

Perma Pure LLC

**Dry Extractive Measurements
for
Low HCl Levels**

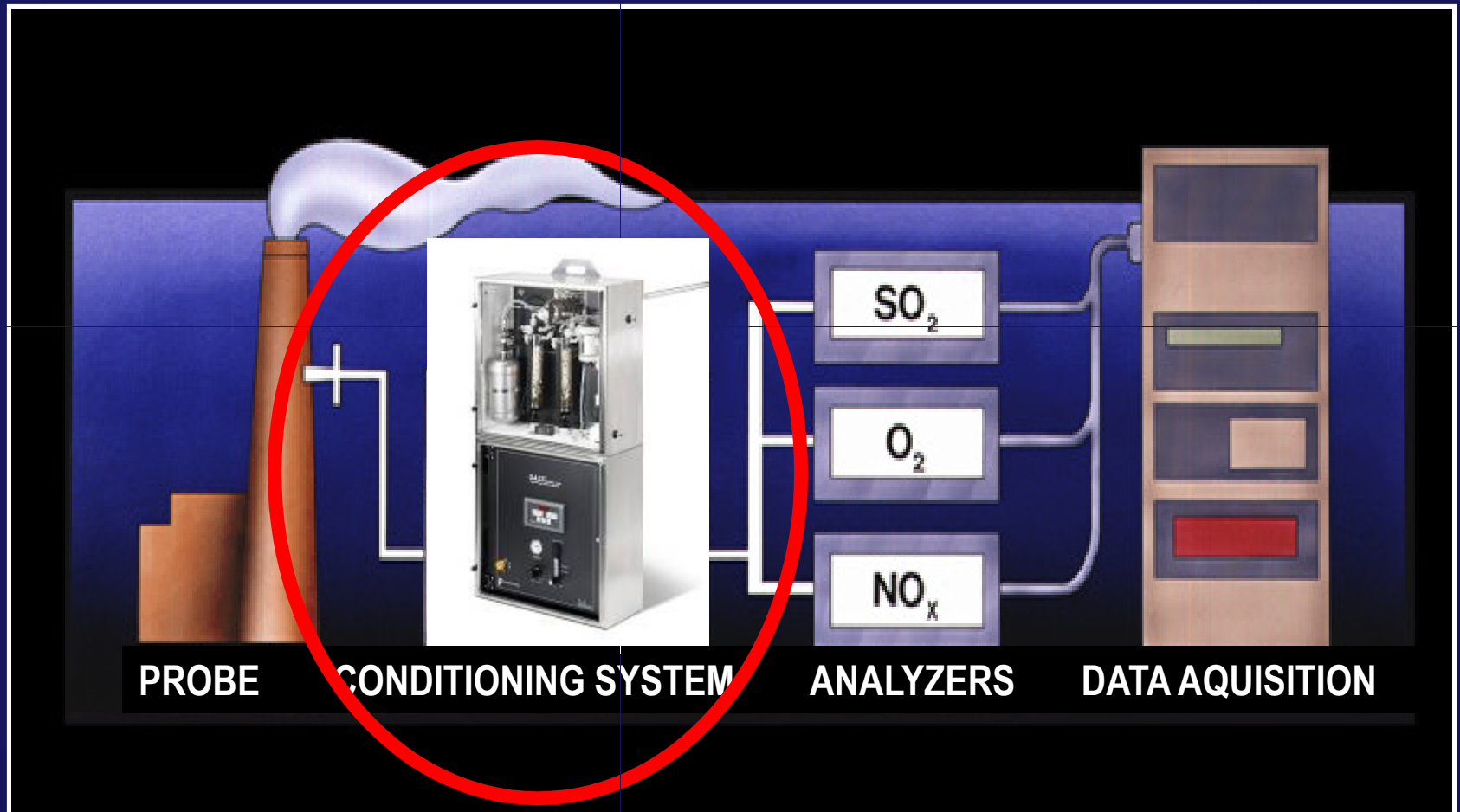
EPRI CEMS User Conference

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Sample Handling – Critical Path for CEMS



Perma Pure – Gas Sample Handling

3 Technologies:

- **Dilution Probes**
 - Wet measurement
- **Baldwin™ Thermoelectric Coolers**
 - Water removal through flash condensation
- **Nafion® permeation dryers and systems**
 - Water removal at the stack through unique membrane dryer technology
- **Plus probes, filters, scrubbers, accessories**





Utility MACT

- Proposed rule March 2011, final rule Nov 2011
- HCl, as a surrogate for acid gasses, reduced average of 91%. Target of 0.30 lb per GWh.
- Continuous HCl measurement now required.
- Option to measure SO₂ if wet scrubbers installed, but then you have to meet the SO₂ standard of 0.40 lb per MWh.
- Approx. 45% of coal fleet does not have SCR or FGD technologies installed.



HCl Measurement Options: Not Good!

Method

Challenges

- | | |
|-------------------------|--|
| • Wet Chemistry | Not continuous or immediate |
| • FTIR | Expense, maintenance, low PPMs, all that data |
| • TDL | Expense, calibration |
| • Dilution | Below detectable limit |
| • Dry Extractive | HCl dissolves in water |



HCl Measurement Options

Is there another approach for Dry Extractive?

YES. The key is to remove water in VAPOR phase before HCl can dissolve.

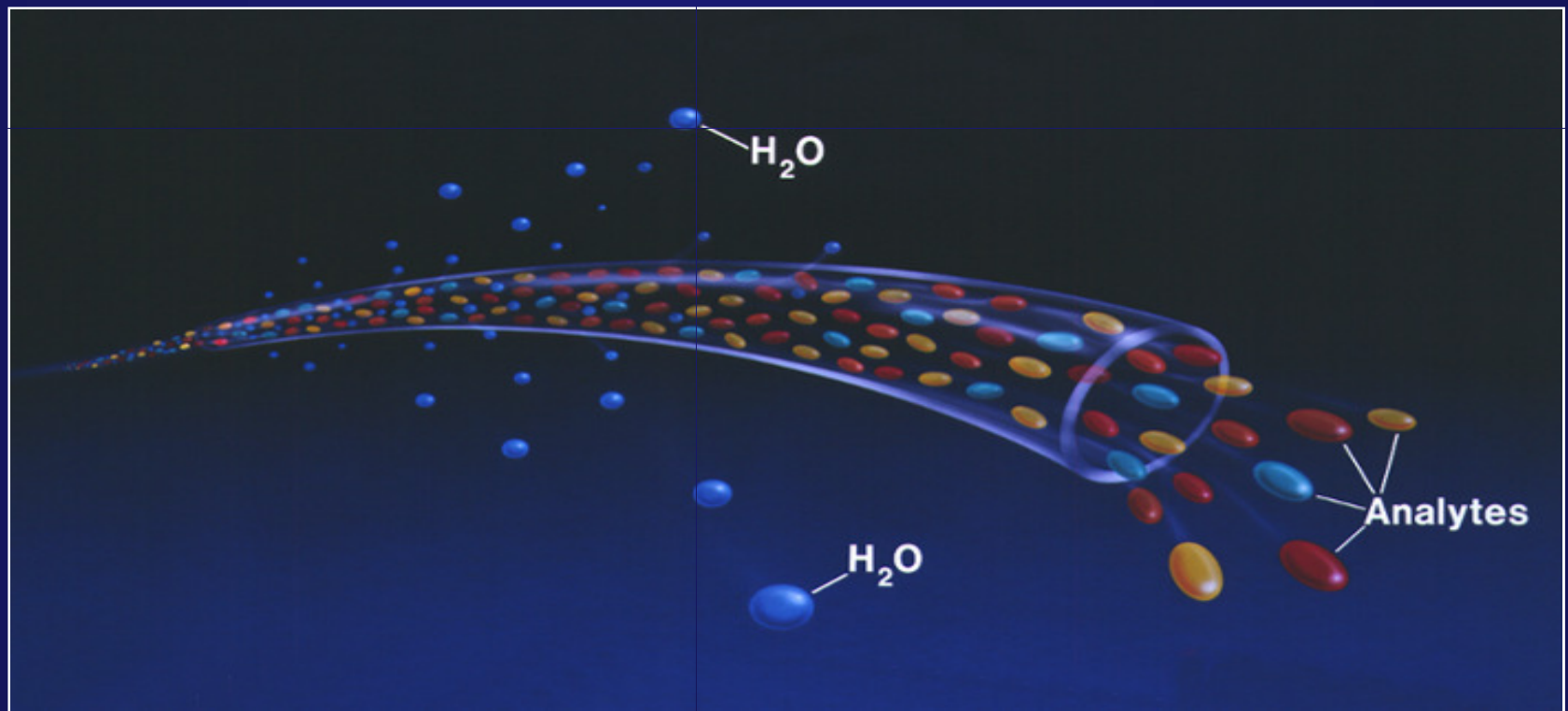
How?

Nafion[®] is a Teflon[®]-derivative co-polymer that selectively and chemically removes water in vapor phase while retaining acid gases.



Nafion[®] Drying Technology

**Fast • Selective • Continuously Self-regenerating
Powerless • No Moving Parts • No Maintenance**



Nafion[®] Selectivity

- Nafion permeation selectivity is based on chemical reactivity, not size
- Only compounds that chemically associate with sulfonic acid permeate through Nafion
- Water and bases associate with sulfonic acid and permeate through Nafion
- Very few bases are gases at typical operating temps, so very few compounds permeate



Nafion[®] Im-Permeability

Totally Retained in Sample

Atmospheric Gases

Ar He H₂ N₂ O₂ O₃

Halogens

Br₂ Cl₂ F₂ I₂

Hydrocarbons

Simple forms (alkanes)

Inorganic Acids

HCl HF HNO₃ H₂SO₄

Other Organics

Aromatics Esters Ethers

Oxides

CO CO₂ SO_x NO_x

Sulfur

COS H₂S Mercaptans

Toxic Gases

COCl₂ HCN NOCl

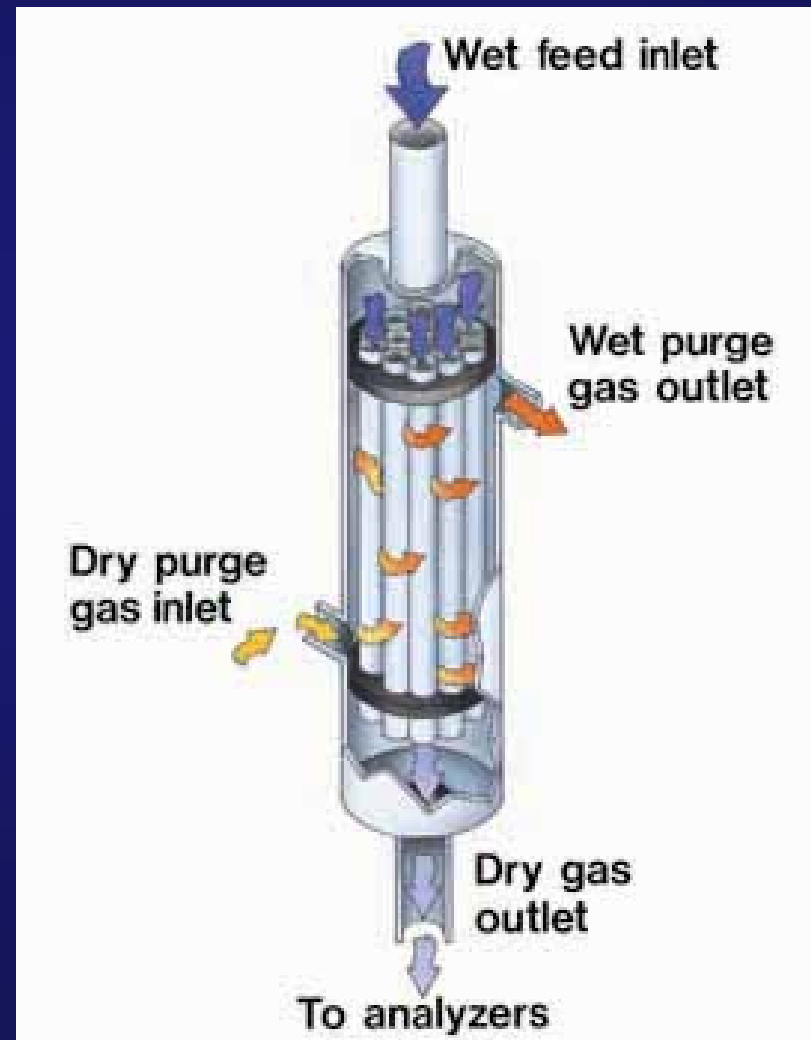
Typical Combustion Analytes



Nafion[®] Dryer Construction

Tube-in-shell, heat and moisture exchanger

To increase drying capacity, simply increase the surface area (wider, longer or more tubes)



GS-2040 Stack-Mounted Sample System

- Integrated probe & sample system
- Final dew point of -10°C to -45°C eliminates water condensation
- Non-corrosive wetted parts
- Dry sample lines
- Low maintenance and high reliability



GS-2040 Current Applications

- Used for 15 years in US refineries
- FCC, sulfur units, tailgas, process applications
- Biomass, incinerators
- Low SO₂ (under 2 PPM) and low NO_x applications
- Hundreds in use in US and around the world



HCl Future Tests and Studies

- **Refused Derived Fuel (RDF) Facility, online February 2010, will publish 18 month HCl results at EUEC, February 2012**
- **New mountain states coal facility launched May 2011. Initial RATA this summer.**
- **Stack tests ongoing using portable MG-2812 Nafion[®]-based system.**

