Biogas Do’s & Don’ts

MWEA

June 2016
Unison Solutions, Inc. Overview

- Company founded on January 1, 2000
- Located in Dubuque, Iowa
- 38 Employees (10 Engineers)
- 45,000 sq. ft. Manufacturing Facility
- 243 systems sold worldwide, 150+ in Operation
- Biogas Conditioning System Design and Fabrication
- Custom System Design and Fabrication

Leaders in Biogas Technology
and put it to work!

- Boiler Fuel
- Electricity Production
- Heat Recovery
- Fuel for Vehicles

Leaders in Biogas Technology
Capture your biogas....

**Municipal Digesters**
- Danville, IL
- Poulsbo, WA
- Sheboygan, WI

**Industrial & Ag Digesters**
- Sierra Nevada Brewery, NC
- KB Bioenergy, OH
- Grande Cheese, WI

**Landfills**
- La Crosse, WI
- Cherry Island, DE
- Mountain View, CA

*Leaders in Biogas Technology*
Siloxane Impact on Engines

Leaders in Biogas Technology
Siloxane Impact on Flares

After operation with biogas containing siloxanes

Leaders in Biogas Technology
Traditional Biogas Conditioning System

Process Flow Diagram

Digester or Landfill → Hydrogen Sulfide Removal → Gas Compression/Moisture Removal → Siloxane/VOC Removal

Biogas Conditioning System

- MicroTurbines
- IC Engines
- Boilers
Case Study’s Electricity and Heat Production
Dubuque, IA WRRC

Site Information
- 40 MGD municipal plant (Avg. flow 14 MGD)
- 350 scfm of biogas produced

Project Timeline
- 2012 - Phase 1 Project Installed Boiler Fuel
- 2013 - Phase 2 Project Installed (1) CR600

Gas Conditioning Equipment
- Hydrogen Sulfide Removal - Sulfatreat
- Gas Compression/Moisture Removal
- Siloxane Removal

End Use Equipment
- Boiler Fuel for thermal energy
- (1) Capstone CR600 Turbine, produces 600 kW of electricity and thermal energy

Leaders in Biogas Technology
Danville, IL Sanitary District

**Site Information**
- 16 MGD municipal plant (Avg. flow 5-8 MGD)
- 50 scfm of biogas produced

**Project Timeline**
- 2008 - Project Planning Begins
- 2012 - System Start Up

**Gas Conditioning Equipment**
- Gas Compression/Moisture Removal
- H₂S Removal – KI impregnated media
- Siloxane Removal

**End Use Equipment**
- (1) Tech 3 IC Engine, produces 150 kW of electricity and 778,000 BTU/hour of thermal energy

*Leaders in Biogas Technology*
Alternative Fuels: Renewable Natural Gas

BioCNG™

Unison Solutions’ patent pending system to convert biogas to a gaseous vehicle fuel, RNG - Renewable Natural Gas.

Leaders in Biogas Technology
BioCNG™ Vehicle Fueling System
Process Flow Diagram

Digester or Landfill → BioCNG™ Gas Conditioning System → CNG Vehicle Fueling Station and Vehicles

MicroTurbines → IC Engines → Boilers

Traditional System with Addition of CO₂ Removal System

Potential Energy Produced
Vehicle Fuel
Electricity
Heat
BioCNG™ Projects

Leaders in Biogas Technology
St. Landry Parish Landfill; Washington, LA

Site Information
- Solid waste landfill disposal rate - 275 tons/day
- 300 scfm of biogas is collected from site

Gas Conditioning Equipment
- \( \text{H}_2\text{S} \) and VOC Removal
- Gas Compression/Moisture Removal
- Siloxane Removal
- Carbon Dioxide Removal

End Use Equipment
- Progressive waste haulers
- Second fueling site

Leaders in Biogas Technology
St. Landry Parish Landfill; Washington, LA

**PHASE 1**
- Gas Collection and Control System (GCCS)
- On-site flare – monitoring for carbon credits
  - Winter 2008
  - October 2011
  - Site work for Vehicle Fueling System

**PHASE 2**
- BioCNG™ 100 Added
  - April 2012
  - BioCNG™ 50
  - Summer 2015

Leaders in Biogas Technology
Persigo WWTF; Grand Junction, CO

Site Information
- 12.5 MGD municipal plant (Avg. flow 8 MGD)
- 100 scfm of biogas produced

Project Timeline
- April 2015 - System Start Up

Gas Conditioning Equipment
- Hydrogen Sulfide Removal
- Gas Compression/Moisture Removal
- Siloxane Removal
- Carbon Dioxide Removal

End Use Equipment
- Time Fill for CNG-Fueled collection trucks and city buses
- 5.8 mile pipeline from the wastewater facility to the fueling facility
- 142,000 gallons of gasoline diverted = CO₂ emissions reduction of 3 million pounds/year

Leaders in Biogas Technology
Fixed Bed Hydrogen Sulfide Removal Systems

- **Reaction Process**
  - Ferric Oxide Fe$_2$O$_3$ coated
    - Wood or clay substrate
  - Ferric Hydrate, FeO(OH) impregnated
  - Potassium iodide, KI impregnated
    - Coal or coconut substrate
- **Adsorption**
  - Wood or coal based

*Leaders in Biogas Technology*
H2S removal at the digester

- Ferrosorp® DGp
- Ferric hydrate powder
- Added directly to the digester on a daily basis
- Can be used alone or in conjunction with fixed bed media systems

New bag After 7 days

Leaders in Biogas Technology
Fixed Bed VOC Removal Systems

- Why remove VOC’s?
  - Harmful to CO$_2$ removal system for RNG systems
  - Can extend siloxane removal media life significantly

- Media works through adsorption
  - Wood based
  - Can be used with either wet or dry biogas
  - Can not tolerate H$_2$S
How Long Will The Media Last?
Why VOC Data Is Important

<table>
<thead>
<tr>
<th>SYSTEM DESIGNED FOR:</th>
<th>St. Landry BioCNG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGN BASIS:</td>
<td></td>
</tr>
<tr>
<td>FLOW (SCFM):</td>
<td>50</td>
</tr>
<tr>
<td>TEMP (oF):</td>
<td>80</td>
</tr>
<tr>
<td>CARBON TYPE:</td>
<td></td>
</tr>
<tr>
<td>%RH:</td>
<td>25</td>
</tr>
<tr>
<td>COAL:</td>
<td></td>
</tr>
<tr>
<td>OPERATING HRS/DAY:</td>
<td>24</td>
</tr>
<tr>
<td>SYSTEM PRESS (PSIA):</td>
<td>114.7</td>
</tr>
<tr>
<td>CARBON BED (LBS):</td>
<td>135</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPOUNDS TO BE REMOVED:</th>
<th>CONC. (ppm)</th>
<th>MOL. WT.</th>
<th>BOILING POINT (°C)</th>
<th>REFRACTIVE INDEX</th>
<th>PART. PRESS (psia)</th>
<th>LB/DAY</th>
<th>GAC LOADING* (wt%)</th>
<th>GAC USE RATE* (lb/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACETONE</td>
<td>3.9</td>
<td>58</td>
<td>56.2</td>
<td>1.3591</td>
<td>0.000447</td>
<td>0.324024</td>
<td>5.844790015</td>
<td>5.543810232</td>
</tr>
<tr>
<td>TOLUENE</td>
<td>4.6</td>
<td>92</td>
<td>110.6</td>
<td>1.4969</td>
<td>0.000528</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETHYL BENZENE</td>
<td>1.3</td>
<td>106</td>
<td>136.2</td>
<td>1.4983</td>
<td>0.000149</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m-XYLENE</td>
<td>2.4</td>
<td>106</td>
<td>139.1</td>
<td>1.4972</td>
<td>0.000275</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o-XYLENE</td>
<td>0.62</td>
<td>106</td>
<td>144.4</td>
<td>1.5054</td>
<td>7.11E-05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILOXANE-D4</td>
<td>1.7</td>
<td>297</td>
<td>347</td>
<td>na</td>
<td>0.000195</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYDROGEN SULFIDE</td>
<td>0.1</td>
<td>34</td>
<td>na</td>
<td>na</td>
<td>1.15E-05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>14.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.324024</td>
<td>5.844790015</td>
<td>5.543810232</td>
</tr>
</tbody>
</table>

*GAC Loading and Use Rate presume saturation capacity

EST CARBON BED LIFE TILL BREAKTHROUGH = 13 DAYS

PREPARED FOR: Reference - KMT
DATE: 5/31/2012

VOC Clarification: D4 - Includes L2, D3, L3, Tetramethylsilane & Trimethylsilanol
D6 - Includes L4 & L5

Leaders in Biogas Technology
Thank You!

Eric Wilgenbusch

Eric.Wilgenbusch@unisonsolutions.com

www.unisonsolutions.com