Agilent

Trusted Answers

Downstream Petrochemical Processes

Application Compendium

Introduction

Petrochemicals are found in a vast range of modern everyday products, such as clothing, packaging, digital devices, detergents, tyres, medical equipment, and many more. Numerous modern energy systems are also reliant on petrochemicals, including solar panels, wind turbines, batteries, building insulation, and electric vehicles. Approximately 12% of global oil demand can be attributed to petrochemical feedstock, which is expected to increase given the rising demand for fertilisers, plastics, and other products[1]. Because of their core role in the daily lives of people across the globe, petrochemicals significantly contribute to promoting the development of economies and improving standards of living.

Petrochemical production focuses on maximizing ethylene and propylene yields, as well as by-product yields for other olefin and aromatic compounds. The testing and analysis of raw materials, intermediates, and finished products is essential to ensure that their quality meets recognised petrochemical standards. Furthermore, climate change concerns and the subsequent implementation of policies to achieve carbon peaking and neutrality goals are driving the energy sector to shift from fossil-fuel-based energy production to the use of alternative energy sources. Alternative energy includes renewables like biofuel and hydrogen, as well as energy storage devices such as lithium-ion batteries. Rigorous testing of alternative energy sources to ensure they are free of impurities is critical to ensure the safety of engines and production and manufacturing systems.

In response to the global demand for alternative energy sources, new downstream petrochemical processes, and accurate testing for petrochemical quality control, Agilent is pleased to announce a portfolio of advanced and intelligent gas chromatography (GC) analyzers. Our latest generation of GCs combine cutting-edge technology, leading intelligent features, and strong reliability to meet the needs of analytical testing and research laboratories across a broad range of applications in downstream petrochemical industries. Integrated instrument intelligence helps avoid GC problems before they affect chromatographic performance, in turn optimizing uptime, cost of ownership, and confidence in results.

This application compendium provides an overview of Agilent solutions for petrochemical applications.

Agilent offers a portfolio of intelligent GC systems to meet your petrochemical testing needs.

Agilent 8890 GC: Smart connected, intelligent, and extendable

- Direct connection and communication with the GC from anywhere your network will allow
- High performance with unparalleled scalability and configuration flexibility
- Representative of the quality that Agilent GCs are known for
- Built-in dual-core processors with smart algorithms, diagnostics, and self-aware features take GC intelligence to new heights

Agilent 8860 GC: Intelligent and reliable

- Designed with a focus on routine laboratory analysis: Built with the same dual-core processor as the 8890 GC to ensure scalability and flexibility for routine applications
- Configurable with up to three detectors, three valves, and six heated zones: Caters to diverse functional needs of routine laboratory analyses
- Color touch screen and browser interface: Provide wonderful smart connectivity and remote touch control

Agilent 990 Micro GC: Fast, reliable GC analysis—in and out of the lab

- Unique, innovative features combined with the quality and speed critical for gas analysis
- Modular design supports up to four channels of separation and detection
- Micro thermal conductivity detector (micro TCD) design allows the system to use only 10% of the power and carrier gas volume used in conventional lab GC

Agilent offers more solutions on the new-generation smart GCs, including:

- Ethylene and propylene
- Polymers
- Ethylene glycol
- Acrylic acid and acrylates
- ABS and acrylonitrile
- 1,4-Butanediol (BDO)
- Ethylene oxide and propylene oxide
- Purified terephthalic acid (PTA)
- Methyl tert-butyl ether (MTBE)
- Lithium-ion battery
- Biodiesel and other renewable fuels
- Hydrogen energy

In addition to the above solutions, Agilent provides customized methods and solutions to support your specific chemical analysis and business needs—today and in the future.

Please contact your local sales representative for more information.

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Methyl tert-Butyl Ether (MTBE)

Lithium-Ion Battery (New)

Biodiesel and Other Renewable Fuels

Hydrogen Energy (New)

Ethylene and Propylene

The ethylene industry represents the core of the petrochemical industry, with ethylene products accounting for more than 75% of petrochemical products. Propylene is also one of the most important petrochemical products and serves as a basic feedstock of strategic materials such as acrolein, polypropylene, acetone, polyacrylonitrile, propylene oxide, and several other industrial products. Furthermore, ethylene and propylene are basic feedstocks for the production of synthetic resins, fibers, and rubbers, pharmaceuticals, dyes, pesticides, new chemical materials, and household and personal care chemical products.

Agilent's experience in the analysis of ethylene and propylene and our broad product portfolio can help labs meet various standards.

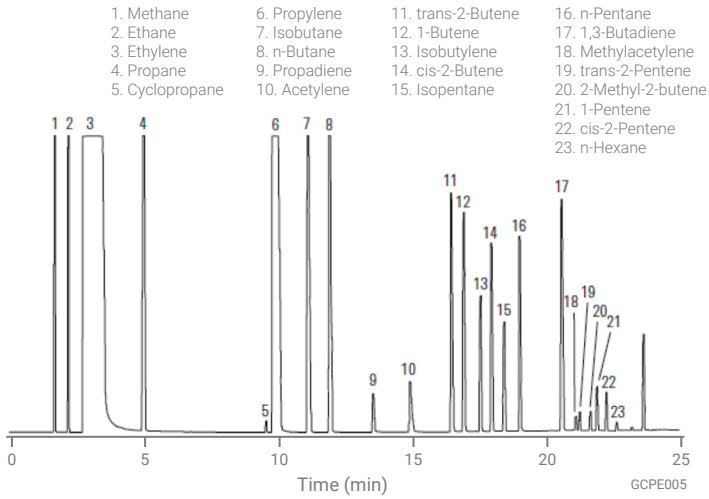
Analysis of hydrocarbon impurities in ethylene

System description:

- Configuration: Six-way valve, split/splitless inlet (SSL), flame ionization detector (FID)
- Compounds of interest: C1-C6 hydrocarbons

Key features and benefits:

- Single FID channel
- Porous layer open tubular (PLOT) alumina column perfect for separation of C1-C8 isomers



Analysis of hydrocarbon impurities in ethylene

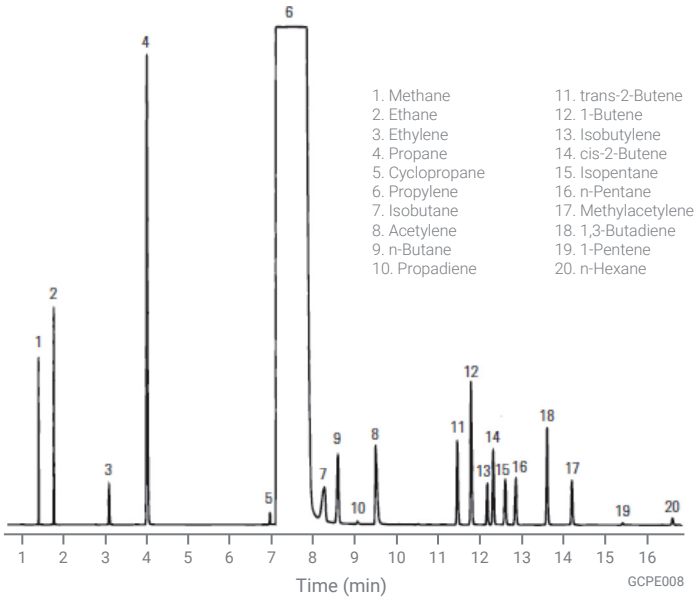
Analysis of hydrocarbon impurities in propylene

System description:

- Configuration: Six-way valve, SSL, FID
- Compounds of interest: C1-C6 hydrocarbons

Key features and benefits:

- Single FID channel
- PLOT alumina column perfect for separation of C1-C8 isomers, in particular, separation of cyclopropane and propylene



Analysis of hydrocarbon impurities in propylene

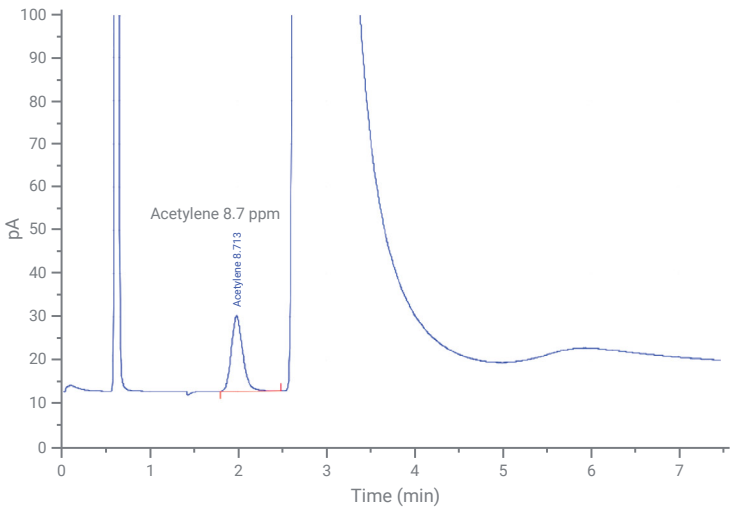
Analysis of trace acetylene in ethylene and propylene

System description:

- Configuration: One valve, SSL, FID
- Compound of interest: Acetylene

Key features and benefits:

- Simple configuration with single valve and single FID channel
- Main peak (ethylene) elutes after acetylene, not affecting the peak elution of trace acetylene
- Ethylene can be backflushed through the precolumn
- Analysis time can be shortened to 7 to 8 minutes



Analysis of trace acetylene in ethylene and propylene

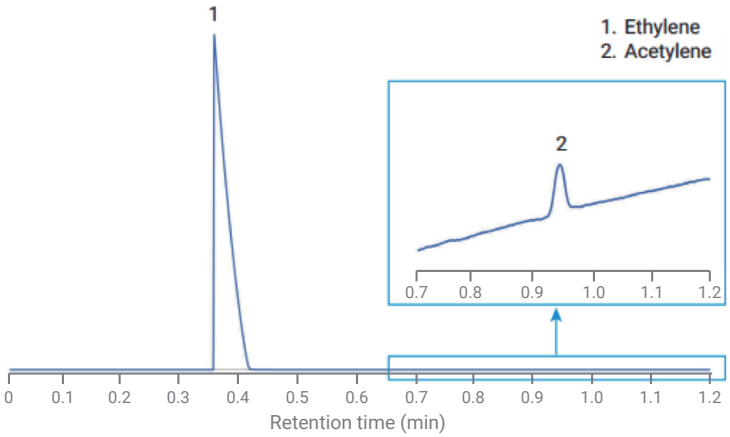
Fast analysis of trace acetylene in ethylene

System description:

- Configuration: 990 Micro GC, CP-Al2O3/KCl single-channel module
- Compound of interest: Acetylene

Key features and benefits:

- Simple configuration with single-channel module
- Typical peak area repeatability (RSD%) < 3%
- Limit of detection: 2 ppm
- Analysis time: 90 seconds



Chromatogram of 5.2 ppm acetylene on the 10 m CP-Al_2O_3/KCl channel

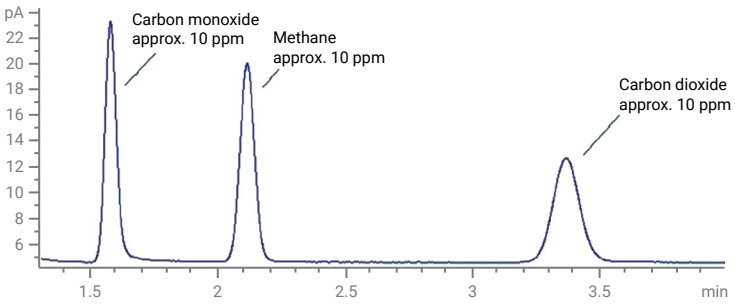
Analysis of trace CO and CO_2 in ethylene and propylene

System description:

- Configuration: One valve, two columns, nickel reformer, FID
- Compounds of interest: CO and CO_2

Key features and benefits:

- Simple configuration with single valve and single FID channel
- Trace amounts of CO and CO_2 are transformed into methane by the nickel reformer and then detected by FID
- Ethylene and propylene can be backflushed through the precolumn
- Analysis time can be shortened to 4 minutes



Analysis of trace CO and CO_2 in ethylene and propylene

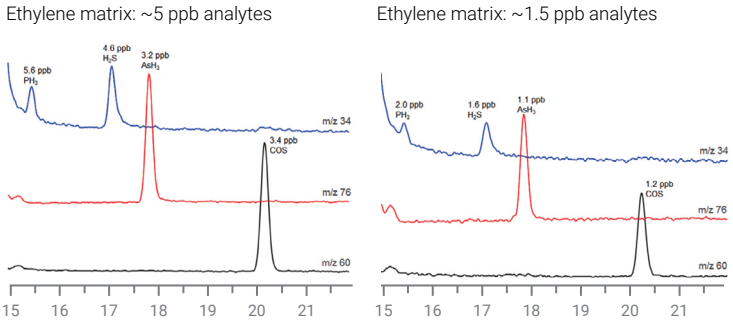
Analysis of arsine and phosphine in ethylene and propylene

System description:

- Configuration: Six-way valve, four-way valve, GC/MSD with high effiency source (HES), inert system
- Compounds of interest: Arsine, phosphine, and H_2S

Key features and benefits:

- 8890 GC with HES for higher ionization efficiency
- Ultrahigh sensitivity with a low limit of detection < 10 ppb
- Excellent long-term analytical stability
- System is deactivated to minimize adsorption
- Selected dedicated columns for better separation



Analysis of arsine and phosphine in ethylene and propylene

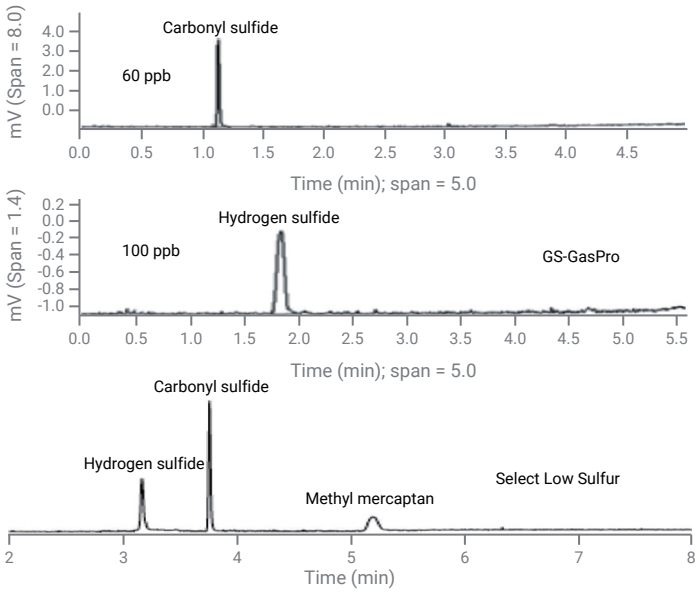
Analysis of trace sulfur in ethylene and propylene

System description:

- Configuration: One valve, volatiles inlet (VI), sulfur chemiluminescence detector (SCD), entirely sulfur inert system flow path
- Compounds of interest: Volatile sulfides such as H_2S and COS

Key features and benefits:

- Configured with the Agilent 8355-SCD detector
- High selectivity: Superior selectivity for sulfur over carbon
- No quenching: Detector response not subject to hydrocarbons
- Equimolar response: Simplifies quantification of unknown compounds
- Linear response: Simplifies calibration curves
- Entire flow path is sulfur inert: Minimizes sulfur adsorption
- Dedicated sulfide analytical column: Allows complete separation of COS and propylene



Analysis of trace sulfur in ethylene and propylene

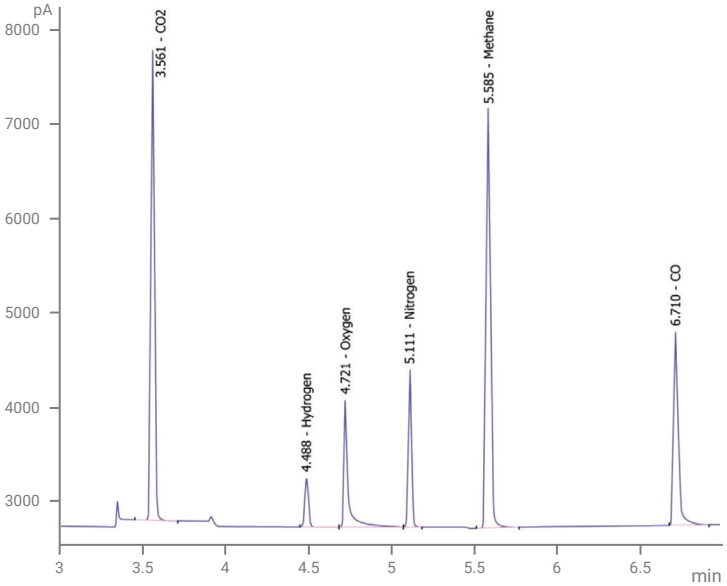
Analysis of trace permanent gas components in ethylene and propylene

System description:

- Configuration: Ten-way valve, six-way valve, pulsed discharge helium ionization detector (PDHID)
- Compounds of interest: H_2, O_2, N_2, CO, CO_2, and H_4

Key features and benefits:

- 8890 GC with PDHID
- Ultrahigh sensitivity with a low limit of detection < 10 ppb
- Helium-protected cabinet to avoid disturbance from air leakage
- Excellent long-term analytical stability



Analysis of trace permanent gas components in ethylene and propylene

Polymers

Polymers are long-chain molecules or macromolecules constructed by connection of repeating chemical units. Each molecule of a polymer may consist of hundreds, thousands, or even millions of repeating units. The detection of residual monomers in a polymer is an essential operation in the production and quality control of the polymer. Considering sample preparation, the headspace sampling method is preferred. Agilent applies a multiple headspace extraction (MHE) technique to a range of polymers including polymethyl methacrylate, polypropylene, and styrene-methyl methacrylate copolymer, enabling a monomer assay with minimal sample preparation.

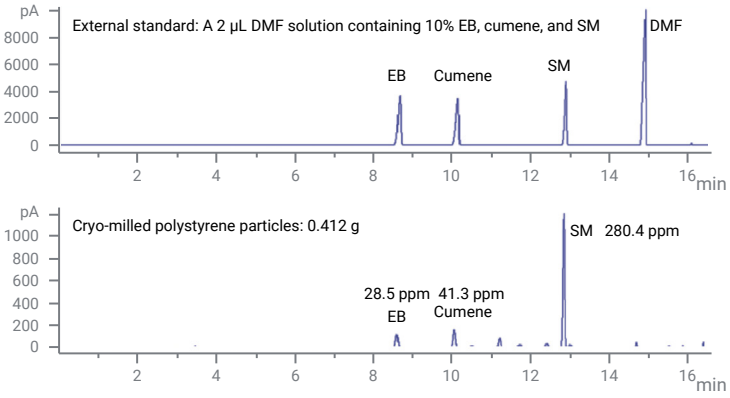
Residual monomers and solvents in polystyrene particles

System description:

- Configuration: Headspace sampler, SSL, FID
- Compounds of interest: Ethylbenzene (EB), cumene, and styrene (SM)

Key features and benefits:

- Direct analysis of solid samples in MHE mode
- Excellent repeatability with intrarun RSD < 2% and interrun RSD < 5.6%



Residual monomers and solvents in polystyrene particles

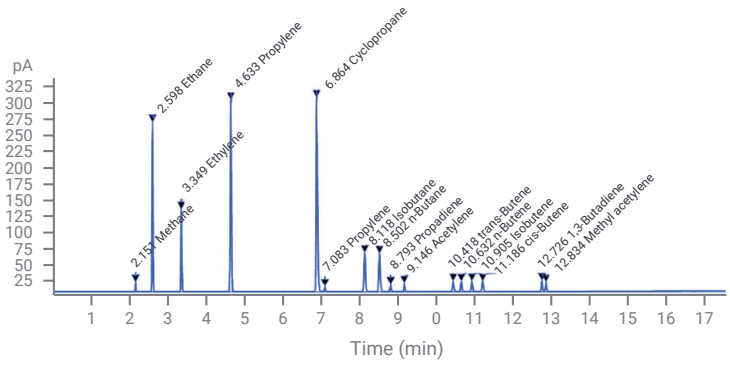
Analysis of residual monomers in polypropylene/polyethylene granules

System description:

- Configuration: Headspace sampler, SSL, FID
- Compounds of interest: C1-C6 hydrocarbons

Key features and benefits:

- Direct analysis of solid samples in MHE mode
- Excellent repeatability



Analysis of residual monomers in polypropylene/polyethylene granules

Ethylene Glycol (New)

Ethylene glycol (EG) is the second largest application of ethylene, mainly used in the production of polyesters, polyester fiber, polyester resins, and other chemical products. Serving a large user base in the EG industry, Agilent has accumulated a wealth of experience in addressing the analytical testing needs of EG units for both ethylene oxide hydration process and coal-to-EG process. Agilent is in a position to provide the users with complete solutions.

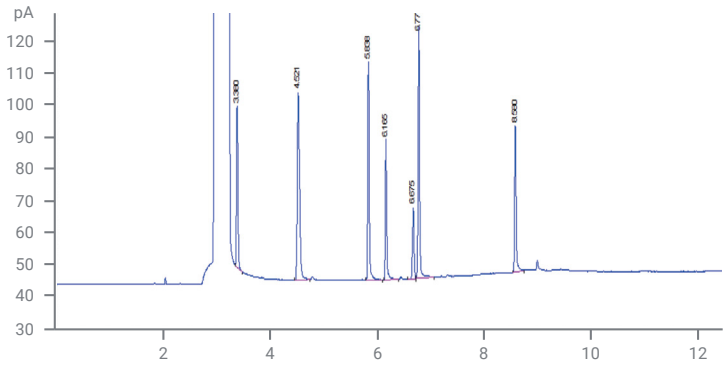
Analysis of impurities in ethylene glycol

System description:

- Configuration: Autosampler, SSL, FID
- Compounds of interest: Impurities in EG

Key features and benefits:

- Single-channel configuration with high-sensitivity FID
- Excellent repeatability



Analysis of impurities in EG

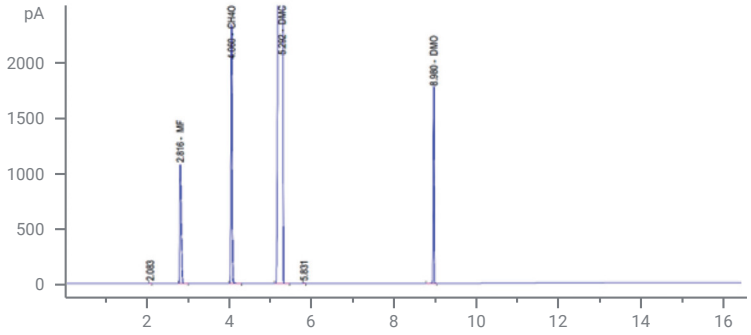
Analysis of impurities in dimethyl carbonate

System description:

- Configuration: Autosampler, SSL, FID
- Compounds of interest: Impurities in dimethyl carbonate (DMC)

Key features and benefits:

- Single-channel configuration with high-sensitivity FID
- Excellent repeatability



Analysis of impurities in DMC

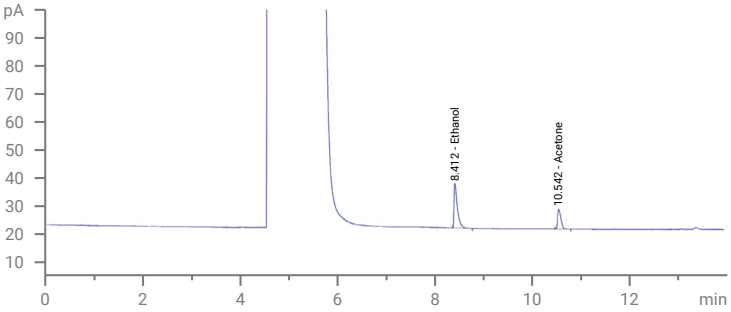
Analysis of impurities in methanol

System description:

- Configuration: Autosampler, SSL, FID
- Compounds of interest: Impurities in methanol

Key features and benefits:

- Single-channel configuration with high-sensitivity FID
- Excellent repeatability



Analysis of impurities in methanol

Acrylic Acid and Acrylates

Acrylic acid is one of the most versatile monomers in the chemical industry and is mainly used as a structural unit for a variety of polymer formulations. Acrylates make up the largest proportion in the subdivisions of acrylic acid, followed by super-absorbent polymers (SAPs). Agilent's reliable and advanced instruments and analytical methods can fulfill laboratory requirements for the analysis of acrylic acid and acrylates.

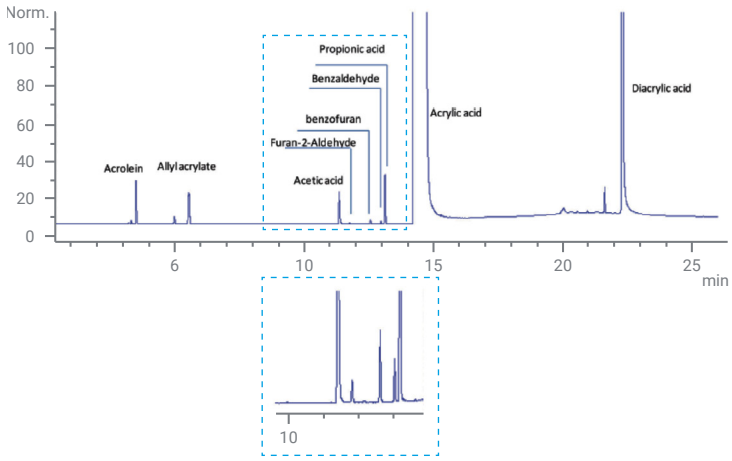
Purity analysis of acrylic acid

System description:

- Configuration: SSL, FID
- Compounds of interest: Acrolein, allyl acrylate, acetic acid, furan-2-aldehyde, benzofuran, benzaldehyde, propionic acid, diacrylic acid, and acrylic acid

Key features and benefits:

- Single-channel configuration with high-sensitivity FID
- Excellent repeatability



Purity analysis of acrylic acid

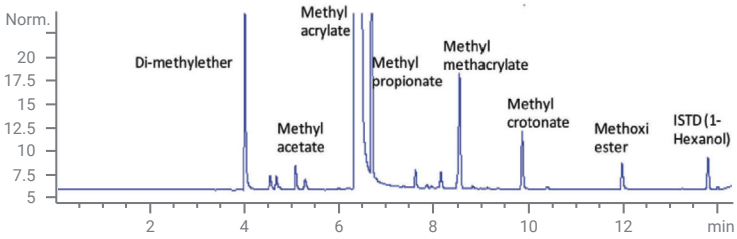
Purity analysis of methyl acrylate

System description:

- Configuration: SSL, FID
- Compounds of interest: Dimethylether, methyl acetate, methyl propionate, methyl acrylate, methyl methacrylate, methyl crotonate, methoxiester, and n-hexanol

Key features and benefits:

- Single-channel configuration with high-sensitivity FID
- Excellent repeatability



Purity analysis of methyl acrylate

Acrylonitrile-Butadiene-Styrene Copolymer (ABS) and Acrylonitrile

Acrylonitrile-butadiene-styrene copolymer (ABS)—a thermoplastic polymer material with high strength, good toughness, and ease of processing and molding—is currently the most produced and widely used polymer. It organically combines the various properties of polystyrene (PS), styrene-acrylonitrile resin (SAN), and butadiene-styrene copolymer (BS), exhibiting superior mechanical properties with balanced toughness, hardness, and rigidity. It is now mainly used in alloys and plastics. Agilent's well-established GC analytical methods allow you to monitor the quality of feedstocks and intermediate control products during ABS production, guaranteeing smooth operation.

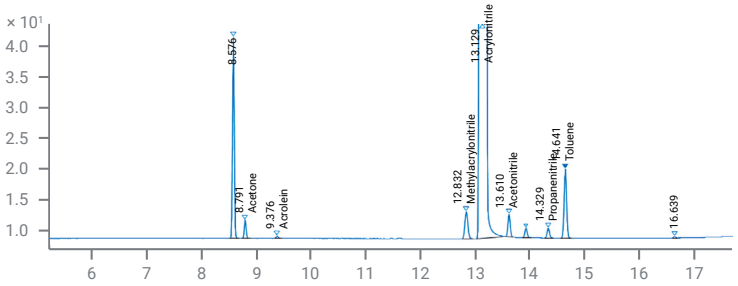
Purity analysis of acrylonitrile

System description:

- Configuration: SSL, FID
- Compounds of interest: Impurities in acrylonitrile

Key features and benefits:

- Single-channel configuration with high-sensitivity FID
- Excellent repeatability



Purity analysis of acrylonitrile

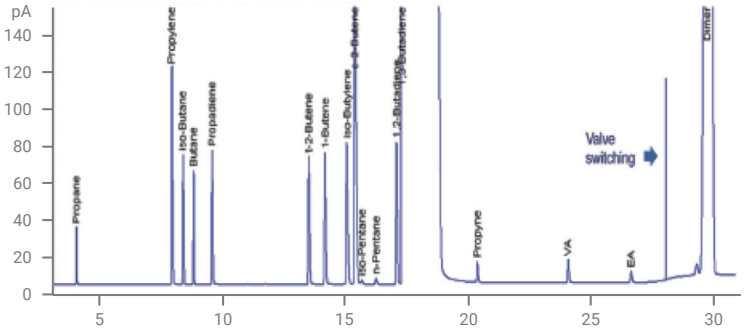
ABS analysis of trace impurities in butadiene

System description:

- Configuration: High-pressure liquid injection (HPLI) valve, SSL, FID
- Compounds of interest: C1-C5 hydrocarbons

Key features and benefits:

- Specially treated alumina column produces good separation and, when used in combination with HPLI valve to reduce dead volume, enables analysis of trace hydrocarbon impurities in 1,3-butadiene, including methyl acetylene
- HPLI offers outstanding repeatability
- Postcolumn backflush shortens analysis period and improves RT repeatability



ABS analysis of trace impurities in butadiene

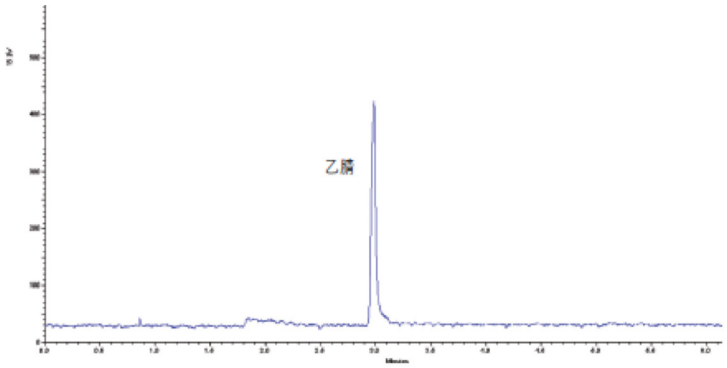
ABS analysis of trace acetonitrile in butadiene

System description:

- Configuration: One valve, VI, nitrogen chemiluminescence detector (NCD)
- Compound of interest: Acetonitrile

Key features and benefits:

- NCD has good selectivity, broad linear range, high sensitivity, and excellent response to acetonitrile
- No quenching, complete equimolar response, and no interference from hydrocarbons
- Various process gases can be analyzed for acetonitrile



ABS analysis of trace acetonitrile in butadiene

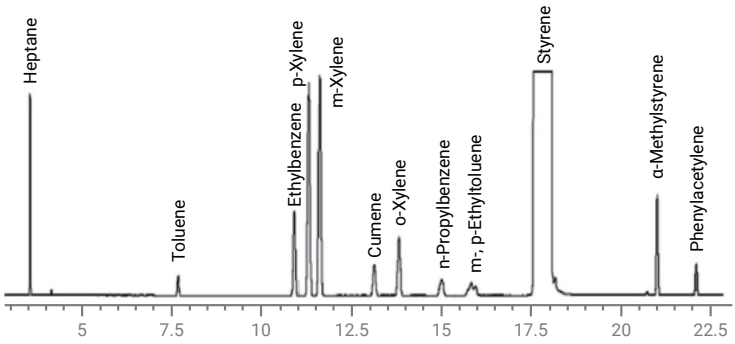
ABS analysis of styrene

System description:

- Configuration: SSL, FID
- Compounds of interest: Toluene, ethylbenzene, o-xylene, m-xylene, p-xylene, n-propylbenzene, cumene, m-ethyltoluene, p-ethyltoluene, α-methylstyrene, and phenylacetylene

Key features and benefits:

- Single column; the easy-to-use method can be applied to aromatic solvents
- ASTM method for 10 related aromatic solvents
- Capable of separating 27 compounds from aromatic products
- Retention time locking can be used to allow easy comparison of results across different instruments, laboratories, and at different time points



ABS analysis of styrene

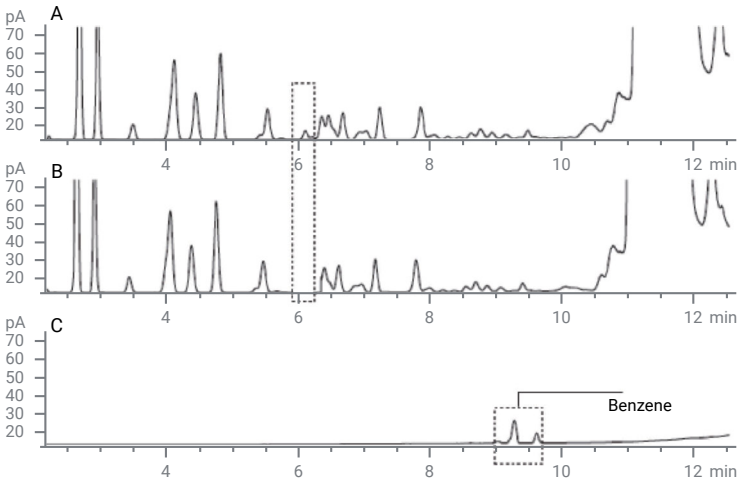
ABS analysis of trace benzene in styrene

System description:

- Configuration: SSL, Deans switch, dual-FID
- Compound of interest: Benzene

Key features and benefits:

- Deans switch 2D GC enables complete separation of trace benzene from other impurities
- Sensitive detection of 1 ppm benzene in styrene



ABS analysis of trace benzene in styrene. (A) Benzene in gasoline coelutes with hydrocarbons on the first column HP-1 and is detected by FID A; (B) Transfer the benzene peak to the second column Innowax, heart-cut window: 5.83-6.34 minutes; (C) After cutting: The benzene co-eluting with hydrocarbons from HP-1 is completely separated on the Innowax column and then detected by FID B

1,4-Butanediol (BDO) (New)

1,4-Butanediol (BDO) is a key feedstock for organic and fine chemicals, capable of generating various derivatives like tetrahydrofuran (THF), polytetramethylene ether glycol (PTMEG), and gamma-butyrolactone (GBL). BDO and its derivatives find wide application in polybutylene terephthalate (PBT) plastics, spandex, polyurethane, pharmaceuticals, and cosmetics. The production routes of BDO include acetylene and maleic anhydride methods. Different processes call for different testing requirements. Agilent provides operational guarantees for production in the BDO industry by deploying robust, reliable instruments and proven solutions that have been validated by numerous customers.

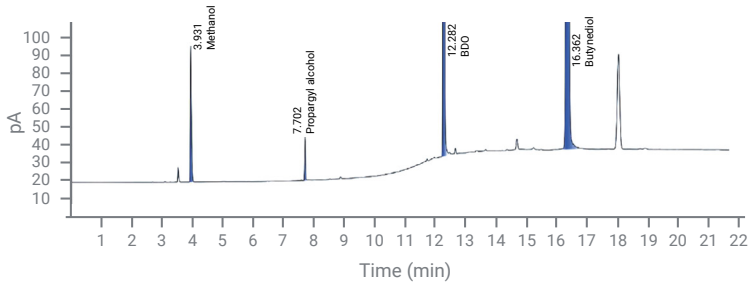
Analysis of butynediol

System description:

- Configuration: SSL, FID
- Compounds of interest: Organic substances in butynediol

Key features and benefits:

- Single-channel configuration with a broad linear range
- Excellent repeatability



Analysis of butynediol

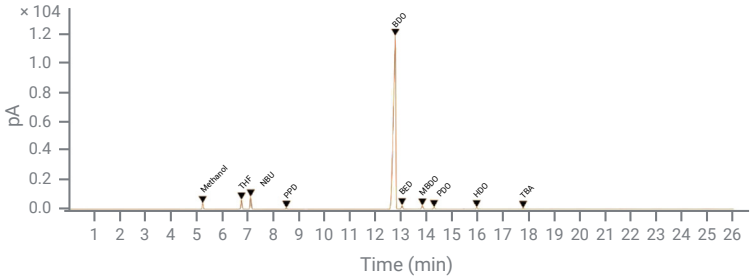
Analysis of 1,4-butanediol

System description:

- Configuration: SSL, FID
- Compounds of interest: Organic substances in 1,4-butanediol

Key features and benefits:

- Single-channel configuration with a broad linear range
- Excellent repeatability



Analysis of 1,4-butanediol

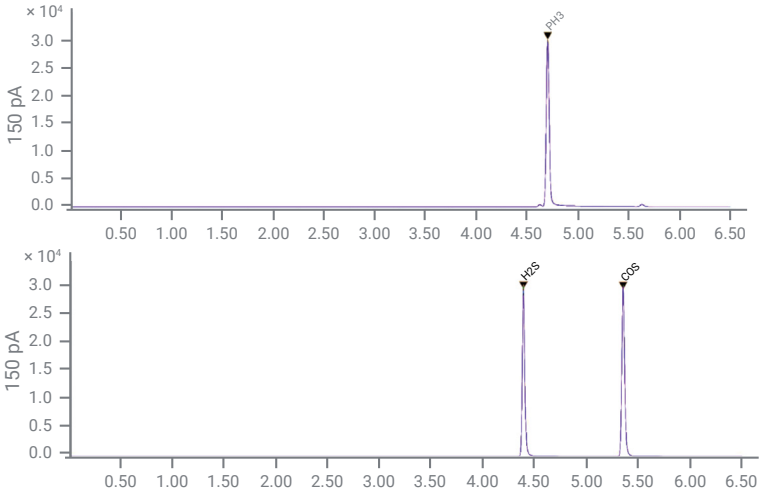
Analysis of trace hydrogen sulfide and phosphine in acetylene gas

System description:

- Configuration: Two 6-way valves, two inert inlets, two flame photometric detectors (FPD), inert system
- Compounds of interest: Hydrogen sulfide and phosphine

Key features and benefits:

- Dual- or single-channel configuration, fast analysis
- Excellent repeatability
- Both channels operate independently and do not interfere with each other



Analysis of trace hydrogen sulfide and phosphine in acetylene gas

Ethylene Oxide and Propylene Oxide

Ethylene oxide and propylene oxide are important basic chemical feedstocks. Ethylene oxide is a toxic carcinogen that was previously used to make germicides. It is now mainly used to manufacture ethylene glycol (a feedstock of polyester fiber), synthetic detergents, nonionic surfactants, antifreezes, emulsifiers, and ethylene glycol acetal products. Propylene oxide is mainly used to produce polyether polyols, propylene glycol, and various nonionic surfactants, which are widely used in many fields such as washing and dyeing, electronics, pharmaceuticals, pesticides, textiles, paper making, automobiles, and oil exploitation and refining.

GC is able to avoid quality issues in the production process by purity analyses of ethylene oxide and propylene oxide.

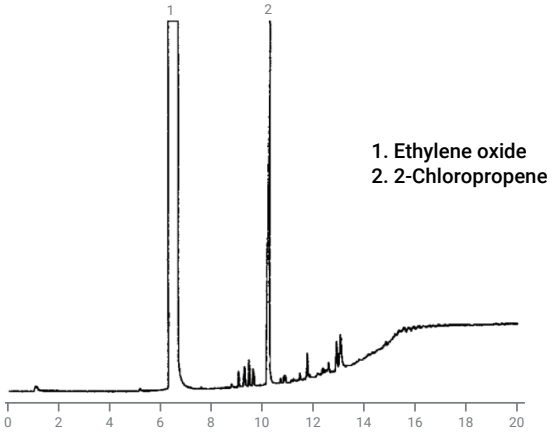
Analysis of impurities in ethylene oxide

System description:

- Configuration: Inlet, FID
- Compounds of interest: Impurities in ethylene oxide

Key features and benefits:

- Single-channel configuration, fast analysis
- Excellent repeatability



Analysis of impurities in ethylene oxide

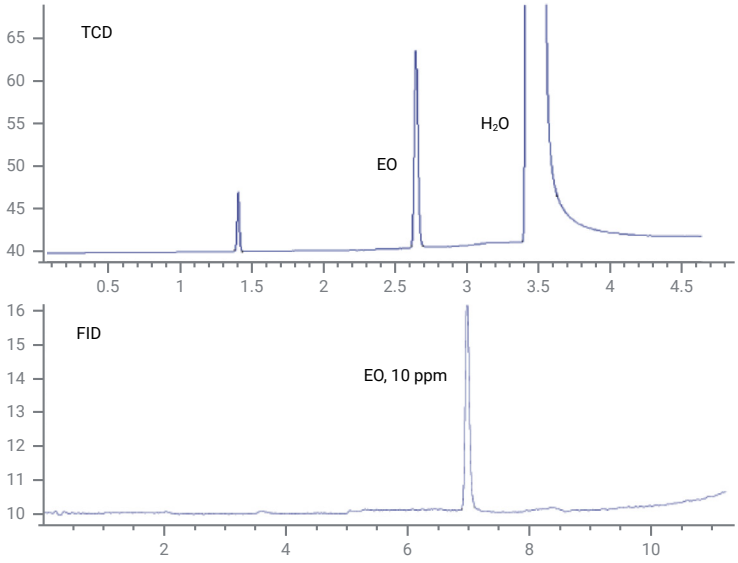
Analysis of ethylene oxide in water

System description:

- Configuration: Inlet, FID (or TCD)
- Compound of interest: Ethylene oxide (EO)

Key features and benefits:

- For a trace amount of EO in water, FID is used
- For a major amount of EO in water, TCD is used



Analysis of EO in water

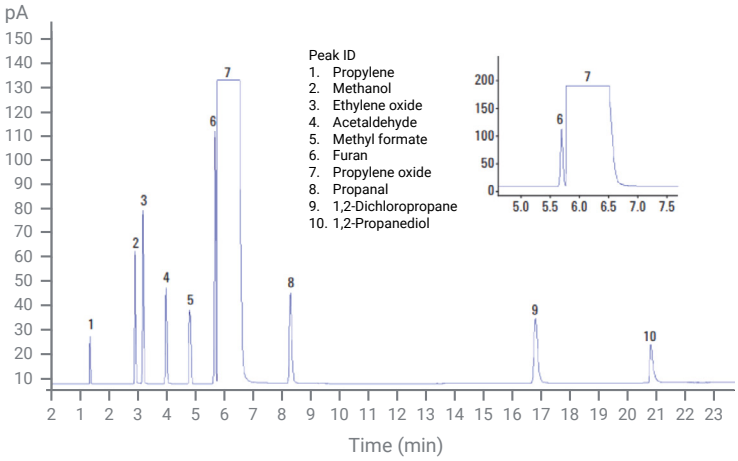
Analysis of impurities in propylene oxide

System description:

- Configuration: Inlet, FID
- Compounds of interest: Impurities in propylene oxide

Key features and benefits:

- Single-channel configuration with a broad linear range
- Excellent repeatability



Analysis of impurities in propylene oxide

Purified Terephthalic Acid (PTA)

Purified terephthalic acid (PTA) is one of the important bulk organic feedstocks, and more than 90% of PTA in the world is used to produce polyethylene terephthalate. In PTA production, GC is mainly used in the stages of feedstock and intermediate product control. Agilent ensures the accuracy and reproducibility of analytical results through proven GC and application protocols.

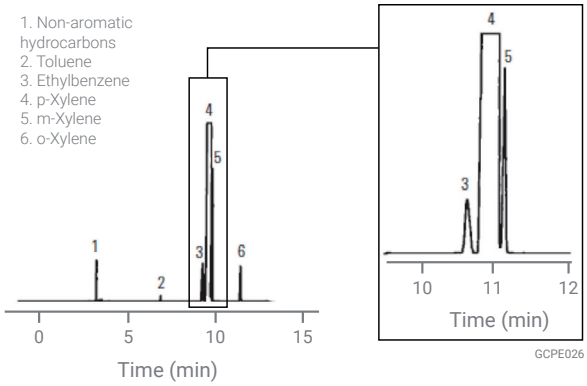
Purity analysis of p-xylene

System description:

- Configuration: SSL, FID
- Compounds of interest: Trace impurities in p-xylene

Key features and benefits:

- Single column; the easy-to-use method can be applied to aromatic solvents
- Retention time locking can be used to allow easy comparison of results across different instruments, laboratories, and at different time points



Purity analysis of p-xylene

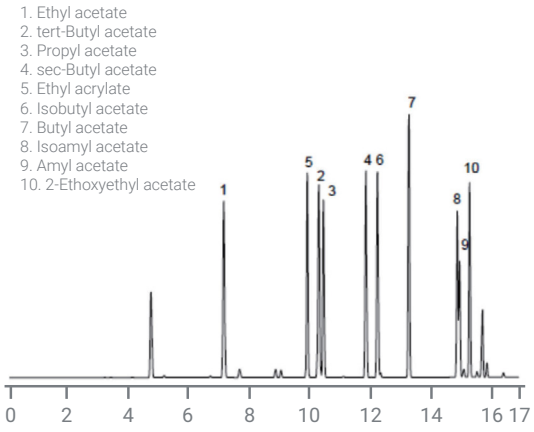
Analysis of acetates

System description:

- Configuration: SSL, FID
- Compounds of interest: Acetates

Key features and benefits:

- Single column; easy-to-use method for analysis
- Retention time locking can be used to allow easy comparison of results across different instruments, laboratories, and at different time points



Analysis of acetates

Methyl tert-Butyl Ether (MTBE)

Methyl tert-butyl ether (MTBE) is primarily used as a gasoline additive to offer excellent antiknock properties and improve octane ratings. It can also be cracked to produce isobutene. Using the fully inert, zero dead volume Agilent capillary flow technology (CFT) satisfies SH/T 1550 analytical requirements for MTBE.

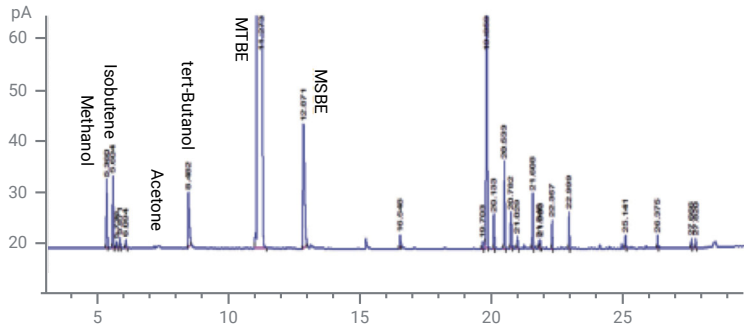
Purity analysis of MTBE: single column

System description:

- Configuration: SSL, FID
- Compounds of interest: Impurities in MTBE

Key features and benefits:

- Single column, single FID channel
- Analysis can be done with different polar columns according to the standard



Purity analysis of MTBE: single column

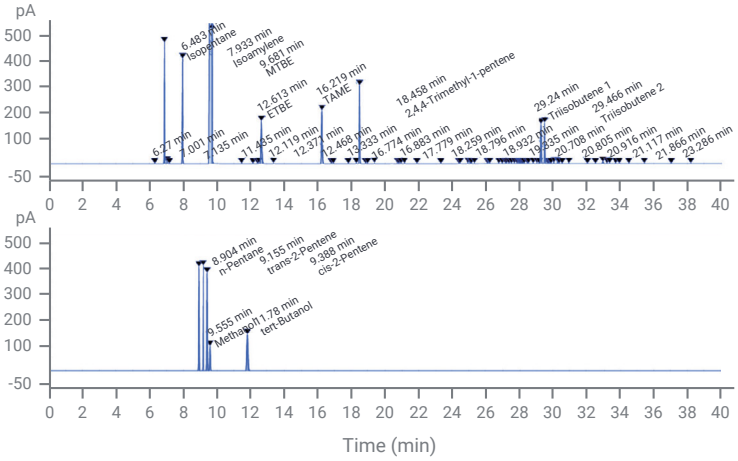
Purity analysis of MTBE: heart cutting (new)

System description:

- Configuration: SSL, Deans switch, 2-FID
- Compounds of interest: Impurities in MTBE

Key features and benefits:

- Inert, zero dead volume CFT prevents peak broadening and adsorption
- Deans switch 2D GC enables the separation of the impurities from MTBE



Purity analysis of MTBE

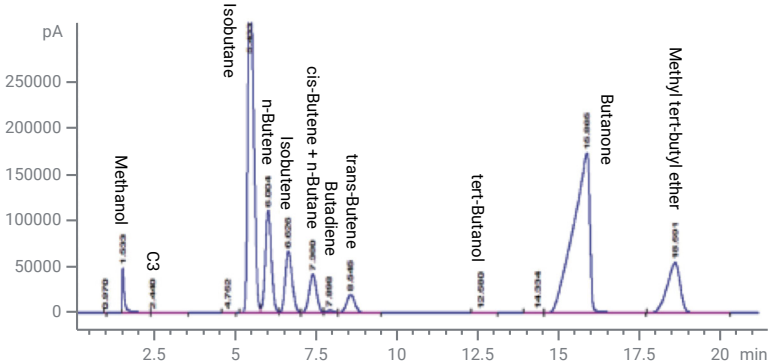
Analysis of post-MTBE C_4

System description:

- Configuration: High-pressure liquid injection (HPLI) valve/Packed column inlet/FID
- Compounds of interest: C_4 hydrocarbons, methanol, tert-butanol, butanone, and MTBE

Key features and benefits:

- Single column, single FID, easy to use
- HPLI valve with low dead volume ensures the repeatability of injection when used in combination with a sight glass



Analysis of post-MTBE C_4

Lithium-Ion Battery (New)

Lithium-ion battery is a secondary (rechargeable) battery that mainly relies on the movement of lithium ions between positive and negative electrodes to work. For a lithium-ion battery, the Agilent 990 Micro GC allows for quick and accurate assay of swelling gases generated after the battery ages. Furthermore, the contents of components in lithium-ion battery electrolytes can be determined using GC or GC/MS.

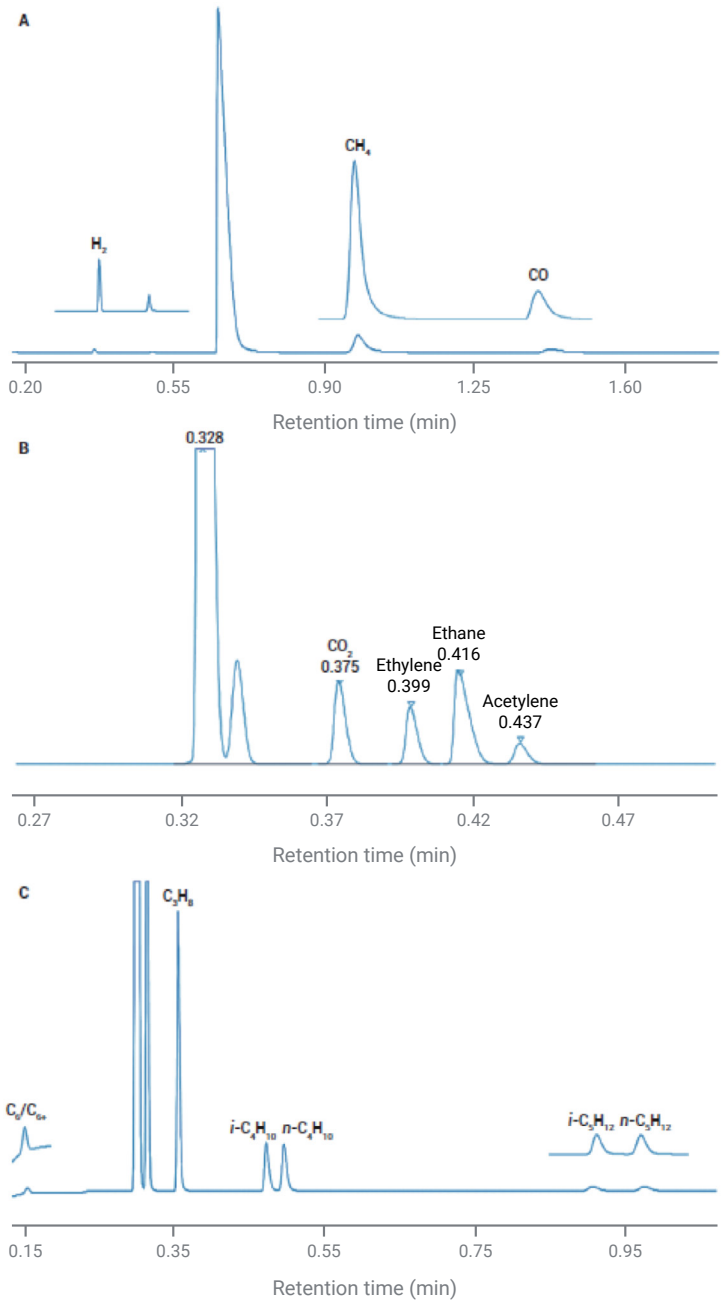
Analysis of swelling gases in lithium-ion batteries

System description:

- Configuration: Three/four channel module, uTCD
- Compounds of interest: H_2, O_2, N_2, CO, CO_2, CH_4, and C_1-C_6 hydrocarbons

Key features and benefits:

- Small sample volume is required
- Depending on components of interest, three or four channels are selected for combination
- Fast and efficient analysis, a single run time < 3 minutes
- Good peak area reproducibility



Analysis of swelling gases in lithium-ion batteries

Analysis of lithium-ion battery electrolytes

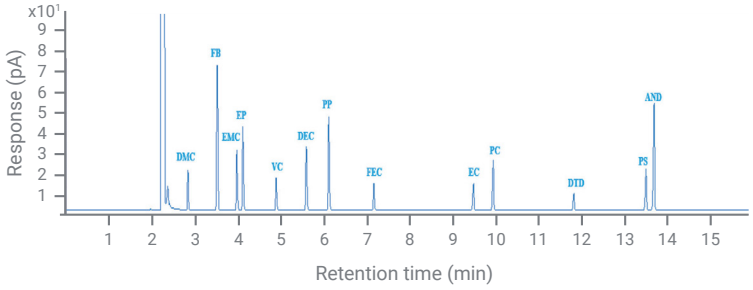
System description:

- Configuration: SSL, FID or MSD
- Compounds of interest: Electrolyte components such as carbonates

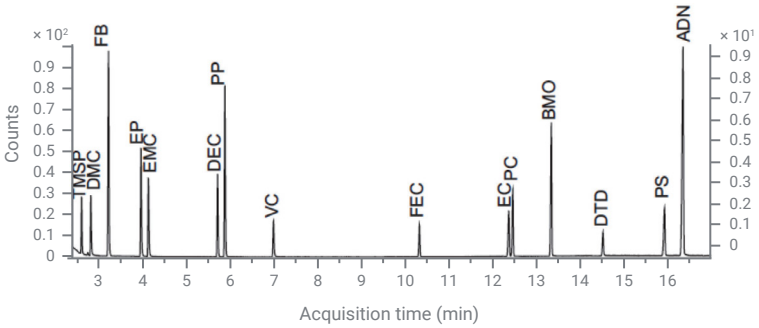
Key features and benefits:

- Fitted with an autosampler, making procedures easy
- All components can be well separated
- Automatic deconvolution feature enables automatic extraction of spectral compounds and automatic retrieval of spectral library for identification, which greatly improves work efficiency and identification accuracy
- The mass spectra of many species are not yet included in the commercial spectral libraries, posing challenges for identification. By GC/Q-TOF, the exact mass information of ions (accurate to four decimal places) can be obtained, and the elemental composition and molecular structure of a compound can be inferred through the analysis of exact mass, thus providing superior identification capability

FID



MS



Analysis of lithium-ion battery electrolytes

Biodiesel and Other Renewable Fuels

Global pressure to reduce our dependence on fossil fuels is driving the demand for sustainable, reliable, and clean alternative energy sources. It has also fueled a steady increase in research involving the conversion of biomass to biofuels. In recent years, vegetable oil derivatives (biodiesel) have successfully powered automobiles, public transportation systems, and long-haul trucking fleets while providing a fuel source—produced from locally available feedstock—that reduces engine wear and generates lower sulfur and CO_2 emissions. While there is no question that biodiesel benefits our environment, producing biodiesel from many different oils does create product quality and uniformity challenges. Success depends upon characterizing raw materials, monitoring chemical conversions, ensuring process efficiency, and validating product quality. Agilent has expanded our alternative energy analyzer portfolio to include biofuel and renewable energy GC analyzers. These ready-to-go systems include proven analytical methods and advanced features that enable your lab to quickly validate methods that conform to ASTM and CEN standards for fatty acid methyl esters (FAMEs), glycerin/glyceride, and trace methanol measurements.

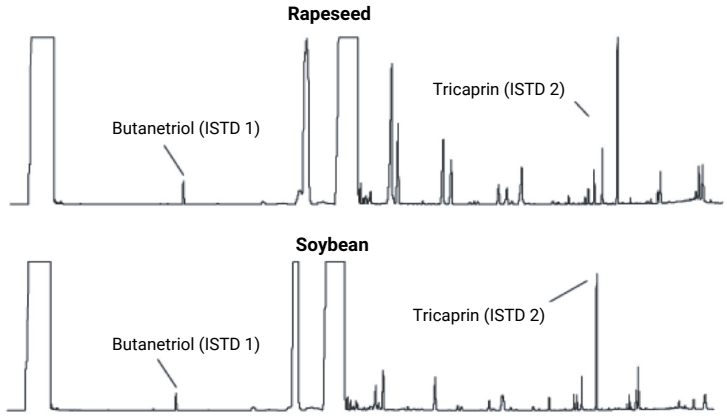
Analysis of glycerin in biodiesel

System description:

- Configuration: On-column inlet, FID
- Compounds of interest: Free glycerin, monoglycerides, diglycerides, triglycerides, bound glycerin, and total glycerin in B100 biodiesel (not applicable to vegetable oil methyl esters derived from lauric oils, such as coconut and palm kernel oil)

Key features and benefits:

- Configured with cool on-column (COC) inlet with a retention gap column in front of the analytical column; significantly improves peak shape for better accuracy and reproducibility
- Use of standard syringes instead of special narrow-bore syringes enhances versatility and saves cost
- Agilent Ultimate union enables reliable, leak-free, high-temperature connection



Analysis of glycerin in biodiesel

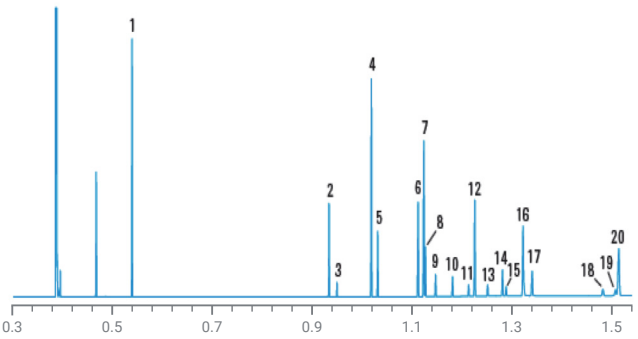
Assay of FAMEs in Biodiesel

System description:

- Configuration: SSL, FID
- Compounds of interest: Methyl esters of C_8-C_{24} in B100 biodiesel

Key features and benefits:

- Excellent precision with a simple, easy-to-use method
- Internal standard (methyl nonadecanoate) used for quantification
- Analysis time of approximately 35 minutes



Peak ID	Name		Retention time (min)	Peak ID	Name		Retention time (min)
1.	Methyl hexanoate	C6:0	6.031	11.	Methyl arachidate	C20:0	22.857
2.	Methyl myristate	C14:0	15.878	12.	Methyl eicosanoate	C20:1	23.166
3.	Methyl myristoleate	C14:1	16.275	13.	Methyl eicosadienoate	C20:2	23.808
4.	Methyl palmitate	C16:0	17.996	14.	Methyl arachidonate	C20:4	24.551
5.	Methyl palmitoleate	C16:1	18.311	15.	Methyl eicosatrienoate	C20:3	24.730
6.	Methyl stearate and	C18:0	20.332	16.	Methyl behenate	C22:0	25.582
7.	Methyl oleate (9)	C18:1	20.617		Methyl eicosapentaenoate	C20:5	25.582
8.	Methyl oleate (11)	C18:1	20.697	17.	Methyl erucate	C22:1	26.031
9.	Methyl linoleate	C18:2	21.205	18.	Methyl lignocerate	C24:0	29.574
10.	Methyl linolenate	C18:3	22.052	19.	Methyl nervonate	C24:1	30.203
				20.	Methyl docosahexaenoate	C22:6	30.365

Assay of FAMEs in biodiesel

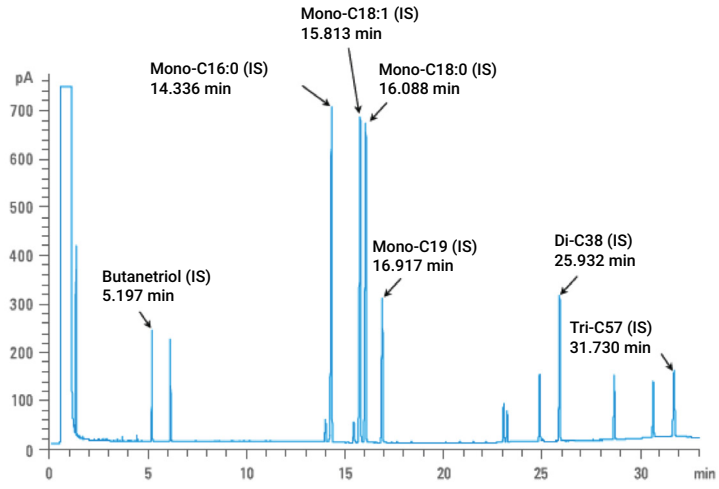
Biodiesel analyzers (EN 14105:2011)

System description:

- Configuration: SSL, FID
- Compounds of interest: Glycerin, monoglycerides, diglycerides, and triglycerides in B100 biodiesel

Key features and benefits:

- Excellent precision with a simple, easy-to-use method
- Meets EN 14105:2011 requirements



Biodiesel analyzers (EN 14105:2011)

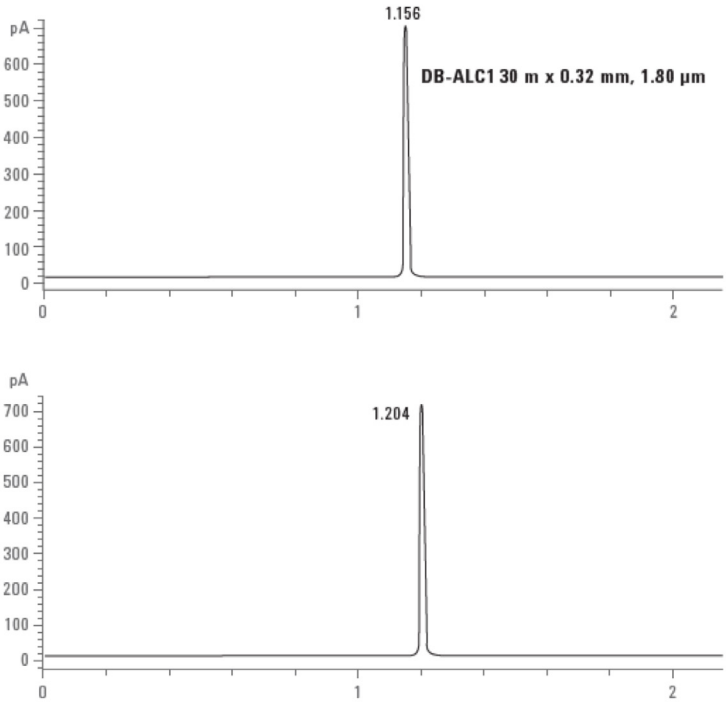
Methanol in biodiesel

System description:

- Configuration: Headspace, SSL, FID
- Compound of interest: Methanol in B100 biodiesel

Key features and benefits:

- Headspace sampler is used for automated sample preparation
- Enhanced precision through backpressure regulation of headspace sampling loop pressure
- Increased sensitivity for low-concentration methanol through backpressure pressurization
- Quantitative analysis using external standard, no internal standard required
- Optimized columns for alcohol analysis
- Improved peak shape for easy quantification of low-concentration components



Methanol in biodiesel

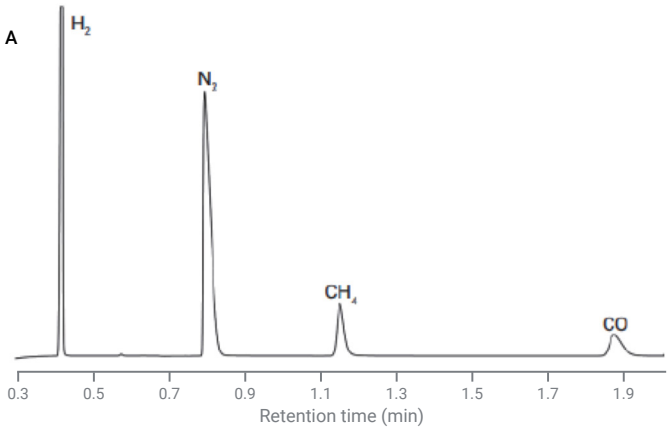
Biomass pyrolysis gas products analysis

System description:

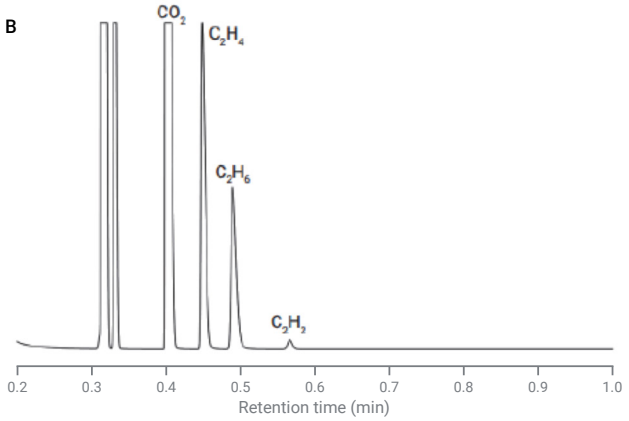
- Configuration: Two-channel module, uTCD
- Compounds of interest: Biogas contains H_2, O_2, N_2, CH_4, CO, CO_2, C_2H_6, C_2H_4, and C_2H_2 in biogas

Key features and benefits:

- Optimized for fast analysis of biogas components in 120 seconds
- Factory-debugged solutions, and preconfigured methods
- Outstanding reproducibility, with a RT RSD of 0.1% and a peak area RSD of 0.5%
- Dual carrier gas for optimal detection



(A) Chromatogram of 5.05% hydrogen, 5.10% methane, and 10.0% carbon monoxide on the 10 m CP-MolSieve 5A backflush channel



(B) Chromatogram of 10.1% carbon dioxide, 2.5% ethylene, 1.5% ethane, and 0.1% acetylene on the 10 m CP-PoraPLOT U backflush channel

Analysis of biomass pyrolysis gas products

Biogas analyzer

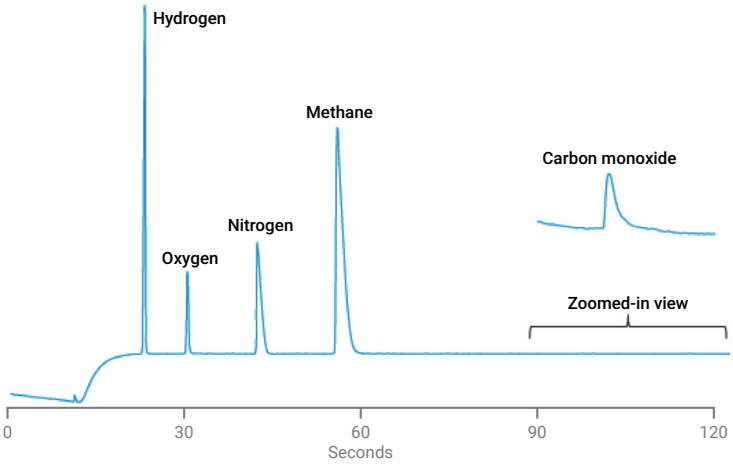
System description:

- Configuration: Two- or three-channel module, uTCD
- Compounds of interest: Biogas contains H_2, O_2, N_2, CH_4, CO, H_2S, CO_2, C_2H_6, C_3H_8 (two-channel module), and C_4-C_7 alkanes (three-channel module) in biogas

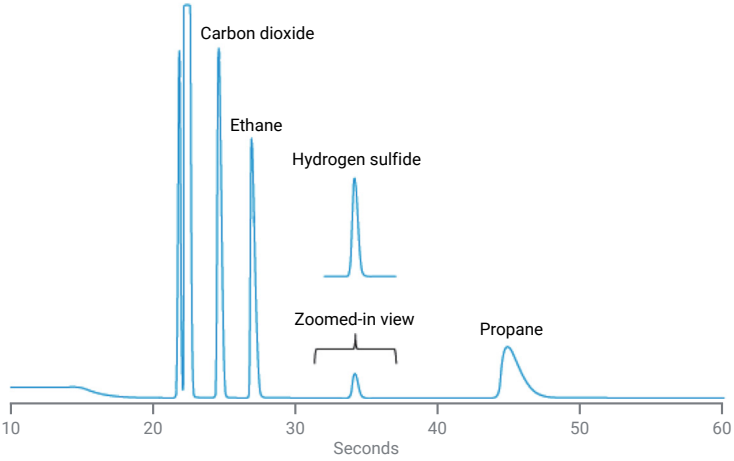
Key features and benefits:

- Optimized for fast analysis of biogas components in 120 seconds
- Factory-debugged solutions, and preconfigured methods
- Outstanding reproducibility, with a RT RSD of 0.1% and a peak area RSD of 0.5%
- Dual carrier gas for optimal detection

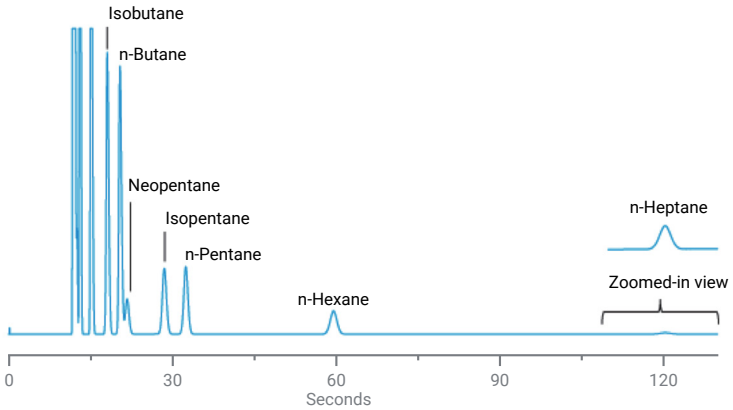
Channel 1: Permanent gases



Channel 2: CO_2, C_2, H_2S, and C_3



Channel 3: C_4-C_7 hydrocarbons



Biogas analyzer

Hydrogen Energy (New)

Hydrogen is a secondary energy source that can be produced in a variety of ways. Hydrogen energy is widely recognized as a clean energy source as it can be directly converted into electrical energy and water through electrochemical reactions without emitting any pollutants. Thus, hydrogen is emerging as a low- or zero-carbon energy source. At present, the most extensive application of hydrogen energy as a clean energy source is in the field of fuel cell vehicles (FCVs). It is considered a potential solution to the energy crisis and environmental pollution.

Analysis of sulfides, formaldehyde, and halides in H_2 for FCV

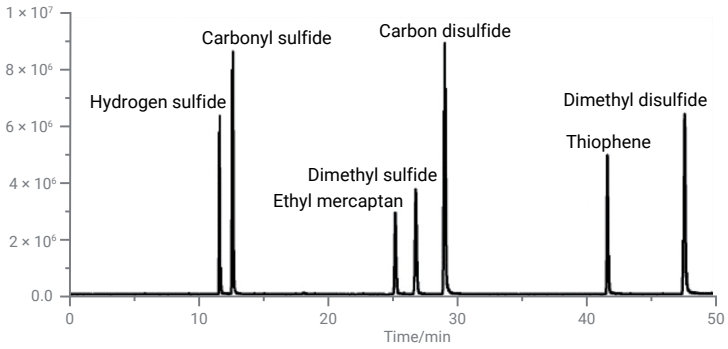
System description:

- Configuration: Preconcentration device, capillary flow, SCD, MS
- Compounds of interest: Sulfides, formaldehyde, and halides in H_2 for FCV

Key features and benefits:

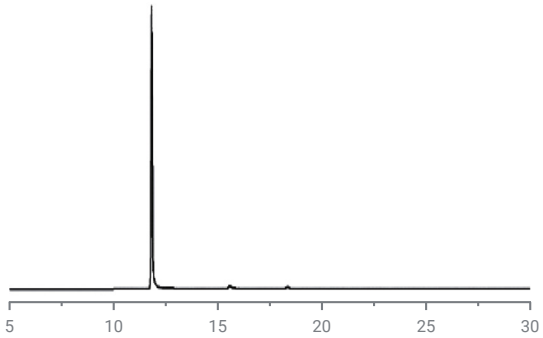
- Test results fully meet the requirements of ISO 14687 and GB/T 37244
- Analytical results of sulfides, formaldehyde, and halides can be obtained in one injection using preconcentration and enrichment mode
- All components can be well separated

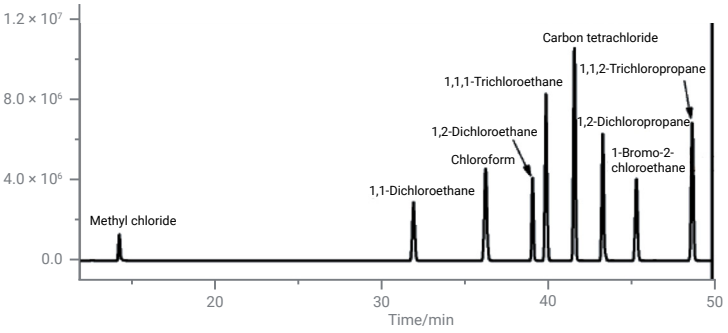
SCD (Data from Sinopec Research Institute of Petroleum Processing Co., Ltd.)



MS

Formaldehyde and halides (Data from Sinopec Research Institute of Petroleum Processing Co., Ltd.)





Analysis of sulfides, formaldehyde, and halides in H_2 for FCV

Analysis of He, Ar, N_2, and hydrocarbons in H_2 for FCV

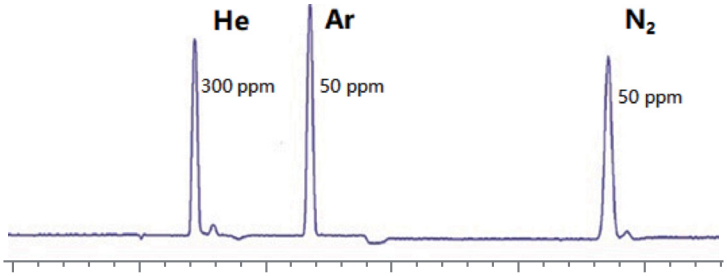
System description:

- Configuration: Ten-way valve, six-way valve, TCD, FID
- Compounds of interest: He, Ar, N_2, and hydrocarbons in H_2 for FCV

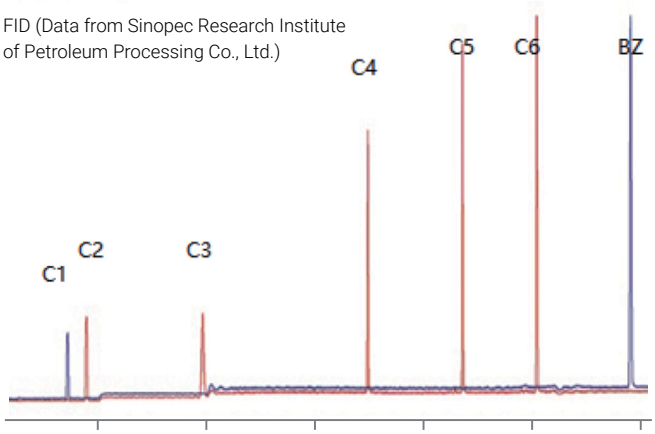
Key features and benefits:

- Test results fully meet the requirements of ISO 14687 and GB/T 37244
- Analytical results of He, Ar, N_2, and hydrocarbons can be obtained in one injection
- All components can be well separated

TCD (Data from Sinopec Research Institute of Petroleum Processing Co., Ltd.)



FID (Data from Sinopec Research Institute of Petroleum Processing Co., Ltd.)



Analysis of He, Ar, N_2, and hydrocarbons in H_2 for FCV

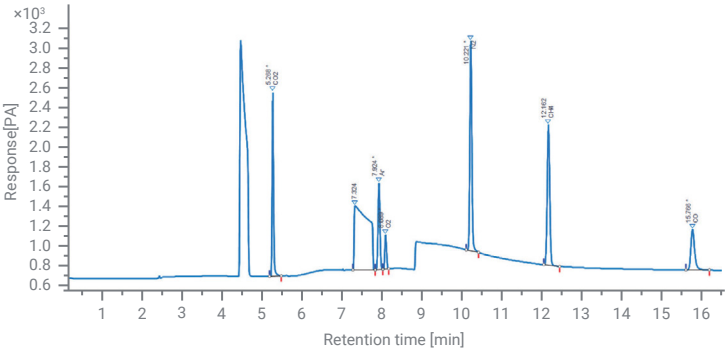
Analysis of trace CO and CO_2 in H_2 for FCV

System description:

- Configuration: Purge valve, purge valve oven, PDHID
- Compounds of interest: Trace CO and CO_2 in H_2 for FCV

Key features and benefits:

- Test results fully meet the requirements of ISO 14687 and GB/T 37244
- The use of the purge valve oven and multiple purifiers delivers low baseline noise and fast stabilization
- The analytical results of trace CO, CO_2, Ar, and N_2 can be obtained in one injection
- All components can be well separated



Analysis of trace CO and CO_2 in H_2 for FCV

Essential Consumables for GC and GC/MS

Recommended supplies for general GC workflow (8890/8860 GC)

Part Number	Description	Recommended Minimum Order Quantity	Brief Recommendation Reason and Selling Points	Product Series and Illustrations	
G3440-81011	Self-tightening GC column nut, finger tight, collared, inlet/detector	2 (1 for inlet and 1 for detector)	Improves flow path connections, and easy to operate using tool-free finger tightening during column installation. Spring-driven piston enables self-tightening feature, eliminating the need to retighten the connector after repeated thermal cycles	Column nuts	
G3440-81018	Winged GC column nut, finger tight, inlet/detector	2 (1 for inlet and 1 for detector)	Similar to finger-tight column nuts, column connections achieved by finger tightening. No self-tightening feature, but less expensive, and operating temperature exceeds 350 °C	Column nuts	
G3440-88000	Column depth guide	1	Ensures column insert fitting is appropriate length for Agilent self-tighening and winged finger-tight column nuts	Column installation tools	
5200-0176	FID jet, universal fit, 0.29 mm id	1	The new universal jet is designed for capillary and packed column compatibility, aiming to prevent thread galling and enhance ease of installation	FID jets	
5190-6145	Ultra Inert gold-plated inlet seal with washer, 10/pk	1	Agilent gold seals are manufactured using a unique process that eliminates microleaks from negatively impacting performance. Inlet seals required for SSI and MMI injection ports (95%). This part includes 10 packs of p/n 5190-6144	Gold seals	
5181-1267	Syringe, 10 µL, tapered, fixed needle (FN), 23-26 s, 42 mm, HP	1	Gold needle, deemed as a standard syringe of the autosampler for users looking for economical purchases	Syringes	
5183-4757	Nonstick, bleed and temperature optimized (BTO) inlet septa, 11 mm, 50/pk	1	BTO septa are optimized to reduce septum bleed at a higher range of temperatures; maximum inlet temperature can be 400 °C	Septa	
5190-3165	Inlet liner, Ultra Inert, split, low pressure drop, glass wool, 5/pk	1	General use liner for split mode, providing high performance for varying applications. This part includes 5 packs of p/n 5190-2295	Liners	
5190-3163	Inlet liner, Ultra Inert, splitless, single taper, glass wool, 5/pk	1	General use liner for splitless injection mode. This part includes 5 packs of p/n 5190-2293	Liners	
5188-5365	Liner O-ring, nonstick fluorocarbon, 10/pk	1	Required to make inlet/detector leak-free connections, especially for MSD	Liner O-rings	
5062-3514	Ferrule, 0.5 mm id, 15% graphite/85% Vespel, for 0.32 mm columns, 10/pk	1	Common ferrule required to make inlet/detector connections. Additional sizes of ferrules are available depending on columns required	Ferrules	
G2855-28502	Capillary flow technology (CFT) ferrule, flex gold, 0.32 mm id column, 10/pk	1	Gold-plated flexible metal ferrules commonly used with Agilent CFT connections. Thanks to the soft and flexible nature of gold, these gold-plated ferrules prevent microleaks caused by scratches and striations in a used CFT device. Additional sizes of gold-plated flexible ferrules are available depending on columns required	CFT ferrules	
07673-40180	Diffusion caps for 4 mL vials, 12/pk	1	Prevents organic solvents from volatilization and subsequent pollution. Users tend to forget to replace or even purchase diffusion caps	Caps	
RDT-1020	Trap, split vent, and 3 cartridges	1	A convenient gas management kit	Gas management	
G6699A	CrossLab Cartridge System (CS) bundle: ADM flow meter and electronic leak detector	1	This latest design combines the two most critical GC flow path monitoring tasks, including flow rate and leak detection monitoring, into a single handheld system with the bundle offering. The latest ADM flow meter (G6691A) and electronic leak detector (G6693A) are also available separately	Gas management	

Online ferrule selector tool:
https://www.agilent.com/search/gn/gc-ferrule-selector

Online GC inlet liner selector tool:
https://www.agilent.com/search/gn/gc-liner-selector

Recommended supplies for general GC/MS workflow (5977B/C GC/MSD and 7000B/D/E GC/TQ)

Part Number	Description	Recommended Minimum Order Quantity	Brief Recommendation Reason and Selling Points	Product Series and Illustrations	
G3440-81013	Self-tightening GC column nut, finger tight, collared, MSD transfer line	1	Improves flow path connections, and easy to operate using tool-free finger tightening during column installation. Spring-driven piston enables self-tightening feature, eliminating the need to retighten the connector after repeated thermal cycles	Column nuts	
G3440-81019	Winged GC column nut, finger tight, MSD transfer line	1	Similar to finger-tight column nuts, column connections achieved by finger tightening. No self-tightening feature, but less expensive, and operating temperature exceeds 350 °C	Column nuts	
G1099-20030	Column installation tool for 5977 GC/MSD series and 7000 GC/TQ series	1	Used to measure the length of capillary from the transfer line deep into the MS, so the user does not have to open the MS side plate when installing the chromatographic column	Column installation tool	
G4513-80204	Syringe, Blue Line, 10 µL fixed needle, 23-26 s, 42 mm, cone	1	Blue Line Syringe: A standard syringe with better reproducibility, for users looking for high-performance purchases	Syringes	
5181-3323	Ferrule, 0.4 mm, 15% graphite/85% Vespel, 0.1-0.25 mm id column, 10/pk	1	Common ferrule required to make MSD interface connections. Compatible with finger-tight column nuts. Additional sizes of ferrules are available depending on columns required	Ferrules	
G3870-20444	Lens, extraction, 3 mm, for 5977 GC/MSD series	1	The most common extractor lens, for 5977 GC/MSD series. Lenses of 6 and 9 mm are also available for selected applications. A 9 mm lens is commonly used if required by environmental volatile organic compound (VOC) or semi-VOC (SVOC) (p/n G3870-20449)	Lens	
G2589-20100	Drawout plate, 3 mm, for inert source	1	The most common extractor lens, for inert ion source. Lenses of 6 and 9 mm are also available for selected applications. A 9 mm lens is commonly used if required by environmental VOC or SVOC (p/n G3440-20022)	Lens	
G7005-60061	Filament, high temperature, EI ion source	2	5977 and 5975 GC/MSD and 7000 GC/TQ filaments. For non-HES sources (5977A/B GC/MSD-inert plus, inert, extractor, stainless steel, 5975 or 5973 GC/MSD)	Filaments	
G7002-60001	High efficiency source filaments	1	Only for 5977B HES and 7010B HES GC/MSD systems	Filaments	
5190-5112-005	Inlet liner, single taper, splitless, Ultra Inert cartridge, 5/pk	1	GC/MS users more commonly run splitless applications	Liners	
CP17973	Gas clean carrier gas filter	1	GC/MS requires clean carrier gas for ideal operation (has indicators)	Gas management	
RMSH-2	Big universal trap, helium, 1/8 in, 250 psig	1	Large capacity filter (but does not have indicators)	Gas management	
5191-5851	Agilent vacuum fluid (AVF), 1 L, AVF 45 Platinum	1	Oil for rough pump maintenance (for oil pumps only)	Rough pump consumables (related to MSDs)	
G7004-67026	Tip seal kit, IDP-10, including tip seals, tools, cloth, swabs, face mask, nylon gloves, filter elements, and a manual	1	For IDP-10 (dry) scroll pumps only (usually sold with triple quadrupole MS)	Rough pump consumables (related to MSDs)	
G7077-67018	IDP-3 tip seal maintenance kit, including tip seal, silencer filter element, face mask, lint-free cloth, gloves, and hex keys	1	For IDP-3 (dry) scroll pumps only (usually sold with single quadrupole MSDs)	Rough pump consumables (related to MSDs)	

Agilent quiet cover for GC/MS pumps:
G6014B for GC/MSD, G3199C for GC/TQ

HydroInert source-specific supplies and GC column recommendations for hydrogen carrier +A37:E44 gas on GC/MS (5977C/7000E)

Part Number	Description	Recommended Minimum Order Quantity	Brief Recommendation Reason and Selling Points	Product Series and Illustrations
G7078-20902	Repeller	2	HydroInert source-specific parts cannot be cleaned, so spare parts are recommended in order to reduce instrument downtime	HydroInert source-specific 
G7078-20909	Extractor lens, 9 mm	2	HydroInert source-specific parts cannot be cleaned, so spare parts are recommended in order to reduce instrument downtime	HydroInert source-specific 
G7078-20905	Ion focus lens	1	HydroInert source-specific parts cannot be cleaned, so spare parts are recommended in order to reduce instrument downtime	HydroInert source-specific 
G7006-60926	Entrance lens-extended	1	For 7000E GC/TQ. HydroInert source-specific parts cannot be cleaned, so spare parts are recommended in order to reduce instrument downtime	HydroInert source-specific 
G7078-20904	Entrance lens	1	For 5977C GC/MSD. HydroInert source-specific parts cannot be cleaned, so spare parts are recommended in order to reduce instrument downtime	HydroInert source-specific 
19091S-577UI	J&W HP-5ms Ultra Inert GC column, 20 m, 0.18 mm, 0.18 µm	1	A 0.18 mm column is recommended for applications using hydrogen as the carrier gas, especially with the HydroInert source	GC column 

The new Agilent HydroInert source is designed to improve chromatographic efficiencies with hydrogen carrier gas to enable faster and shorter separations, help avoid loss of sensitivity and spectral anomalies, and offer superior high-boiler peak shape.

For more information, please refer to:
HydroInert Source for Hydrogen Carrier Gas on GC/MS

References

1 The Future of Petrochemicals – Analysis - IEA

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