Agilent–Markes Solution for EPA PAMS
Improving on-line analysis of trace-level compounds in ambient air

Agilent Technologies

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Topics covered

- Hardware overview of the Markes Thermal Desorber (TD)
- Hardware overview of the Agilent 7890 GC
- Setting up the AutoGC method, identification of targets – Orsat
- Orsat specific details on their offerings - necessary air, sampling and hydrogen systems, setting up a sequence, running curves
- Show data from the Orsat database to show how the instrument performance can be monitored by charting the QC data
- Setting up sequences, calibrating and reviewing data without the Orsat application
Hardware overview of the Markes Thermal Desorber (TD)

- Agilent–Markes solution – workflow and system overview
- Agilent–Markes solution – the advantages
- Chromatographic performance – why it matters when sampling real air
- System calibration
- TD system maintenance
Agilent–Markes solution – workflow

1. Ambient air
2. Blank
3. RTS standard
4. ICAL standard

Markes TD
- Automated stream selection, water removal, focusing and injection

Agilent 7890 GC
- Chromatography and detection of the compounds

PC
- TD and GC control, data collection with time/date, automatic report generation with time/date

Raw instrument data
Compound report with concentrations

Internet connection

Remote PC
- Data review and upload
- Remote instrument access
Principle of operation – Markes TD

Sample selection

Water management

Focussing and injection

Separation and detection

CIA Advantage –xr

Kori-xr

UNITY-xr

Agilent 7890 GC

Ambient air

Blank

Standards

Sample selection valves

Drying

Carrier Gas

Cold trap

Optional split

Sampling flow

Desorption flow

- H₂O
Agilent–Markes solution

Sample introduction: UNITY-xr, Kori-xr and CIA Advantage-xr

- **Efficient cryogen-free trapping** – Rapid operation of the electrically-cooled focusing trap ensures fast sample throughput.
- **Excellent performance for PAMs application** – as demonstrated in the EPA PAMs evaluation (1st place).
- **Trouble-free sampling of humid air** – New Kori-xr water management option avoids loss of polar species and maintains excellent peak shape.
- **Remote system control** – Ability to remote in and check system any time.
Advantages of the Markes – Agilent solution

• Superior water management without the use of nafion dryer
  – No compound losses
  – More robust system – maintains performance throughout the year

• Excellent peak shape and resolution
  – Easy and confident automatic identification of target compounds from interfering compounds = less data review
  – Excellent detection limits and calibration results
Water management – analyte losses with nafion dryers

- Water management option is needed for GC based PAMs solutions – all EPA recommended systems.
- Nafion dryer was previously used by Markes and is still used by all competitor systems on at least one module.
- However nafion dryer removes key polar and other target compounds in updated PAMS list, as noted in EPA memorandum Oct 2017.
- Markes Kori-xr introduced – allows site to measure target and optional VOCs – **great for Enhanced Monitoring Plan (EMP)**

![Comparison of Kori-xr vs. nafion dryer running a 4 ppbC 80% RH standard](chart.png)
Chromatographic performance – Real air

- With FID detection (used on all AutoGCs) retention time is the only means of identifying the peaks.
- Incorrect management of water can cause retention times to shift – causing issues with peak ID.
- Real air contains interfering compounds that can lead to mis-identification.

Good chromatography = good data and less data review

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**Styrene**

Rack-based system
Tailing peak shape

**Unknown**

Black = PAMS standard

Red = Ambient air at semi rural location
Calibration performance

- Proposed re-engineered PAMS calibration requirements.
- ICAL standard (propane and benzene):
  - Low-concentration: Near 1 ppbC
  - Mid-range: 1:10 dilution of the stock PAMS standard
  - High-concentration: Straight PAMS standard
- Performance criteria:
  - Minimum correlation coefficient 0.995
  - Y intercept not greater than 0.5 ppbC

Data provided by New York State DEC
Markes TD maintenance

- Easy to maintain – users can change focusing trap in < 5 minutes.
- Only routine maintenance required and is typically done annually before the start of the PAMs season.

**Remove Trap**
1. Power-down the instrument
2. Undo pneumatics screw and move back
3. Grip the collar on the trap and remove by pulling back

**Install Trap**
1. Insert new trap until it seals into place
2. Place pneumatics back on guide and slide on to new trap
3. Hold pneumatics and tighten screw
4. Condition according to supplied instructions
Considerations for choosing a PAMS system

• **How easy is it to maintain?**
  - Agilent–Markes is a modular system with easy access and low cost consumable parts readily available in the US, should they be required.

• **How responsive is service support?**
  - This can impact up-time during the season if any problems are encountered.
    • Agilent–Markes have trained engineers throughout the US, including email, phone and remote support.
    • Agilent–Markes partners, Orsat, have extensive experience in this field and can also offer support throughout the US.
Questions?
Topics covered

- Agilent–Markes solution – GC operation overview
Agilent Hardware

- Agilent 7890B Gas Chromatograph
- Dual FID
- Deans Switch
- Auxiliary EPC Control
- DB-1 (Boiling Point Column)
- AL PLOT Column
- Simultaneous Analysis on Both Columns
Principle of operation – Agilent GC

Sample / standard
C₂ – C₁₂

C₆ – C₁₂

DB-1 column

Restrictor

FID

PLOT column

C₂ – C₅

Front inlet
EPC

Markes
TD

Aux
PCM

Start of GC run until 12.5 minutes
Principle of operation – Agilent GC

Front inlet EPC → Markes TD → DB-1 column → Restrictor → FID

Aux PCM → PLOT column → FID

C_6 \text{–} C_{12}

C_2 \text{–} C_5

12.5 minutes until end of GC run
Questions?
Topics covered

- Agilent–Markes solution – detailed workflow (without optional support package from ORSAT)
Agilent–Markes solution – workflow

- **Ambient air**
- **Blank**
- **standard cylinder**
- **2nd standard cylinder**

**Markes TD**
- Automated stream selection, water removal, focusing and injection

**Agilent 7890 GC**
- Chromatography and detection of the compounds

**PC**
- TD and GC control, data collection with time/date, automatic report generation with time/date

- **Raw instrument data**
- **Compound report with concentrations**

**Internet connection**
- Data review and upload

**Remote PC**
- Remote instrument access
Markes method setup

- Methods already exist for TD and GC conditions (Markes application note 129, available for download on www.markes.com).
Markes sequence setup – initial calibration

Sample volume
Markes sequence setup – daily operation

Will repeat the sequence indefinitely

Can set a specific start time
Agilent–Markes solution – workflow

- Ambient air
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- standard cylinder
- 2nd standard cylinder

Markes TD

Automated stream selection, water removal, focusing and injection

Agilent 7890 GC

Chromatography and detection of the compounds

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GC methods setup

- Methods already exist for GC conditions (Markes application note 129, available for download on www.markes.com).
GC sequence setup

- OpenLabs CDS – very simple, set a file format e.g. ‘PAMS (Date)(Time)’ and it will auto generate a data file for each run containing the raw chromatogram data.
Agilent–Markes solution – workflow

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Methods and reporting

- Data processing / review recommended to be done off-site (transferred via internet).
- Agilent offer standalone data analysis options.
- Reports can be customized as required.
- Recommend having training from Agilent’s experts, if not already familiar, to set this up as required.
Questions?

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