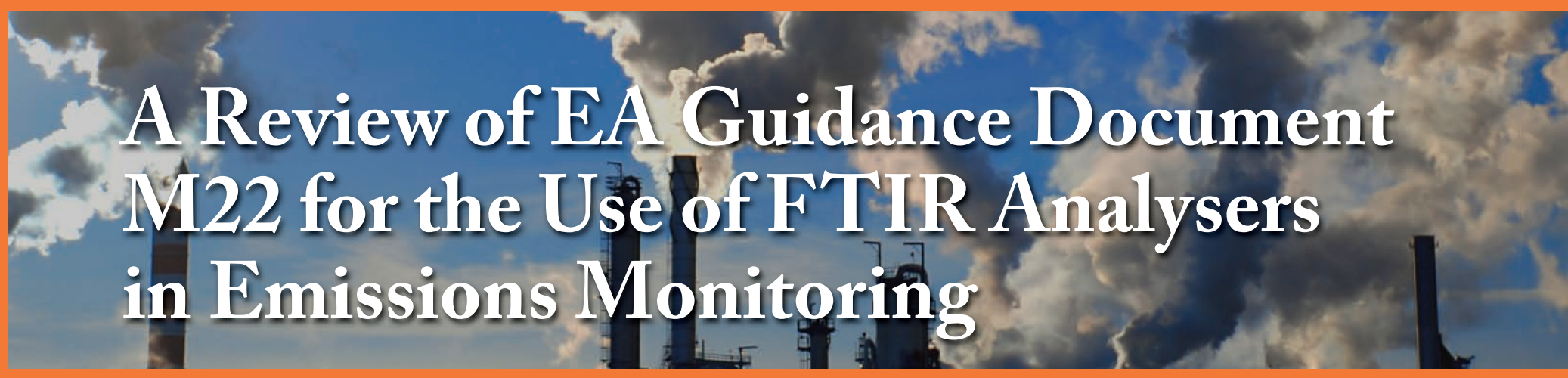

A Review of EA Guidance Document M22 for the Use of FTIR Analysers in Emissions Monitoring

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M22 is an Environment Agency Technical guidance note on measuring stack gas emissions using Fourier Transform Infra Red (FTIR) instruments. FTIR is a powerful analytical technique that is able to identify and quantify a large number of species from the common combustion process pollutants such as CO, NO_x and SO_2 through to complex organic compounds. Prior to the publication of M22 the internationally recognised standards that were used for the deployment of FTIR in the UK for the purposes of stack emissions testing were issued by the US EPA in the form of Method 320 and ASTM D6348-03. Protea Ltd, with its 15 year history of deploying FTIR in the UK, were the first to gain Mcerts accreditation under ASTM D6348-03 and the process was not an easy one. The ASTM standard includes different levels of validation that can be difficult to apply to specific monitoring projects and as a result many compromises were made during the accreditation process to enable a UK test houses to comply with the requirements. M22 was introduced to overcome these challenges.

History of M22

As a result of the compromises made when operating an FTIR under ASTM in the UK and the need for an in depth knowledge of FTIR operation and spectral analysis it became clear that a UK FTIR standard would be of great benefit. The Environment Agency therefore commissioned the National Physical Laboratory to create a viable standard for FTIR deployment within the emissions monitoring industry in the UK (M22). Many refinements were made to the first draft by NPL by an FTIR working group consisting of FTIR manufacturers, operators and the Source Testing Association (STA).

The final version from the working group was submitted to the Environment Agency for approval, where it had some revision at the request of technical specialists within the EA. These changes have now been a matter of debate amongst the FTIR operators and manufacturers. Protea is a member of the STA's FTIR working group, which is assisting the EA in finalising Version 1 of M22. The objective is to create a standard that is both viable for users and provides increased assurance in the quality of data reported by test houses using FTIRs.

M22 outlines how an appropriate FTIR should be selected, how it is checked to ensure it is fit for purpose and how it should be operated in the field. Critically, M22 also covers the post-sampling Quality Assurance checks that are needed to confirm reliable results and it has removed many of the ambiguities of the ASTM method. M22 also harmonises with the style used in Europe for CEN standards.

M22 in Operation

When operating under M22, the FTIR must first pass a series of laboratory tests for accuracy, linearity etc before it can be used in the field. Many of these initial requirements, such as defining the effect on the final result caused by changing supply voltages, are already defined for you and rendered unnecessary if you use an MCERTS approved FTIR.

Before taking the FTIR out in the field to carry out sampling from a specific source, it is necessary to define an analytical (software) model that will take into account all of the anticipated components in a vent and be able to accurately quantify these. There are specific rules within M22 for how these analytical models should be constructed.

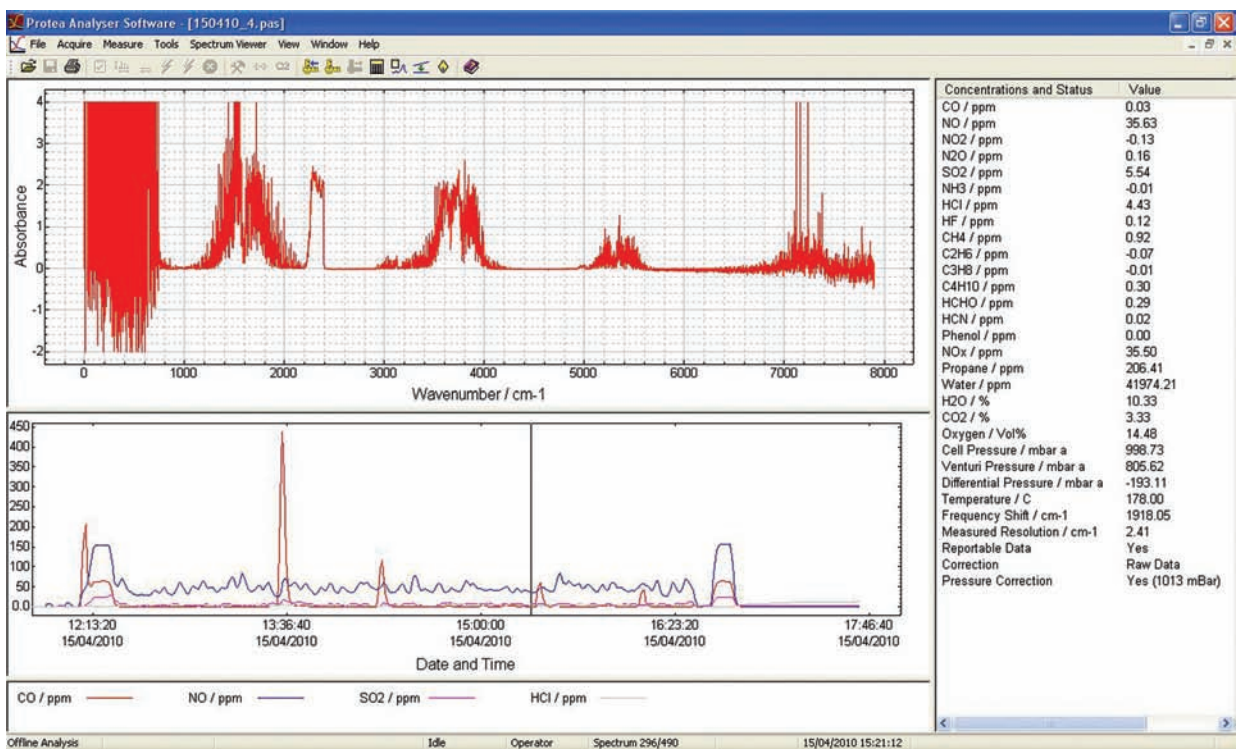

Figure 1: Powerful FTIR Spectral Analysis Software

Once in the field, M22 requires careful testing of the analyser to ensure it is operating correctly. For example, the exact position of a specific infra red absorbance peak caused by water is measured to ensure it is in the correct place within the generated infra red spectra. Additional more classic tests are also carried out using a series of test gases to demonstrate that the FTIR can re-produce the correct result and that the associated sampling equipment is suitable to deliver a representative sample to the analyser.

Following the stack emission monitoring on site, further checks are made to ensure the FTIR has remained within specification during testing. Any failure of these post campaign tests would result in the rejection of all collected test data.

FTIR Validation Under M22

In addition to the requirements laid out in M22 for testing of the analyser in the field, post-campaign tests are required. These demonstrate that the selected analytical model used in the FTIR to calculate concentrations from the collected infra red spectra is sufficient to ensure a quality result. One of the great advantages of the FTIR is that it can detect a vast range of different components – in fact most compounds have an Infra Red absorption. This however also means that the analytical model can be affected by the presence of additional unknown substances leading to calculation errors due to the interference. This must be carefully checked before the final results of any analytical model can be published. Full procedures on how these checks are made are defined in M22.

Figure 2: Deployment of FTIR under M22 on a Combustion Process

Protea gained accreditation to M22 (version 1) earlier this year under their MCERTS certification. All of the requirements mentioned above have to be included within a technical procedure that an accredited test house must follow. This technical procedure is checked against the requirements of M22 by UKAS. In addition to confirming that the technical procedure covers all of the requirements, UKAS also witness an actual test on-site to ensure that the testing is completed as defined.

With any new standard like M22, it is likely that there will be frequent revisions – for example Protea is already discussing the contents of version 2 of M22 and expects to see this published by the Environment Agency before this summer. For any test house that has obtained an FTIR and accreditation to M22 it is important that the technical procedures are regularly revised and kept up to date with the standards.

M22 and Existing Standards

Currently if a test house wishes to perform a sampling exercise for a chosen component, they would consult the EA guidance document M2. This lists common components and the techniques that should be used to determine their concentrations in chimney stacks. For many components there will be a stated Standard Reference Method (SRM). This is generally an international standard such as a CEN or ISO standard. M2 also lists methods that can be used as alternatives to the SRM – the alternative reference method (ARM).

FTIR is not accepted as an SRM but is acceptable for most components as an ARM. Currently M2 lists the ASTM standard be used as a suitable alternative method, but this will be removed from M2 in July 2011 and will be replaced by M22. Therefore from July 2011 on, test houses wishing to use FTIR for MCERTS compliance monitoring will need to be accredited to M22 rather than the current ASTM standard.

Summary

The FTIR technique offers great advantages over traditional sampling techniques because it is a continuous and sensitive tool capable of measuring individually a large number of inorganic and organic compounds in emission gases. The FTIR means it is possible to provide real time, continuous measurements rather than the single averaged values that the manual chemistry techniques give. FTIR provides a powerful technique for studying new plant and processes and helps in the optimisation of production and reduction of emissions to atmosphere. For example, FTIR is ideal for monitoring batch chemical processes, as continuous FTIR monitoring can track discontinuous or varying emissions and the technology's capability to measure multiple components makes it suitable for many different plants and different reactions. This makes it possible to consider emissions reduction approaches to operations.

It is a credit to those involved that M22 has been published to allow wider use of this powerful tool within the stack testing industry and we should applaud the EA for their foresight in encouraging this new technology.

Figure 3: Using FTIR for a Process Investigation Study