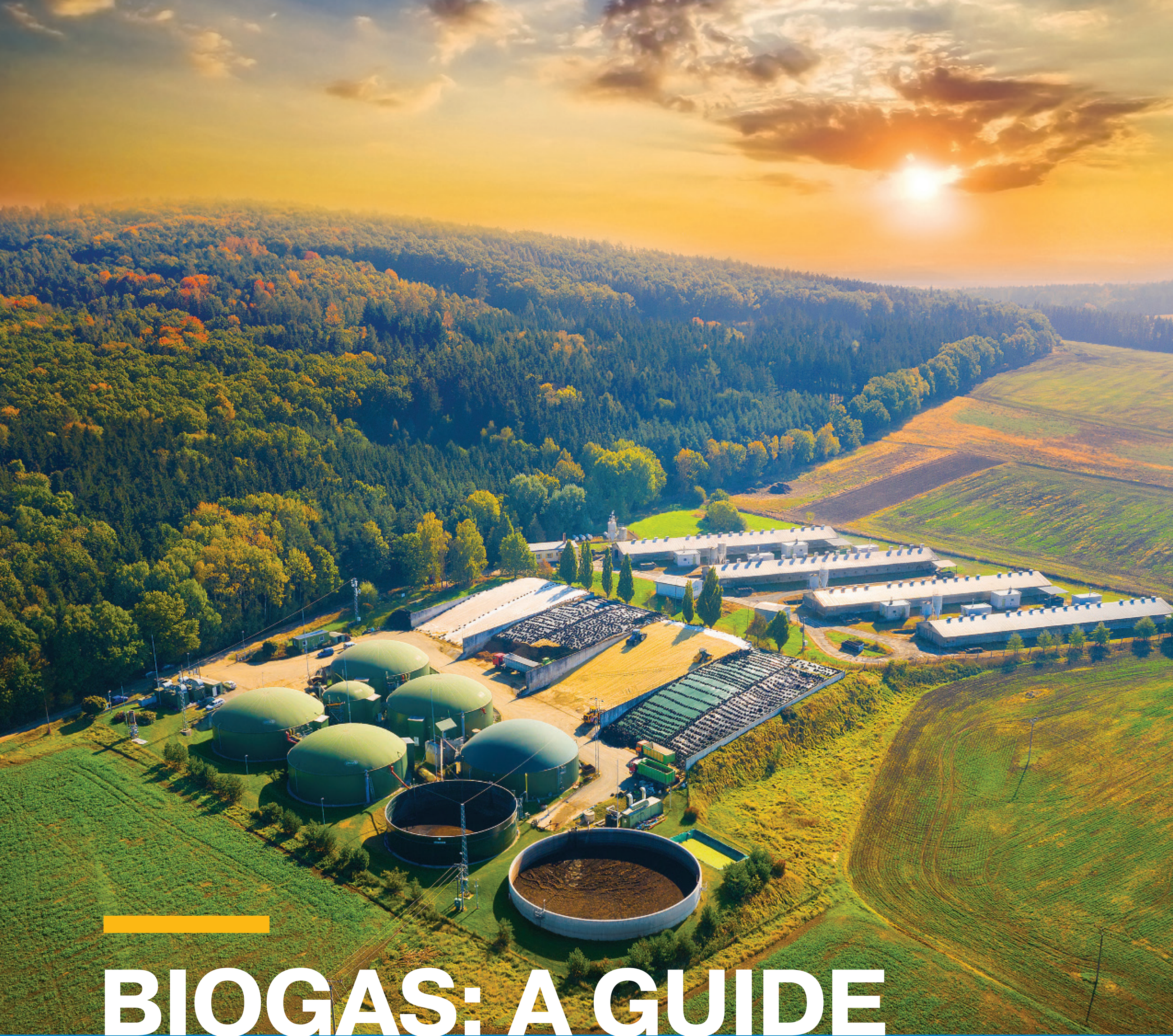


BIOGAS: A GUIDE TO FILTRATION REQUIREMENTS FOR GAS UPGRADING

Parker

APPLICATIONS

Digester Gas

Description

Anaerobic digestion involves converting organic materials such as animal waste and food processing waste into what is known as digester gas, or biogas. The waste material is put into an airtight container, called a digester, where temperature, pH levels and the amount of time spent in the container are closely monitored. The waste is then decomposed and broken down into smaller molecules. The decomposed matter is converted to organic acids. Finally, the acids are converted to digester gas. This renewable gas can then be immediately used as an energy source, or can be stored for future use.

Challenge

Once the waste material has been placed in the digester, mixed, and converted to gas, the resultant gas will contain impurities generated by and left over from the actual digestion process. This includes water, condensed gas liquids, hydrocarbons, and acid gas that must be removed prior to transport for use or storage. If not dried and filtered adequately during the upgrading process, gas will be unsuitable for use as energy. And, if the gas is not managed at each step in the process, the contamination can lead to irreversible damage in system components: membranes, PSAs, TSAs, scrubbers, compressors, valves, and instrumentation.

Landfill Gas

Description

Landfill waste decomposes and produces what is known as landfill gas. Like digester raw gas, this gas is composed mainly of methane and carbon dioxide, with small amounts of other organic gases, but also contains inorganic compounds from the breakdown of plastics and other chemical wastes found in everyday household products. Landfill gas is collected in underground wells, brought to the surface, upgraded, and compressed before being sent out for resale and delivery.

Challenge

Landfills are naturally dirty and retain particulate, moisture and contaminants less common in digestor gas. Also, temperature changes increase the amount of condensate at both the heat exchanger outlet and gas collection point, and make for more variation in the raw gas composition than in a "controlled" digestor process. However, the same as in digester gas treatment, inadequate filtration of the gas can damage upgrading system components: compressor, heat exchangers, membranes, and media in PSA and TSA subsystems.

RAW BIOGAS UPGRADING

Filtration of biogas removes contaminants, improves efficiency, and protects system components.

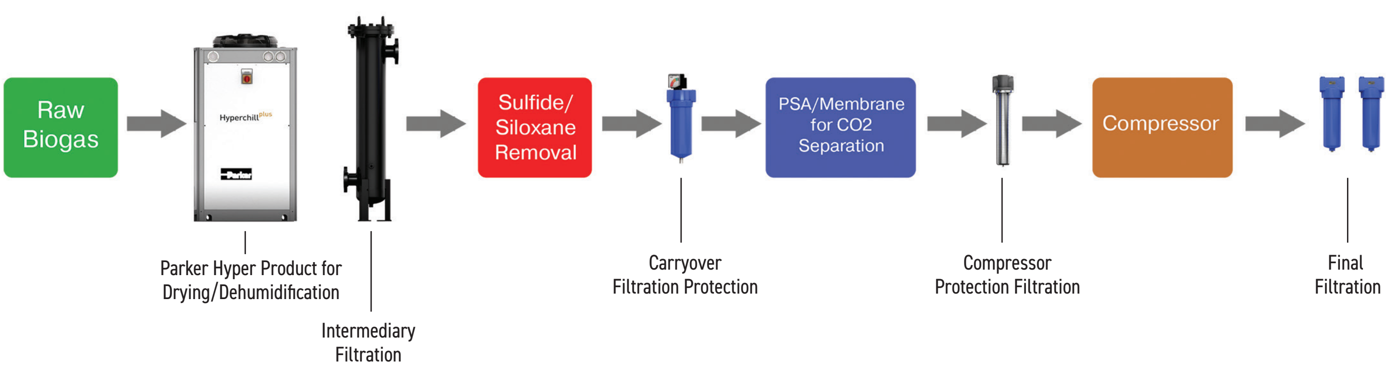
Biogas, renewable natural gas (RNG), originating from biomass, wastewater plants, and landfills is an increasingly important alternative and renewable energy. In raw form, it is primarily composed of methane and carbon dioxide with smaller amounts of hydrogen sulfide, ammonia, nitrogen, and carbon monoxide.

Before utilization, the raw biogas must first be treated to remove water vapor and other contaminants. After being upgraded, the gas may then be used as fuel directly or blended with natural gas. Additionally, CO_2 separated from the methane can be purified and sold as a product to multiple industries.

The selection of effective biogas treatment equipment is critical, to treat and purify the raw gas by the most efficient and cost-effective method, making the most of the available renewable energy from the methane, and capturing CO_2 in order to reduce overall carbon footprint.

Essential to the effectiveness of the upgrading system is the protection of components from the corrosive impurities in the gas. Parker's range of gas drying, separation, and coalescing technologies for gas provide optimum protection in the most demanding application.

Flow Diagram Upgrading System



SOLUTIONS

Parker's range of products to dry the raw biogas assures efficiency in each step of the upgrading process. The goal is to remove moisture before it carries over to critical separation components such as membrane or PSA systems, as well as harmful particulates carried with the moisture and the gas, especially from a landfill. Post the membrane or PSA system, Parker's coalescers and particulate filters further protect compressors, instrumentation, control valves, and provide the final filtration to make sure the product gas meets customer and industry expectations and regulations.

Biogas is usually saturated with water vapor and contains contaminants that need to be removed or reduced, including hydrogen sulfide, carbon dioxide, chlorides, fluorides, siloxanes, and aromatic compounds. Most of these elements are water-soluble; so, by achieving efficient dehumidification it is possible to significantly reduce the water vapor content in the biogas and partially or completely remove some of these impurities. Parker's solution is to dry the gas by cooling to around 41°F (5°C) using a water-cooled heat exchanger working with a water chiller and secondly, remove the condensed water with a cyclonic water separator followed by a final coalescing filter.

Drying & Dehumification Products

HYPERCHILL BIOENERGY	HYPERCOOL BIOENERGY	HYPERSEP BIOENERGY	HYPERFILTER BIOENERGY	HYPERDRAIN BIOENERGY
				
• Chiller output 5 – 360 kW • Special coating for corrosive environment • Pump and tank installed in casing • Microprocessor controlled • Ambient range -4 °F to +113 °F (-20°C to +45°C) • Compliant scroll refrigerant compressor • IP54 protection as standard	• High cooling efficiency with low pressure drop design • Max. working pressure: 0.5 barg	• Cyclonic separator optimized for biogas applications • High separation efficiency with very low pressure drop • Max. working pressure: 0.5 barg	• Particle removal size 5 or 20 µm • Filtration Efficiency 99.999% • Differential pressure 2 mbar • Max. working pressure: 0.5 barg	• Designed to work with dirty condensate and for low pressure operation • No electrical wiring • No gas loss • Parts in contact with condensate in stainless steel and reinforced polyamide, body treated with special Hiroshield treatment for optimal operation in harsh passivation treatment environments

PROTECTION FOR SYSTEM PROCESSES

For coalescing and particulate filtration once the gas has been dried, and to protect system components at each step, Parker has a range of housings by size/flow rate, material of construction, and with various element medias, to suit different size systems and different cleanliness level requirements of components.

ASME Vessel Range

- Pressures to 185 PSIG
- Coalescing, particulate and adsorption elements available
- Connections from 3" to 16"
- Flows from 1500 to 37,000 SCFM
- Temperatures to 450°F
- Optional indicators, gauges and drains
- Design: ASME code/Canadian registration
- Custom pressure, temperature, and material options

H-Series

- Pressures to 500 PSIG
- Coalescing, particulate and adsorption elements available
- Connections to 3”
- Flows from 190 to 1600 SCFM (@ 100 psig)
- Temperatures to 450°F
- Only manual drains should be used with flammable gases

M-Series

- Pressures to 800 PSIG
- Coalescing, particulate and adsorption elements available
- Connections from 1/4” to 2”
- Flows from 78 to 2500 SCFM
- Temperatures from 175°F

J-Series

- Pressures to 5000 PSIG
- Coalescing, particulate and adsorption elements available
- Connections from ½” to 1½”
- Flows from 30 to 18,000 SCFM
- Temperatures from 350°F

ZJ-Series

- Pressures to 6000 PSIG
- Coalescing, particulate and adsorption elements available
- Connections from 3/4” to 2”
- Flows from 90 to 25,000 SCFM
- Temperatures from -40°C/°F to 350°F

Stainless Steel Filter Options

- Pressures to 4000 PSIG
- Coalescing, particulate and adsorption elements
- Connections from ¼” to 2”
- Flows from 90 to 25,000 SCFM
- Temperatures from -40°C/°F to 350°F

THE PARKER ADVANTAGE

Receiver and Gas Treatment System (Membrane/PSA) Protection

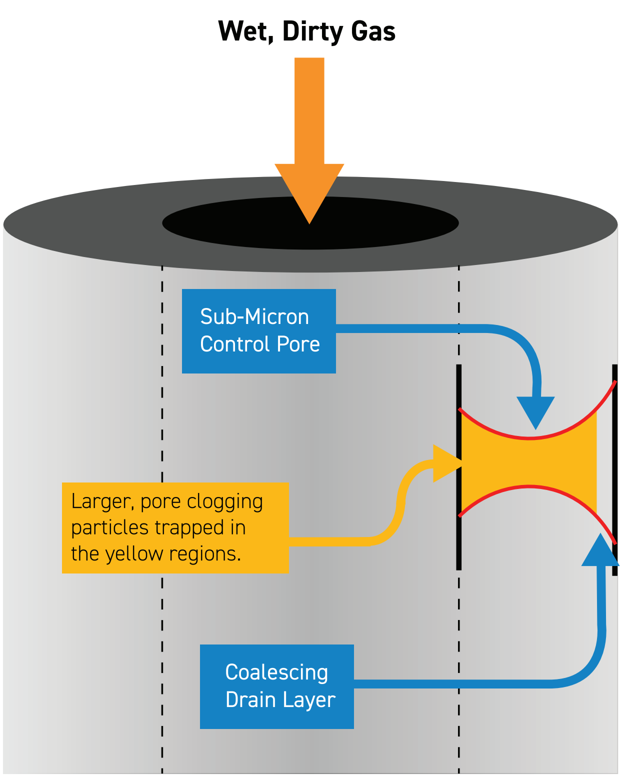
The gas coming off of the digester should be filtered prior to entering a gas receiver to eliminate contaminants generated by digestion. Gas leaving treatment should be filtered to remove any liquids carried over from the process.

Compressor Protection & Final Filtration

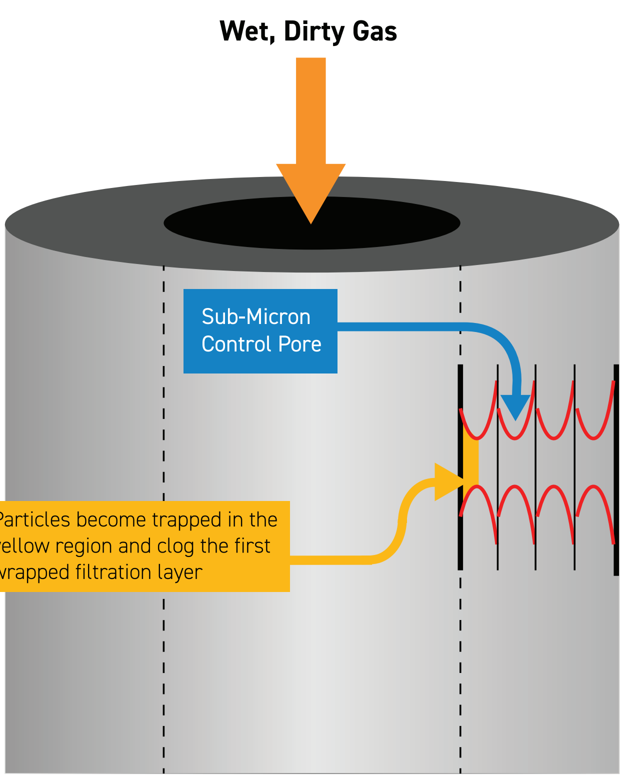
Filtration of collected landfill gas entering into the compressor will eliminate particles, liquid slugs and aerosols that could otherwise damage downstream equipment. Also, a coalescer should be placed downstream of the heat exchanger to collect any compressor lube oil and condensed liquids.

Parker's Uni-Cast elements maintain coalescing efficiency over a very wide range of flow. The unique Uni-Cast design provides a deeper, progressively efficient filtration media bed that allows for high efficiency and low differential pressure. Wrapped or layered style elements will satisfy a normal range of compressed air flows, but the flow rate and pressure dynamics of a natural or biogas system are much different. When the dynamics change within a matter of minutes, a wrapped element loses its filtration efficiency over the wide range of volumetric flow.

Good filtration prevents contamination and compressor oil from migrating downstream. Parker filters are designed to withstand high differential pressures without rupturing. The Parker Uni-Cast depth style elements for high pressure housings have steel retainers to ensure high burst strength and minimize the chance of breakthrough in the media.



Uni-Cast Pore Structure



Wrapped Pore Structure

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BRO_PKR_Biogas Filtration_122024