

Biogas Impurity Removal and Conditioning for Fuel Cell Applications

October 18, 2010



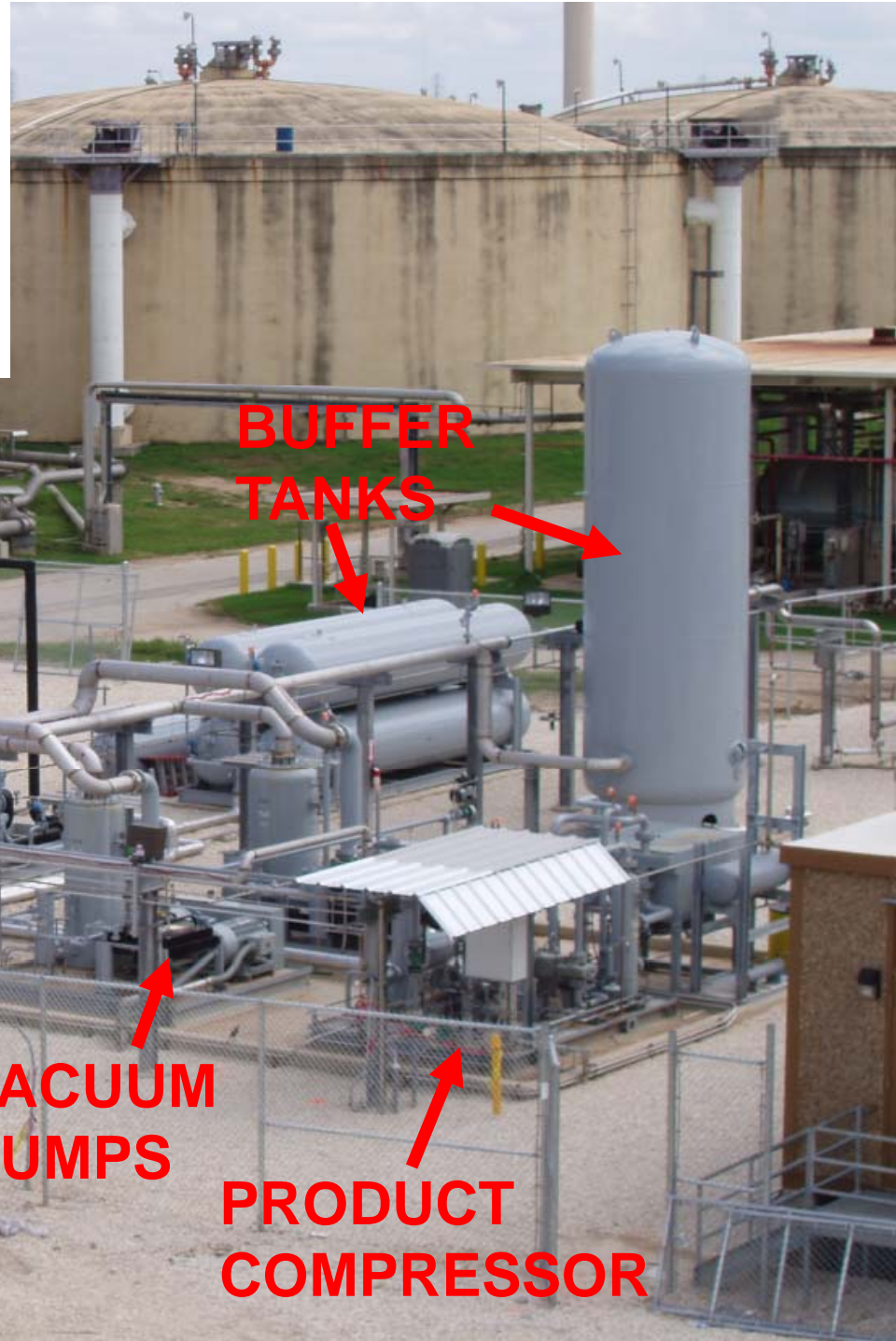
Guild Associates, Inc
Molecular Gate Technology
www.moleculargate.com



Guild Products to the Natural Gas Industry

- Molecular Gate for N₂ Rejection
- Molecular Gate for CO₂ Removal
- TSA dehydration (Water vapor removal)
- Sorbead “Quick-Cycle” dew point control (Heavy hydrocarbon removal)
- Heavy hydrocarbon removal for CARB standards
- CO₂ removal for LNG / Peakshaver plants
- Membrane units
- Helium purifiers
- Chiller Packages
- Compressors

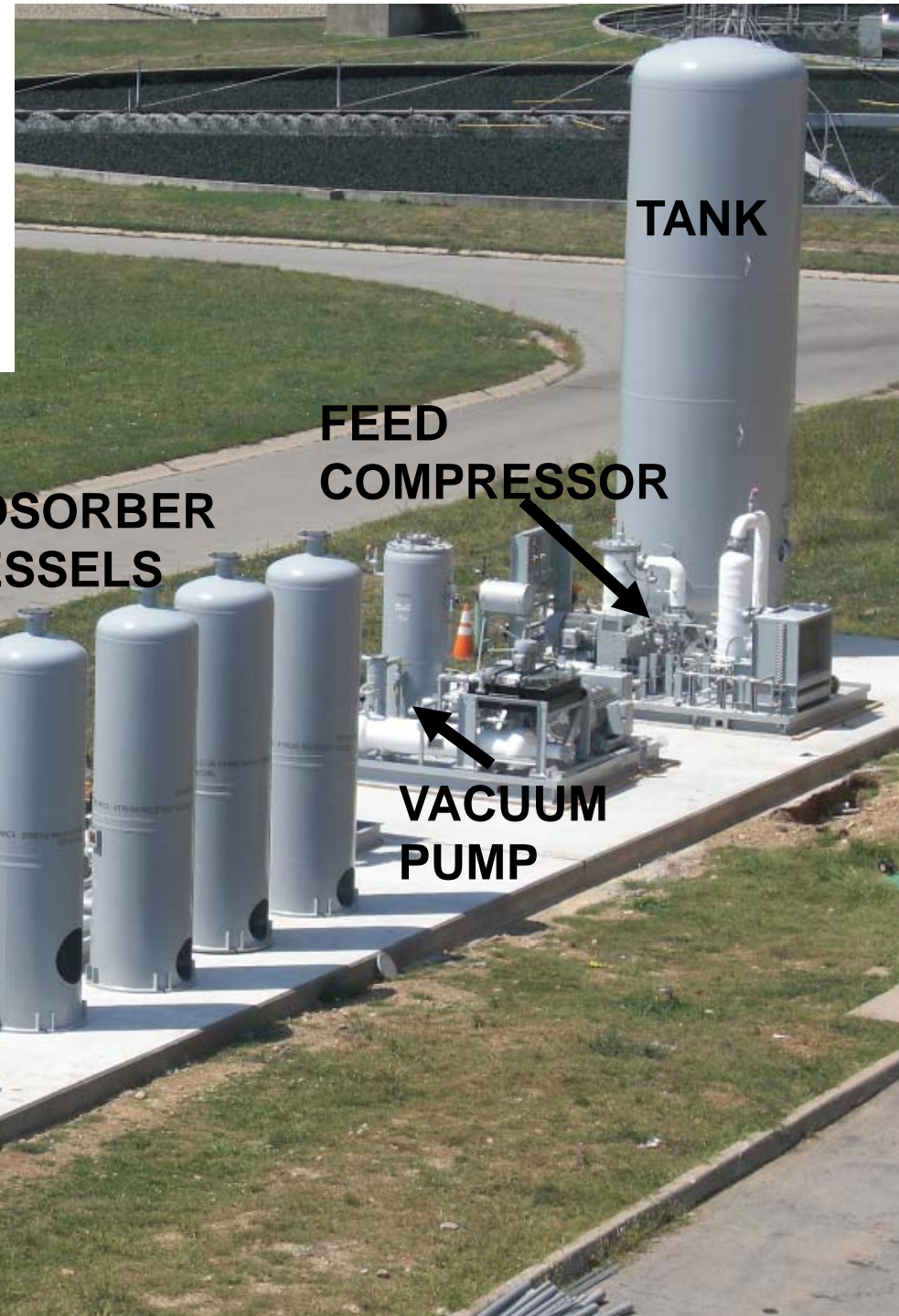
Guild Molecular Gate PSA System
San Antonio, TX (through Ameresco)
Digester (Waste Water Plant)
1300 SCFM (2100 nm³/hr) feed rate
Product to Pipeline Quality (98% Methane)
Product = Dry...Siloxanes, H₂S removed



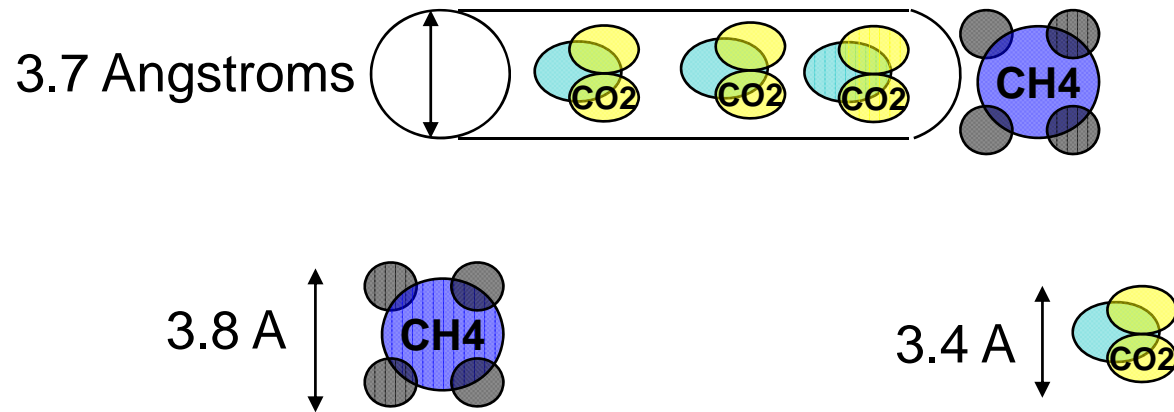
Unit List – Biogas and Landfill Systems

Unit	Location	Feed SCFM	Source	Start-up
1	Idaho	350	Dairy	May 2006
2	Idaho	350	Dairy	May 2008
3	California	1000	Dairy	May 2008
4	Texas	1300	WWTP	August 2010
5	Ohio	150	WWTP	<i>October 2010</i>
6	Ohio	700	WWTP	<i>November 2010</i>
7	Ohio	< 100 SCFM	WWTP	March 2009
1	UK	850	Landfill (LNG)	May 2008
2	Washington	5600	Landfill	March 2009
3	Tennessee	850	Landfill (LNG)	December 2008
4	California	2300	Landfill	July 2009
5	Pennsylvania	5000	Landfill	June 2009
6	Montana	3900	Landfill	<i>November 2010</i>
7	Brazil	12000	Landfill	<i>May 2011</i>

Guild Molecular Gate PSA System
City of Dayton, OH
Digester (Waste Water Plant)
700 SCFM (1125 nm³/hr) feed rate
Product to Pipeline Quality (98% Methane)
Product = Dry...Siloxanes, H₂S removed

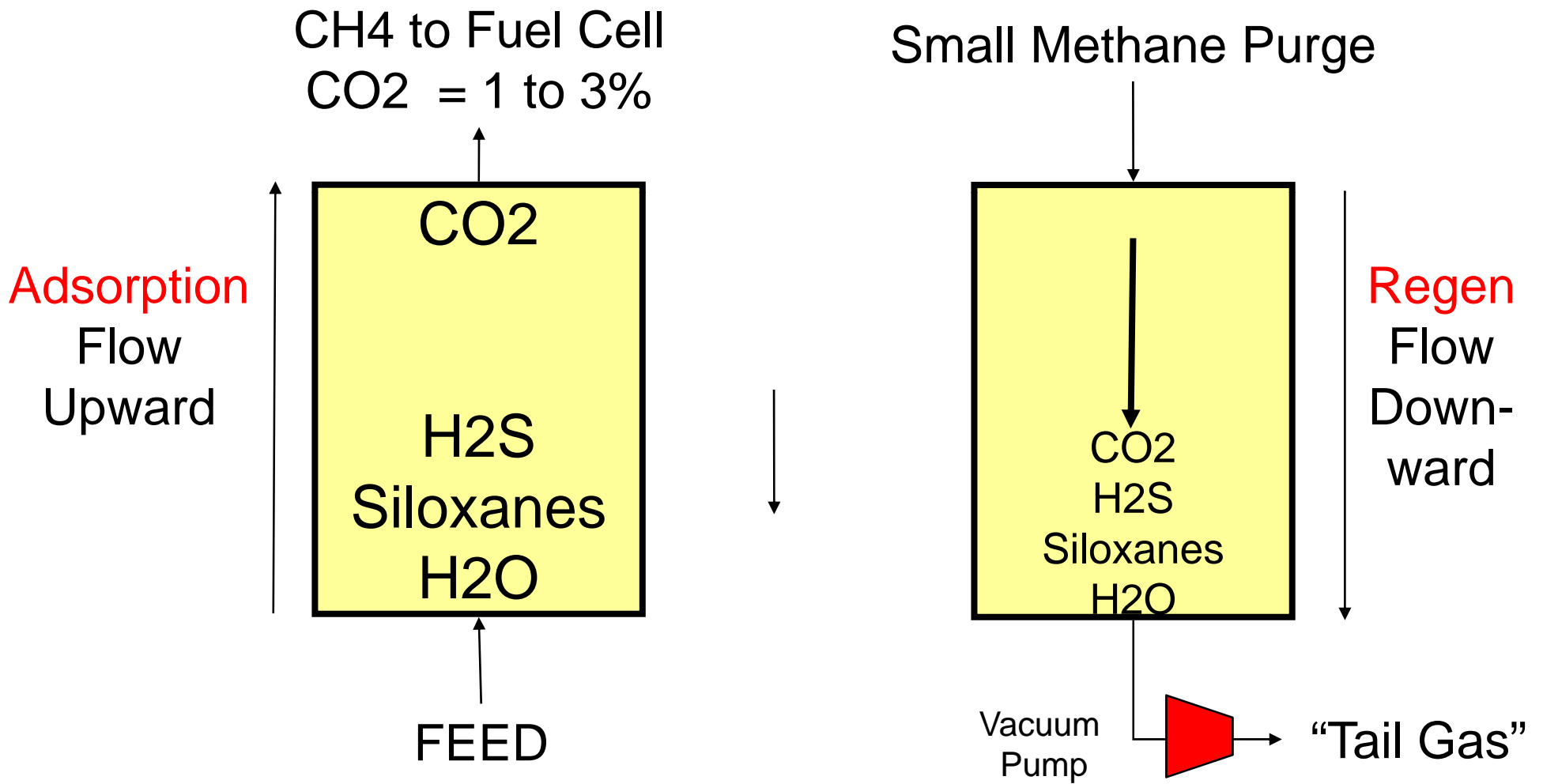


Molecular Gate – Pore Contracted to 3.7 Angstroms to *Exclude Methane*

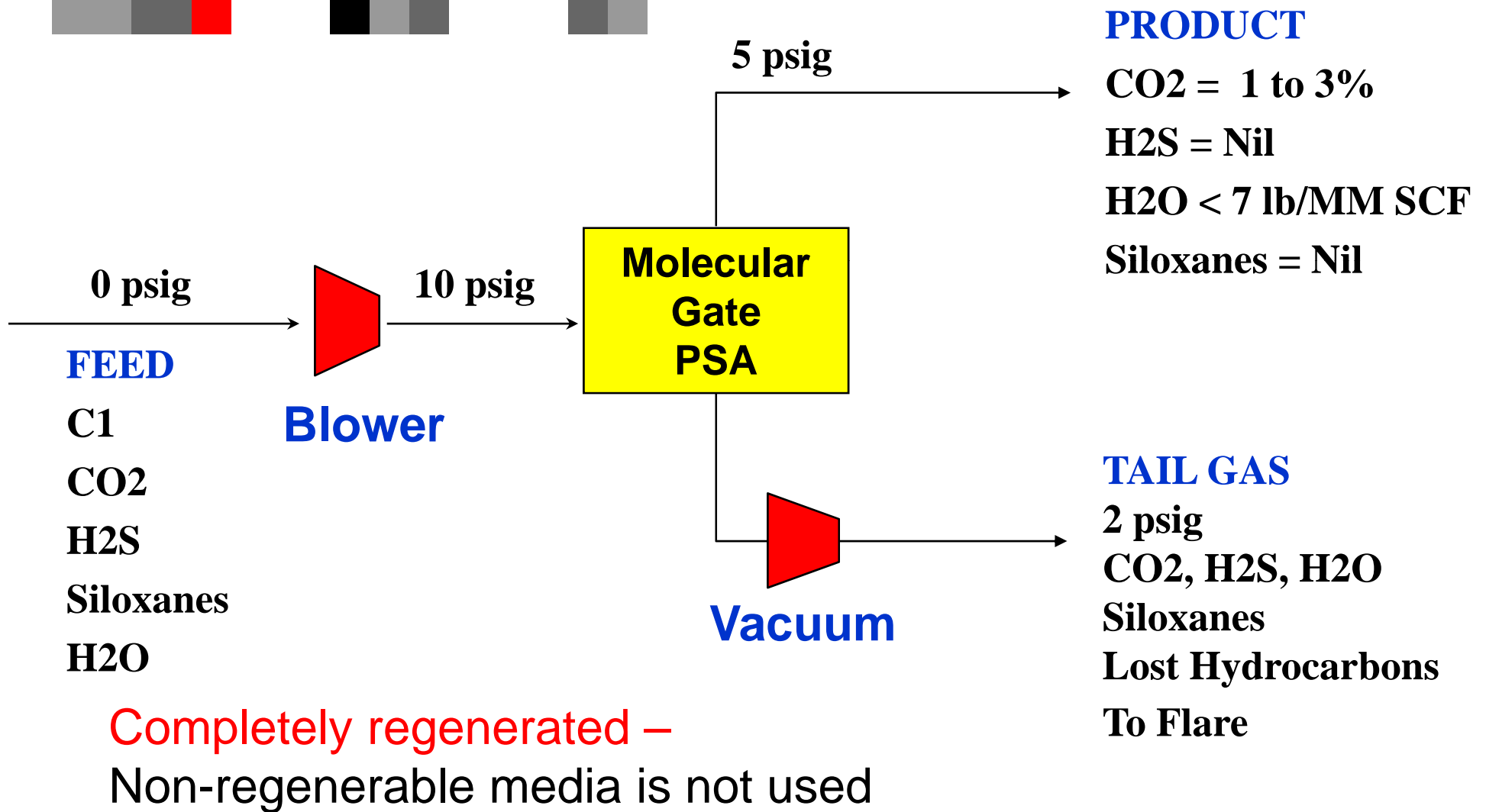


Siloxanes, H₂O, H₂S, VOCs adsorbed on surface and/or in pore

Process Steps



Flow Balance – Low pressure System



Typical Material Balance – High Purity Methane Product

	Feed	Sales Gas	Tail Gas
Flow	100	~50	~50
Pressure, psig	10	5	2
Temperature, F	~100	~100	180
Composition, Mol %			
C1	60.00	97.0 to 99.0	11 to 22
CO2	39.60	1.0 to 3.0	Balance
H2S	0.40	Nil	~1
Siloxanes	2 – 30 ppm	< 20 PPB Si	By Difference
H2O	Saturated	< 7 lb/MM SCF	Wet
HHV BTU/FT3	609	~980 - 1000	111 - 222





Process Steps – Digester Gas



Feed
Compression



Guild
PSA

Product
To Fuel Cell

Tail Gas
To Flare

Quality Acceptance

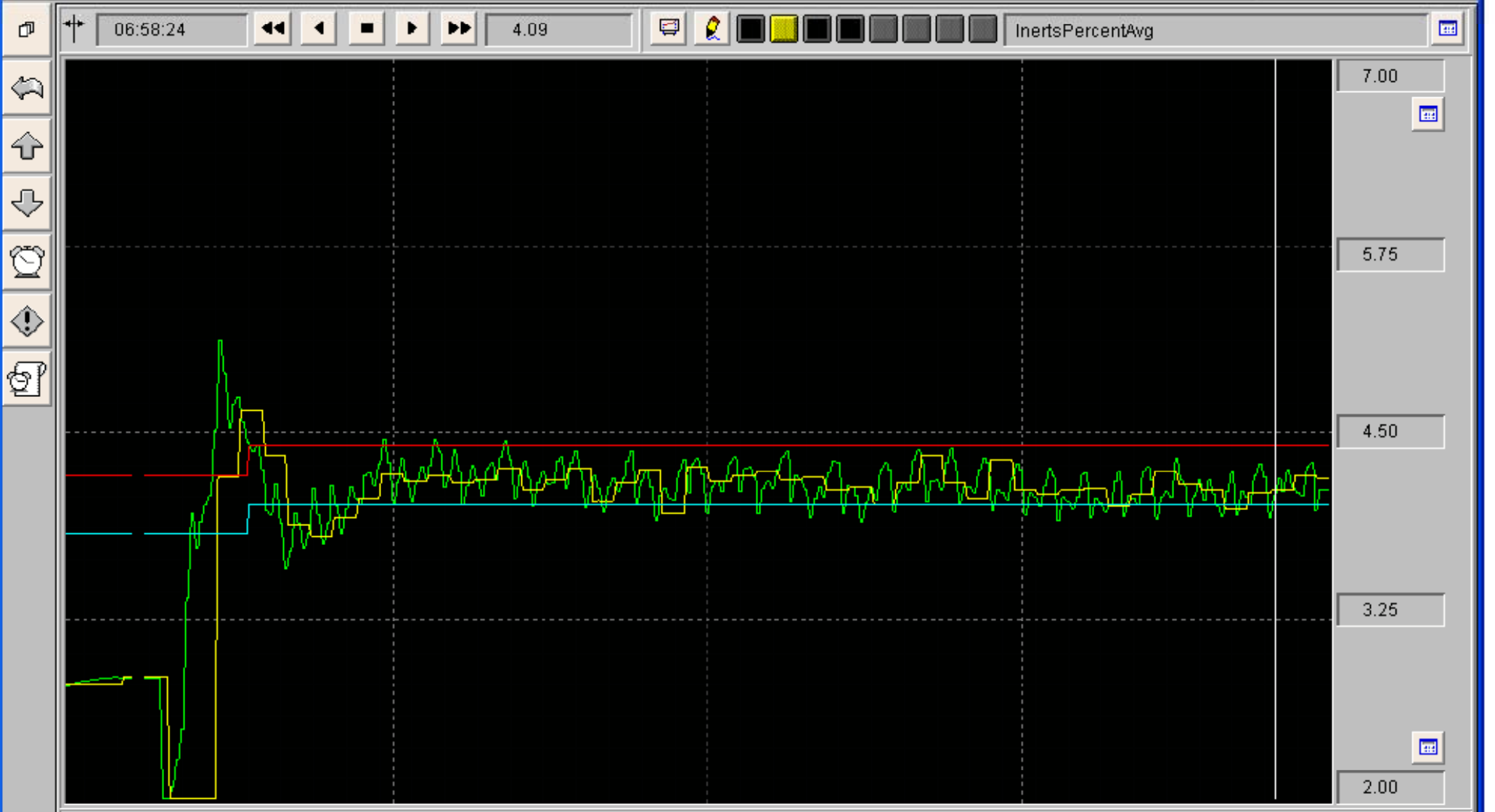
- Intrepid Technology and Resources, ID (Two units)
 - Extensive testing of product stream purity
 - Quality accepted by Intermountain Gas Company
 - Sales also accepted as CNG meeting DOT regulations
 - Removes 40% CO₂ to <2%, Dehydrates,
Removes 4000 ppm H₂S
- BioEnergy Solutions, CA (Vintage Dairy)
 - Sales to PG&E pipeline
 - Removes 30 to 40% CO₂ to <1%, Dehydrates,
A few hundred ppm H₂S removed
- San Antonio & Newark WWTP (Ohio)
 - Producing pipeline quality gas





Process Steps

- Feed compression to 10 psig with an electric drive blower
- Feed flow measurement and control at the blower discharge
- PSA treatment removes water vapor, siloxanes, H₂S and CO₂ in a single step
- Delivery to fuel cell at low pressure
- Automatic product purity control / Automatic PSA adjustment





Tideland's CO₂ Removal System

1 MM SCFD

38% CO₂
Removed to <2%

Start-up May 2002









**THANK
YOU**

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