New developments in GC-MS and GC-PID instrumentation for rapid on-site analysis of trace environmental contaminants

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On-site analysis of trace environmental contaminants

Technology      Use                     Applications

The Torion Technologies
TRIDION 9 GC-TMS

The Defiant Technologies
Frog 4000 GC-PID
Technology - TRIDION 9 GC-TMS

- Helium Cartridge & Battery
- Touch-screen User Interface
- Keypad
- Universal Injection Port
- Toroidal Ion Trap MS
- Gas Chromatograph
- Person Portable Case
On-site analysis of trace environmental contaminants

Technology - TRIDION 9 GC-TMS
LTM GC module

- Injection Port with Removable Liner
- LTM Capillary Column Bundle
- Cooling Fan
- GC Electronic Board
- Electronic Pressure Control
On-site analysis of trace environmental contaminants

Technology - TRIDION 9 GC-TMS
LTM GC Column

Low thermal mass (LTM) gas chromatograph
On-site analysis of trace environmental contaminants

Technology - TRIDION 9 GC-TMS
Ion trap module

- Electron Ionization Source
- Electron Multiplier Detector Shield
- Gold Plated Toroidal Ion Trap Electrodes
- Ion Trap Cartridge Heater
Technology - TRIDION 9 GC-TMS
Toroidal ion trap
On-site analysis of trace environmental contaminants

Technology - TRIDION 9 GC-TMS

Sample path
On-site analysis of trace environmental contaminants

Technology - TRIDION 9 GC-TMS

User interface

Insert syringe, then depress plunger

Abort

Please Wait ...

Abort

Depress plunger, then remove SPME

Abort
On-site analysis of trace environmental contaminants

Technology - TRIDION 9 GC-TMS

Result display

Post-run Showing Library Hits

<table>
<thead>
<tr>
<th>RT</th>
<th>Identification</th>
<th>Alert</th>
<th>Match</th>
<th>Area</th>
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<td>Diethylamine</td>
<td>66.7</td>
<td>1975.3</td>
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</table>
On-site analysis of trace environmental contaminants

Technology – FROG 4000 GC-PID

Sample flow path

Sample Sparger → VOC’s → Preconcentrator → Micro-GC → PID Detector → Pump → Exhaust
On-site analysis of trace environmental contaminants

Technology – FROG 4000 GC-PID
Analytical module
Technology – FROG 4000 GC-PID
Pre-concentrator

- ‘Tombstone’ array
- Sol gel (application specific) coating
- Heating to ‘fire’ sample to GC
Technology – FROG 4000 GC-PID
Micro GC column

- 2.5m Column
- 0.80 Micron OV-1 Deposition
- Ramping to 150°C
On-site analysis of trace environmental contaminants

Technology – FROG 4000 GC-PID
Analytical module
On-site analysis of trace environmental contaminants

Technology – FROG 4000 GC-PID
Result display
On-site analysis of trace environmental contaminants

Use - TRIDION 9 GC-TMS
Solid Phase Microextraction (SPME) Syringe

Field Sampling Must Be:

- **Quick**: single step sample extraction and concentration
- **Easy** single-handed operation in protective glove
- **Reliable** sampling of gases, liquids and solids
On-site analysis of trace environmental contaminants

Use - TRIDION 9 GC-TMS
Solid Phase Microextraction (SPME) Syringe

- Concentrations ranging from parts per trillion to percent
- Wide boiling point range
- Sample matrix
- Chemical activity

Direct Gas Sampling
Thermal Desorption Concentrator
Liquid Injection

Gas   Vapor   Liquid   Solid
On-site analysis of trace environmental contaminants

Use - TRIDION 9 GC-TMS

Injection of sample using SPME sampler automatically initiates analytical run

Automatic deconvolution of GC and MS output with results and supplementary information displayed on UI
On-site analysis of trace environmental contaminants

Use – FROG 4000 GC-PID

Sample vial containing water or water/soil sample

Sparge with scrubbed air to pass volatiles to pre-concentrator
Use – FROG 4000 GC-PID

Air Sampling module – passing air sample over pre-concentrator. Sample desorbed and passed through analytical module.
Case study – TRIDION GC-TMS

Trihalomethanes (THMs) in water
- Carcinogens
- 80 ppb limit in treated water
- On site analysis for screening
- Eliminates error and sample change or loss during transportation
- SPME sampler used to acquire sample, headspace or immersion
On-site analysis of trace environmental contaminants

Case study – TRIDION GC-TMS

Geosmin – Released during bacterial breakdown,
Extracted Ion Chromatograms of 1 ppt Geosmin in Water

GC conditions:
- Injector: 290°C
- Column: 50°C initial, hold 10 s; 1°C/s rate;
- 290°C final hold 10 s
- Inlet pressure: ~26 psi
- Splitless mode: 50:1/40-60 s; 10:1/20-40 s

Chemical name: \((4S,4aS,8aR)-4,8a\)-Dimethyl-1,2,3,4,5,6,7,8-octahydronaphthalen-4a-ol

Causes ‘earthy’ taste in fish (broken down with acid – vinegar!)

Responsible for the smell after rain

Detectable by humans at 5 ppt
Case study – TRIDION GC-TMS

Odour analysis

- 90% of complaints to EA for air pollution are due to odour
- Waste processing away from landfill on increase
- Standard method of odour analysis is human assessment
- GC-MS provides on-site speciated analysis of odour compounds

Allyl methyl sulfide
Dimethyl disulfide
Diallyl sulfide
Allyl n-propyl sulphide
Aminothiazole
Methyl propyl disulfide
Methyl 1-propenyl disulfide

Dimethyl trisulfide
Diallyl disulphide
Dipropyl disulfide
Ethanedithioamide N N-dimethyl-
Ethanol
Thiocyanic acid, methyl ester
On-site analysis of trace environmental contaminants

Case study – FROG 4000 GC-PID

Analysis of ppb VOCs in soil, water or air

- Collect 30 seconds
- GC Ramp:
  - Cold 40°C hold for 360 seconds
  - Ramp 40°C to 60°C over 60 seconds
  - Hot 100°C hold for 60 seconds

<table>
<thead>
<tr>
<th>Time (Seconds)</th>
<th>Response (A/D Counts)</th>
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<td>0</td>
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<td>40000</td>
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<tr>
<td>360</td>
<td>15000</td>
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Hand held micro system for the 6-minute detection of:
1) Vinyl Chloride
2) cis-1,2-Dichloroethene
3) Benzene
4) Trichloroethylene
5) Toluene
6) Tetrachloroethylene
7) Chlorobenzene
8) Ethylbenzene
9) p/m-Xylene
10) o-Xylene
Case study – FROG 4000 GC-PID

- Tetrachloroethylene intrusion into indoor environment from contaminated sub-soil
- Long term in-situ analysis showed influence of meteorological conditions
On-site analysis of trace environmental contaminants

- On-site analysis of environmental pollutants
- Results available immediately
- No error or sample loss in transportation
- Easy to use intuitive user interface
- Reconfigure for new applications