High Performance Biogas Treating
Contract # RD-72

Presented to the
RDF Advisory Board
December 8, 2009

Project Scope

■ Biogas (Digester Gas) Under Utilized
  ■ Contaminants – H2O, CO2, H2S and Siloxanes
  ■ Typical Composition
  ■ Most Biogas Flared – H2S to SO2 – Acid Rain

■ Size/Location of the Resource
  ■ Relatively Small - < 2 mmscfd
  ■ Municipal WWTP – more than 200
  ■ Future – Rural Locations/AG waste – Manure/litter

■ Current Treating Methods
  ■ Regenerative – Require Large Gas Volumes > 10 mmscfd
  ■ Non-Regenerative – Solid Waste Stream
Project Goals and Approach

- Develop Non-Regenerative/H2S Selective Chemisorbent
  - Gas Volumes - < 2 mmscfd
  - H2S Concentrations – 1,500 to 3,500 ppm
  - 99 pct removal
  - No Solid Waste Stream or Atmospheric Release
  - Cost < $0.50/mmbtu of gas
- Make Biogas Utilization a More Viable Renewable Energy Resource
- Lab Study and Field Study

Laboratory Study – Phase 1

- Simulated Biogas
  - Primary Components – CH4, CO2, H2S
  - No Water Vapor or Siloxanes
- Single Contactor –
  - Counter Current Flow
  - Packed Bed
- Analytical System – Measures H2S as SO2
- Confirms Chemisorbent System Potential
Laboratory Set-up/Testing

Laboratory Testing Operation
Field Study – Phase 2

- Field Test Unit
  - Uses "lead/lag" counter current contactors
  - Chemslibor bent Storage Integral to Contactor Vessel
  - Installed at Norman WWTP – May 2009
  - H2S Concentration 4,000 to 6000 ppm
  - Siloxanes
    - ~ 85 ppm
    - D4 and D5 present

- Adjacent Skid-Mounted Enclosure w/Instrumentation

Field Test Set-up/Testing
Field Test Unit

Features of Treating Technology

- Cost Effective H2S Treatment
  - ~ $0.5/mmbtu
- Suitable for Small to Moderate biogas streams
- No SO2 generated/released, No Solid Waste Generated
- Non-Regenerable Aqueous Solution
- 97.5 % hydrogen sulfide removal
- Not effective for siloxane removal
Benefits of Project/Technology

- Cost Effective Gas Sweetening Technology For Biogas Streams (~ $0.50/mmbtu)
- Significant Improvement in Biogas /Renewable Electric Power Generation Potential
  - Extends life of Capital Equipment
  - Reduces operating/maintenance costs
- Significant Reduction in SO2 Emissions (97.7% reduction)
- Improved Economics for Renewable Electric Power Generation from WWTP
- Improved Economics for Renewable Electric Power Generation from Ag Waste Digesters