GES Siloxane Removal Systems

Market Application Publication

Background:

As waste in a landfill (or in a digester at a waste water treatment plant) decomposes it produces a gas consisting primarily of methane (CH4) and carbon dioxide (CO2). While both are greenhouse gases, methane is by far the most potent – it is over 20 times more effective at trapping heat in the atmosphere than carbon dioxide. Landfills and digesters are the largest human-related source of methane emissions in the United States.

Environmental regulations require landfill and digester operators to capture and burn the gas to prevent it from getting into the atmosphere. In many cases this gas is simply burned in a flare stack – however, when economically viable, this gas can be used to fuel boilers, engines, turbines or fuel cells to generate electricity. This not only reduces methane emissions but also provides a renewable energy source.

Siloxanes are chemical compounds which contain silicon, oxygen and an alkyl - usually methyl (i.e. SiO[CH3]2). Siloxanes can be found in products such as cosmetics, deodorant, water repelling coatings, food additives, soaps, lotions and plastics. When disposed of in a landfill or in waste water, the siloxanes in these products volatilize into the landfill or digester gas, contaminating it.

When the gas combusts inside a boiler, engine or turbine the siloxanes are converted into silicon dioxide (sand) which is deposited onto the internal surfaces of the combustion chamber and exhaust. These deposits significantly increase maintenance costs and downtime, reduce engine efficiency, plug downstream catalysts, and make it difficult to meet emissions standards. Because of this, engine, turbine and fuel cell manufacturers impose strict limits on allowable levels of siloxanes in fuel gas.

Contact Information:

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Features and Benefits:

- **The only regenerative system proven to consistently meet or exceed the original equipment manufacturer's specifications for fuel gas siloxane content.**
- **Fully adjustable cycle allows the unit to handle a wide range of gas qualities or to adjust to changing gas conditions.**
- **Individually designed to meet the specific needs of each application.**
- **Provides efficient particulate and aerosol filtration, VOC reduction & dehydration in addition to siloxane removal.**
- **Cost effective –as little as 0.2 to 0.6 cents per kWh.**
- **Guaranteed – The only proven long term performance guarantee in the market.**

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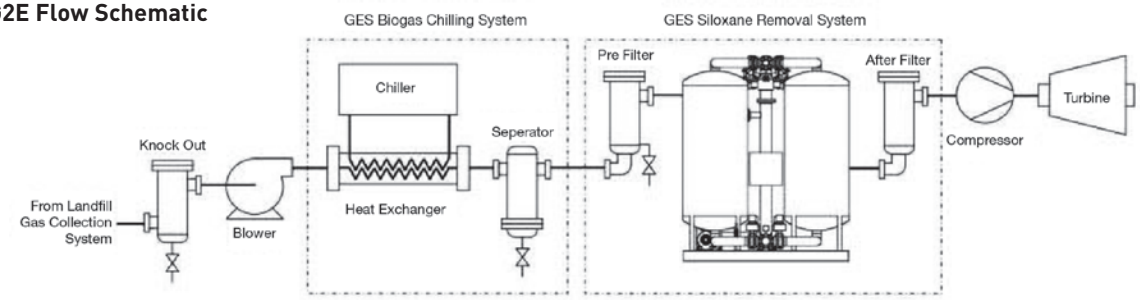
Parker Hannifin: The right solution.

The operator of a landfill gas to energy project was experiencing high maintenance costs due to frequent overhauls of their turbines due to siloxane related buildup. Silicon dioxide was building up inside the combustion chamber and exhaust causing significant damage to the turbine blades, and eventual failure. Their only recourse was to regularly disassemble these turbines to chip and grind the siloxane build up off the affected surfaces at the cost of millions of dollars per year in maintenance and downtime.

In 2007 they installed two Parker Hannifin GES Siloxane Removal Systems in the fuel gas streams prior to the turbines. The result has been a significant reduction in maintenance costs and a significant increase in service life between turbine overhauls resulting in rapid payback of their investment.

Typical LFG2E Flow Schematic



Performance Chart

GES offers a complete range of base models to be tailored to the unique needs of the end user.

Parameter	GES 350	GES 400	GES 600	GES 900	GES 1500	Unit	Note
Rated flow at 5 psig*	300	425	750	1150	2000	scfm	1
Rated flow at 12 psig*	400	625	950	1500	2500	scfm	1
Inlet/Outlet connection	4" 150#	4" 150#	6" 150#	8" 150#	10" 150#	Flanged	-
Purge Exhaust Connection	3" 150#	3" 150#	4" 150#	6" 150#	8" 150#	Flanged	-
Blower Motor	10	10	20	20	40	hp	2
Heater	43	51	122	122	168	kW	2
Height	115	130	155	155	170	in	3
Length	200	200	215	215	250	in	3
Depth	100	100	110	120	120	in	3

Notes:

1 Rated flow is the maximum allowable flow at the maximum allowable inlet temperature of 100°F.

2 Blow hp, Heater kW, Amp Draw and Purge Air Flow are all maximum instantaneous values encountered during specific steps of regeneration.

3 Approximate and subject to change without notice.

Principle Specifications

Parameter	Value
Minimum Inlet Pressure	5 psig
Maximum Inlet Temperature	100°F
Maximum Inlet H2X Content	100 ppmv**
Pressure Vessel Code	ASME Section VIII
Electrical Enclosures	Nema 4X
Pre Filter Element	0.01 micron coalescing
After Filter element	1 micron particulate

* Chilling packages available for high inlet gas temperatures.

** Upstream H2S treatment may be required.

Guaranteed siloxane removal - for an investment of only 0.2 to 0.6 cents* per kWh

*Typical cost intended for reference only. Actual cost depends upon the type of combustion equipment used, and the specific parameters of your application.

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