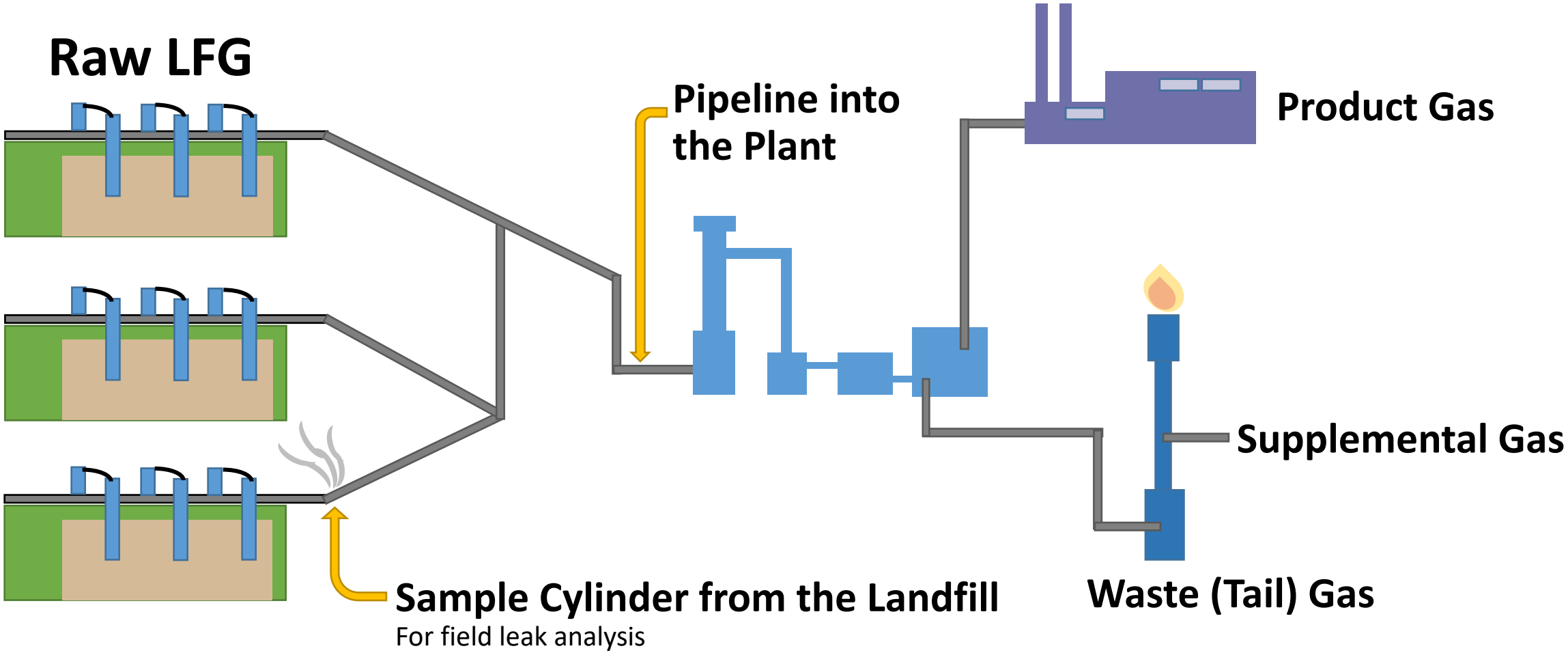
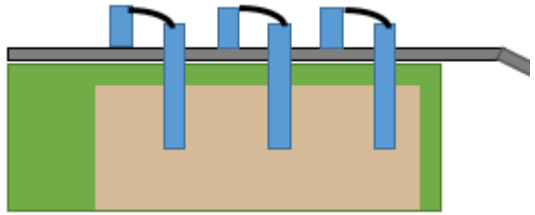
Landfill Gas Monitoring

Real-time Gas Analysis

Landfill Gas Points of Analysis





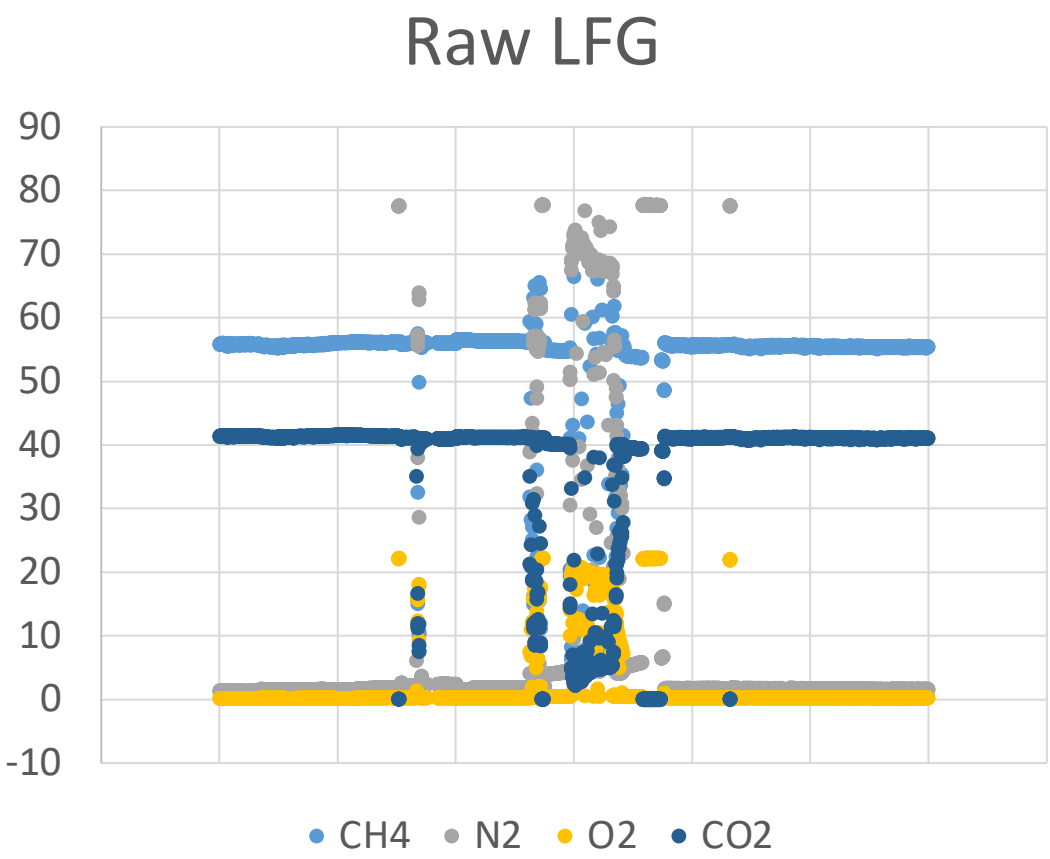
Raw LFG Concerns

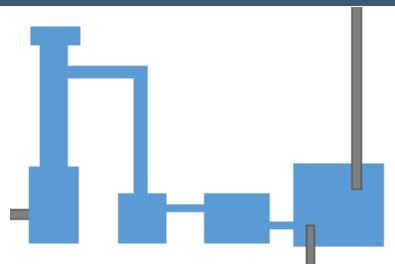
Main Components

- Methane
- Carbon Dioxide
- Sulfurs
- Moisture
- Other
  - Non-methane Organic Compounds

Air (N2, O2, Ar)

- Excess amounts may indicate a leak
- Quick assessment of landfill health





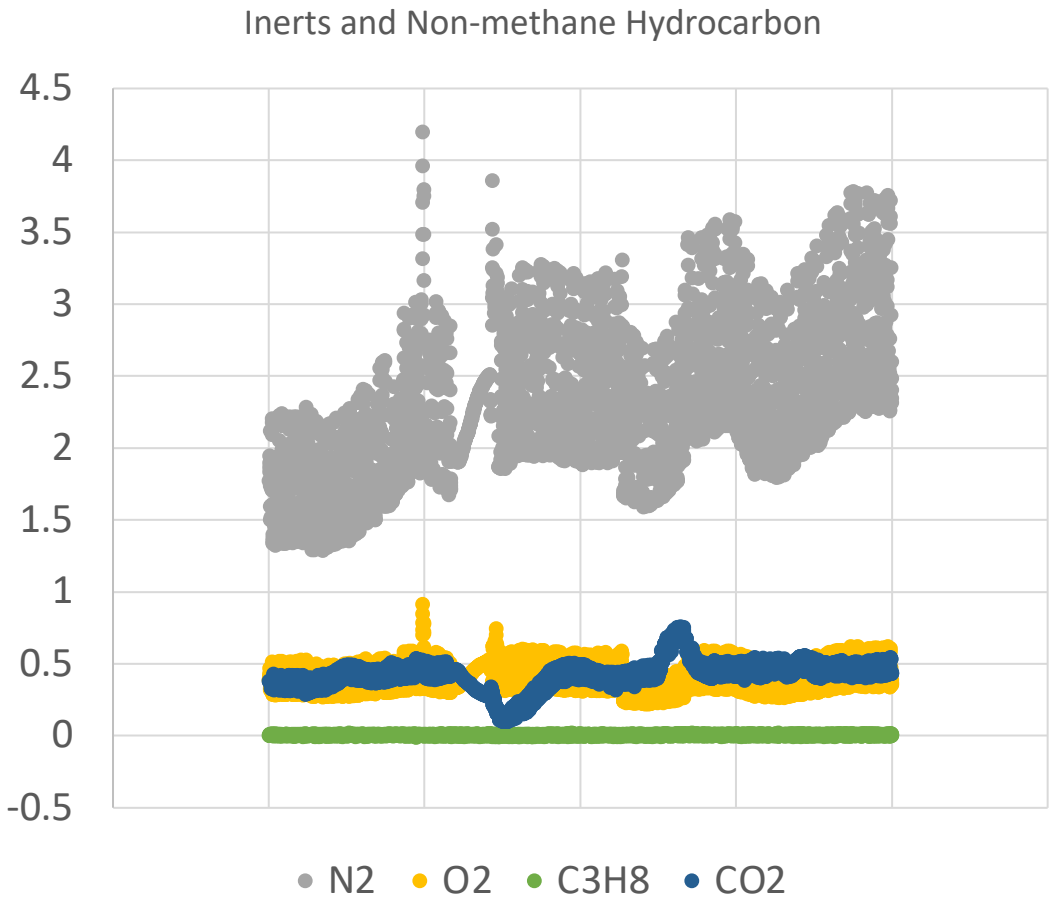
Processing Concerns

- In-processing monitoring can aid in identification of process break down or leaks
- Make real time plant adjustments as needed
- Trend overall performance in real-time to reduce downtime

Product Gas Concerns

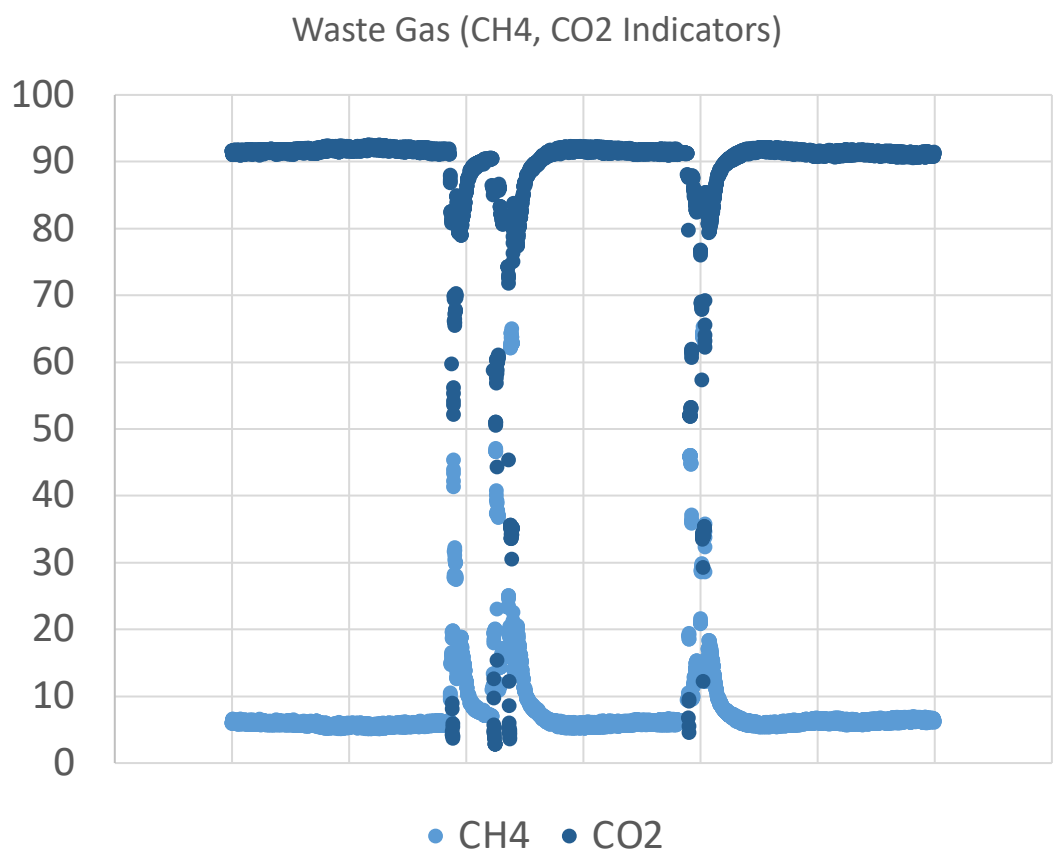
Is your product within agreed specifications?

- BTU Value
- Moisture
- Carbon Dioxide
- Oxygen
- Inerts
- Non-methane hydrocarbons
- Sulfur content
  - Hydrogen sulfide
  - Mercaptans
  - Total Sulfur (COS, CS2, H2S, Mercaptans, Sulfides…)
- Carcinogens
  - Ethylbenzene, Vinyl Chloride….



Waste (Tail) Gas Concerns

- Excess product being sent to the flare/thermal oxidizer
- Meeting minimum BTU flaring requirements
- Avoid excess consumption
  - Supplemental Gas
  - Steam



What analytical technique can handle this analysis?

Mass Spectrometry

Speed of Analysis

- 0.4 sec/constituent
- 10-20 sec/stream
- Advanced Process Control (APC)

Selectivity

- Mass/Charge Ratio (M/Z)

Multiple Stream

- 1-46 Process Streams
- 1-160 Environmental Channels
- Different Composition

Dynamic Range

- Linear From ppm to 100%

Accuracy

- Equal to Calibration Standards

Precision

- Better than Primary Method
- 0.0025 on 1% Ar

Maintenance

- Better Than 99% Uptime
- Reduced Routine Maintenance

Typical Methods

Process Monitoring

Pipeline

- Stream composition

Waste (Tail) Gas

- Stream composition

Product Gas

- Stream composition
- Odorants

Stream Composition

- Methane
- Carbon Dioxide
- Sulfurs
- Non-methane Organic Compounds
- Moisture
- Air (N2, O2, Ar)
- BTU Value

Additional Tools

Sample Cylinder

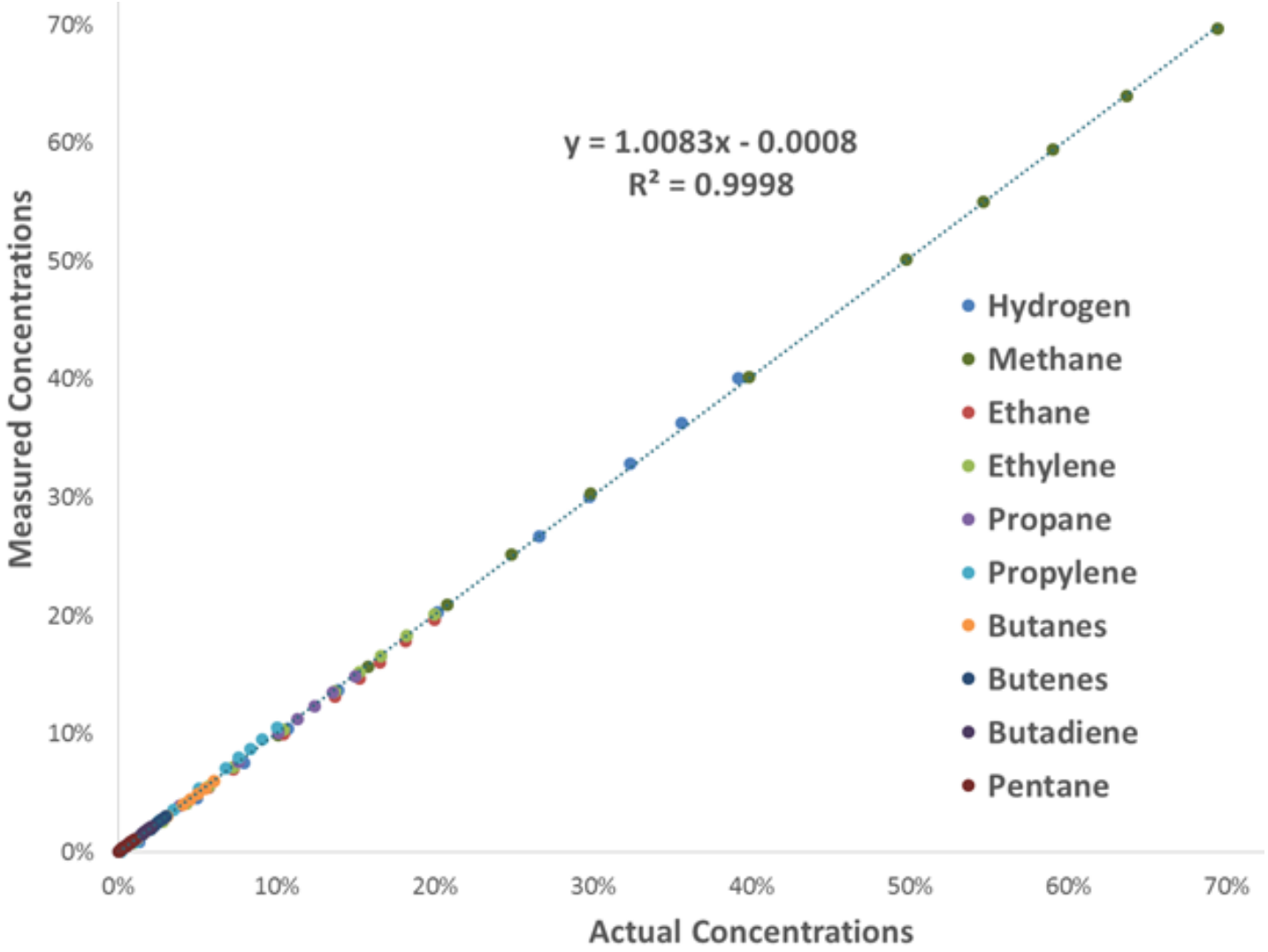
- Methane
- Carbon Dioxide
- Nitrogen
- Oxygen
- Argon

Supplemental Gas

- Methane
- Non-methane Organic Compounds
- Air (N2 ,O2, Ar)
- Moisture
- BTU Value

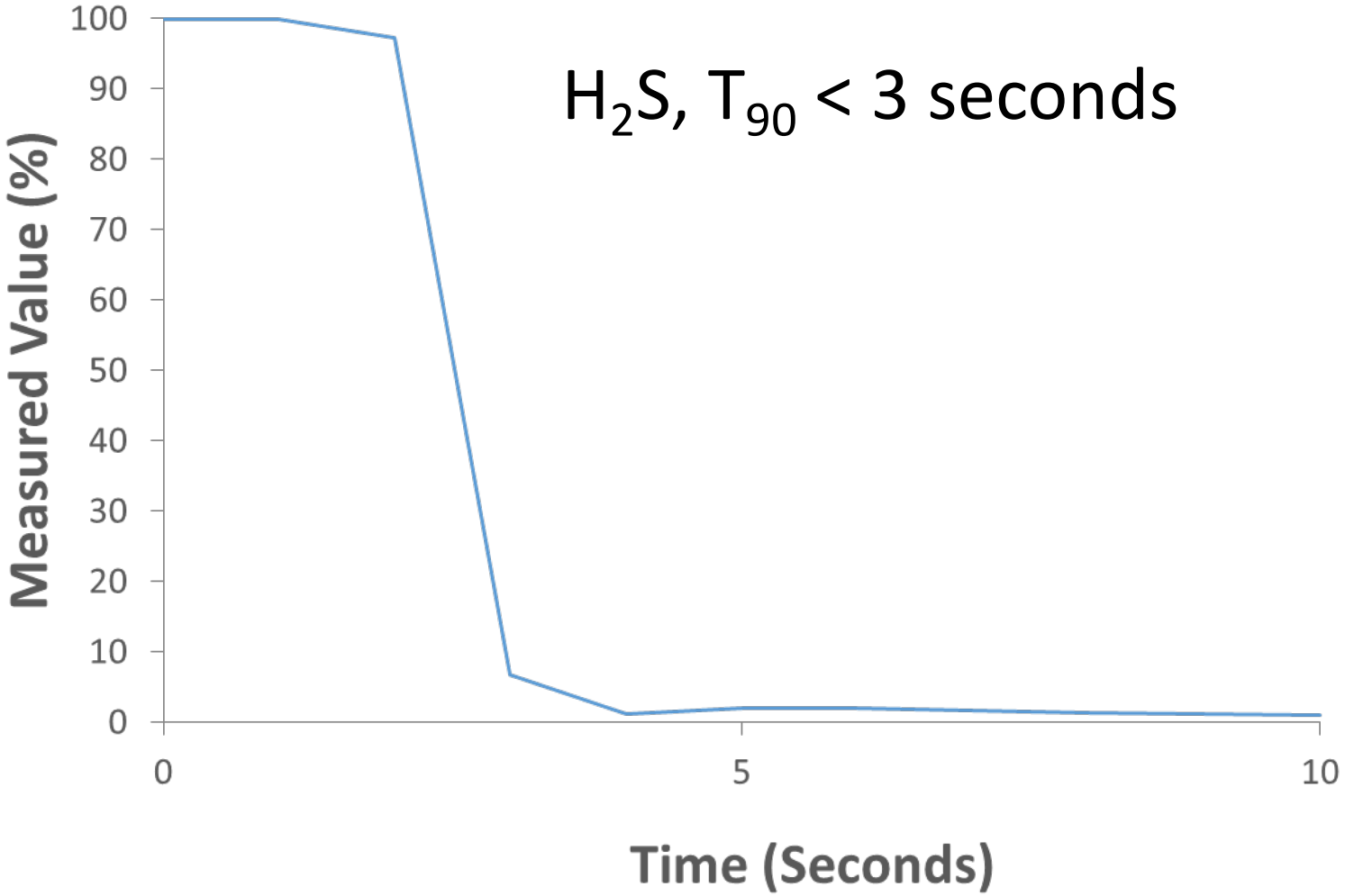
Detection Range and Accuracy

- Speciated analysis of certified gas mixtures of known concentrations
  - 10 components
  - Total analysis time <10 seconds



Sulfur Detection

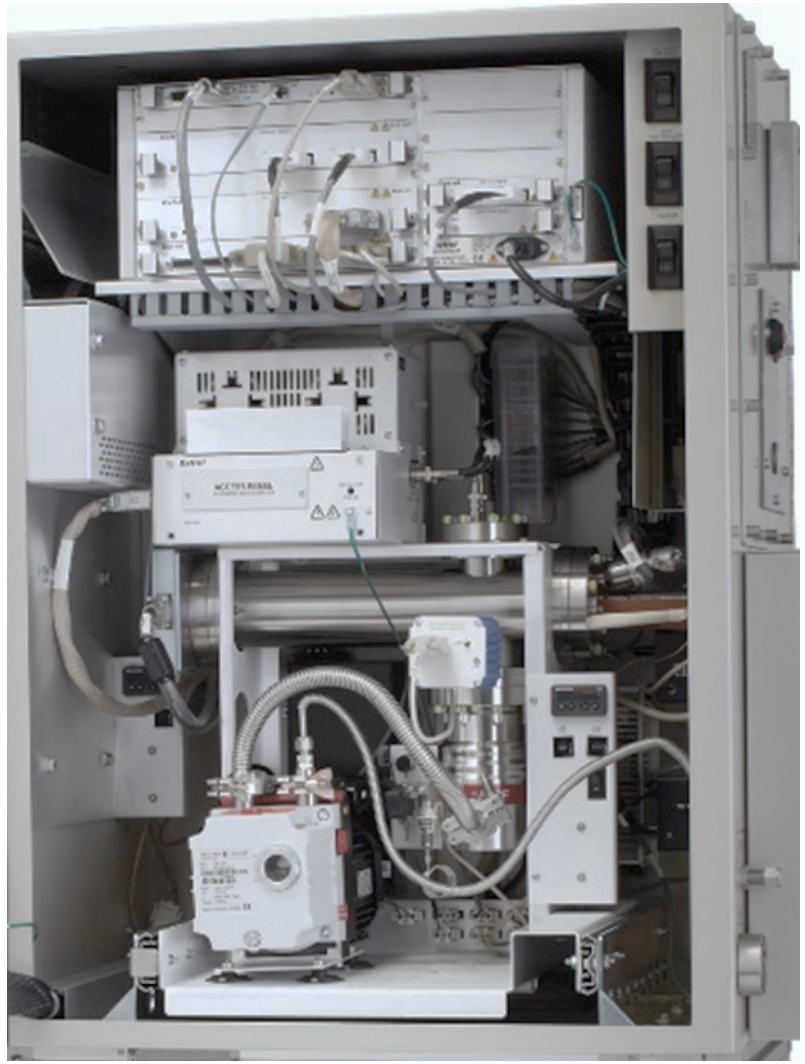
- Sulfinert coated sample path for fast dynamic response
- Increased sensitivity
  - 19 mm quadrupole



H_2S, T_{90} < 3 seconds

Components of a Mass Spectrometer

- Inlet
  - Stream Selection
  - Sample Introduction
- Ionizer
  - Electron Impact (EI) Ionization
- Mass Filter
  - Quadrupole
- Detector
  - Faraday and Electron Multiplier
- Data System
  - Signal Acquisition, Processing and Display



Sampling Requirements

Are the same for any Gas Analyzer

- Vapor Phase
  - non-condensing
- Particulates
  - 5 micron filter
- Pressure Range
  - 20PSI to 0.1PSI (1034 to 5 torr)
- Flow
  - 100 cc/min
- Temperature
  - Min. above point of condensation
  - Max. 250C

Calibration and Validation

Calibration Gases

- Required:
  - Any time instrument does not accurately validate
  - Following maintenance that involves venting the vacuum chamber
  - Typically once every 1-6 months
- Each calibration step requires <500 atm cc of gas
- Small gas bottle will allow for biweekly calibration for 3+ years

Validation Gases (if required)

- Daily, Weekly or Monthly depending on company policy or local regulation
- Each validation requires <500 atm cc of gas
- Small gas bottle will allow for biweekly validation for 3+ years

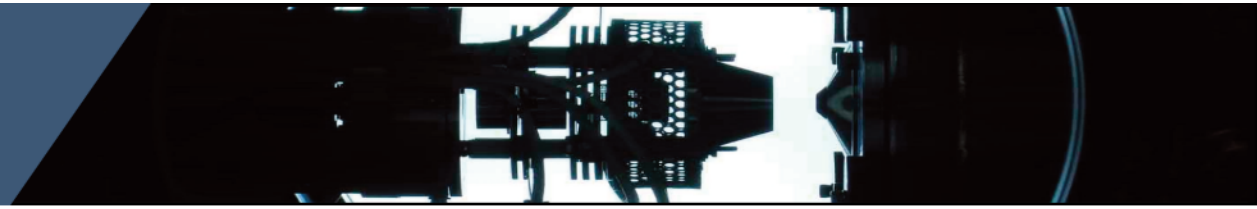
Mass Spectrometers Offer

- Real-time process control
- “Hands-off” analysis
- Stability
- Reduction in the number of analytical techniques
- Flexibility for future requirements or process improvements

Mass Spectrometers

- **Speed of Response**
  - Real time analysis
  - On average, <30 seconds per stream
- **Accuracy and Sensitivity**
  - 0.0025 on 1% Ar
  - Speciated analysis
- **Analysis Flexibility**
  - Changes to the application are possible in software, no changes to hardware required
- **Easy to Use**
  - Low maintenance and utilities
  - No carrier, detector, or dilution gases
  - Network accessible, automated, integrated into the control system

Landfill Gas Monitoring



Real-time Gas Analysis

Thank you for your attention

- Any Questions?