



Ammonia analyser

- Analysis of low ppb and high % NH_3
- < 100 ppb detection limit
- fast online analysis
- for PEM fuel cells, fertiliser synthesis and biogas applications

AN37WA0125D

GAS offers custom configured GC analysers for many application fields for over 40 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 instruments with an optimal return on investment.

Ammonia is an important intermediate in fertiliser synthesis and a promising candidate as a next generation sustainable carbon-free energy carrier. It is also a control parameter in biogas plants. GAS offers ammonia analysers for low ppb and high % concentration levels.



Figure 1. Ammonia analyser with external valve oven

PEM fuel cells

Ammonia is expected to play an important role in renewable energy production. It can be used directly as a fuel in internal combustion engines or is utilised to produce electricity via (PEM-Proton Exchange Membrane) fuel cells. It can fuel cars, trains, ships, industrial engines and gas turbines. Ammonia acts as a hydrogen carrier, containing more energy than liquid hydrogen per volume, and is easier to transport and store. Hydrogen is an excellent fuel as only water is formed after combustion, so unlike fossil energy, there is no CO₂ emission. As a consequence there is a need for NH₃ analysis from high percentage level to low ppb level. Delft University, The Netherlands, faculty of applied science, chemical engineering department and GAS developed a method for low level ammonia detection based on GC-PDD (Pulsed Discharge Detector). See figure 2 and 6.

Biogas

Ammonia content is considered to be an important factor in optimising the processes in biogas plants. For this reason our biogas analysers have an optional ammonia analysis channel using Thermal Conductivity Detector (TCD). See figure 3.

Fertiliser synthesis

Ammonia is an important globally produced chemical with approximately 85% being used as fertiliser for food production. The other 15% is used in diverse industrial applications including explosives and polymers production. Hence a demand for analysis of high % levels is seen; an inert analysis system equipped with TCD is the appropriate analyser for this purpose.

Benefit of CompactGC^{4.0}

Due to the aggressive property of ammonia, detection of ammonia at high % level is challenging for the lifetime of the analyser. MicroGC's based on MEMS technology are not suitable for this purpose. GAS CompactGC^{4.0} is a microGC based on proven GC technology with rigid injectors and detectors. Providing fast and reliable analysis of high levels of ammonia. See figure 4 and 7.

GC-MS

GC equipped with mass spectrometer has proven to be effective for the analysis of ammonia. Reported LOD is < 100 ppb. GC-MS has the advantage that other species like sulphur components, siloxanes and terpenes can be analysed simultaneously at ppb levels (figure 5).

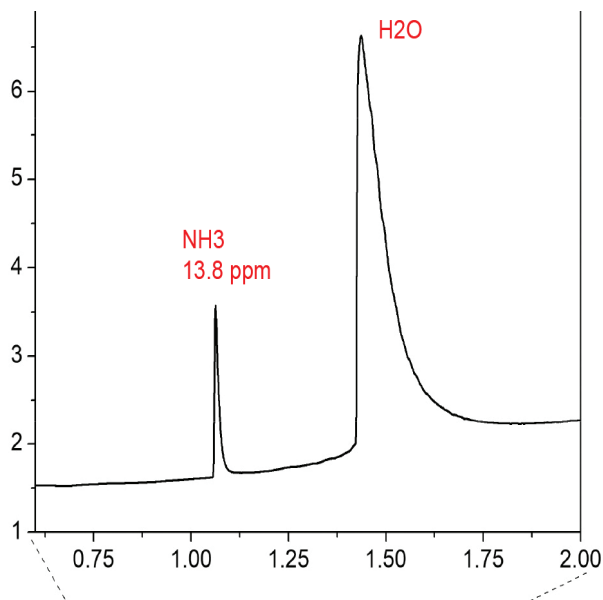


Figure 2. 13.8 ppm NH_3 using GC-PDD. LOD: < 100 ppb

Results

Figure 2 demonstrates the analysis of 13.8 ppm ammonia. Further dilution proved a lower limit of detection down to < 100 ppb. Note the excellent peak shape and good separation from water.

Injection: GSV (Gas Sampling Valve)

Detection: PDD (Pulsed Discharge Detector).

Figure 3: NH_3 analysis in biogas

Injection: GSV

Detection: TCD (Thermal Conductivity Detector)

Figure 4 shows fast analysis of 10% NH_3 using CompactGC^{4.0}

Note that high % H_2S is also analysed.

Injection: GSV

Detection: TCD

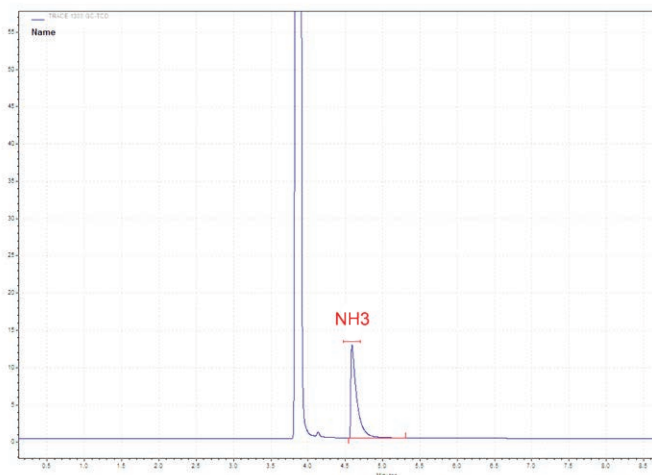


Figure 3. Calibration standard for ammonia analysis in biogas. (1000 ppm in N_2). Detector: TCD. LOD: < 50 ppm

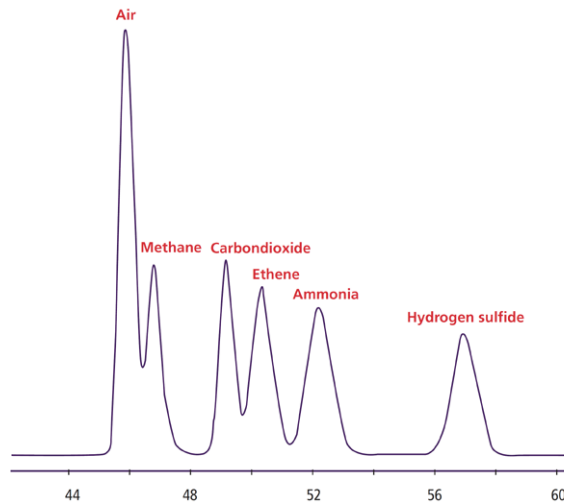


Figure 4. 10% NH_3 analysis using CompactGC-TCD. Fast and robust analysis



Figure 5. Extended gas analyser equipped with TCD, PDD and mass-spectrometer (ISQ-7000) for analysis of ammonia and many other species.



Figure 6. PDD (Pulsed Discharge Detector) on GC1600. InstantConnect injector and detector technology.

Specification

Application:	Low ppb level analysis of ammonia PPM level analysis of ammonia High % level analysis of ammonia
Configuration:	Single channel analyser based on GC1600 or CompactGC ^{4.0}
Injection type	GSV (Gas Sampling Valve)
Detection:	PDD (Pulsed Discharge Detector) TCD (Thermal Conductivity Detector) GC-MS (Mass Spectrometer)
Optional:	Extra analyser channels for additional components
Sample requirements:	See our pre-installation guide for additional requirements
Analysis time:	2-5 minutes, depending on used GC platform
Limit of detection	TCD: < 50 ppm PDD: < 100 ppb MS: < 100 ppb
Repeatability:	< 3% RSD, depending on concentration level
Data systems:	Chromeleon, OpenLab



Figure 7. CompactGC^{4.0}



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