Application Note

No. 230GA0193-E

Quantitative Analysis of Gases using Multi-component Analysis and Interval Measurement Software

Introduction

Fourier transform infrared (FT-IR) spectrometer systems are widely used for gas analysis, instead of dedicated gas detection systems due to the greater flexibility of FT-IR instruments. Gas detectors are capable of simple measurement but, when analyzing mixtures of multiple gases, the measurement can be corrupted by the influence of the other component gases. Often, the gas detector has to be changed depending on the gas components and it can be difficult to simultaneously analyze the components of multiple gases. FT-IR instruments allow the detection of the absorption peaks specific to the multiple compounds, and almost all gases have an absorption in the mid-infrared spectral range. The simultaneous analyses of multicomponent gases can be accomplished by the creation of a calibration curve for each gas component based on each specific absorption peak. The simultaneous monitoring of multicomponent gas samples can be accomplished utilizing the 'Interval Measurement' software for the FT/IR-4000/6000 series instruments. The combination of a full vacuum model FT-IR and multi-pass gas cells provides a gas analysis system capable of providing analyses of very low concentration gases and is capable of eliminating the influence of atmospheric water vapor and carbon dioxide. This application note will provide additional details on the software programs for gas analysis and the various gas cells used in this application.

Software program overview for simultaneous quantitation of multi-component samples

- Simultaneous quantitation of up to 20 components
- Time interval measurement capability
- Multicomponent spectral quantitative analysis
- Flexible calibration, selection and exchange of calibration curves
- Concentration monitoring display

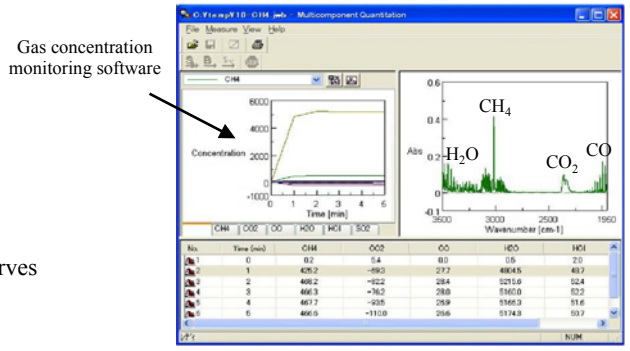

Fig.1 Example of multicomponent measurement using simultaneous quantitation program

Figure 1 displays an example of the simultaneous quantitative analysis program for measurement of a multicomponent gas sample The time course monitor of each component is simultaneously displayed. Figures 2 and 3 illustrate the gas monitoring instrument systems.

Fig. 2 VIR-9500 and 8 meter gas cell

Fig. 3 FT/IR-6200 vacuum model and 10 meter gas cell

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Registration and selection of component calibration curves

The multi-component quantitative analysis software allows the registration of up to 20 components. For the desired quantitative analysis, the desired calibration curve is selected from the registered calibrations. Figures 4 and 5 illustrate the registration and selection dialogs. Figure 6 is a display of a methane spectrum and an example of the calibration curve using the 8 meter gas cell. The detection limits depend upon the gas component and measurement conditions, including the resolution, accumulations and detector. Examples of quantitation ranges with respect to gas cell pathlength are shown below. [These are representative detection limits only and should be verified by actual experimental data.]

10 cm cell:	several % - 100 ppm
3 meter cell:	several hundreds - 1 ppm
8 meter cell:	several tens ppm - 0.2 ppm
10 meter cell:	several tens ppm - 0.2 ppm
20 meter cell:	several tens ppm - 0.1 ppm

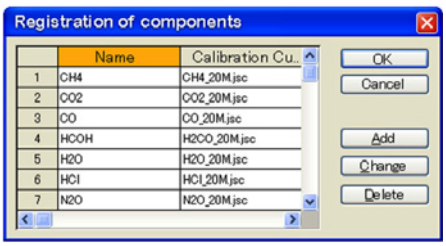

Fig. 4 Gas component registration dialog

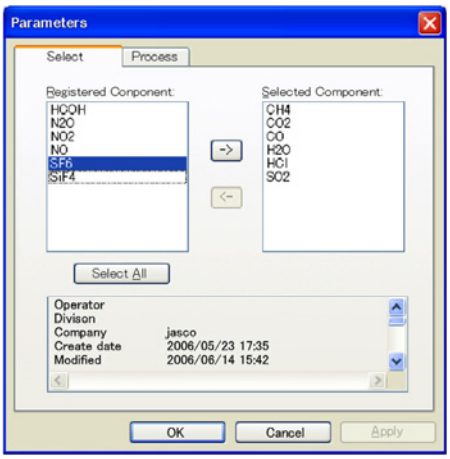

Fig. 5 Gas component selection dialog

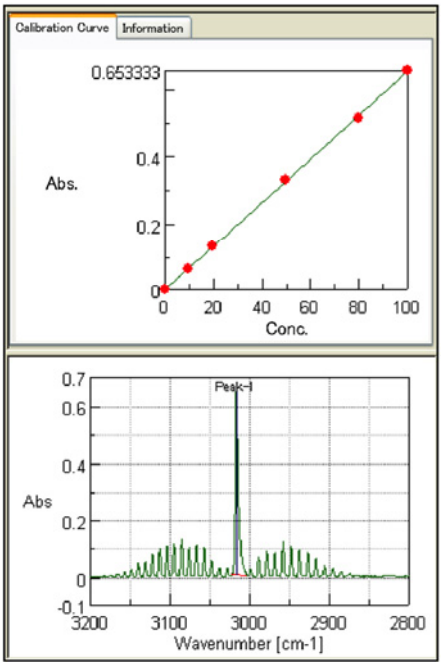

Fig. 6 Calibration curve and methane spectrum