IUTMedicalGmbH

Ion Mobility Spectrometry
Photo Ionization Detector
Gas Chromatography

High Sensitive Industrial Trace Gas Analyzers

IUTMedicalGmbH

- Process Gas Monitoring
- Environmental Monitoring
- Ambient Air Monitoring
- Emission Control
- Semiconductor
- Sea Container Inspection
- Building Protection
- Homeland Security

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Photo Ionization Detector
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Data Sheet

IMS-Analyzer

The environmental and industrial IMS multi-gas analyzers

The **IMS-Analyzer** is a multi-gas analyzer as Ion Mobility Spectrometer (IMS) with high sensitivity in the lower ppb-range and high resolution. With this trace-gas analyzer toxic gases can be detected and identified without any enrichment directly in situ already at a very low concentration level.

For the further enhancement of the selectivity and further reduction of cross sensitivities the **IMS-Analyzer** is also available as GC-IMS approach. There the IMS is coupled with a gas chromatographic column (GC) for pre-separation.

With the **IMS-Analyzer**, IUT Medical offers a high sensitive, high selective, reliable, and easy to operate analyzer. The analyzer offers an excellent price / performance ratio which makes it quite interesting for replacements of expensive process gas chromatographs.

This unique combination of GC column with IMS to a GC-IMS is also offered as mobile analyzer and is the smallest GC-IMS analyzer available on the market.

Analysis Application

- Ambient Air Monitoring
- Process Gas Monitoring
- Continuously Emission Control (Stack)
- Semiconductor Fabrication
- Environmental Monitoring
- Medical / Pharmaceutical Monitoring

Features

- Real-time analysis of Toxic Industrial Compounds (TICs)
- High sensitivity in lower ppb-range
- Superior selectivity and cross sensitivity rejection
- Enhancement with GC-column coupling (GC-IMS)
- Analysis directly in situ (No Tedlar bag sampling / no lab analysis)
- Operation under ambient air pressure
- Low operations costs, no consumables, no carrier gas required

Data Sheet

The environmental and industrial IMS multi-gas analyzers

IMS-Analyzer

With this trace-gas analyzer toxic gases can be detected and identified without any enrichment directly in situ already at a very low concentration level. The detection including sampling and identification process takes few seconds, depending on the possible GC-Setup.

Compared with other systems the **IMS-Analyzer** has the advantage to operate under atmospheric pressure. This makes it best suitable for mobile applications for on-site measurements. The powerful rechargeable battery offers an optimal mobile use. Due to the special approach the sensitivity is extremely high. Unlike other IMS systems the **IMS-Analyzer** does not use dopants and does not use a membrane.

For the enhancement of the selectivity and further reduction of cross sensitivities the **IMS-Analyzer** is also available as GC-IMS approach. There the IMS is coupled with a gas chromatographic column (GC) for pre-separation. The GC-IMS version operates without carrier gas which keeps the operation costs low and makes it best suitable for the mobile use.

The **IMS-Analyzer** enclosures can range from Class 1 Division 1 to general purpose. Also EX-protection (purge system) is available.

Calibration functions with an additional calibrator for SPAN/ZERO calibration is offered as well as Multi-Point-Sample (MPS) systems, dilution- or even gas probe chiller systems.

Technical Data

Detection principle:	Ion Mobility Spectrometry (IMS), or Gas-Chromatography-IMS.
Ionization:	Tritium (3H). No license or wipe test required.
Measurable compounds (only as example; other compounds possible):	Acetone, Ammonia, Acrylonitrile, Benzyl Chloride, Bromine, Chlorine, Chlorocyane, CMME, Dibutyl Phthalate (DBP), Dimethyl Sulfate (DMS), HCFC's, HFC's, HFPO, Hydrazine, Hydrogen Chloride, Hydrogen Bromide, Hydrogen Fluoride, Isocyanates, NMP, PFIB, Phosgene, Sulfur Dioxide, Vinyl Chloride
Sensitivity:	Low ppb range
Moisture:	0% to 90% RH
Data output: (depending on version)	• Integrated GUI • 4 - 20 mA (analog) • RS-232 (optional) • RS-485 (optional) • USB (optional) • LAN / WLAN (optional) • Digital in/out
Warm-up time:	20 minutes
Measuring time:	Seconds to minutes (depending on GC setup)
Power:	100V- 240 V / 50Hz - 60 Hz mobile: typically 8 hours with Li-ion battery
Carrier gas:	No carrier gas required

Enclosure:	**19" rack mount**	**Industrial enclosure (NEMA 4X)**	**Mobile**
Dimensions:	483 mm L • 381 mm W • 89 mm H (19" • 15" • 19.7")	160 mm L • 400 mm W • 500 mm H (6" • 15.7" • 19.7")	280 mm L • 100 mm W • 280 mm H (11" • 4" • 11")
Weight:	~6.7 kg (~14.3 lbs)	18 kg (40 lbs.)	~7 kg (~15.5 lbs)
Operation temperature:	0°C - 50°C (+32°F - 122°F)	-40°C - 50°C (-40°F - 122°F)	-10°C - 50°C (+14°F - 122°F)
Storage temperature:	-10°C - 50°C (+14°F - 122°F)	-10°C - 50°C (+14°F - 122°F)	-10°C - 50°C (+14°F - 122°F)

IUT Medical GmbH

IUT Medical GmbH
Volmerstrasse 7 B
D-12489 Berlin
Germany
phone: +49 (0)30 20 14 33 00 0
fax: +49 (0)30 20 14 33 00 9
e-mail: info@iut-medical.com
www.iut-medical.com

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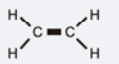
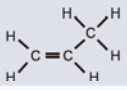
Application Note

Ammonia impurities in hydrocarbon streams

Ammonia impurities in Ethylene or Propylene fluid streams

Ammonia (NH_3) is a well-known, widely spread air pollutant, which is present almost everywhere in low ppm/ppb concentrations. Ammonia can be found in various processes, where gases are the basic media, such as steam crackers producing gaseous hydrocarbons for further production steps like polymerization. Gases like these are for example Ethylene, Propylene and even so called cracker gas, which is mostly a mixture of above mentioned gases as well as Water and Hydrogen. The gases of interest are separated and afterwards fed into a pipeline which is serving other chemical plants, producing for example Polyethylene. Ethylene and Propylene are widely used in industry chemistry and they are one of the most important compounds used.

Compound	other names	Sum formula	CAS-No.	Structure
Ammonia	• Hydrogen nitride • Trihydrogen nitride • Nitro-Sil	NH_3	7664-41-7	
Ethylene	• Ethene	C_2H_4	74-85-1	
Propylene	• Propene • Methylethylene	C_3H_6	115-07-1	

Ammonia is a serious contamination in Ethylene and Propylene because it acts as poison for the catalysts in the Polyethylene (PE) and Polypropylene (PP) production. In order to increase the performance of the polymerization process for their production the sensitivity of the used catalyst has to be increased. Therefore the purity of Ethylene and Propylene is an important topic especially the contamination with Ammonia impurities.

Large quantities of Ethylene and Propylene are transported via pipe lines with lengths of several hundreds of km. Companies producing Ethylene or Propylene will lead in their products at different point into the pipe line for the transportation to the final users. The purity of Ethylene and Propylene especially the contamination with Ammonia at the point of lead in and extraction of the pipe line but also in the production process is important. There are growing concerns over the management of Ammonia impurities.

With the **IMS-Analyzer**, IUT Medical offers a high sensitive, reliable, and easy to operate analyzer. The **IMS-Analyzer** allows for the continuous, long-term direct measurement of low ppb of Ammonia in such streams (see **IMS-Analyzer** data sheet).

Application Note

Ammonia impurities in Ethylene or Propylene fluid streams

NH_3 in processes like these can be a problem in terms of process efficiency, quality control and avoidance of damages, which cause the need to replace very expensive equipment such as catalysts. The fast, accurate and quantitative measurement of NH_3 in Hydrocarbon streams is a growing need in plastics manufacturing. An amount of NH_3 which is higher than 5 ppm can poison catalysts and impairs the quality of the produced polymers in an unacceptable way.

Solution

The **IMS-Analyzer** is capable of detecting and quantifying NH_3 directly from f.i. Ethylene or even in the process step of steam cracking beforehand to avoid technical problems as well as ensuring the quality and efficiency. The outstanding sensitivity and resolution as well as the almost immediate response to concentration changes make the **IMS-Analyzer** to one of the most suitable process monitoring techniques available. Compared to other methods used in that field like process gas chromatographs, IMS is relatively cheap.

The following table provides information of the performance of **IMS-Analyzer** measuring Ammonia in hydrocarbon fluid streams:

Compound	Standard range	MDC	Resolution
Ammonia	0 - 5 ppm	< 50 ppb	0.1% of maximum

The **IMS-Analyzer** bases on the proven technology of ion mobility spectrometry (IMS) and also GC-IMS, which operates with atmospheric pressure conditions, highly selective and sensitive to Ammonia. Typical detection limits for Ammonia in such streams are less than 50 ppb without prior enrichment.

IMS is an atmospheric pressure, time of flight detection technique. The sensitivity, selectivity and speed of response make the technique superior in many aspects to other monitoring methods. Unlike electrochemical devices, the IMS units are impervious to extreme temperature or humidity conditions. In addition, in contrast to paper tape detection methods, the IMS units are designed for long term, continuous measurements with little or no maintenance and few consumables. The electronics are completely solid-state without moving parts or optics to require alignment.

Advantages:

- Unique combination of GC column with IMS to a GC-IMS
- Real-time analysis of Ammonia
- High sensitivity in the lower ppb range without enrichment
- Superior selectivity and cross sensitivity rejection
- Automatic operation with Multi Point Sampler system (MPS)
- As stationary and mobile devices available
- Available in various protection classes (From general purpose to IP 55 and NEMA 4X)
- Also in explosion-proof design available

IUT Medical GmbH

IUT Medical GmbH
Volmerstrasse 7 B
D-12489 Berlin
Germany
phone: +49 (0)30 20 14 33 00 0
fax: +49 (0)30 20 14 33 00 9
e-mail: info@iut-medical.com
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Application Note

Chlorinated hydrocarbons in ion exchange resin production

Measurement of CMME, BCME, EDC, DCM in ion exchange resin production

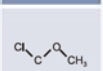
Chloro (methyl) methyl ether (CMME) and Bis (chlorodimethyl) ether (BCME) and ethylene dichloride (EDC) and methylene chloride (DCM), as well as other chlorinated hydrocarbons, are known as carcinogens. BCME is also highly toxic. These substances are widely used in the chemical industry, especially in the production of ion exchange resins.
CMME is used in the production of ion exchange resins as chloro methylation reagent, while BCME as contamination cannot be avoided.

A potential danger caused by these chlorinated hydrocarbons, is due to inhalation or absorption through the human skin. Employees who work in chemical factories for the production of ion exchange resins and similar products (e.g. as polymers) can be exposed to these hazards daily.

Thus, it becomes a duty to monitor the presence of substances such as CMME, BCME, EDC and DCM at workplaces to minimize the health risk to employees and also to ensure the officially prescribed monitoring.

CMME is classified as particularly dangerous carcinogenic substance under the Hazardous Substances Ordinance and may be produced or used only in closed systems.

Therefore the approval and the operation of such facilities using CMME is only granted if a monitoring system has been installed ensuring the official documentation.

Compound	Other names	Sum formula	CAS-No.	Structure
Chloro(methyl)methyl ether (CMME)	• Chlorodimethyl ether • Monochlorodimethyl ether (MCD) • Methoxymethyl chloride (MOMCl) • Chloro(methoxy)methane	C_2H_5ClO	107-30-2	
Bis(chlordimethyl) ether (BCME)	• Chloromethyl ether • Dichlorodimethyl ether	$C_2H_4Cl_2O$	542-88-1	
Ethylene dichloride (EDC)	• 1,2-Dichloroethane • Ethylene dichloride • Ethylene chloride	$C_2H_4Cl_2$	107-06-2	
Dichloro methane (DCM)	• Methylene chloride • Methylene dichloride • R30	CH_2Cl_2	75-09-2	

Both CMME and BCME hydrolyze rapidly in the presence of moisture. Therefore, all surfaces within the sampling system and within the analyzer, with which these compounds may come in contact, have to be inert.

Application Note

Measurement of CMME, BCME, EDC, DCM in ion exchange resin production

Solution:

For the detection of these chlorinated hydrocarbons, in particular CMME and BCME, the IUT Medical installed an ion mobility spectrometer (IMS) coupled with chromatographic column (GC) for pre-separation to a GC-IMS in such facilities. This GC-IMS device, the so-called **IMS-Analyzer** (see data sheet), is a multi-gas analyzer, achieved the qualitative and quantitative detection of these compounds in the required lower ppb range.
The coupling of IMS technology with a gas chromatographic column opens the possibility to measure quantitatively the compounds specified without losses of sensitivity and reproducibility within a few minutes online.

The **IMS-Analyzer** is based on the proven technology of ion mobility spectrometry (IMS), which operates under atmospheric pressure conditions. It is highly sensitive to chlorinated hydrocarbons with typical detection limits for CMME and BCME of less than 1 ppb without prior enrichment.

The following table provides information of the performance of **IMS-Analyzer**:

Compound	Sum formula	Standard range	MDC	Resolution
Chloro(methyl)methyl ether (CMME)	C_2H_5ClO	0 - 500 ppb	< 1 ppb	0.1 % of maximum
Bis(chlorodimethyl) ether (BCME)	$C_2H_4Cl_2O$	0 - 100 ppb	< 1 ppb	
Ethylene dichloride (EDC)	$C_2H_4Cl_2$	0 - 1 ppm	~10 ppb	
Dichloro methane (DCM)	CH_2Cl_2	0 - 1 ppm	~10 ppb	

Compared to similar technologies, ion mobility spectrometry is superior in terms of sensitivity, selectivity, accuracy, response and price/performance ratio.

In contrast to electro-chemical sensors, the IMS is insensitive with respect to high temperature or humidity. Furthermore, the IMS technology, unlike for example the test strip method has been developed for long-term measurements. The GC part and also the IMS part operate without carrier gases which makes the **IMS-Analyzer** best suitable for mobile applications. It requires little or no maintenance expenses and it requires no consumables or expensive carrier gas.

Advantages:

- Unique combination of GC column with IMS to a GC-IMS allows the separation of chlorinated hydrocarbons from each other and from possible cross sensitivities
- Real-time analysis of chlorinated hydrocarbons
- High sensitivity in the lower ppb range without enrichment
- Superior selectivity and cross sensitivity rejection
- Automatic operation with multi point sampler system (MPS)
- As stationary and mobile devices available
- Available in various protection classes (From general purpose to IP 55 and NEMA 4X)
- Also in explosion-proof design available

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IUT Medical GmbH
Volmerstrasse 7 B
D-12489 Berlin
Germany
phone: +49 (0)30 20 14 33 00 0
fax: +49 (0)30 20 14 33 00 9
e-mail: info@iut-medical.com
www.iut-medical.com

IUT Medical GmbH

IUT Medical GmbH
Volmerstrasse 7 B
D-12489 Berlin
Germany
phone: +49 (0)30 20 14 33 00 0
fax: +49 (0)30 20 14 33 00 9
e-mail: info@iut-medical.com
www.iut-medical.com