Using a Micro GC to measure, monitor, and optimize your process

ASTS, Houston – June 2015
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Agilent Technologies
The Agilent 490 Micro GC

- Immediate answers for **gas** and **vapor samples**
- **Fast analysis**, separations in seconds
- **Analyze anywhere**, in the lab, at-line, on-line, in the field
- **Easy to use**, no need for specialized trained personnel
- Consuming less bench space
- Local or remote control
How does the 490 Micro GC Work

Show animations
Agilent 490 Micro GC

- One to four independently controlled, micro-machined, plug-n-play GC channels
- Electronic gas control
- Micro machined injector
- Narrow-bore column
- Micro Thermal Conductivity Detector
490 Micro GC: *Electronic gas control (EGC)*

Each GC Channel have built-in pneumatics

- Different carrier gases: Helium, Argon, Nitrogen and Hydrogen
- Improved speed of the analysis
- Time programmable backflush (optional)
- Elimination of contaminants
- Software selectable continuous flow or pump
490 Micro GC: *Injector*

Each GC channel have a silicon micro-machined, variable volume injector

- No moving parts
- Temperature range from 30ºC to 110ºC
- Software selectable variable injection time (volume up to 10 µl)
- Excellent injection quality
- Sharp peaks, narrow bandwidth
- Maximum sample pressure 1 bar /15psi
Each GC channel has a heated column

- Backflush Capability
- Temperature range from 30°C up to 180°C
- Excellent thermal stability
- Narrow-bore capillary columns (PLOT and WCOT)
- Micro-packed GC columns
- Rapid separations of gases and vapors
- Extended analysis time up to 600 seconds
- Optional time programmable backflush
490 Micro GC: *Thermal Conductivity Detector (µ-TCD)*

Each GC Channel has its own miniaturized ultra low volume Thermal Conductivity Detector (µ-TCD)

- Limit of quantification (L.O.Q.):
  - 1 ppm for C5 on WCOT column
  - 5 ppm for CO2 on PLOT column

- Linearity $10^6$ (1 ppm up to 100% level)

- Fast auto-ranging for high and low concentrations

- Software selectable detector signal inversion
The 490 Micro GC column channel is ........

- Injector + column + detector
- Onboard pneumatics
- Onboard electronics
- Onboard Electronic Data Sheet (EDS)
- Onboard auto diagnostics

........ a complete GC
Sample inlets
Up to 2 separate sample inlets in a 490 Micro GC

Dual Channel Cabinet

Sample 1 → Channel 1
OR
Sample 1 → Channel 1
Sample 2 → Channel 2

Quad Channel Cabinet

Sample 1 → Channel 1
OR
Sample 1 → Channel 1
Sample 2 → Channel 2
Sample 2 → Channel 3
Sample 2 → Channel 4

Sample 1 → Channel 1
Sample 1 → Channel 2
Sample 2 → Channel 3
Sample 2 → Channel 4
Standard 2 sampling pumps on the 490 Micro GC:

- Sample pump
  - ~ 15 ml/min per channel
  - Dual carrier gas/ dual sample inlet → 2 sample pumps

- Continuous flow
  - Max. 1 bar (over)pressure
The **Micro Gasifier** expands the range of samples you can analyze.

The Micro Gasifier provides controlled evaporation of Liquid Petroleum Gas (LPG) and Liquefied Natural Gas (NGA).
The **field case** provides “on-the-go” measurements.

The field case is compact in size and weight, and includes carrier gas supply and battery pack.
Use accessories more conveniently with the integrated accessory bracket

The Micro GC accessory bracket is an on-board universal mounting platform for accessories such as stream selector valve, Micro Gasifier, Genie membrane filters, pressure regulator and sample relief valve.
Stream Selection Valves (Vici-Valco)

Two main valve types are used for the 490 Micro GC

- SD (dead ended) valves select one of 4 to 16 dead-ended streams, directing it through the valve outlet to a sample valve, pressure sensor, detector, column, etc. The same configuration can also direct one stream to a number of outlets for fraction collection.

- SF (flow-through) valves are similar to SD’s and SC’s, selecting a stream and sending it to the outlet. However, SF’s allow the non-selected streams to flow through individual outlets instead of a common outlet.
Syringe Injection
For on-line analysis a 19” rack mounting is available

The 490 and 490-PRO are also available in a 19” rack mounted chassis.

Sampling and sample conditioning devices, such as stream selection valves and Genie membrane filters, are mounted within the housing.
Application overview

<table>
<thead>
<tr>
<th>Column type</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molsieve 5Å</td>
<td>Permanent gases, methane, CO, NO, natural gas, (H.R. for O₂-Ar baseline separation). Optional Retention Time Stability (RTS) configuration.</td>
</tr>
<tr>
<td>Hayesep A</td>
<td>Hydrocarbons C1-C3, N₂, CO₂, air, volatile solvents.</td>
</tr>
<tr>
<td>CP-SIL 5 &amp; 8 CB</td>
<td>Hydrocarbons C3-C10, aromatics, organic solvents.</td>
</tr>
<tr>
<td>CP-SIL 19 CB</td>
<td>Hydrocarbons C4-C10, high boiling solvents, BTEX.</td>
</tr>
<tr>
<td>CP-WAX 52 CB</td>
<td>Polar higher boiling solvents.</td>
</tr>
<tr>
<td>PLOT Al₂O₃/KCl</td>
<td>Light hydrocarbons C1-C5 saturated and un-saturated, refinery gas analysis</td>
</tr>
<tr>
<td>PoraPlot U</td>
<td>Hydrocarbons C1-C6, halocarbons/freons, anesthesia gases, H₂S, CO₂, SO₂, volatile solvents, biogas.</td>
</tr>
<tr>
<td>PoraPlot Q</td>
<td>Hydrocarbons C1-C6, halocarbons/freons, anesthesia gases, H₂S, CO₂, SO₂, volatile solvents.</td>
</tr>
<tr>
<td>CP-COₓ</td>
<td>CO, CO₂, H₂, Air, CH₄.</td>
</tr>
<tr>
<td>CP-SIL 19 for THT</td>
<td>THT and C3-C6⁺ in Natural Gas Matrix.</td>
</tr>
<tr>
<td>CP-SIL 13 for TBM</td>
<td>TBM and C3-C6⁺ in Natural Gas Matrix.</td>
</tr>
<tr>
<td>CP-PoraPlot Special</td>
<td>PP-Q, specially tested for H₂S in natural gas (10 to 50 ppm)</td>
</tr>
<tr>
<td>MES</td>
<td>Unique column specially tested for MES in natural gas (1 ppm)</td>
</tr>
</tbody>
</table>
Differences between Plot U and Plot Q

**CP-PoraPLOT U**
- Separate ethane, ethylene and acetylene
- Propane and propylene will co elute

**CP-PoraPLOT Q**
- Propane and propylene separated
- Co elution of ethylene and acetylene
Micro GC Analyzers

**Easy to Order**
- Single part number, easy to quote and order
- Application Note, Data Sheet and “Solutions” web site

**Easy to Install**
- Factory Tested with Check-Out sample (delivered with the Analyzer)
- Analytical method parameters, Data files, User manual and Reports included

**Fast to deliver**
- Made-to-stock, available for shipment from the LCs worldwide

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Key applications

For production and research, the Agilent 490 Micro GC provides gas analysis in matter of seconds for:

• Natural gas / calorific value determination
• Analysis of simple to complex refinery gases
• Oil and exploration / mud logging
• Analysis and quality control of specialty gases
• Biogas
• Assessing efficiency of catalysts, fuel cell stacks
• Air monitoring
Natural Gas Analysis

• A complete range of natural gas analysis solutions

• Easy to operate, powerful GC solutions

• Comprehensive single-vendor solution

# Natural Gas Analyzer portfolio

<table>
<thead>
<tr>
<th>Analyzer characteristics</th>
<th>Natural Gas Analyzer A</th>
<th>Natural Gas Analyzer A Extended</th>
<th>Natural Gas Analyzer B</th>
<th>Natural Gas Analyzer B Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option number</td>
<td>G3882A#120</td>
<td>G3882A#121</td>
<td>G3882A#122</td>
<td>G3882A#123</td>
</tr>
<tr>
<td>Micro GC cabinet</td>
<td>Dual with 2 channels</td>
<td>Quad with 3 channels</td>
<td>Dual with 2 channels</td>
<td>Quad with 3 channels</td>
</tr>
<tr>
<td>Column channels installed</td>
<td>HayeSep A 40 cm, without back flush</td>
<td>HayeSep A 40 cm, with back flush</td>
<td>PoraPLOT U 10 m, with backflush</td>
<td>CP-MolSieve 5A 10 m, with backflush and retention time stability option</td>
</tr>
<tr>
<td></td>
<td>CP-Sil 5 CB 6 m, without back flush</td>
<td>CP-Sil 5 CB 4 m, with back flush</td>
<td>CP-Sil 5 CB 6 m, without back flush</td>
<td>CP-Sil 5 CB 6 m, without back flush</td>
</tr>
<tr>
<td>Analysis</td>
<td>Hydrocarbons C1-C9</td>
<td>Hydrocarbons C1-C12</td>
<td>Hydrocarbons C1-C9</td>
<td>Hydrocarbons C1-C9</td>
</tr>
<tr>
<td></td>
<td>Carbon dioxide, Air</td>
<td>Carbon dioxide, Air</td>
<td>Carbon dioxide, Air</td>
<td>Carbon dioxide, Air</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hydrogen sulfide</td>
<td>Hydrogen sulfide</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Permanent gases (N₂, O₂, He &amp; H₂)</td>
</tr>
<tr>
<td>Typical analysis time</td>
<td>100 s (until C7)</td>
<td>100 s (until C7)</td>
<td>75 s (until C7)</td>
<td>75 s (until C7)</td>
</tr>
<tr>
<td></td>
<td>400 s (until C9)</td>
<td>240 s (until C12)</td>
<td>400 s (until C9)</td>
<td>400 s (until C9)</td>
</tr>
</tbody>
</table>
Natural Gas Analysis within 45 seconds

Column: HayeSepA

Column: CP-Sil 5 CB

Nitrogen
Methane
CO2
Ethane

Propane
i-Butane
Butane
i-Pentane
Pentane
Hexane

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Extended Natural Gas Analysis

Extended Hydrocarbon and Odorant (THT) analysis in Natural Gas

Column: CP-Sil 5 CB

Column: CP-Sil 19 CB
Refinery Gas Analysis on a Quad Micro GC

**Channel 1: MolSieve5A**

Peak Identification

1. Hydrogen
2. Oxygen
3. Nitrogen
4. Carbon monoxide
7. Methane

**Channel 2: CP-PoraPlot U**

Peak Identification

5. Carbon dioxide
6. Hydrogen sulfide
8. Ethane
9. Ethylene
16. Acetylene
Refinery Gas Analysis on a Quad Micro GC

**Channel 3: Al$_2$O$_3$**

<table>
<thead>
<tr>
<th>Peak Identification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Acetylene</td>
</tr>
<tr>
<td>10</td>
<td>Propane</td>
</tr>
<tr>
<td>12</td>
<td>Propylene</td>
</tr>
<tr>
<td>13</td>
<td>iso-Butane</td>
</tr>
<tr>
<td>14</td>
<td>n-Butane</td>
</tr>
<tr>
<td>15</td>
<td>Propadiene</td>
</tr>
<tr>
<td>17</td>
<td>trans-2-Butene</td>
</tr>
<tr>
<td>18</td>
<td>1-Butene</td>
</tr>
<tr>
<td>19</td>
<td>iso-Butene</td>
</tr>
<tr>
<td>20</td>
<td>cis-2-Butene</td>
</tr>
<tr>
<td>21</td>
<td>iso-Pentane</td>
</tr>
<tr>
<td>22</td>
<td>n-Pentane</td>
</tr>
<tr>
<td>23</td>
<td>1,3-Butadiene</td>
</tr>
<tr>
<td>24</td>
<td>Propyne</td>
</tr>
</tbody>
</table>

**Channel 4: CP-Sil 5 CB**

<table>
<thead>
<tr>
<th>Peak Identification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>iso-Pentane</td>
</tr>
<tr>
<td>22</td>
<td>n-Pentane</td>
</tr>
<tr>
<td>26</td>
<td>C6+ (e.g. n-Hexane)</td>
</tr>
</tbody>
</table>

**Agilent Technologies**
Micro GC Biogas Analyzer

- **Biogas**: composition primarily CH$_4$, CO$_2$, N$_2$ and some H$_2$, O$_2$ and CO
- Dual channel cabinet with 2 column channels
- Heated sample line and injectors
- UltiMetal treated sample lines: ready for H$_2$S analysis

**CP-Molesieve 5A – Permanent gases**

**CP-PoraPLOT U – C2, CO2, H2S and C3**
Micro GC Biogas Analyzer Extended

- **Biogas mixed with other hydrocarbon streams**, like Liquefied Petroleum Gas (LPG) or Natural gas

- Sample composition primarily CH\(_4\), CO\(_2\), N\(_2\); some H\(_2\), O\(_2\) and CO and **higher hydrocarbons**

- Quad channel cabinet with 3 column channels

- Channel 1 & 2 identical to biogas analyzer (#110)
490-PRO Micro GC

A Fast, Small Form Factor, High Performance Gas Measurement Platform Designed for Unattended Operation and supports Industrial networks
Agilent 490-PRO Micro GC

One to four independently controlled, micro-machined, plug-n-play GC channels

Electronic gas control

Same hardware as 490 Micro GC

Micro machined injector

Narrow-bore column

Dual

Quad

Micro Thermal Conductivity Detector
All the intelligence is in the 490-PRO Micro GC

On-board data handling
- Peak integration, identification, grouping, calibration and normalization with using external PC with CDS

Results only!
- Modbus TCP/IP, Modbus serial (optional), 4-20 mA, FTP-server

Energy metering (optional)
- Calculation of calorific value, density, compressibility etc.
- In accordance to ISO 6976, ASTM D3588, GPA 2172, GOST 22667 & GOST 31369*
- Requires additional license

History logging (optional)
- 35 day storage of analysis results, calibration data, error log, etc.
- In accordance to API (chapter 21)

Webserver
- Available from anywhere on the internet
- Status and last analysis results

* currently limited to particular OEM
490-PRO versus 490 Micro GC

Set up / Operation

PC with CDS

Control

Signal

490 Micro GC

Standard 490 Micro GC
490-PRO versus 490 Micro GC

Set up / Operation

PC with CDS

Control

Signal

490 Micro GC

Report

Standard 490 Micro GC

Set up

PC with PROstation

Method

Maintenance

490-PRO

490-PRO Micro GC
490-PRO versus 490 Micro GC

Set up / Operation

PC with CDS

Control

Signal

Report

PC with PROstation

490 Micro GC

Standard 490 Micro GC

Set up

PC with PROstation

Method

Maintenance

490-PRO

490-PRO Micro GC

Operation

PC PROstation

490-PRO

Communication Result

Industrial networks

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What is PROstation?

Tool to setup the 490-PRO

Application method development
- Integration, peak identification
- Calibration, validation and normalization
- Energy metering settings and component constants
- External I/O’s (alarms, 4-20 mA)
- MODBUS register setup
- LCD display parameters

It displays info obtained from instrument
- Instrument status
- Chromatograms
- Integration parameters
- Calibration curves
- Results

All settings are send to the 490-PRO, where all intelligence is.
# Calorific value calculations

<table>
<thead>
<tr>
<th>ISO 6976 / GOST 22667 / GOST31369</th>
<th>GPA 2172 / ASTM D-3588</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unnormalized concentration per component ppm, %</td>
<td>Unnormalized concentration per component ppm, %</td>
</tr>
<tr>
<td>Normalized concentration per component ppm, %</td>
<td>Normalized concentration per component ppm, %</td>
</tr>
<tr>
<td>Compressibility</td>
<td>Compressibility</td>
</tr>
<tr>
<td>Molar Mass</td>
<td>Molar Mass</td>
</tr>
<tr>
<td>kg/kmol</td>
<td>lb/lbmol</td>
</tr>
<tr>
<td>Molar Mass Ratio</td>
<td>Molar Mass Ratio</td>
</tr>
<tr>
<td>Absolute Density</td>
<td>Gross Heating Value</td>
</tr>
<tr>
<td>Kg/m³</td>
<td>Btu/ft³</td>
</tr>
<tr>
<td>Superior Heating Value</td>
<td>Gross Heating Value for dry real gas</td>
</tr>
<tr>
<td>MJ/m³</td>
<td>Btu/ft³</td>
</tr>
<tr>
<td>Inferior Heating Value</td>
<td>Gross Heating Value for water saturated real gas</td>
</tr>
<tr>
<td>MJ/m³</td>
<td>Btu/ft³</td>
</tr>
<tr>
<td>Wobbe Index based on Superior Heating Value MJ/m³</td>
<td>Net Heating Value</td>
</tr>
<tr>
<td>Wobbe Index based on Inferior Heating Value MJ/m³</td>
<td>Net Heating Value for dry real gas</td>
</tr>
<tr>
<td></td>
<td>Net Heating Value for water saturated real gas</td>
</tr>
<tr>
<td></td>
<td>Specific Gravity (Relative Density for real gas)</td>
</tr>
<tr>
<td></td>
<td>Wobbe Index</td>
</tr>
<tr>
<td></td>
<td>Gross Heating Value converted to MJ/m³</td>
</tr>
<tr>
<td></td>
<td>Net Heating Value converted to MJ/m³</td>
</tr>
<tr>
<td></td>
<td>Mass Density lb/ft³</td>
</tr>
<tr>
<td></td>
<td>Spec. volume ft³/lb</td>
</tr>
<tr>
<td></td>
<td>GPM Total ft³/gal</td>
</tr>
<tr>
<td></td>
<td>GPM per compound ft³/gal</td>
</tr>
<tr>
<td></td>
<td>Weight % per component</td>
</tr>
</tbody>
</table>

Calculation in accordance to:

[ISO](https://www.iso.org), [ASTM](https://www.astm.org), [GPA](https://www.gpashp.com), [GOST](https://gostassociation.org), [AGA](https://www.agaausa.org), [API](https://www.api.org), [SPE](https://www.spe.org), [ASME](https://www.asme.org), [STP](https://www.stp.org), [API](https://www.api.org), [SPE](https://www.spe.org), [ASME](https://www.asme.org), [STP](https://www.stp.org)

[Agilent Technologies](https://www.agilent.com)
Accessories

LCD
• User definable time based scrolling of sample results, GC status, Error information etc

Extension boards (basic, digital and analog)
• Stackable up to 8 boards with 64 x relays, 25 x analog outputs, 4-20mA outputs, 0-1V, 64 x digital I/O’s
• mountable on DIN-rail

Micro-gasifier
• Heated pressure reducer for Liquified Natural Gas (LNG) and Liquified Petroleum Gas (LPG)
Process market requirements

- On-line, 24/7, unattended operation
- Speed of analysis
- Connection to process system
- Small instrument size for easy integration
- Single method - Results only
- Sensor / Monitoring type Analysis
- Reliable instrumentation
For genuinely better analysis performance, the Agilent 490 Micro GC gives you the results you need in seconds

The Agilent 490 Micro GC features:
• More data generation in less time for faster, better business decisions
• Compact dimensions making it easily transportable
• Modular and flexible; easily reconfigured
• Easy to operate, without special training or skills

Learn more:
www.agilent.com/chem/microGC