



**Gas Clean-up for Fuel Cell Applications, Argonne National Lab
Fuel (NG, LPG, LFG, ADG, APG, biodiesel) opportunities and impurity issues**

Gas Cleaning for Remote SOFC Applications

Acumentrics SOFC Corporation

March 6th-7th

Acumentrics SOFC, Inc

- SOFC division established in 2000, “Powder to Power” in single facility in Westwood, MA
- Pioneered small tubular SOFC; focus on rugged fuel cells
 - Tubular SOFC →30 min startup to 750°C
- PRODUCTS:
 - 250W-10kW products,
 - **250-1500W commercial** power products (NG, APG, LPG) with - **1 million+ operating hours**
 - 3kW and 10kW development products (biofuel, diesel, JP8) for the US military
- FUELS and APPLICATIONS
 - **Natural gas, wellhead gas, LPG**, JP8, biofuel
 - **Critical remote power**
 - Units utilize remote monitoring for additional reliability

Remote Power Applications Example

- US Coast Guard Radio Network Towers in Alaska
- LPG flown in by helicopter; fuel efficiency highly desirable



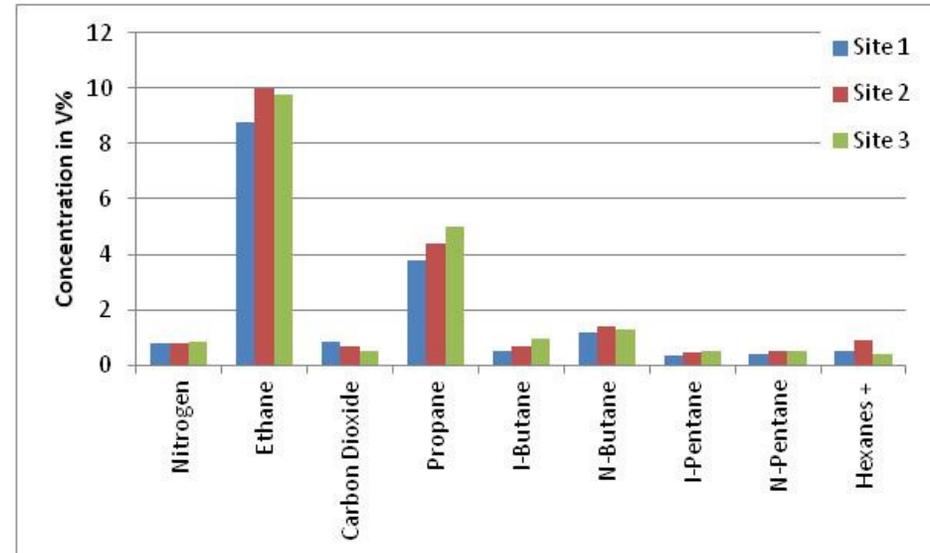
Sulfur Cleaning – Well head and Associated Gas



- Sulfur makeup **generally unknown**
- Sulfur observed as low as 1ppm H₂S and up to 100ppmW in some wells.
- Other contaminants? No severely debilitating species observed that are not trapped in beds (as yet...)

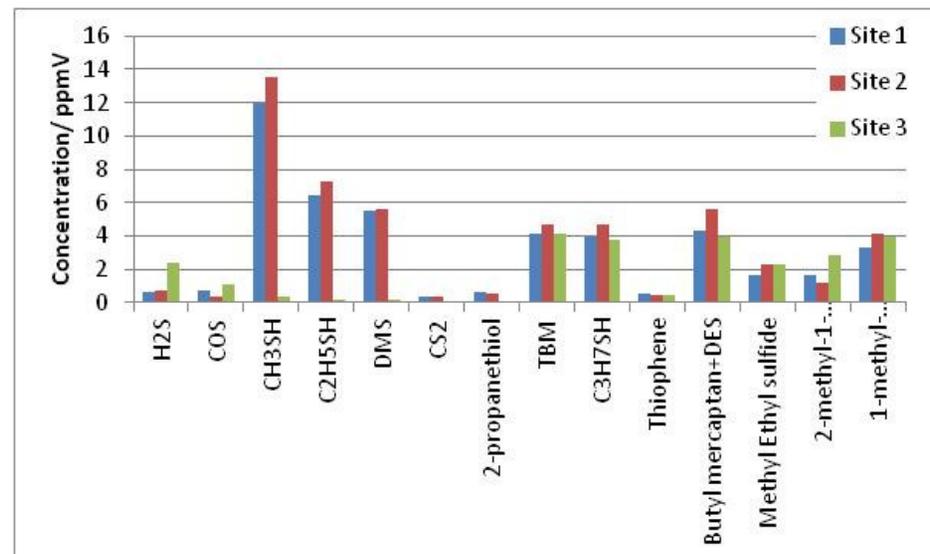
Top: Wellhead gas composition

- ▶ Measured at 3 sites in Texas in 2011



Bottom: Sulfur Makeup.

- ▶ Measured at 3 sites in Texas in 2011



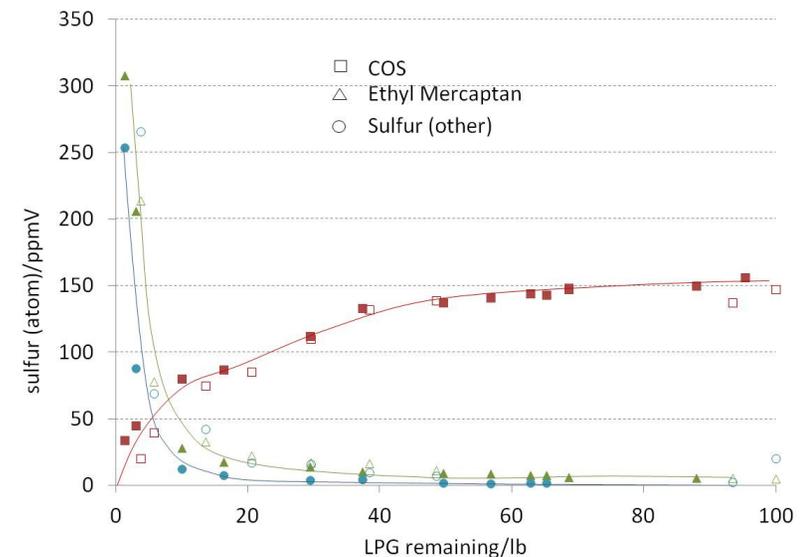
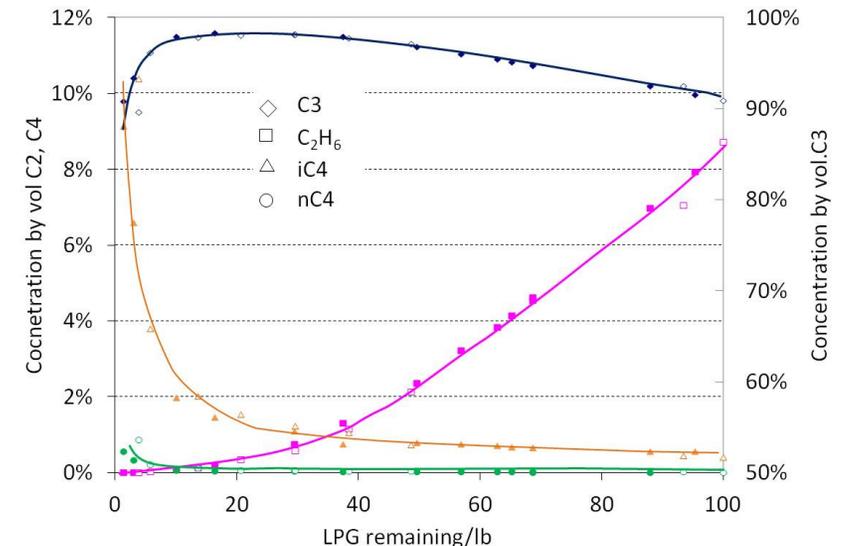
Sulfur Cleaning - LPG

- Transient compositions
 - Typically 35ppmW but as high as 180ppmW sulfur
 - **COS**, THT, EM and higher MW species
 - Accumulation of sulfur in the bottom of the tank

Top: Hydrocarbon composition as LPG tank depletes

Bottom: Anomalous sulfur in commercial LPG as a function of depletion.

- ▶ Measured in February 2012 in Westwood, MA
- ▶ Similar composition encountered in Canada in April 2012



Gas Cleaning Challenge

- Associated and well head gas
 - Sulfur and gas composition varies geographically
 - **Not predictable? Composition unknown?**

- LPG
 - Mostly propane in US, propane and butane in other parts of the world.
 - Composition not highly defined; Odorants as well as residual sulfur
 - **COS can be present in LPG and is difficult to remove.**
 - Sulfur composition changes as bottle empties

- Clients do not care about sulfur! They want \$aving\$
 - Cost is number one driver for widespread commercial applications
 - Need to reduce maintenance cycle cost . **Reduce bed sizes and eliminate unnecessary bed changes**
 - **Low cost, robust sulfur sensor** would be ideal for limiting life-cycle cost