Biogas: A Sustainable Renewable Energy

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Economical and Effective Biogas Processes to Purify Alternative Fuels

BgPur™

Removal of H_2S from Biogas

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Biogas Sources

- Agriculture
- Landfill gas
- Municipal wastewater treatment plants
- Industrial wastewater treatment plants
- Food Process Plants
- Others, including sweep gases

Biogas Composition

Mesophilic Generation: 35°C

- **Methane (CH_4): 40 - 70%**
- **Carbon Dioxide (CO_2): 30 - 60%**
- **Hydrogen Sulfide (H_2S): 0.005-3%**
- **Ammonia (NH_3): 5 - 350 ppmv**
- **Oxygen (O_2): 0 - 2%**
- **Particulates: Variable**
- **Siloxanes: 0.5 - 140 ppmv**
- **Pressure: -500 to 2000 Pa**

Biogas Composition

Thermophilic Generation: 55 - 70°C

- **Methane (CH_4): 60 - 80%**
- **Carbon Dioxide (CO_2): 20 - 40%**
- **Hydrogen Sulfide (H_2S): 0.005-5%**
- **Ammonia (NH_3): 5 - 300 ppmv**
- **Oxygen (O_2): 0 - 1%**
- **Particulates: Variable**
- **Siloxanes: 0.5 - 140 ppmv**
- **Pressure: -500 to 2000 Pa**

Hydrogen Sulfide (H_2S):

- **Toxic**
  - **TLV® = 5ppmv**
    (Threshold Limit Value)
  - **IDLH = 100 ppmv**
    (Immediately Dangerous to Life and Health)
- **Odorous > 5 ppb**
- **Corrosive**
- **Explosive LEL = 4%**

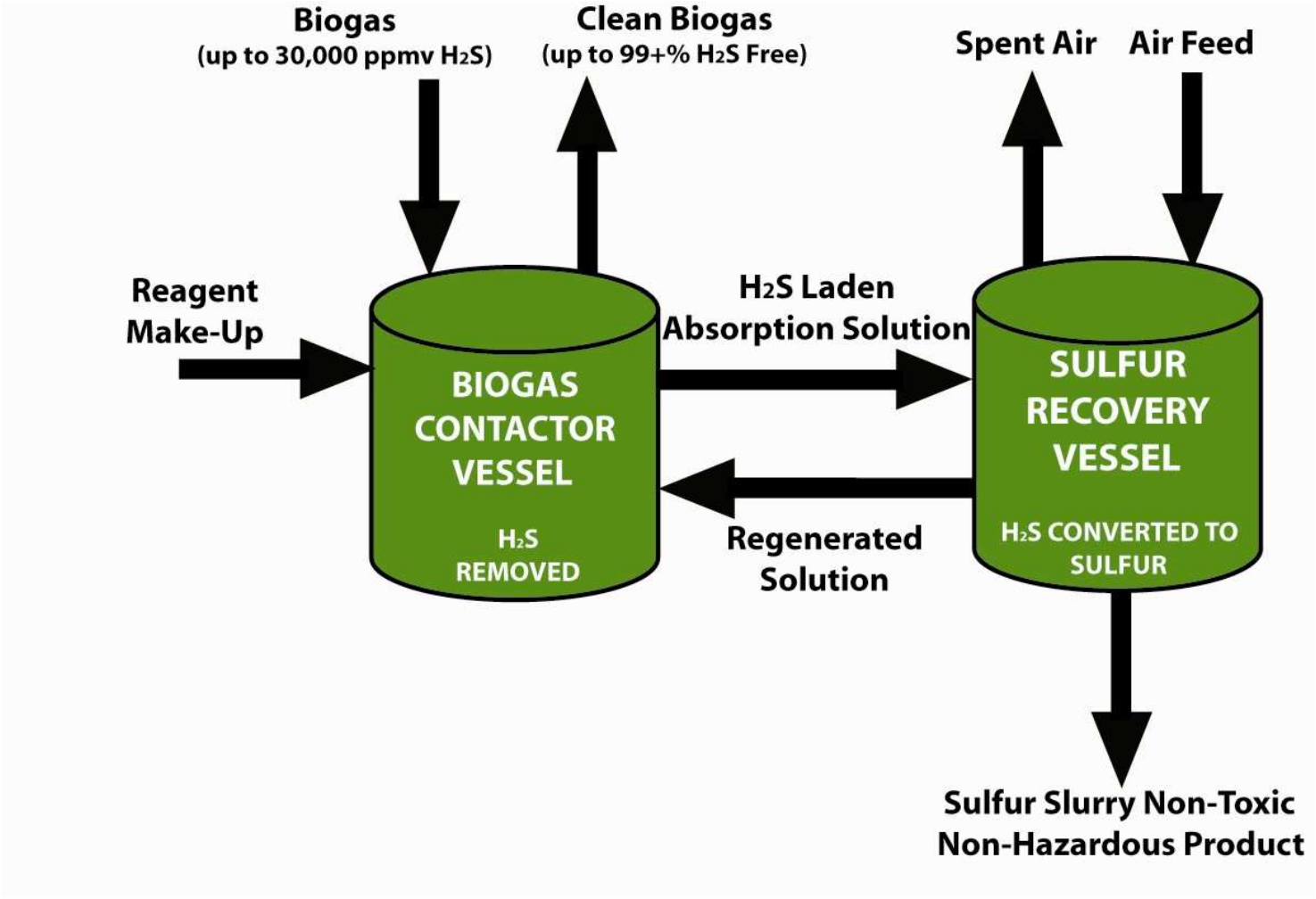
H_2S Removal

- Reduces toxic emissions
- Reduces odour potential
- Reduces maintenance costs due to corrosion
- Enables use of gas for energy or heat production
- To meet , National, County & Other Emission Standards

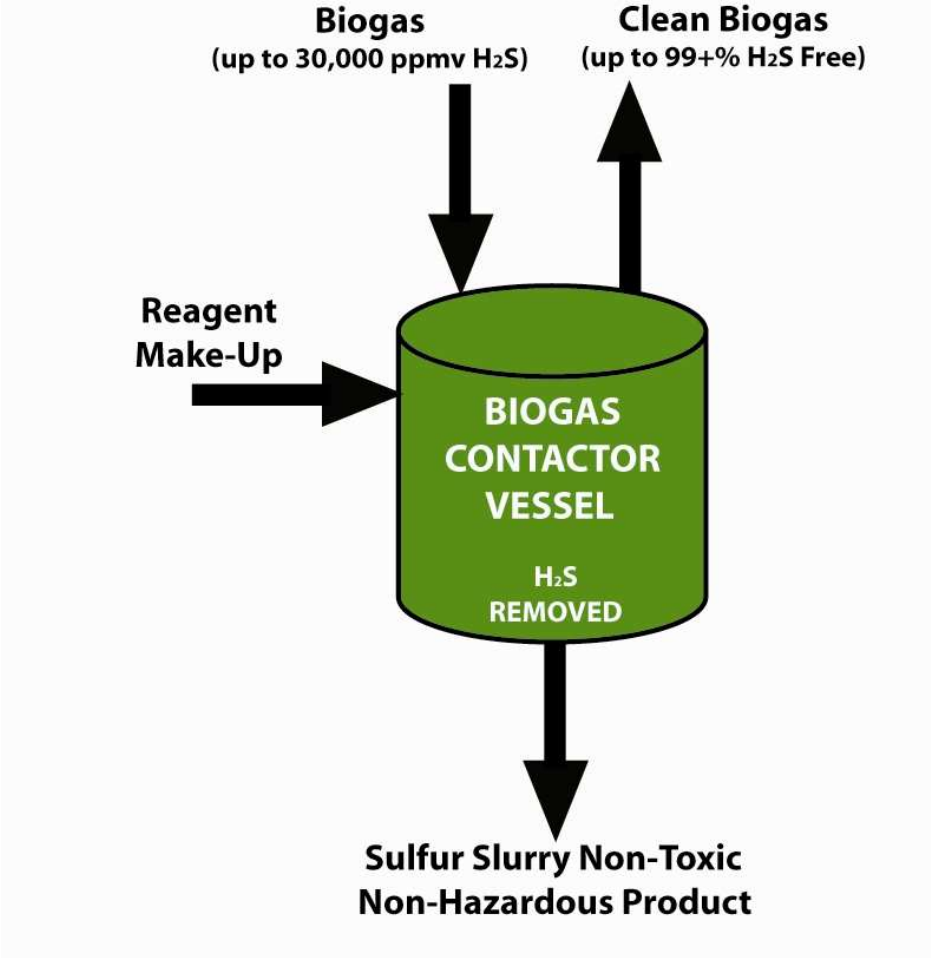
Removal Options

- **Addition of iron salts in the digester (municipal)**
- **Solid state scavenging systems (S < 25-50 kg/day)**
- **Alkaline absorption with bacterial regeneration (S > 25-50 kg/day, < 500 kg/day)**
- **Regenerable redox LO-CAT, BgPur™ (S > 25-50 kg/day, < 1000 kg/day)**
- **Modified Claus (CrystaSulf, SgPur™) (S > 500 kg/day, < 15,000 kg/day)**
- **Amine-Claus Process (> 15,000 kg/day)**

BgPur™ Simplified Process Flow



BgPur™ Simplified Process Flow for Landfill Gas applications



Chemistry

Based on absorption of hydrogen sulfide in a chemical absorbent*.

BioGas Contactor Vessel:

$$HS^- + Absorbent \rightarrow Absorbent.HS^-$$

Sulfur Recovery Contactor Vessel:

$$Absorbent.HS^- + O_2 \rightarrow H_2O + Absorbent + S$$

* Absorbent is ***safe*** and ***non-toxic***.

Features & Benefits

Feature	Benefit
Patented Gas-Liquid Contactor	• >99% H_2S removal • Forgiving of gas flow & H_2S concentration fluctuations
Quick Reaction Time	• Small footprint • Skid-mounted
Flexible Design	• Scalable to be cost effective to customer's specific needs
Robust Design	• Suitable for industrial applications and resists sulfur plugging and foaming problems • Low maintenance costs
Simple Operation (pH control only)	• Low operating cost (electrical and chemical) • Environmentally friendly (agricultural chemicals used and agricultural by-product produced)

Hampton Roads Municipal District

Sewage Treatment Plant

Virginia Beach, VA, USA

400 CFM, 2500 ppm H_2S

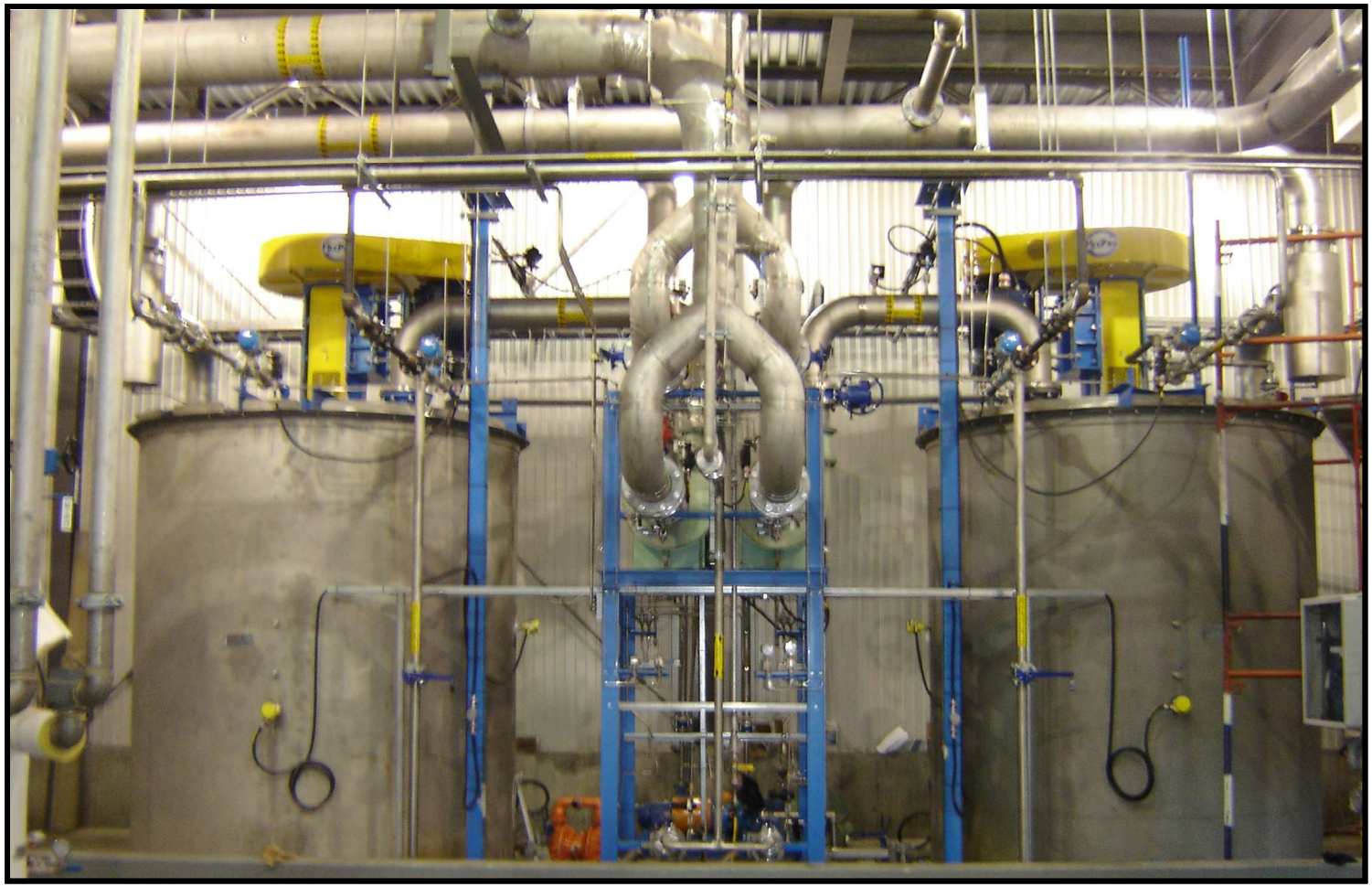
GRD Minproc
Sydney, Australia

GRD MinProc
Sydney, Australia

- **Commissioned 2005**
- **Municipal Garbage Processing Plant**
- **Design gas flow rate 640 scfm, actual less**
- **H_2S levels ranging between 4000 – 5000 ppmv**
- **After purification, H_2S levels ≤ 10 ppmv**
- **Purified gas designed to produce up to 2.4 MW electrical power**

W2R – Lancashire Project

BgPur - RGMRM



BgPur™ User's List

Customer	Date	Gas Details	Application	Status
HRSD Baltimore Black River Waste Water Treatment Maryland, USA	1998	410 Nm^3/hr 0.2% H_2S	Municipal Waste Water Treatment Plant using the biogas to produce electricity	Commissioned in 1998 by Apollo Environmental Systems. System was subsequently shutdown as a result of the use of iron chloride in treatment digesters. HRSD is presently reviewing this practice with the view to stop using the iron salt and recommissioning the Apollo system.
GRD Minproc NSW, AUSTRALIA	2005	1,080 Nm^3/hr 0.4-0.5% H_2S	Municipal Solid Waste Treatment Plant biogas to produce electricity	Commissioned in 2005 by Apollo Environmental Systems.
Archer Daniel Midlands Iowa, USA	2008	700 Nm^3/hr 1.2% H_2S	Corn Ethanol Plant using biogas from thin stillage Waste Water Treatment as energy source to DDGS dryers	Being installed and will be scheduled for commissioning summer 2009
RGMRM Quebec, CANADA	2008	3,850 Nm^3/hr 0.005% H_2S	Municipal Landfill gas being used as energy source to 50,000 m^2 greenhouse	Commissioned early 2009
W2R Lancashire Project Leyland, ENGLAND	2008	1,080 Nm^3/hr 0.4-0.5% H_2S	Municipal Solid Waste Treatment Plant Biogas to produce electricity	Scheduled to ship from Eco-Tec in January 2009 and be installed spring 2009
W2R Lancashire Project Thornton, ENGLAD	2008	1,080 Nm^3/hr 0.4-0.5% H_2S	Municipal Solid Waste Treatment Plant Biogas to produce electricity	Scheduled to ship from Eco-Tec in January 2009 and be installed spring 2009

Thank you!

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