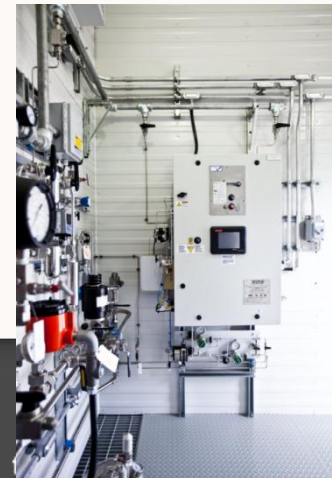


Experience & Solutions



Engineered Products & Services Across North America



Introduction

- **Multi-point sampling of VOC's**
- **Specific detection of several components**
- **Multi-stream and multi component analysis**
- **40 sample points in 1 minute**

Ambient Air Monitoring by Membrane Inlet Mass Spectrometry (MIMS)



Air Monitoring of VOC

- VOC can present a significant threat to worker **health** and **safety**.
- Identification and quantification of these VOC through air monitoring is an essential component of a health and safety program at a hazardous site or industry.
- Reliable measurements of airborne contaminants are useful.
 - Providing early warning for **health** and **safety hazard**.
 - Providing early warning for potential leak breakout LDAR
 - Delineating areas where protection is needed.
 - Assessing the potential health effects of after-exposure
 - Determining the need for specific medical monitoring.
 - Selecting personal protective equipment.
- Meets the detection requirements of Ministry Of Labour Ontario

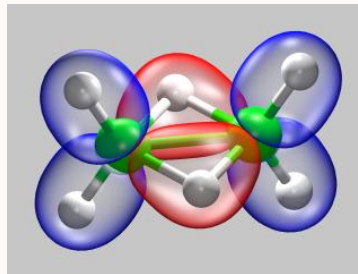
The onsite use of direct-reading instruments

- As early warning devices for use in industrial settings, where a leak or an accident could release a high concentration of a known chemical into the ambient atmosphere.
- Direct reading instruments provide information at the time of sampling, enabling rapid decision-making vs laboratory analysis
- Numerous locations need real-time monitoring:
Analyzer Buildings, inlet & exhaust ducts, perimeter points, along sample lines, storage facilities & ambient locations with potential problem areas.

The needed performance for VOC detection -why use Process MS?

The Need

- Speed
- Multi-stream/locations
- Detection limits
- Precision & accuracy
- Multi-component
- Flexibility
- Wide dynamic range
- Continuously



MS Capability

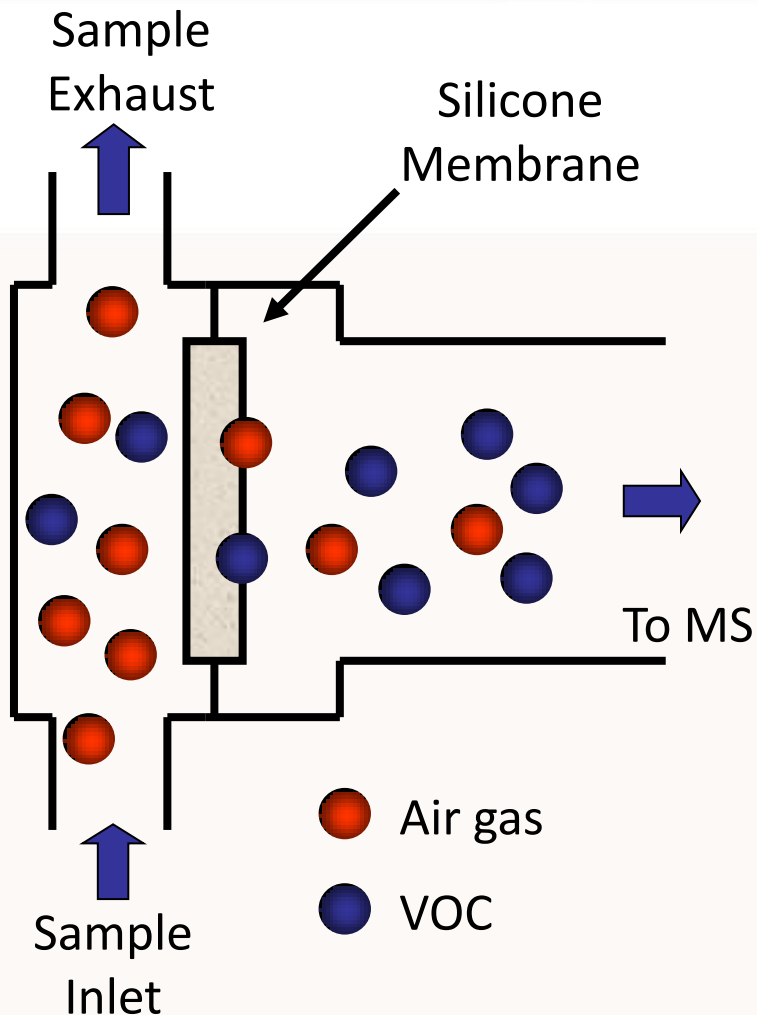
- seconds
- 16, 32, 40, 64 streams
- Sub ppm, normally 0.025ppm
- 0.25% RSD
- Multi-component
- Different Calibration per stream
- 0-100%
- 24 hours /7 days

Process MS: Easy to own



- Analyzer/ Electronics slide right on/off
- Allow easy maintenance and switch with spare parts.
- Cost effective
- No complicated multi-board assemblies, mechanical adjustments, start-up procedures
- Affordable back-up spares

Membrane Inlet Mass Spectrometry

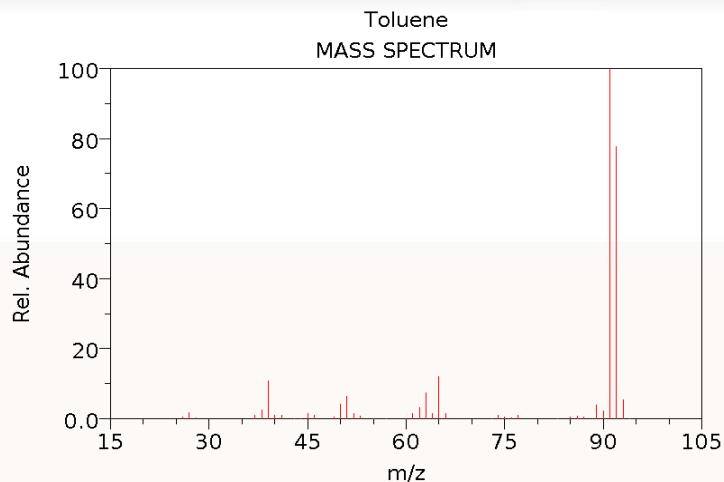


- Silicone membrane shows strong preference for organic molecules over N_2 , O_2
- Membrane provides selective enrichment and high signal/noise
- Membrane Inlet MS is method of choice for low level detection

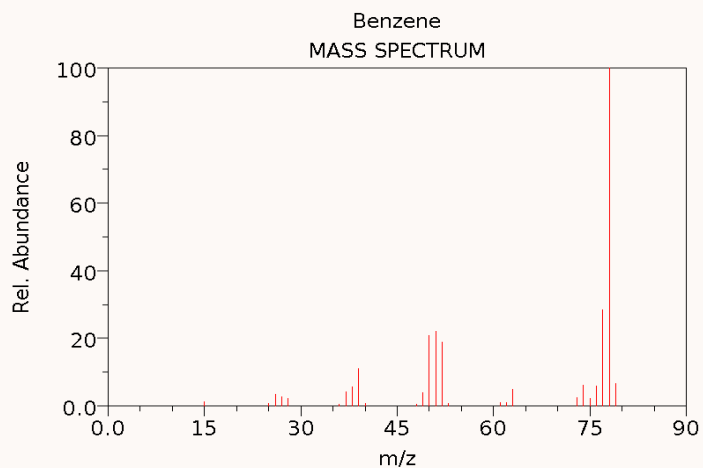
Membrane Holder for VOC enrichment



Example: Aromatics



NIST Chemistry WebBook (<http://webbook.nist.gov/chemistry>)



NIST Chemistry WebBook (<http://webbook.nist.gov/chemistry>)

Toluene

C_7H_8

MW 92

Principle peaks 92 ($C_7H_8^+$),
91 ($C_7H_7^+$)

Benzene

C_6H_6

MW 78

Principle peaks 78 ($C_6H_6^+$),
77 ($C_6H_5^+$)

Proline and ProMaxion VOC applications

- Analysis of atmosphere in Vinyl Chloride Monomer (VCM) and Polyvinyl Chloride (PVC) plants
- Analysis of atmosphere in Benzene, Toluene, Xylene (BTX) plants
- Workplace monitoring in general manufacturing industries that use toxic chemicals, such as specialty chemicals and specialty gases

Ambient Air ProLine for VOC monitoring

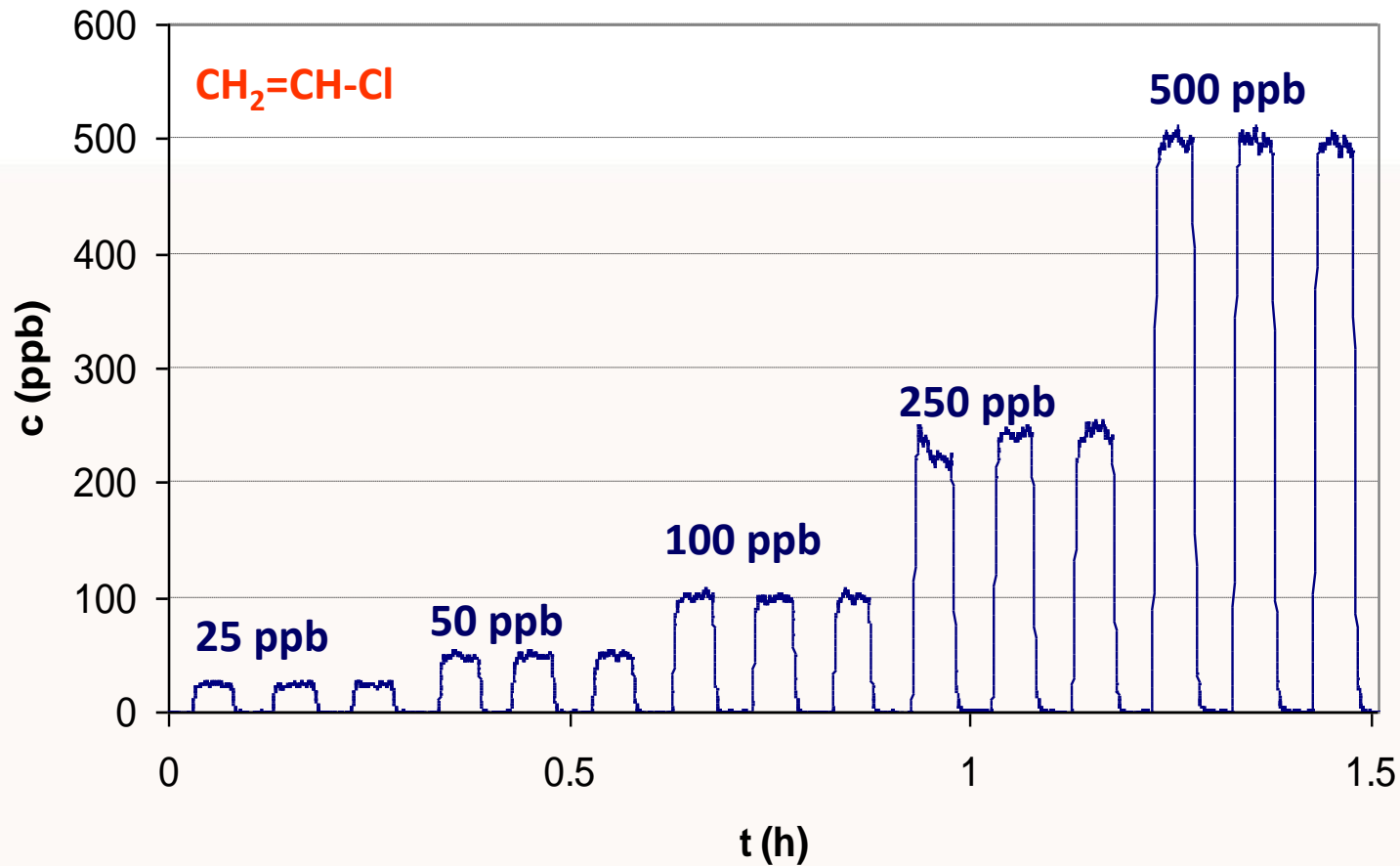


ProMaxion Process Mass Spectrometer



- Process Mass Spectrometer for explosive environments
- Same proven components as in the ProLine
- Suitable for operation directly in the process areas
- High-speed, analyte specific monitoring at multiple points

Detection of low levels of VCM



A PVC Plant Example for EDC Monitoring (8 streams)

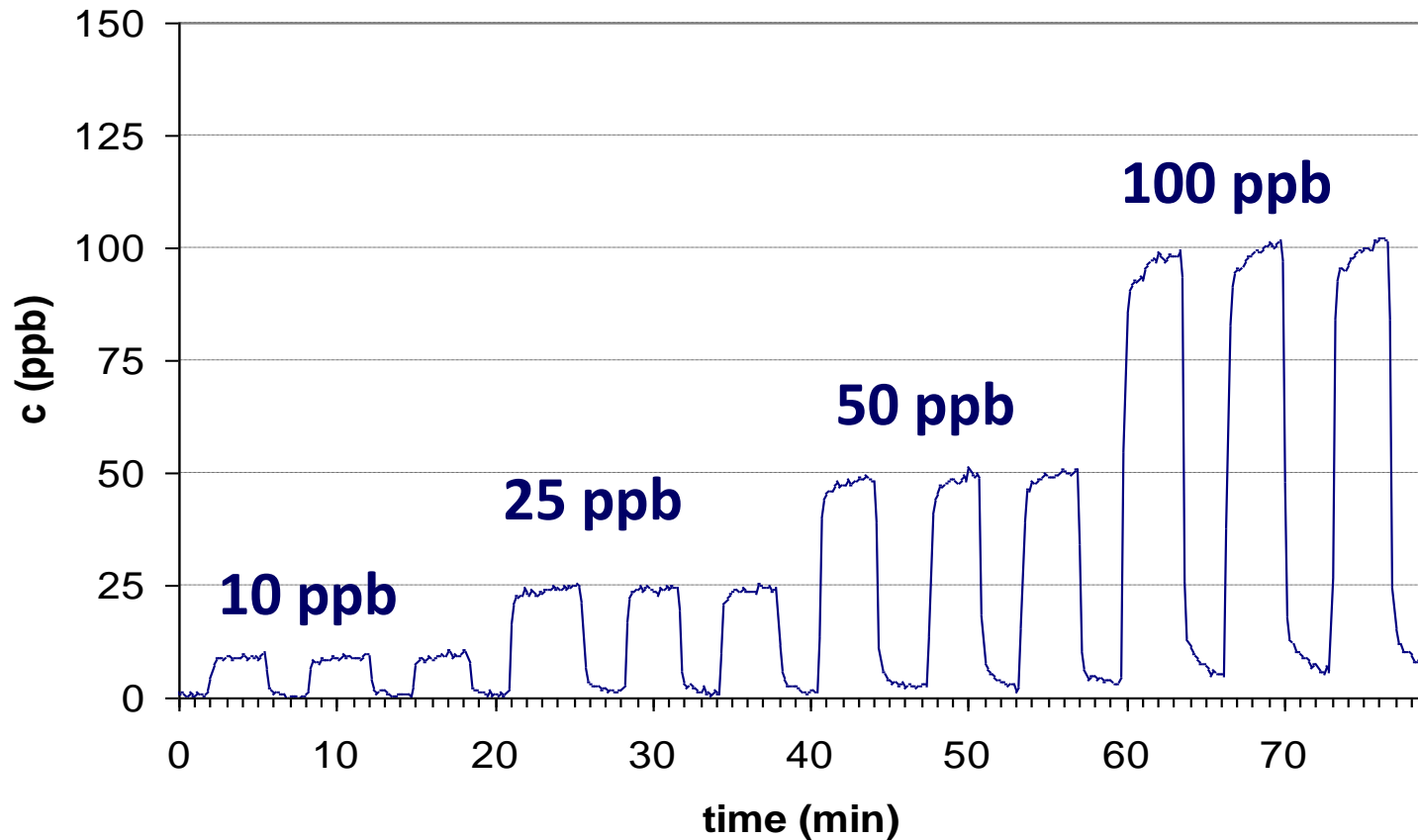
Sampling points	ppm levels
1	0.76
2	20.62
3	0.23
4	0.48
5	6.81
6	31.07
7	0.28
8	0.23
Average	7.56

Sampling points	ppm levels
1	0.90
2	2.24
3	4.44
4	2.12
5	3.94
6	5.57
7	1.57
8	2.37
Average	2.89

Benzene

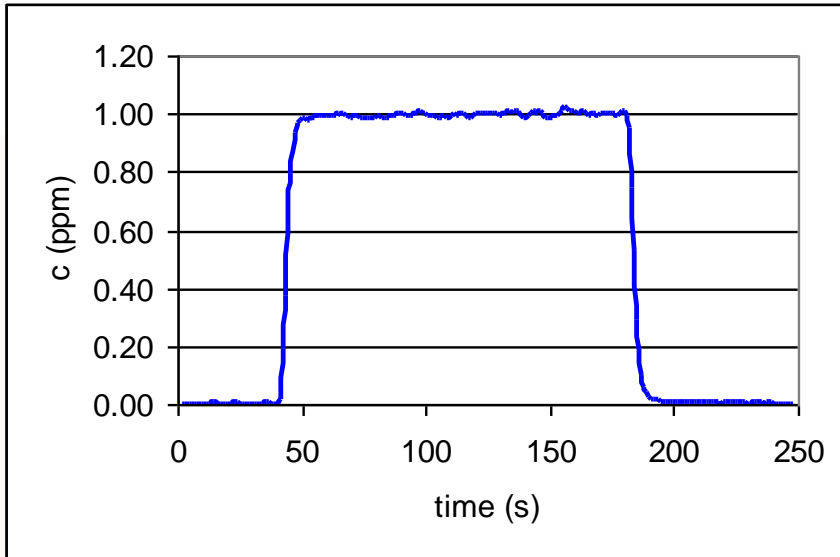
- Present in gasoline and other fuels
- Used to produce plastics, detergents and pesticides
- Shown to be carcinogenic
- Ontario 8 hour TWA limit is 0.5 ppm in air
- Short-term exposure limit, STEL is 2.5 ppm
- Need to measure in the presence of other, less harmful, aromatics which can be present at higher levels
 - E.g. Toluene - 8 hour TWA is 20 ppm

ppb-level Benzene detection

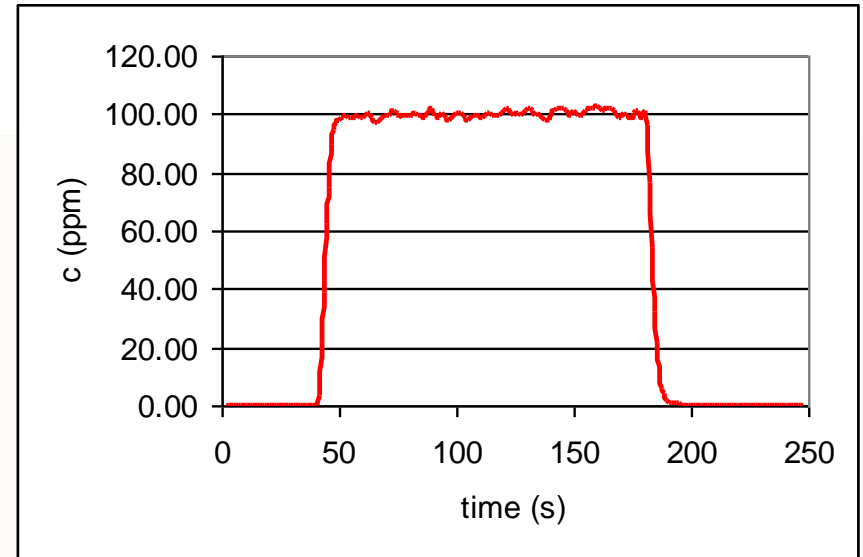


allow for absolute alarm confidence at higher level of 1ppm.

Response Time: Benzene & Toluene



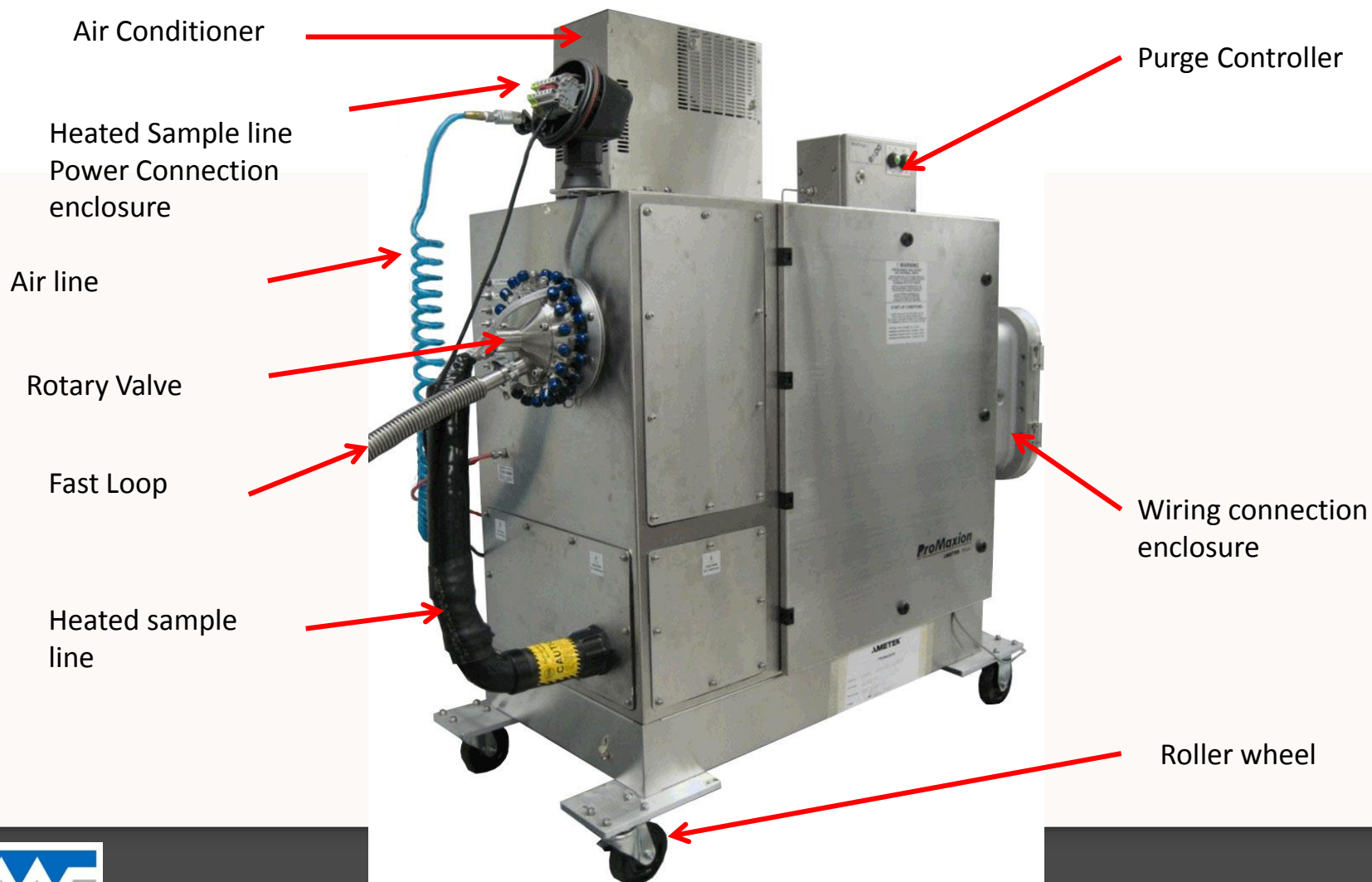
Response time of 1 ppm benzene



Response time of 100 ppm toluene

less than 10s response time

ProMaxion 40 inlets Rotary Valve

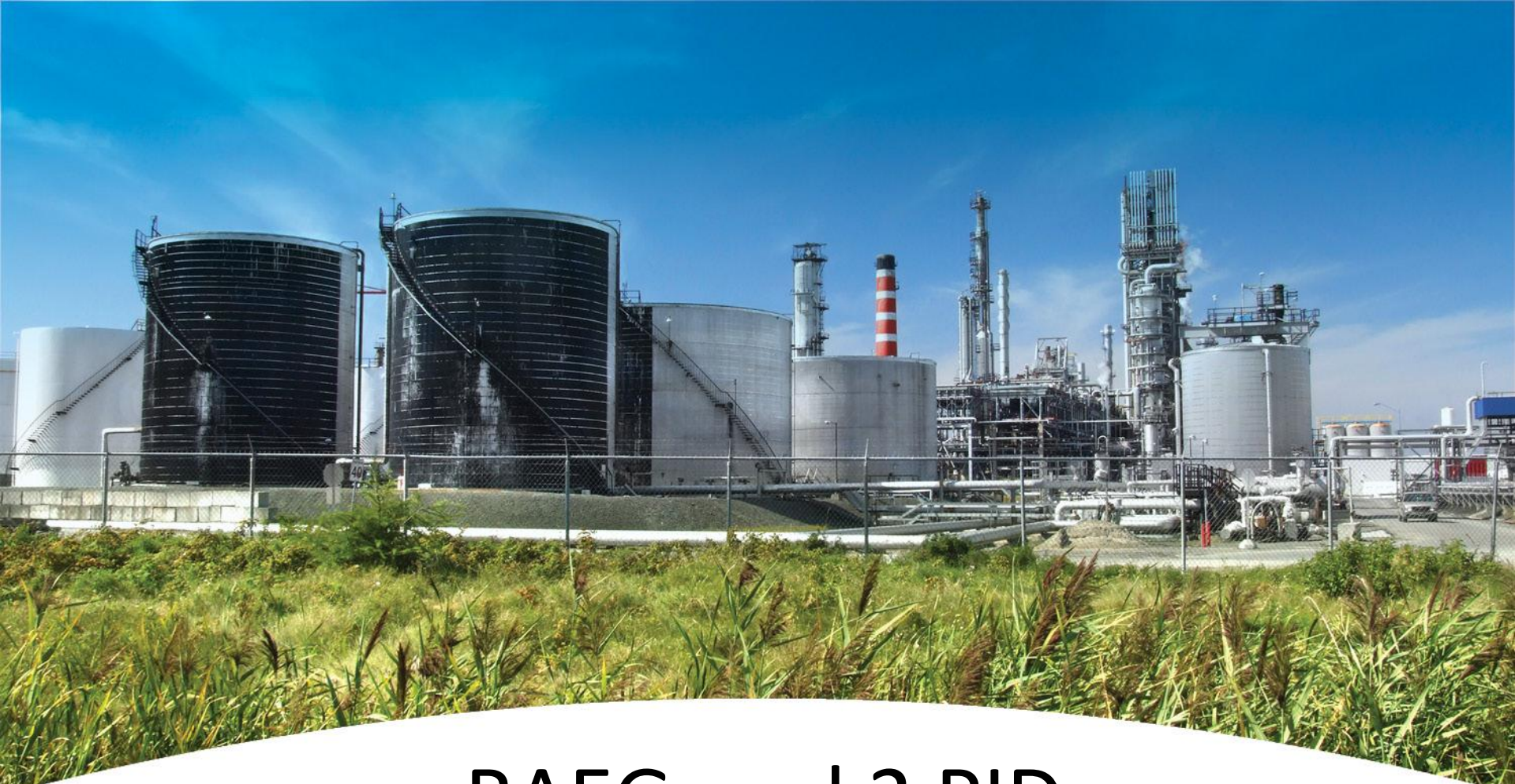


Atmospheric Monitoring Applications

- PVC Production – Vinyl Chloride Monomer
- Petrochemical – Benzene, Toluene, Xylene
- ABS Polymer Resins – Acrylonitrile, Butadiene, Styrene
- Pharmaceutical – Chlorinated Solvents
- Semiconductor – Halogenated Organic Compounds
- Paint Manufacturing – Organic Solvents
- Epoxy Resin – Epichlorohydrin
- Synthetic Fibers – Dimethylacetamide
- Solvent use – Explosive limit analysis

Typical compounds detected in the 0.02 to 1 ppm range

- Acetone
- Acetonitrile
- Acrylonitrile
- Benzene
- Butadiene
- Carbon disulfide
- Carbon tetrachloride
- Chloroform
- Chlorobenzene
- Cyclohexane
- Dichloromethane
- Dimethylacetamide (DMAC)
- Dimethyl formamide
- 1,4-Dioxane
- Epichlorohydrin
- Ethyl benzene
- Ethyl lactate
- Freon's
- Hexamethyldisilazane
- Methyl bromide
- Methyl ethyl ketone
- Methyl iodide
- Methyl isobutyl ketone
- Methyl methacrylate
- 1-Methyl-2-pyrrolidinone
- Methyl tertiary-butyl ether (MTBE)
- Propylene oxide
- Propan-2-ol
- Perchloroethylene
- Styrene
- Tetrahydrofuran
- Tetrachloroethylene
- Toluene
- Trichloroethylene
- Vinyl acetate
- Vinyl bromide
- Vinyl chloride
- Xylene



RAEGuard 2 PID Point Detection of VOC's

Honeywell

Introduction to RAEGuard 2 PID

- The RAEGuard 2 PID is a fixed photoionization detector (PID) that measures a broad range of volatile organic compounds (VOCs).



DigiPID

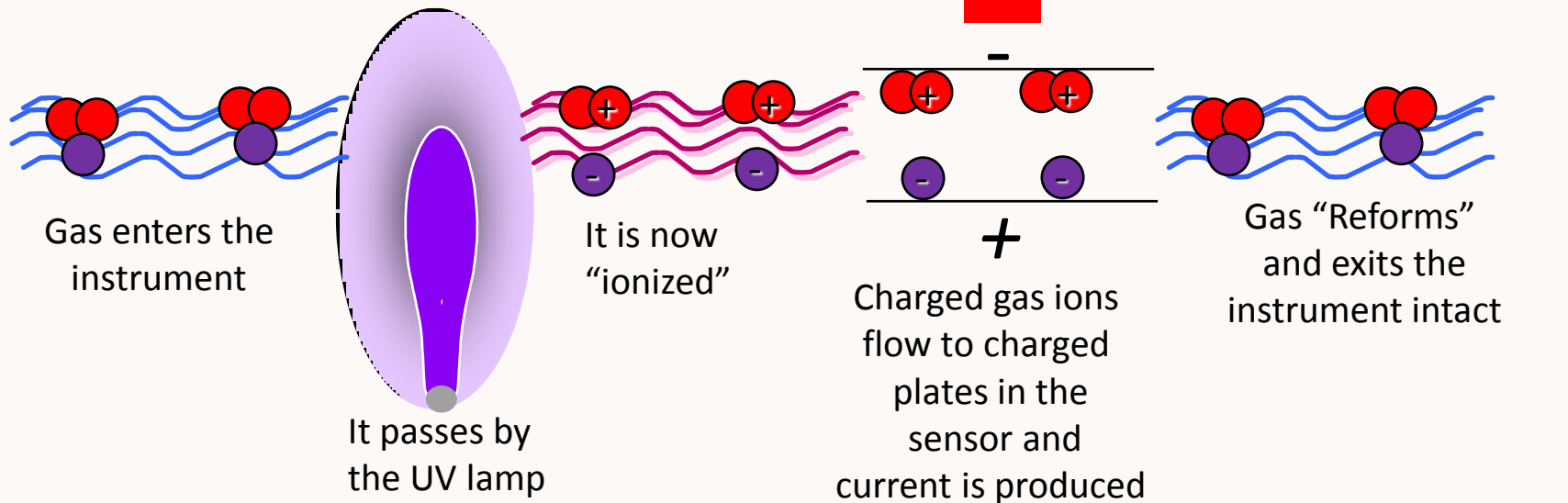
- DigiPID sensor module features:
 - Separate gas inlet and outlets
 - Digital interface to fixed head can be safely removed from the fixed head in hazardous locations
 - 10.6 eV lamp
 - 3 sensor ranges
 - 0.01 to 99.99 ppm
 - 0.1 to 1000 ppm
 - 1 to 1000 ppm



DigiPID
Sensor Module

How does a PID work?

An optical system using Ultraviolet lamp to breakdown vapors and gases for measurement



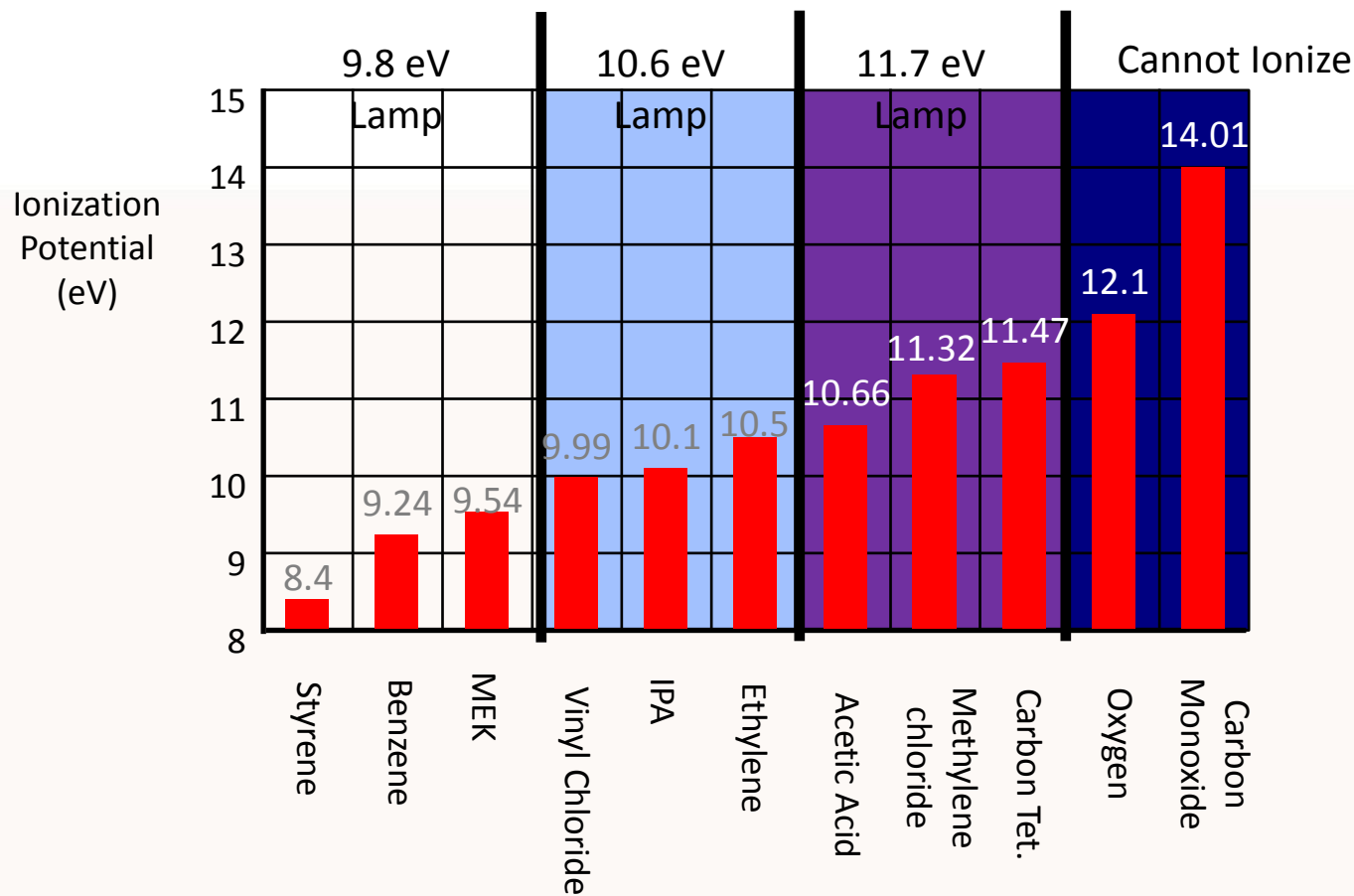
Current is measured and concentration is displayed on the meter

100.0 ppm

Gas "Reforms" and exits the instrument intact

What does a PID Measure?

Some Ionization Potentials (IPs) for Common Chemicals



PIDs can not measure

- **Radiation**
- **Air**
 - N₂
 - O₂
 - CO₂
 - H₂O
- **Toxics**
 - CO
 - HCN
 - SO₂
- **Natural gas**
 - Methane CH₄
 - Ethane C₂H₆
- **Acids**
 - Hal
 - HF
 - HNO₃
- **Others**
 - Freon's
 - Ozone O₃

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