IngenieríaAnalítica
Chromatography & Spectrometry

GAS

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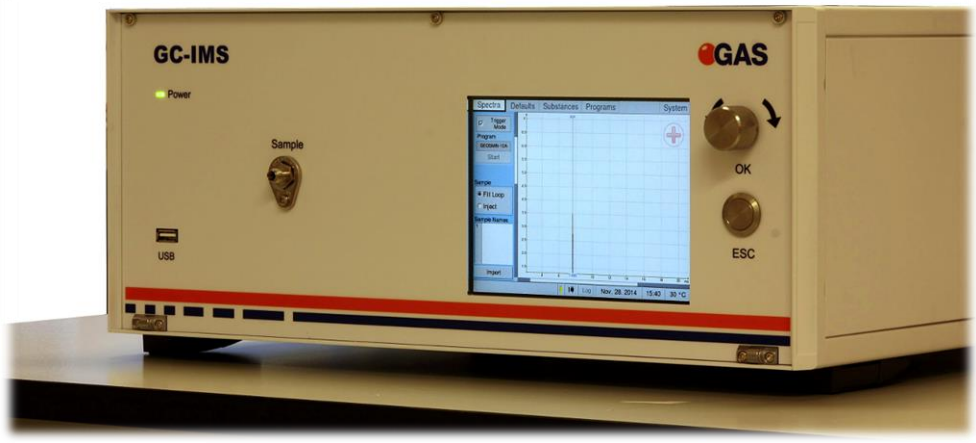
GC-IMS

GAS CHROMATOGRAPH - ION MOBILITY SPECTROMETER

THE MULTI-PURPOSE TRACE GAS ANALYZER

Combining Excellent *Selectivity* of GC
with Extraordinary *Sensitivity* of an IMS



GC-IMS - The Multi-Purpose Trace Gas-Analyzer

SENSITIVE AND SELECTIVE DETECTION OF VOLATILE COMPOUNDS

The GC-IMS combines the high selectivity of a chromatographic separation with the extraordinary sensitivity (low ppb_v or µg/L range) of an IMS. Therefore it is an excellent analytical tool, even for measurements in complex matrices. Due to the possibility to change the polarity of the drift voltage the GC-IMS can detect several substances e.g. ketones, aldehydes, alcohols, amines, sulfates and phosphor organics as well as halogenated compounds. The chromatographic pre-separation enables to overcome the technological limitations of the IMS technology caused by ion-ion inter-actions in complex mixtures and hence assures a selective identification.

UNIQUENESS OF THE GC-IMS MADE BY GAS

The GC-IMS carries an in-system computer unit that can be operated as a stand alone device. It shows a very user friendly interface through a self explaining menu. Operational steps as well as settings of a measurement are visualized on the 6.4” TFT and can be executed or changed through a touch-screen display. The system can be run as online monitoring device same as in manual mode. Specific areas of interest and alarm levels for pre-defined compounds can be determined. Further to that the *Laboratory Analytical Viewer* PC-software enables (advanced users) further data processing like a three dimensional finger print analysis. Additional data handling tools and interfaces are available.

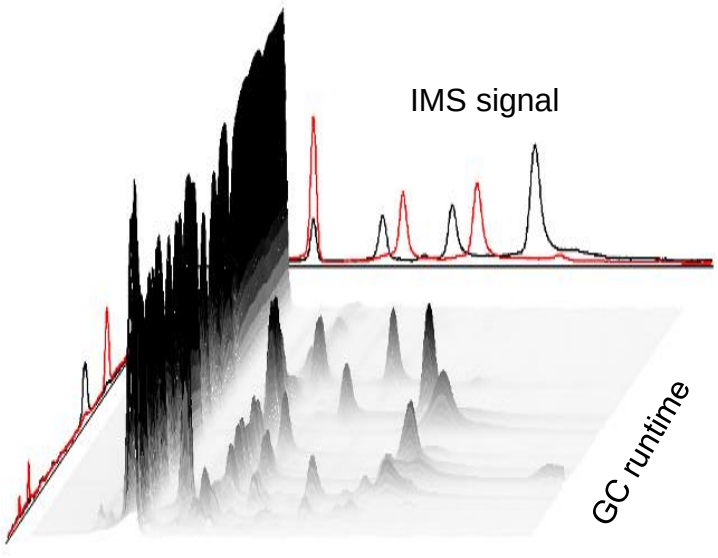


Figure 1: *2-dimensional separation of complex matrices using GC-IMS technology.*

MULTI-VARIABLE SET-UP SERVING CUSTOMERS NEEDS

The GC-IMS exhibits several possibilities for adjustments in order to establish a custom-build solution. Besides optimization of measurement parameters like temperature(s), flow(s) or measurement programs, e.g., G.A.S. also offers client-specific solutions concerning changes of system components, such as GC columns (multi capillary/ capillary columns, polar or non-polar phases, column length, e.g.).

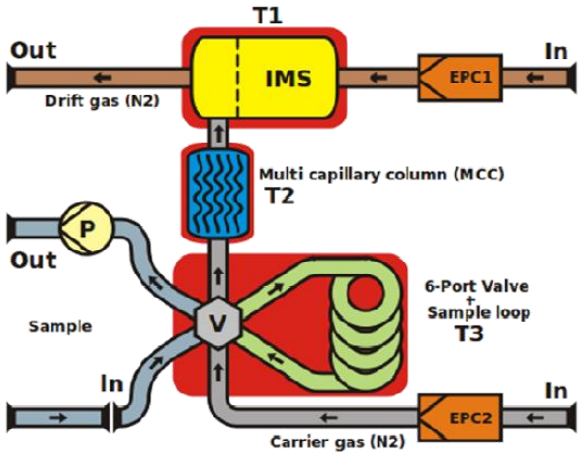
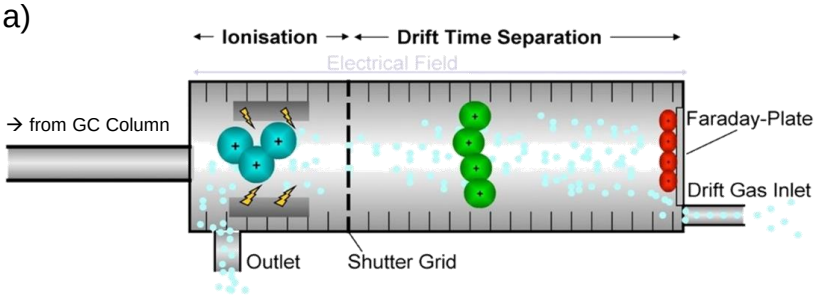


Figure 2: *General set-up of the GC-IMS instrument.*

GC-IMS - The Multi-Purpose Trace Gas-Analyzer

a)



b)

Figure 3: *Working Principle of an Ion Mobility Spectrometer (a). G.A.S. uses soft chemical-ionization initiated by a low-radiation tritium (H3) source (below exemption limits of IAEA resp. EURATOM) to generate analyte ions via proton transfer. These ions travel at atmospheric pressure towards a flow of inert drift gas (N_2 or air). The drift time of each substance is determined by its ion's mass and geometric structure, as slowing collisions with the drift gas molecules are more frequent for sterically demanding structures. For detection, the resulting ion current is measured by an electrometer as a function of time. (b) IMS module including electronics (b).*

CUSTOM-BUILT MEASUREMENT METHODS

In addition to the 'tailor-made' set-up of each instrument G.A.S. also offers the development of complex measurement methods customized for each application.

PORTABILITY OF GC-IMS

Molecular based analytical instruments such as GC-MS set-ups require a lab infrastructure with high purity gas supplies and even vacuum pumps which makes it very challenging to bring them into the field. In order to leverage applications of GC-IMS system with regards to *out-of-lab* measurements G.A.S. devloped the Circular Gas Flow Unit (CGFU). This tool supports the instrument with circulating air that is filtered by the CGFU to reach a 5.0 quality. Furthermore nitrogen or zero-air generators that reach this quality level can be used alternatively. Both gas supplying tools make an external gas cylinder obsolet, enabling a flexible use of the instrument. An additional advantage is the cost savings that can be dramatically reduced by either choice.

Figure 4: *Portable measurement system - CGFU (Circular Gas Flow Unit) coupled to a GC-IMS. For full performance the system only needs power supply.*

PORTABLE SOLUTION – KEY FEATURES

- Extended application spectrum for G.A.S. measuring systems
- Autarkic gas supply
- Low operational costs
- System only needs power supply for entire performance
- One-click operation
- On-site measurements viable
- No gas cylinder needed

GC-IMS – Multiplicity of Applications

WORKING PLACE CONTROL OF TOXIC INDUSTRIAL CHEMICALS (TICs)

For monitoring of TICs G.A.S. applied its GC-IMS technology as a highly selective and sensitive measuring system for rapid monitoring of DMS, a carcinogenic, mutagenic and highly poisonous substances and further for *trans*-4-methyl cyclohexyl isocyanate (4-MCI), whose exposure can result in lung edema, emphysema, hemorrhages, bronchial pneumonia and death, e.g., in industrial areas. The instrument continuously samples the ambient air on-site to be monitored. The run time was optimized to only 2 min. including a cleaning step of all the instrument's gas touching parts in order to avoid carry-over. The instruments were calibrated to monitor DMS or 4-MCI to the low ppb_V-range. In order to prevent hidden system failures or false-negative measurement results the GC-IMS is equipped with comprehensive self-monitoring check-up features, such as an integrated hardware watchdog or flow/temperature controllers assuring compound specifity.

GC-IMS-ODOR – MONITORING OF ODORANTS IN NATURAL GAS

The gas odor level of natural gas needs to be monitored at regular intervals to secure the required level of the organosulphur compounds tetra-hydro-thiophene (THT) and tert-butyl-mercaptane (TBM) or the sulfur-free (Gasodor®-S-Free®) markers which are used worldwide to odorize natural gas. The safety concern is to assure a minimum concentration of the alarming smell while not overdosing the high-priced odor markers.

Figure 5: *GC-IMS on-site integrated into process measuring and control technology system of Bilfinger Maintenance GmbH.*

Figure 6: *GC-IMS instrument for monitoring of TICs in chemical plants embedded into a pressurized enclosure system. The pressurized enclosure system ensures safety class Ex II 2 G Ex px II T4 (German Explosion Protection Ordinance).*

ODORANT MONITORING – KEY FEATURES

- Quantification of all common gas odorants
- One-click operation
- Accuracy better than ± 1 mg/m^3
- optimized user-interface to correspond to the daily routines and operations of utility personnel in the field
- Data transfer via USB, Ethernet or 4-20 mA output to a control room.

GC-IMS – Multiplicity of Applications

GC-IMS-SILOX – MONITORING OF SILOXANES IN LANDFILL/SEWAGE GAS

Municipal waste, landfill, sewage, sludge etc often carry silicon containing materials from sources like washing agents, skin care products or waterproofing materials. Thus and as a consequence of anaerobic digestion or fermentation siloxanes are formed within the combustion gas which is used more and more as an alternative energy source. When the gas surpasses a certain tolerable amount of siloxanes resp. 'total silicon' (Si) and is combusted to generate power e.g. in gas turbines of block heat power plants siloxanes are converted to silicium dioxide (SiO_2), which deposits on combustion parts and/or exhausts of the engine. Corrosion and system break downs are the consequences.

Figure 7: *GC-IMS SILOX on-site. The instrument precisely quantifies individual siloxanes species, L2-L5 same as D3-D5, calculates 'total silicon' and 'total silica' and by this allows to take a reliable decision on-site. Besides a flexible spot-to-spot measurement using its one-click operation it even enables a continuous and remote online monitoring to test for the pipe gas same as for a potential filter breakthrough while sampling and quantifying the siloxanes automatically in user defined intervals.*

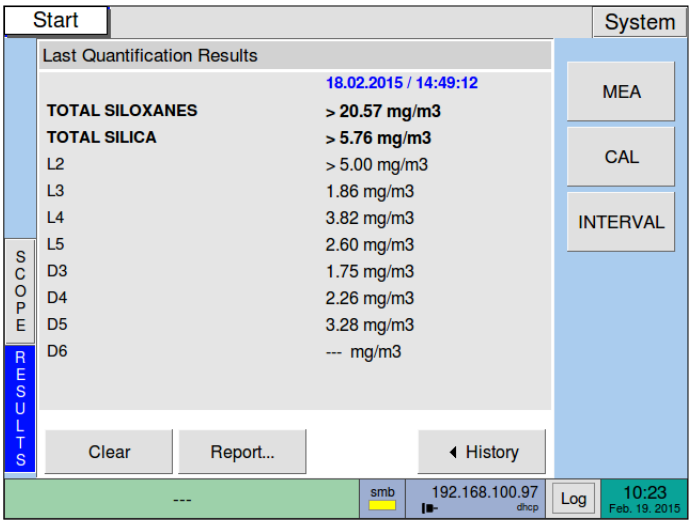


Figure 8: *Results window of the GC-IMS SILOX. Concentration of siloxane species L2-L5 and D3-D5 are displayed just as the calculated concentration for total siloxanes and silica.*

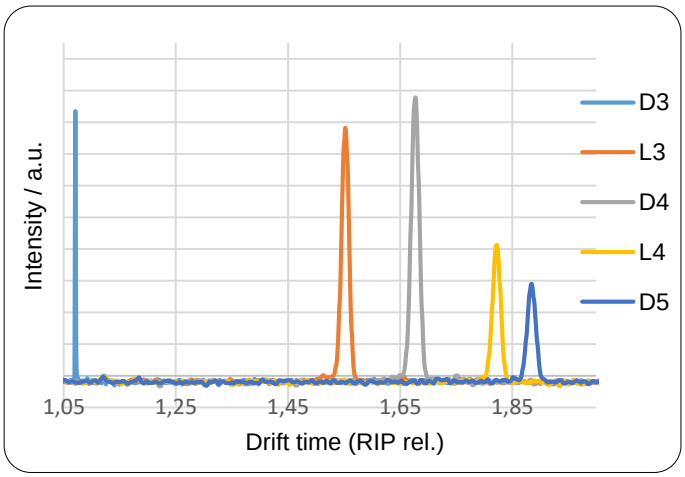


Figure 9: *IMS spectra of several siloxane species.*

GC-IMS-SILOX– KEY FEATURES

- Active sampling from the process gas or by gas bags
- On-site measurements with “one-click” menu
- On-line/continuous monitoring at set intervals
- Detection limits for the relevant siloxane species (L2-L5 and D3-D5) down to the µg/m³ range
- High reproducibility and accuracy
- Very low running and maintenance costs
- Optional: Detection of Terpenes

GC-IMS – A Multi-Purpose Gas-Analyzer

OVERVIEW GC-IMS – KEY FEATURES

- Stand alone operation due to integrated computer unit
- Manual or automatic operation including data acquisition, analysis, visualisation and data export
- High reproducibility
- Access to all relevant parameters for method development: temperature control for IMS, column and sample loop, flow control of internal sampling pump, drift and carrier gas
- Heating mode up to 100 °C for fast cleaning of the system
- Direct sampling using electrical six-port-valve and integrated pump
- Software controlled switching between positive and negative ionization mode
- Chromatographic pre-separation of water; suitable for samples with high moisture content
- Simultaneous calibration/ quantification of different compounds
- Adjustable alarm thresholds
- Comprehensive self-monitoring check-up features
- Integrated hardware watchdog to control hardware failures
- Status of the instrument (correct temperatures, pressures, flows) are continuously checked
- Calibrated test-substance to verify readiness scope of supply

TECHNICAL SPECIFICATION

Ionisation method: ß-radiation
Source: Tritium (3H)
Activity: 300 MBq, below the exemption limit of 1 GBq acc.to EURATOM guideline, no licence required
Column type: Multi Capillary Column (MCC) or Capillary Column (CC) – various stationary phases available
Sampling: Integrated pump plus heated electrical 6-port-valve (stainless steel), gas tight loop (1-10 mL)
Detection limit: Typically low ppb_v-range
Dynamic range: 1-3 orders of magnitude
Display: Touchscreen 6.4”TFT
Communication: RS232, USB, Ethernet
Power: 100 – 240 V AC, 50-60 Hz (external) 24 V DC / 8.3A, XLR-connector (internal)
Power consumption: < 200 Watt
Dimensions: 449 x 435 x 177 mm (WxDxH)
Weight: 15,5 kg or 34,2 lb
Housing: 19” compatible, IP 20 enclosure, CE Marking

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