

# Screening Solutions of Volatile Compounds



- Product Quality Control
- Industry & Process Control
- Human Breath Analysis



G.A.S. facility at TechnologyCenterDortmund, Germany

## Company

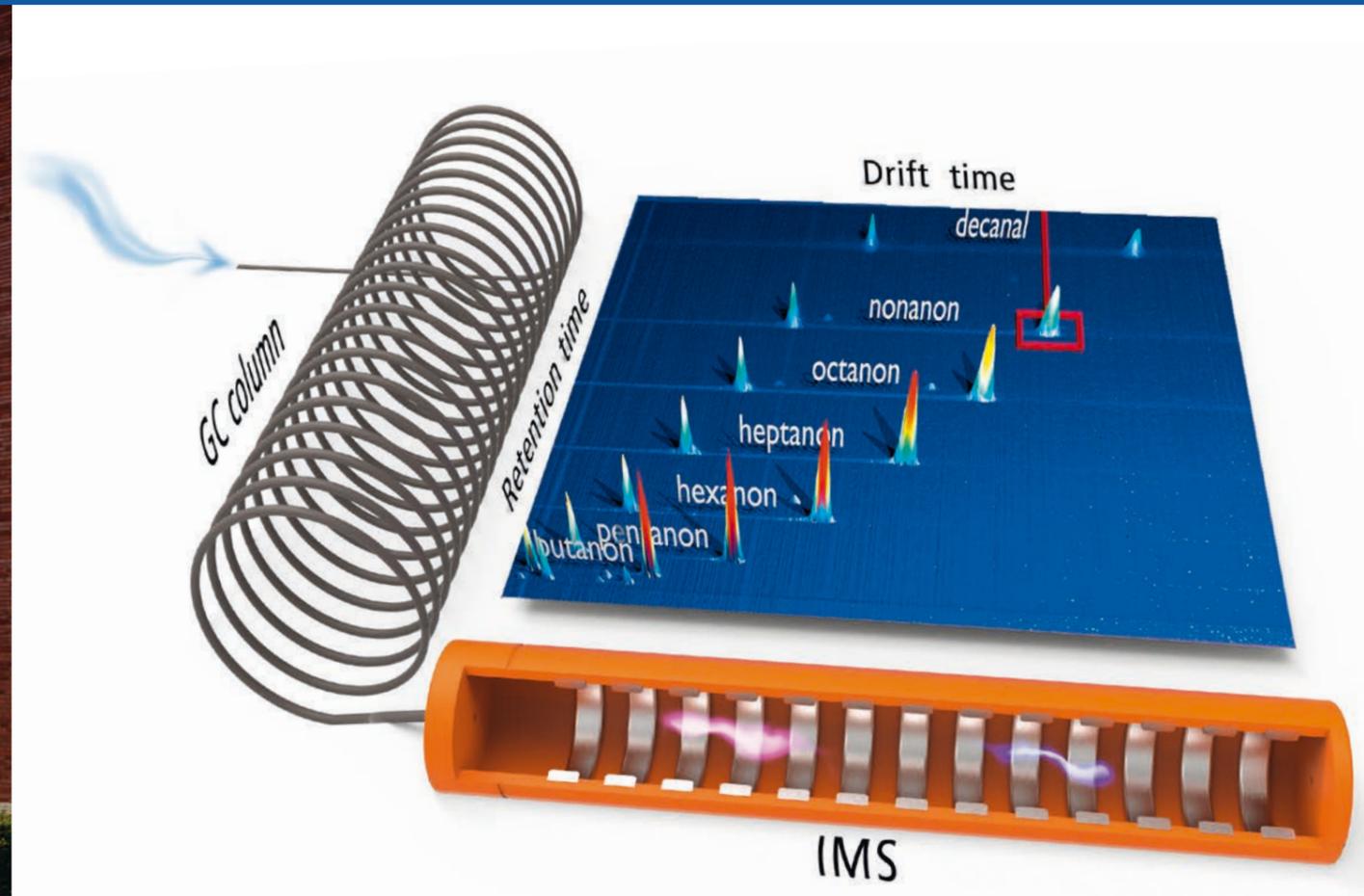
G.A.S. is a German high-tech company founded in 1997 that is specialized in the field of gas analytical solutions for specific assignments. Range of applications is typically related to the measurement of traces of Volatile Compounds (VCs).

Since 2016 it belongs to the Hanon Jinan Instruments Ltd. group respecting a professional market approach in the fast-growing Chinese market and to expand its global customer base significantly.

The interdisciplinary team of chemists, physicists, electrical and software engineers stands out due to its competence and experience related to the coupling of Ion-Mobility-Spectrometry (IMS) to Gas Chromatography (GC). In contrast to other IMS manufacturers G.A.S. applies its instrumentation to civilian applications where it further adapts and optimizes its technology platform to the individual customers' analytical assignments and requested workflows.

In 2018 G.A.S. integrated a miniaturized version of its IMS into the  $\mu$ GC 490 (Agilent Technologies Ltd.), coupled the IMS detector to standard benchtop GCs with its 'Ion Mobility Spectrometer' to make the advantages of the IMS-technology available to the entire analytical society and became a value added reseller (VAR) of Agilent Technologies.

Further to that G.A.S. offers a professional after-sales service to its customers through its global distributor network and is continuously striving for better and innovative analytical solutions.



## Technology

During the 20 years of its existence G.A.S. not only built-up fundamental know-how in the field of IMS as it develops and manufactures its sensors, electronics, same as software in-house but also on coupling gas chromatography (GC) to the IMS, which is key to make optimal use of the IMS' outstanding sensitivity.

Using IMS detectors means obtaining qualitative information due to its intrinsic physical separation same as quantitative analysis by evaluation of the substance specific signal. However, when it comes to rather complex matrices like in food & flavour, process, environmental same as human breath related applications the coupling of gas chromatography is a MUST.

By this coupling G.A.S. realizes an enhanced **2-dimensional separation** (full orthogonality) so that co-elution problems can be overcome and a reliable substance identification at extremely low concentrations (typically ppb-/sub ppb) can be assured.

Due to this technological advantages pre-concentration of samples – usually affecting their characteristics – can be avoided and by that **support** the sometimes very demanding **decisions of sensory panels** can be achieved to an optimal extend.



## Product Quality Control

Product identification and authentication same as quality control in general plays a major role in the food and flavour industry.

Due to the 2-dimensional separation characteristics GC-IMS technology stands out with a unique performance in several quality control related applications. In combination with an automated sampling system fast and efficient workflows can be realized.

The sensitivity (low-/sub ppb) for volatile organic compounds (VOCs) lies in the range of the human nose for many applications so that impartial results can be provided to e.g. support sensory panels and avoid time and labour-intensive analysis.



### Applications FlavourSpec®:

- Food freshness, storage conditions, best before date (fish, meat)
- Process control (quantification of VDKs during beer fermentation)
- Quality control of commodities and finished products (ingredients, herbs)
- Product authentication (habitat, detection of frauds, counterfeits)
- Impartial prove of product flavours
- Support of sensory panels (claim management, detection of off-smells)
- Flavour composition, blending (green tea, coffee, cigarettes etc)
- Optimisation of manufacturing processes (products not made for human testing)



## Industry & Process Control

Monitoring of ambient air, industrial gases, contaminants/volatiles become more important to the industry due to a more demanding environmental legislation and cost-by-cause principle. Therefore e.g. stack monitoring, odour mapping same as control of maximum allowable concentrations in the field of working place control are assignments where sensitive, reliable and rugged analytical instruments that go beyond common sensor technologies are needed. The GC-IMS by G.A.S. can be adopted to various environmental and process control related applications by adjusting sampling, operating mode as well as data analysis. Robustness, self-check functions and easiness of operation are key premises for industrial solutions. A straightforward menu, without the need of an analytical background, completes G.A.S. on-site focussed approach. By that it becomes feasible to transfer the analytical lab to the place where instant and reliable results are needed.

**Control of siloxanes and terpenes in landfill/sewage/biogas:** Monitoring of the generated gas quality is essential because unwanted off-smells and specific compounds should be avoided or kept below a certain threshold. On the other hand due to the presence of washing agents, cosmetics, skin/hair care products etc within the feedstock, siloxanes can be present. During combustion siloxanes are converted to silica (SiO<sub>2</sub>) leading to corrosion and system break downs. Thus it is essential to monitor different siloxane species same as the related silicon (Si) concentration using the GC-IMS-SILOX.

**Monitoring of Odorants in natural gas** like the sulphur containing compound tetrahydrothiophene (THT), sulphur-reduced Spotleak1005 or even sulphur-free Gasodor®-S-Free® have to be controlled to secure the alarming smell. The GC-IMS-ODOR comprises a user friendly single-click operation, automatic grid pressure adjustment and sampling same as data storage on a flash memory and output on its display. Alternatively the device can be run as 24/7 on-line monitoring device to test the odour concentration in user defined intervals sending results via 4-20mA or MODBUS (TCP) protocol.

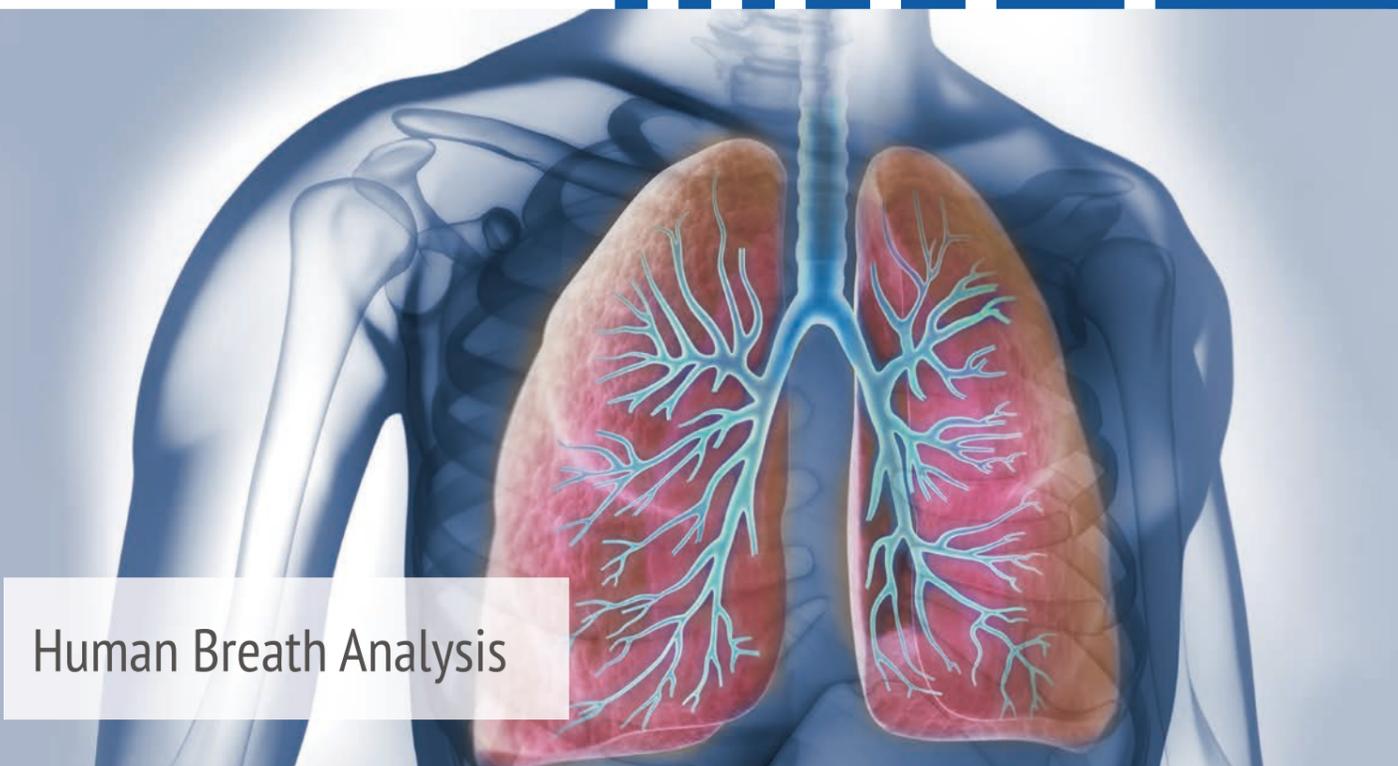
Industrial gases and products can be contaminated with traces of impurities coming from processes or raw materials. In case of low olfactory thresholds e.g. regarding surface emissions of indoor or cars off-smells negatively affect the product quality. In natural gas the total of sulphurous compounds must not exceed a level of 0.5 ppm. In process related applications certain

compounds even at ppb-level can be extremely dangerous either for the process itself e.g. nitric oxide in fluid catalytic cracking process gases or to the workers being exposed to carcinogen or toxic compounds, like dimethyl sulfate or isocyanates.

**The GC-IMS can be applied, calibrated and optimized for such demanding analytical assignments, like:**

- Process control (siloxanes in landfill/sewage/biogas)
- Filter breakthrough/efficiency
- Quantification of odorants in natural gas (THT, Spotleak1005, Gasodor-S-Free)
- Test of raw and process gas quality
- Low sulphur in natural gas
- Finished product control (off-smell in propellant gases)
- Surface emissions in buildings or cars
- Maximum allowable concentration of toxic chemicals in air (e.g. dimethyl sulfide, isocyanates)





Human Breath Analysis



Tailor-Made Solutions

Breath analysis represents a diagnostic technique which can provide information beyond conventional analysis of blood and urine. Advantages of breath tests are the noninvasive and painless testing procedures. Furthermore no specially trained personnel is required for sampling. Hundreds of different substances are found in human breath depending on nutrition, metabolic state, diseases, medication, microbial infections and personal oral hygiene. The appearance or absence of specific metabolites can be used for early diagnosis and their presence for therapy control when identified relevant for a particular disease or medication.

Beyond that, breath analysis can be used to analyse poisoning of humans after exposure to toxic chemicals. Medical research also addresses the detection of diseases via specific markers from the metabolism found in breath.

Several research studies and publications show that the coupling of gas chromatography to ion mobility spectrometer (GC-IMS) represents a promising analytical approach to test for volatiles in exhaled breath based on the intrinsic selectivity and sensitivity of the technique. G.A.S. developed a user friendly low-cost set-up to sample breath in standard disposable syringes to introduce the sample via a Luer-adaptor into the measurement device.

This is a flexible configuration as -besides the dynamic and active process of exhaling into the device through a hose- it accepts gaseous (breath) samples from any source.

By that it is possible to investigate the gas phase e.g. from nose or mouth cavities and even from the skin. Since the Luer tip is a standard adaptor used in a wide range of medical equipment sampling can be done even on intubated patients. Typical runtime of the analysis is 10 minutes. Examples for detectable compounds in healthy human breath are isoprene, short chained alcohols, aldehydes and ketones, acetonitril, nitric oxide, dimethyl sulfide and further sulphur-compounds.

**Application related to medical research/human breath are:**

- Recognition or monitoring of diseases through testing of volatiles
- Monitoring of work-related exposure of hazardous substances, personal safety
- Control of drug decomposition (pharmacokinetics)
- Outgasing from human skin



G.A.S. stands-out due its core competence in developing analytical solutions primarily based on the combination of Gas Chromatography and Ion-Mobility-Spectrometry in various set-ups. Here the main focus is fulfilling the analytical requirement and pre-defined customers needs.

**Application-specific set-up of instruments**

The generic 'GC-IMS' instrument platform with its different GC-column configurations, sample inlets, application related measurement programs and firmware versions offers a high flexibility to make best use of the instrument's advantages regarding selectivity and sensitivity.

If the available hardware and software options do not fully match the performance targets or workflow preferences of the operator in the field or scientist in the lab, the instrumental configuration can be optimized to achieve maximum analytical output and user satisfaction. Besides that self-checks, watchdogs, additionally alarms etc can be implemented into the GC-IMS to respect plant management requirements.



**Individual analytical solutions**

Even very demanding customized technical solutions belong to G.A.S. portfolio. Examples of tailor-made devices/devices' properties:

- Hybrid-solutions:
  - a) coupling of common benchtop GC-MS with an IMS
  - b) use of a pre-concentration unit in front of the GC-IMS
- Application-specific set-up of the devices' configurations and parts
- Customized measurement methods with application optimized programs
- User workflow related software
- Incorporation of a miniaturized IMS into a  $\mu$ GC channel
- Special software algorithms for analysis of toxic substances in complex matrices
- etc.



## FlavourSpec®:

- Measurement of flavour inducing traces of (off-) flavour inducing traces of volatiles
- Automatic static headspace sampling of liquids and solids (no sample pre-treatment)
- Does not require lab environment, can work at-line
- Extremely easy-to-use (colleague-to-colleague)
- Rugged: Minor maintenance required



## GC-IMS\*:

- Integrated pump and 6-port-valve for active sample introduction
- Manual and automatic 24/7 sampling of gaseous samples
- Portable and rugged: Suitable for on-site applications
- Results on touch-screen or transferred via 4-20mA or MODBUS (TCP) protocol
- Can be equipped with operation gas recycling unit

\* Available with single-click menu/closed firmware for several applications, such as detection of siloxanes, control of odorants in natural gas and monitoring of toxic industrial compounds.

## BreathSpec®:

- Flexible set-up with disposable mouthpieces and syringes for easy and hygienic sampling
- Heated sampling lines to clean instrument and avoid memory effects
- Versatile due to different sampling modes (continuous exhaling)
- Equipped with operation gas recycling unit (transportable, sampling at site)
- Integrated pump and 6-port-valve for manual and automatic sampling



## Ion Mobility Spectrometer:

- Ready for coupling/interfaces to Agilent 6890/7890B and Shimadzu GC-2010 Plus
- <sup>3</sup>H source below exemption limit in all EURATOM countries
- Positive and negative ion modes to test for ketones, aldehydes, alcohols, amines or sulphurous and halogenated compounds, e.g.
- Operation with N<sub>2</sub> and synthetic air (quality 5.0)
- Software for 3-dimensional data recording, IMS and flow controller parameter setting

## Minaturized Gas Chromatograph - Thermal Conductivity Detector - Ion Mobility Spectrometer (µGC-TCD-IMS):

- Test of natural gas composition incl. detection of low sulphur <0.5ppm
- Measurement of saturated and unsaturated hydrocarbons
- Sensitive detection of greenhouse gases
- Portable and stationary (24/7) monitoring
- Standard data protocols and interfaces available

