Global Analyser Solutions

Hydrogen purity analyser

- Green hydrogen testing
- ISO 21087
- PEM fuel cell applications and risk assesments

Get ready for ***tomorrow's analytics***

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.

Fuel cell electric power is widely recognised as a promising alternative to combustion engines in the transportation sector due to its numerous benefits, including zero emissions, high efficiency, long range, and short refueling time. However, the reliable operation of fuel cells heavily depends on delicate components such as platinum catalysts and proton exchange membranes (PEM), which are highly sensitive to the quality of the hydrogen fuel. Ensuring the purity of the hydrogen fuel is crucial to maintain the performance and efficiency of the fuel cell system, and requires careful handling, storage, and transportation. Despite these challenges, the potential advantages of fuel cell electric power make it a compelling option for heavy-duty transportation applications, such as trucks, buses, and trains.

Various GC & GC-MS methods

The International standard ISO 21087 provides a comprehensive range of methods for analysing impurities in hydrogen for proton exchange membrane (PEM) applications. The standard recommends various gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) methods for detecting trace amounts of impurities at ppb and ppm levels. Figure 1 outlines the types of impurities, ISO 21087 limit, the analysis method used by GAS, and the detectable range.

Analyser configuration

The instrument's configuration is described in Figure 2. Helium is analysed using TCD, while PDD (Pulsed Discharge Detection) is utilised to detect argon, oxygen, nitrogen, and methane. A Methaniser/FID is employed to complete the analysis of the permanent gases. Other components, including sulphur species, halogenated compounds, formaldehyde and ammonia, are measured using a mass spectrometer with an Advanced Electron Impact (AEI) source, which offers low ppb sensitivity without requiring sample pre-concentration.

Impurity	Limit 21087 (umol/mol)	GAS GC method	Detection range
Total hydrocarbons	2	MS-AEI	0.1-1000
Oxygen	5	PDD	0.02-1000
Helium	300	TCD	50-10000
Nitrogen	100	PDD	0.02-1000
Argon	100	PDD	0.02-1000
Carbon dioxide	2	Methaniser-FID	0.05-1000
Carbon monoxide	0.2	Methaniser-FID	0.05-1000
Total sulphur components	0.004	MS-AEI	0.0001-100 (per comp.)
Formaldehyde	0.01	MS-AEI	0.005-100
Ammonia	0.1	MS-AEI	0.1-100
Halogenated components	0.05	MS-AEI	0.001-100

Figure 1 Analysed components

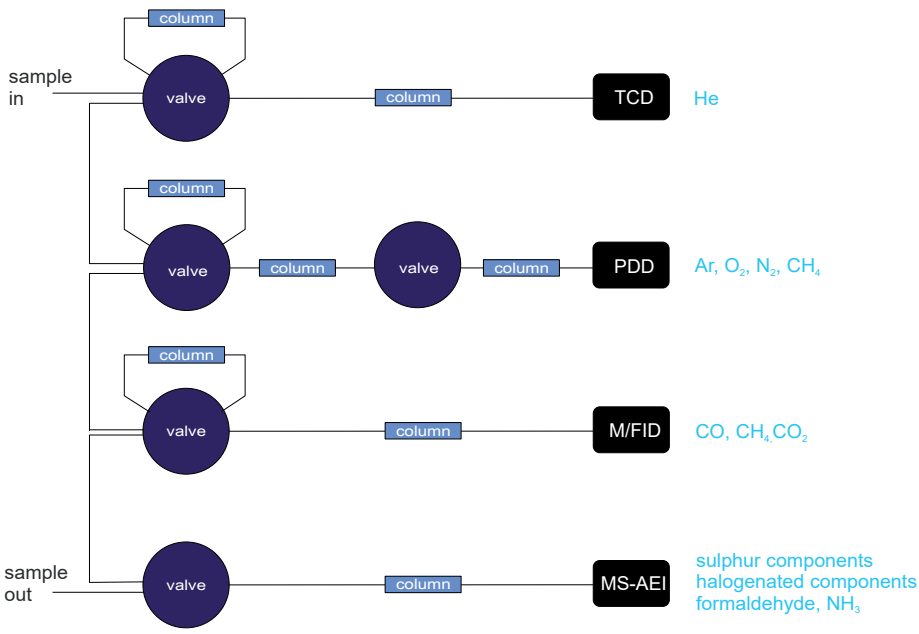

Figure 2 ISO 21087 analyser setup

Results

Figures 3 and 4 display the chromatograms of the permanent gases analysis using PDD and methaniser-FID. In Figures 5-9, the MS-AEI detection results for the other components are presented.

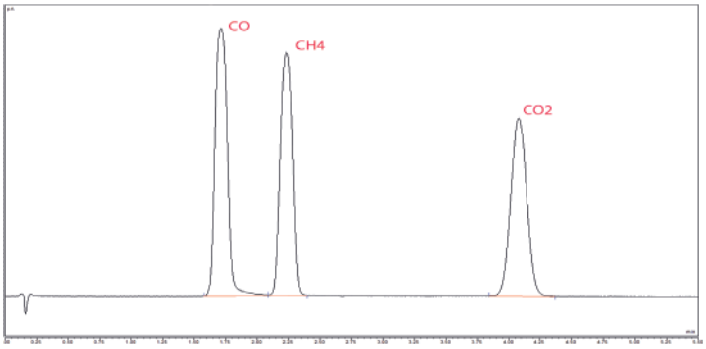

Figure 3 CO, CH4 and CO2. Detection: methaniser-FID

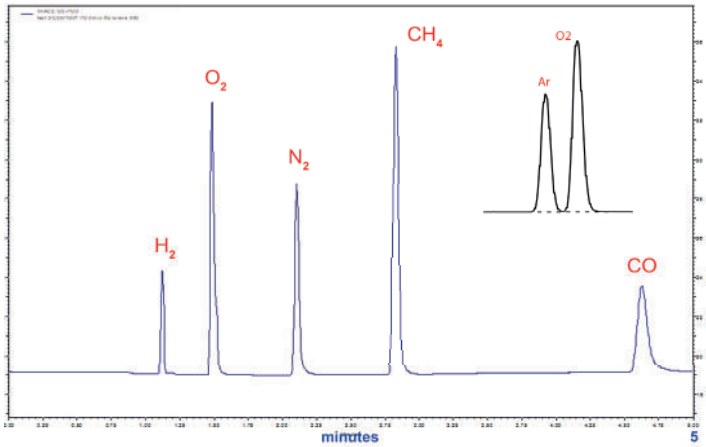

Figure 4 Permanent gases using PDD. 5 ppm standard.

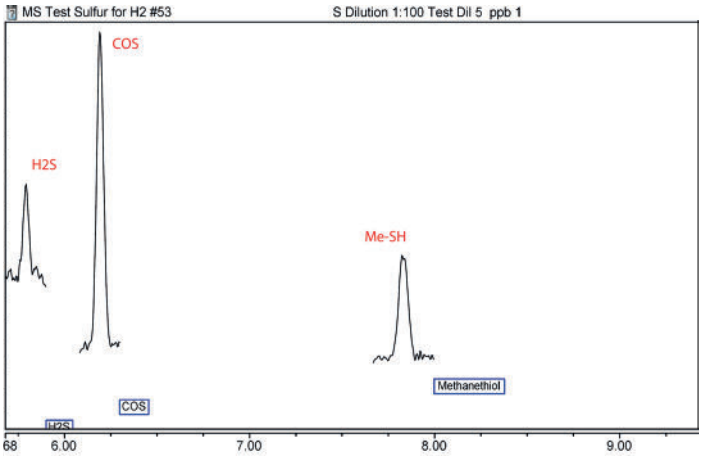

Figure 5 Sulphur components using MS-AEI. 5 ppb standard.

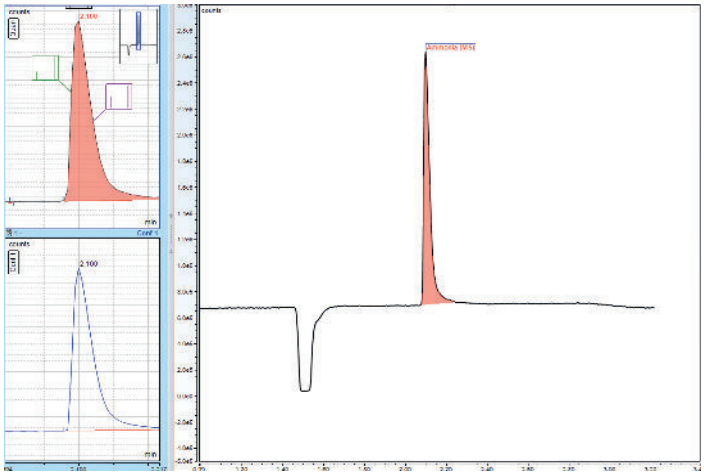

Figure 6 13 ppm Ammonia using MS-AEI detection

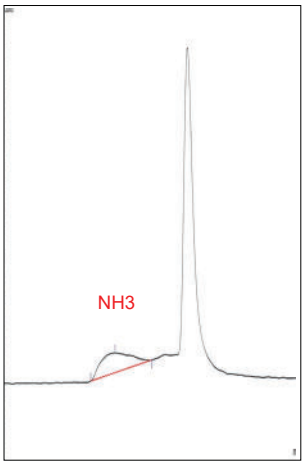

Figure 7 200 ppb standard ammonia. Detector: MS-AEI.

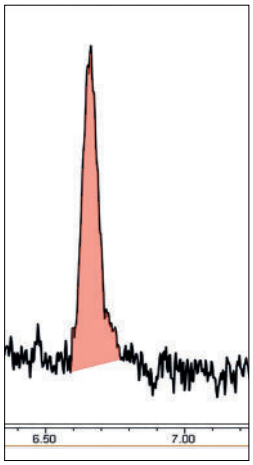

Figure 8 60 ppb standard formaldehyde. MS-AEI.

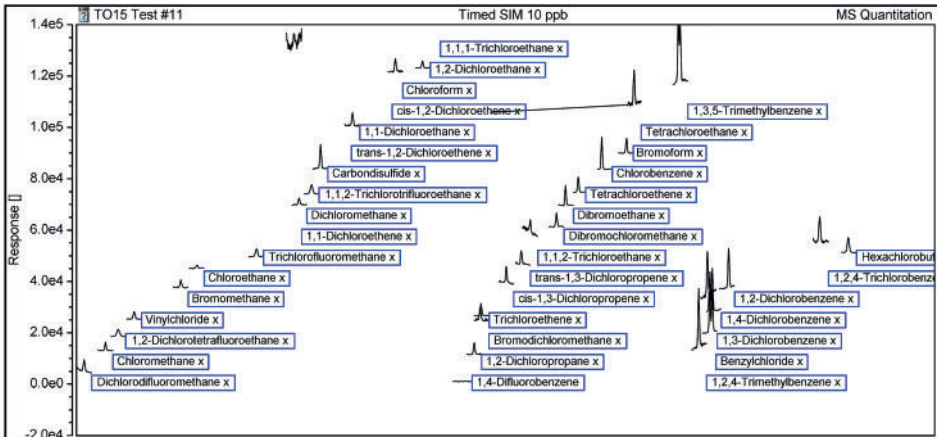

Figure 9 Halogenated components using MS-AEI.10 ppb standard.

Specification

Application:	Hydrogen purity analyser, fuel cell PEM.
Standardised methods:	ISO 21087
GC instrument:	GC 1600 with TCD, methaniser-FID, PDD and MS-AEI
Options:	Selector valve, sample pump
Analysed components:	Permanent gases, hydrocarbon, sulphur components, halogenated components, formaldehyde, ammonia
Minimum detectability:	See figure 1
Analysis time:	20 minutes
Sample requirements:	See our pre-installation guide
Data systems:	Chromeleon® CDS

Figure 10 H2 purity PEM analyser