet Technologies is able to take a remote connection to the system in order to check, that

everything is working as it should. What this means in practice is, that unnecessary service visits can be avoided and possible problems can be spotted from early on.

5. Calibration

Each Gasmet analyzer is subject to a factory specific calibration which is performed in our laboratory, after the manufacturing and final testing have been completed. Each calibration gas is introduced to the instrument in known concentrations in pure nitrogen. Reference spectra are generated in different concentrations to cover the complete measuring range. Linearity is proofed. If needed, gas mixtures are generated and cross interferences tested. The instrument specific calibration ensures the best possible performance.

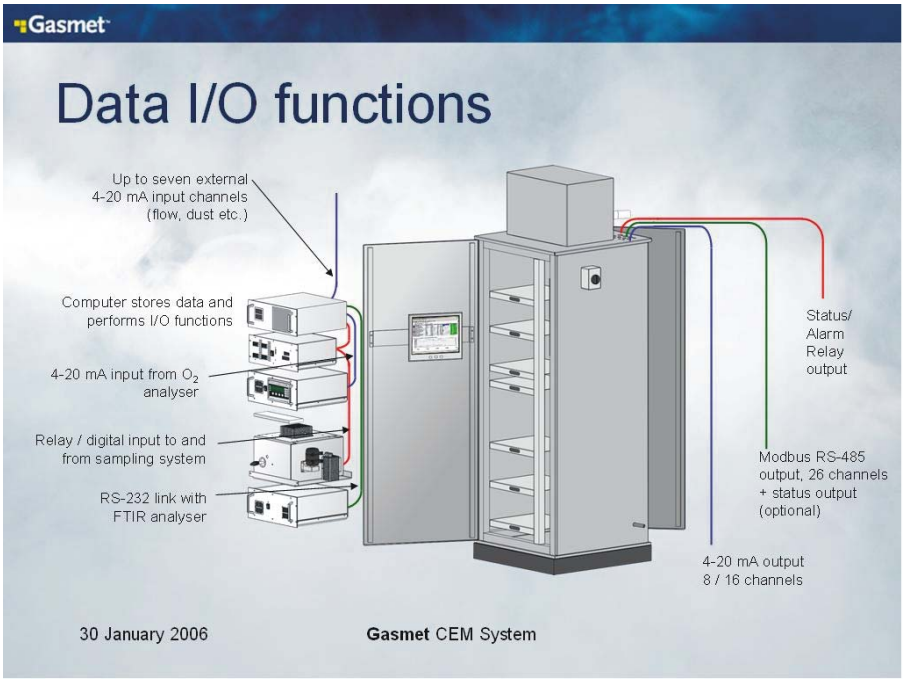
There's no need to do any span calibrations with the Gasmet CEMS since each Gasmet gas analyzer has a built-in He-Ne laser. The laser signal is used to measure the exact position of the moving mirrors in the interferometer. The measured interferogram presents the detector signal strength as a function of the mirror position. Now, when we make the FFT (Fast Fourier Transformation) to the measured interferogram, the result is the infrared spectrum. The mirror position scale is transformed to the wavenumber (wavelength) scale, which is thus measured with laser precision. As such, the instrument is continuously calibrated with a He-Ne laser, which provides a stable wavenumber scale. High spectral signal-to-noise ratio and high wavenumber precision are characteristic of the FTIR method. This yields high analytical sensitivity, accuracy and precision.

It is necessary to make the zero calibration (background) measurement once a day. The zero calibration compensates for all changes in the signal level or in the instrument. Background spectrum is measured by filling the gas cell with an infrared-inactive gas (for example, dry nitrogen, dry oxygen, or even dry instrument air). No other gases / recalibrations are ever needed; H2O is the only exception in normal operation. The H2O calibration must be valid in order to make reliable measurements for other components. We recalibrate H2O each time an analyzer is serviced, typically during the annual maintenance (that is, once a year).

Thus, the Gasmet CEMS does not require span checks per se; however in some countries the legislation requires span checks to be conducted periodically to prove that the instrument is responding correctly. Simple span checks can be provided via the valves on the sampling system by simple activation of the span solenoid valve. The background is automatically measured daily on the Gasmet CEMS by purging the sample cell with Nitrogen. This system accounts for any baseline drift and frequency can be programmed by the user (typically 24 hrs or 12 hrs).

In addition to the span checks detailed above, a procedure that is commonly known as “Spiking” is also possible through the sample probe. Spiking introduces a calibration gas of known concentration into the sample at the probe, which is mixed with the stack gases so that the entire system can be tested in order to prove the can detect the calibration gas in amongst the actual sample. This can be required to prove that compounds in the sample are not causing interference.

With all types of IR – analyzers, one source of measurement uncertainty is spectral overlapping i.e. cross-interference. In the Calcmet – software cross-interference is automatically taken into account in the analysis settings of each compound. And, should there be a previously unknown compound in the sample, the Calcmet – software gives a warning to the user with an increase in the residual of the compound(s) that are affected by the unknown.



6. Cost of Ownership

The Gasmet FT-IR has a very low cost of ownership; the equipment is extremely well designed, and requires very little maintenance. In addition, upgrading the system is also easy; in order to add new compounds to the analysis, one does not need to do any changes in the hardware, only in the software. The system also has a number of in-built failsafe devices to protect the instrument from potential damage; this ensures that should any individual component fail, the analyser is protected from condensing gases causing damage particularly to the cell. For example, in the event of power cut, the system will automatically start to flush itself with instrument air.