First class performance

A new platform for on-line analysis using process gas chromatography

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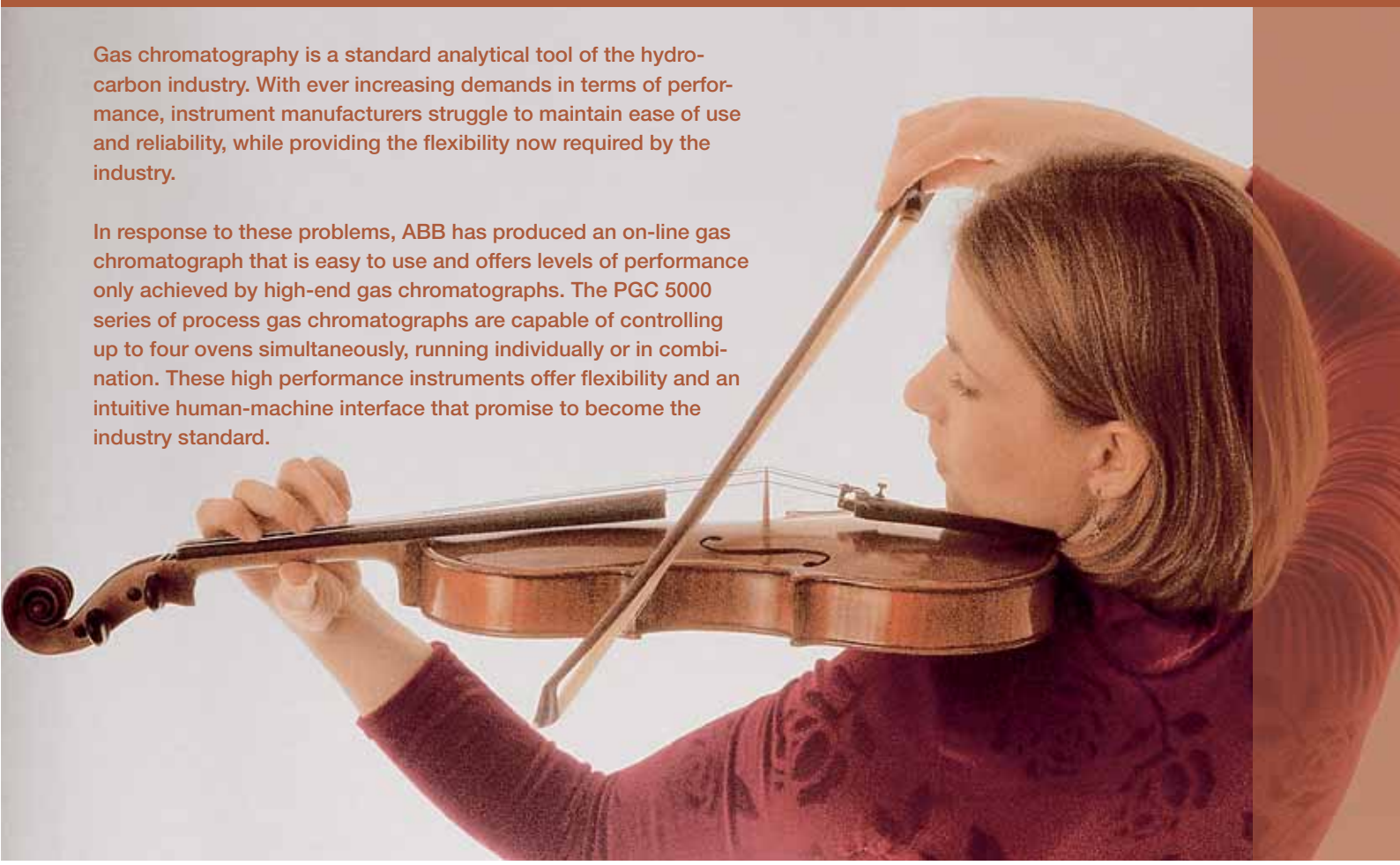
Gas chromatography is a standard analytical tool of the hydrocarbon industry. With ever increasing demands in terms of performance, instrument manufacturers struggle to maintain ease of use and reliability, while providing the flexibility now required by the industry.

In response to these problems, ABB has produced an on-line gas chromatograph that is easy to use and offers levels of performance only achieved by high-end gas chromatographs. The PGC 5000 series of process gas chromatographs are capable of controlling up to four ovens simultaneously, running individually or in combination. These high performance instruments offer flexibility and an intuitive human-machine interface that promise to become the industry standard.



Process chromatography [1] is an analytical technique that allows the on-line separation and measurement of the components of a mixture in a chemical process. Chromatographic analyzers utilized for on-line analysis must operate continuously and independently of human interaction, taking a fixed quantity of sample, separating the chemical components using adsorption[1)] or partitioning columns, and measuring the concentration of each with a detector. The chromatograph provides both quantitative results, by measuring the area of the peak generated as the components pass through the detector, and qualitative results based on the retention time, measured from injection to detection.

The process gas chromatograph is the most commonly used process analyzer because of its many applications in the hydrocarbon processing industry. A variety of valve, column, and detector configurations is available for these analyses, which can range from parts per million to percent levels. All

Footnote

[1)] Adsorption of a substance is its concentration on a particular surface of adsorbent. Adsorption is a process whereby a substance, usually a gas, accumulates as a thin layer on the surface of a solid.

samples must be gas-phase or liquids, that can be vaporized prior to analysis. The analyzers are controlled using a cyclic timing device, which switches valves and columns to provide the necessary separation as the components pass through the system. This time cycle is a limitation of the technique for applications requiring continuous or very fast analysis times. Even with these limitations, the advantages of cost, flexibility, sensitivity, and reliability have made Process Gas Chromatography (PGC) the most widely used analytical technique for on-line process control.

Over the past ten years, increasing demands on PGC have led to the development of highly sophisticated analyzers. Multiple stream switching has become the norm for single-oven analysis, but such sophistication has come at a price. Multitasking analyzers are harder to operate, less reliable, and more difficult to maintain than their less complicated forerunners. A new generation of PGC from ABB instrumentation further promises a future of simplicity and reliability for process chromatography.

Textbox PGC 5000B and PGC 5000C ovens

The PGC5000B oven, 1, is smaller than the existing PGC 2000 series oven and is designed to keep analyses simple. It can be equipped with a thermal conductivity detector (TCD) or a flame ionization detector (FID), one intercolumn detector (ITC) and no more than three analytical valves, including a single liquid injection valve. This simple set-up ensures greater reliability.

The PGC 5000C oven is approximately the same size as the existing PGC 2000 oven and supports specialty applications, such as total sulfur determination, simulated distillation and temperature-programmed analyses. It can be equipped with two main detectors, including the flame photometric detector (FPD) and/or any third party detectors, two ITC's, and no more than eight analytical valves, which include two liquid injection valves.

The PGC 5000B and PGC 5000C ovens provide an unlimited range of application capability and matchless flexibility. The ability to operate multiple ovens in combination allows complex analyses to be made simple, scaleable and more accessible.

Drawing on 50 years of experience in process chromatography, ABB Analytical in Lewisburg, West Virginia, has developed the simple, reliable and highly flexible PGC 5000 platform. This allows complex analyses to be broken down into their fundamental elements. Each analytical detector has a new digital signal processing (DSP) module, which allows the use of expanded peak integration techniques. The new instruments also incorporate a novel, highly robust, real-time operating system (RTOS), which provides an extremely stable analytical core that is not affected by external conditions, thereby enabling flawless processing of critical analyzer tasks.

1 A typical process gas chromatography oven – Type PGC 5000B

a Main detector (TCD)
b Analytical valve
c Analytical column

Analysis development capability

The ultimate goal of ABB's PGC 5000 platform series is to make complex analysis simple and more reliable. To achieve this, the instruments incorporate a patented analysis development tool that offers two formats in which to construct an analysis: 1) a highly interactive, graphical user interface, and 2) a tabular user interface. Analyses are composed of sequences, containing time-coded analytical functions that are integrated to form a method. Multiple methods are combined to form a complete analysis. On the PGC 5000, each sequence and method is color-coded for easy identification and logical troubleshooting. The system allows complex applications, such as stream analysis, to be broken down into their constituent parts (sequences and methods), which are easier to understand and maintain.

Scalable, modular platform – parallel chromatography

The PGC can be thought of in three sections: an analyzer, a controller and a sophisticated human machine interface (HMI).

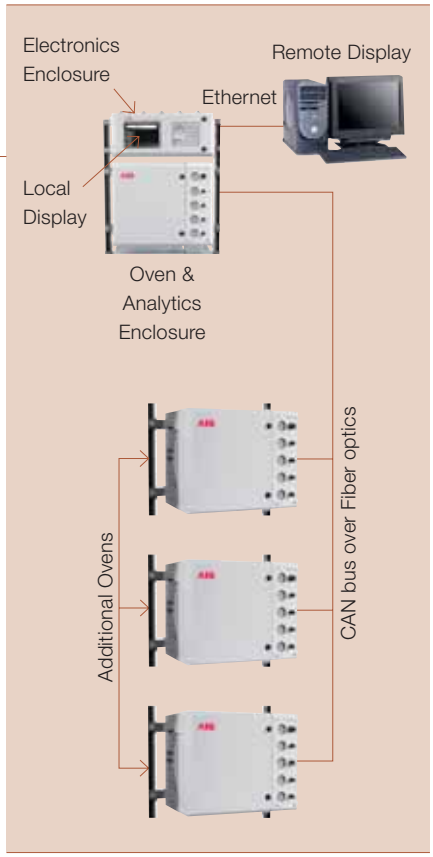
The analyzer

A typical PGC analyzer contains basic hardware components, such as sample valves, columns, column switching valves and detectors, enclosed in an oven Textbox with precise temperature control. The most common analyzer configuration is the isothermal oven. Specialty applications with wide boiling-point range that require temperature programming can also be accommodated. Accurate and precise temperature control is essential for the

2 A typical PGC5000A master controller front panel screenshot display

3 The PGC5000A master controller front panel and keypad

4 The PGC5000 series operating platform



reliability of the analytical hardware and the reproducibility of results.

The controller

The PGC 5000A master controller, 3, can support up to four analytical ovens. Since each has its own controller, a range of activities can be accommodated. For example, a single oven can be dedicated to a specific analysis, or up to four ovens can be used in combination, as shown in 4.

New HMI

The instruments contained within the PGC 5000 platform series carry a new HMI that operates via a simple "point" and "click" method. This new 10.4-inch display has highly visible, color-coded tabs, which allow the user to navigate between operation screens via a fully functional keypad and a mouse touchpad. It is intuitive, and all major functions can be accessed within two steps. The chromatogram is easy to read with simple color graphics 2 and will support nine different languages. Up to four PGC ovens can be accessed and displayed simultaneously, in real time.

Digital Signal Processing (DSP) Module

The PGC5000 platform 4 uses the power of DSP to enhance the performance of automated PGC analyzers. These instruments now operate at levels that were once the exclusive domain of high-end laboratory gas chromatographs with computer-based post-analysis software. The key parameters of the PGC 5000 signal analysis system are:

- Robustness
- Reproducibility
- Automation
- Adaptability

The operating interface can be accesed both locally at the chromatograph and remotely. It is designed to function in two principal modes of operation:

Model Based Analysis

This mode produces a functional representation of each peak, on which subsequent chemical component concentration, confidence estimates and GC performance measures are based. Such functional representations enable maximum compression for chromatogram storage.

Gated Integration Analysis

This mode utilizes user-specified and/or automated time gates, within which the chromatographic peaks are integrated, to obtain area factors to determine the chemical component of the concentration. This is an advanced form of the traditional, gated GC analysis.

In addition to these modes of operation, the raw chromatogram data can be made available to computer resident, third party post processing software, either explicitly or in response to alarms generated by the GC resident analysis software.

The operating system

The PGC 5000 platform uses the INTEGRITY RTOS, from Green Hills Software, to ensure reliable co-processing of critical real-time analyzer tasks with multiple networking/user-requested tasks. The operating system provides the analyzer with a robust analytical core, capable of handling all major instrument functions without interference from other devices. It makes a vital contribution to the reliability of the PGC 5000 platform, ensuring the long-term stability and reliability that are essential in a process analyzer.

With the PGC 5000 platform series, ABB demonstrates its commitment to the development of a simple and reliable process analyzer with a limitless range of application capability and matchless flexibility. This next generation of instruments will become the new standard for PGC.

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References

[1] Clemons, J., "Process Chromatography", Encyclopedia of Analytical Chemistry, John Wiley, A-21-07, 2000. Jerry M. Clemons is a Senior Scientist at ABB Inc., Analytical, Lewisburg, WV, USA