

Guild
Associates, Inc.

Nitrogen and Oxygen Removal Using Equilibrium PSA

Landfill and other high nitrogen feed gas is cleaned for pipeline injection

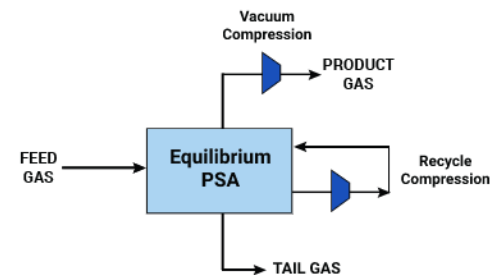


Landfill gas is usually contaminated with carbon dioxide, nitrogen and oxygen, each requiring unique molecular separation technologies. Guild Associates has developed the Equilibrium Pressure Swing Adsorption (PSA) system, which can operate downstream from virtually any CO₂ removal technology to remove the nitrogen and oxygen to pipeline quality levels.

Following removal of CO₂, VOC, H₂S, and H₂O from the raw feed gas, partially processed landfill gas streams often contain enriched levels of nitrogen and oxygen. Guild's Equilibrium PSA technology operates using a carbon-based adsorbent, which adsorbs the methane from the feed gas at high efficiency (96-98%) and rejects nitrogen and oxygen. The Equilibrium PSA has been field-proven to process gas exceeding 15% nitrogen content to pipeline standards. Product gas oxygen is also reduced within this process, to below the typical 0.2% pipeline standard.

Plant operation is highly automated with minimal operator intervention, utilizing similar control theory from Guild Associate's highly successful Molecular Gate™ PSA equipment for CO₂ removal. Maintenance chiefly consists of normal preventive care of rotating equipment, including oil monitoring, mechanical belts and alignment, and oil & filter changes. The carbon adsorbent has been field proven to last beyond one year.

Guild Associates' field proven Equilibrium technology is methane efficient, has high turn-down capability, and is easy to operate and maintain. Please contact Guild Associates to discuss your site's specifications.

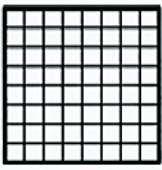


About Guild Associates

Guild Associates designs and manufactures gas processing equipment at our Dublin, Ohio facility. Guild has over 40 plants in operation in the USA, Canada, Brazil, United Kingdom and Phippines, and first installed gas processing equipment in 2004. Guild Associates also manufactures BSR-050 Hydrogen Sulfide Removal Media, the highest capacity dry media in the industry.

Contact us for more information:

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California Rule 21/30 Compliance Made Easy with Molecular Gate™ PSA

Gas sampling at Billings, Montana Landfill to RNG plant proves worry-free removal of Trace Level Constituents and Siloxanes



Guild Associates' Molecular Gate™ Pressure Swing Adsorption (PSA) systems will remove the target gas (CO₂ or N₂) plus water, volatile organic chemicals (VOC), hydrogen sulfide and siloxanes in a single-step process. This is accomplished without the use of disposable media, as the Molecular Gate adsorbent is not replaced during the lifetime of the equipment.

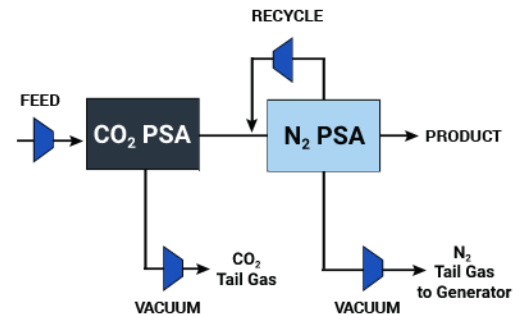
The gas specifications for RNG insertion into California pipelines are PG&E Rule 21 and SoCalGas Rule 30. The purity requirements for gas sourced from landfills stretches the limits of gas laboratory detection, so no real-time instrument is capable of monitoring these trace gasses. Guild Associates has proved through testing at the Billings, MT landfill that the Molecular Gate process is capable of meeting this requirement.

The Billings facility is a two-stage PSA system

described in the process flow diagram to the right. Gas samples were taken at the landfill feed; the product gas of the CO₂ PSA; and the final product gas from the N₂ PSA. The gas samples were then analyzed for constituents included in the two California RNG specifications.

Partial results of the testing are in the chart below. Trace constituents detected at the landfill gas feed was reduced to either below detection levels or below trigger levels after passing through the CO₂ PSA. Of note, the plant and media were >8 years old when sampled.

Landfill gas contaminants vary over seasons and decades. Selecting the robust Molecular Gate PSA is an easy solution that eliminates the need for additional equipment, media replacement and operational challenges

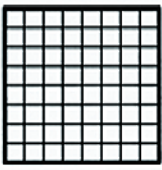


About Guild Associates

Guild Associates designs and manufactures PSA systems for CO₂ and N₂ removal, and also manufactures BSR-050, the highest capacity hydrogen sulfide removal media on the market. Guild is the sole licensee of BASF's Molecular Gate™ Adsorbent, which was first commercialized in PSAs in 2004.

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Trace Level Constituents Results Table				
	TRIGGER LEVEL	FEED	CO ₂ PRODUCT	N ₂ PRODUCT
p-Dichlorobenzene	0.006 ppmv	0.275	ND, <0.006	ND, <0.006
Ethylbenzene	6.0 ppmv	81	ND, <0.001	ND, <0.001
Vinyl Chloride	0.33 ppmv	1.0	0.225	0.009
Hydrogen Sulfide (H ₂ S)	22 ppmv	86.5	ND, <0.011	ND, <0.011
Mercaptans	12 ppmv	2.219	ND, <0.011	ND, <0.011
Toluene	240 ppmv	18.5	ND, <0.001	ND, <0.001
Acid Producing Bacteria	40,000 / SCF	16,800	1,350	BDL
Siloxanes	10 ug/m ³	7700	BDL	BDL



Guild Associates BioGas Processing Plant Locations Throughout North America



Guild Associates, Inc. has biogas plants in operation at landfills, waste water treatment plants, lagoon digesters, and other facilities where the biogas is purified to either pipeline or LNG specifications. Our portfolio of equipment includes: feed compression, Pressure Swing Adsorption (PSA), Temperature Swing Adsorption (TSA), membrane separation, vacuum compression, and product compression. We have standard system offerings or can custom build a package to meet individual customer needs. Guild's Molecular Gate™ PSA systems use only regenerable media with our longest running plant in operation since 2004. Tours of operating commercial units in similar scale and application can be arranged upon request.

Biogas plant locations:

- USA
- Canada
- UK
- Brazil
- Philippines

Feed Flows:

- 50 to 8,000 SCFM

Product Compression:

- Pressure up to 1,400 PSIG for high pressure interstate pipeline
- CNG up to 4,500 PSIG with both slow fill and direct fill

Applications:

- RNG Pipeline Injection
- CNG for Vehicle Fuel
- LNG for Vehicle Fuel

Contaminants removed:

Bulk rejection of:

- Carbon Dioxide (CO₂)
- Nitrogen (N₂)

Rejection of common components:

- Hydrogen Sulfide (H₂S)
- Oxygen (O₂)
- Volatile Organics (VOCs)
- Moisture (H₂O)
- Heavy Hydrocarbons (C₆+)
- Ammonia (NH₃)
- Siloxanes
- California Rule 21 and Rule 30 compliance.