Global Analyser Solutions

Fermentation gas analyser

- Analysis of fermentation gases in seconds
- Permanent gases, hydrocarbons, esters, aldehydes, sulphur components, ammonia and more
- ppb to high % concentration levels
- Flexible sampling options
- Only 1 ml sample required

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Global Analyser Solutions

GAS offers custom configured GC analysers for many application fields for over 50 years. GAS analysers are designed to meet many standardised methods from GPA, ASTM, UOP, ISO, EN and others. The efficient configurations are based on proven GC technology, resulting in robust, highly productive instruments with an optimal return on investment.

The analysis of fermentation gases is crucial in biotechnology, microbiology, and environmental science, offering insights into the efficiency and nature of microbial processes. Fermentation produces gases like carbon dioxide, methane, hydrogen, and volatile organic compounds, whose composition and volume reveal the health and activity of microbial cultures and the completeness of substrate conversion. In industrial applications, gas analysis optimises biofuel, pharmaceutical, and food production, while in environmental science, it aids in understanding carbon cycling and greenhouse gas emissions. Gas analysis using gas chromatography enables better control and optimisation of fermentation processes, and allows a wide range of components to be analysed.

Figure 1 CompactGC$^{4.0}$. Fast analysis of fermentation gases in seconds on a small 19" footprint

Figure 2 Sample stream selector for sequential analysis of headspace of fermenters

Analysed components

Various components are analysed depending on the type of fermentation and the target of the process. O_2 and CO_2 are often required, and other permanent gases (such as H_2, N_2, N_2O), hydrocarbons, alcohols, aldehydes, sulfur components, and ammonia are frequently required for monitoring the fermentation process.

Instrument configuration

The fermentation gas analyser (fig 1) is equipped with 1 or 2 analysis channels (injector-column-detector) when only a limited number of components is required. The instrument can be expanded up to 4 channels when a variety of compounds must be analysed. A TCD (Thermal Conductivity Detector) is often present for ppm to % concentration range. A PDD (Pulsed Discharge Detector) allows for low-level ppb analysis for all components . With a PFPD (Pulsed Flame Photometric Detector), sulphur components are selectively analysed at the ppb level. The optional on-board thermal desorption trap is another method for trace component detection (fig. 7).

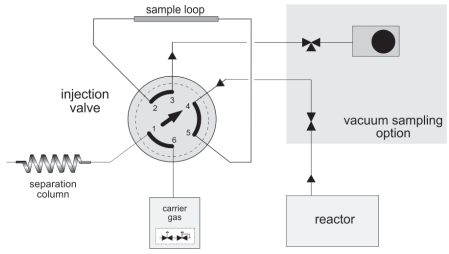

Figure 3 Vacuum sampling option. 1 ml sample is adequate

Flexible sampling

Several sampling types are offered for different sample pressures and available volumes. For sufficient sample volume, a sample pump or stop-flow valve is adequate. In the case of small fermenters, we offer a vacuum sampling option that requires only a few millilitres of sample gas to report the full composition (fig. 3). When samples are manually collected in syringes, a syringe sampler is available that automatically pulls the content through the sample loop (fig. 4).

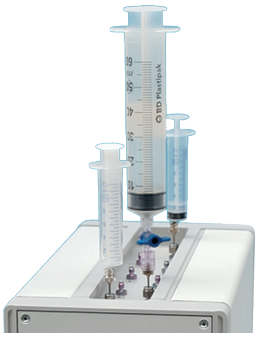

Figure 4 Automatic sampling of syringes with manual obtained samples

Stream selection

Often a series of fermenters must be analysed by a single fermentation gas analyser. The optional stream selection module (fig. 2) automatically selects the pre-programmed sample stream. One selector can manage up to 16 sample lines. For higher numbers, additional selection modules are linked and conveniently controlled by the Chromeleon chromatography data system.

Advanced control by Chromeleon CDS

The Chromeleon Chromatography Data System provides integration, identification, and reporting for all components. It also offers flexible control of stream selection valves. Additionally, it provides several options for trend analysis, and we offer tailored coupling to the fermenter controller.

Application examples

Figure 5-10 show several application examples for analysis of gases from fermentation processes.

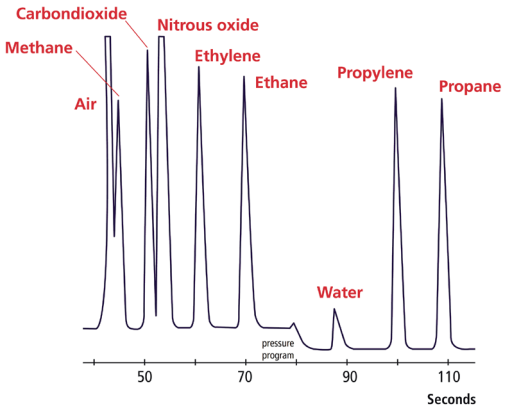

Figure 5 Analysis of permanent gases using TCD (QBond column)

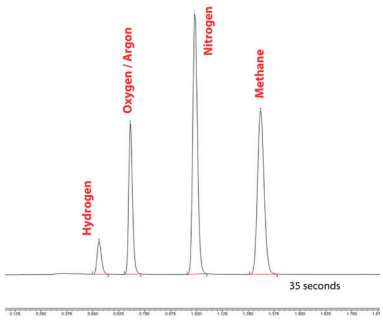

Figure 6 Analysis of permanent gases using TCD (MSieve column)

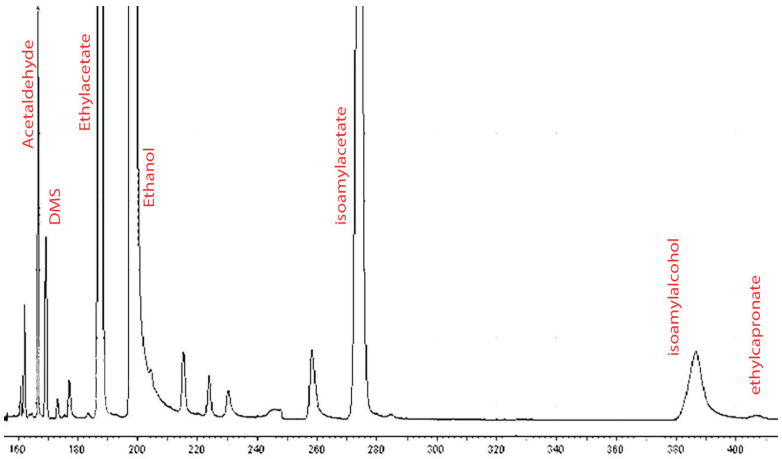

Figure 7 On-line analysis of fermentation gas of beer production using CompactGC equipped with Thermal Desorption option (FID detection)

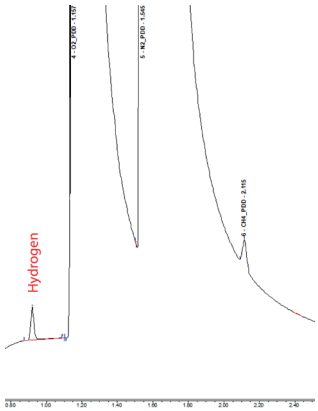

Figure 8 Analysis of low ppb level H_2 using PDD

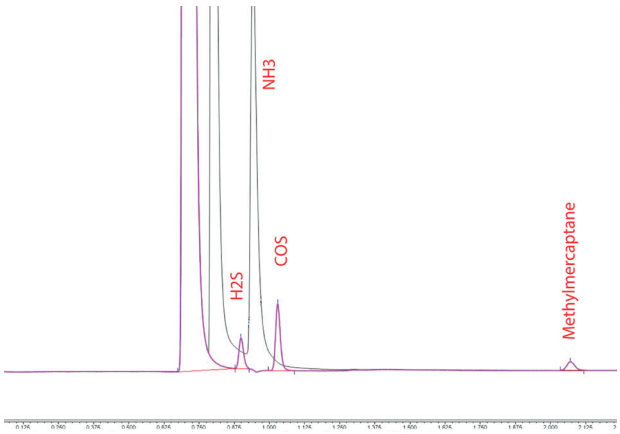

Figure 9 Analysis of sulphur components and ammonia at ppm level using TCD. ppb level sulphur can be analysed with PFPD

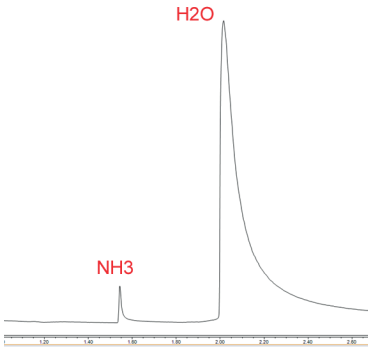

Figure 10 Analysis of ammonia at 13 ppm using PDD (LOD = 100 ppb)

Specification

Configuration:	1-4 channel instrument based on CompactGC or Thermo TRACE GC 1600
Application:	(On-line) analysis of gases formed by fermentation processes
Analysed components:	Permanent gases, hydrocarbons, alcohols, esters, aldehydes, sulphur components, ammonia
Detectors:	TCD (Thermal Conductivity Detector), FID (Flame Ionisation detector), PDD (Pulsed Discharge detector), PFPD (Pulsed Flame Photometric Detector), MS (Mass spectrometer), VUV LUMA
Optional:	- Sample pump - Stop flow valve, - Stream selector - Vacuum sampling option (requires only 1 ml sample) - Thermal Desorption option offers sample pre-concentration for ppb level analysis
Sample tubing:	Sulfinert® tubing for inert sample path (sulphur and other polar components)
Application:	Custom configured analyser for the analysis of gaseous biogas and natural gas samples, containing hydrocarbons, permanent gases, sulphur components, siloxanes, terpenes, ammonia and other components
Sample requirements:	See our pre-installation guide for additional requirements
Analysis time:	1-3 minutes, depending on analysed components
Minimum detectability:	Dependent on configuration, detector and sample composition. Examples: - Permanent gases, hydrocarbons, alcohols, esters, aldehydes, sulphur components, using TCD: < 0.001%. Using PDD: < 20 ppb - Sulphur components using PFPD: < 25 ppb - Hydrocarbons using FID: < 1 ppm
Dynamic Range:	TCD: 4 decades; FID: 7 decades
Accuracy:	Depending on external calibration and repeatability
Repeatability:	< 1 % RSD
Data systems:	Chromeleon, OpenLab
C	

Figure 11 The GAS fermentation gas analyser is available on Compact[4.0] and Thermo Trace GC1600

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