



An Ovivo Division

## DIGESTER GAS CLEANING/ DRYING EQUIPMENT

### VAREC BIOGAS 236 Series GAS PURIFIER

The 236 Series Gas Purifier is designed to be the most cost-effective system to remove Most  $H_2S$  from biogas produced in anaerobic digester, lagoons, and municipal landfills.

#### Introduction

Biogas is produced in anaerobic digesters, lagoons, and municipal landfills. It is generated by the anaerobic digestion of organic solids that contain small amounts of hydrogen sulfide ( $H_2S$ ). Biogas is an effective alternate source of energy to fuel engine generators or boilers. Due to the rising cost of fuel it is beneficial for wastewater treatment plants to utilize and capitalize on the production of biogas. The 236 Series is designed as the most cost-effective method for  $H_2S$  removal from biogas.

Biogas contains relatively small amounts of  $H_2S$ , enough to corrode metals and damage equipment. This can create maintenance and operational problems.  $H_2S$  is also a toxic air pollutant that can create a severe odor nuisance in minute concentrations. Stringent regulations restricting sulfur emissions requires the treatment of biogas for removal of sulfur compounds.

#### Design Features

- Specifically designed for low pressure biogas applications.
- Provides the necessary volume to ensure optimum space velocity for efficient digester gas/iron sponge reaction time.
- Multiple purifier installs allow separate vessels to operate in series or parallel. During maintenance, vessels can be taken off line while others remain in operation.
- Fiberglass tanks provide more than four times the operating life than steel tanks.
- Optional Iron Sponge Removal System allows for a crane (provided by others) to remove media in bulk. Lifting capacity is 20,000 lbs.
- Optional insulated tanks for outdoor applications in freezing environments.



#### Applications

Biogas contains hydrogen sulfide in concentrations of up to 3000 ppm or more, depending on the influent wastewater composition. The odor of  $H_2S$  becomes offensive at 3 to 5 ppm. An atmospheric concentration of 300 ppm can be lethal.

The life cycle of any high cost capital equipment, such as a heat exchanger or engine-generator, is significantly reduced when subjected to the corrosive effects of  $H_2S$ . Many engine manufacturers require the  $H_2S$  content to be as low as 100 ppm. When biogas is burned or flared,  $H_2S$  generates sulfur dioxide ( $SO_2$ ) emissions.  $H_2S$  removal is a must when your local Regulatory Commission limits  $SO_2$  emissions. The 236 Series Gas Purifier is designed to remove most of the  $H_2S$  from the biogas stream. It is usually installed upstream of a gas engine generator or boiler.

The following parameters should be measured for proper sizing and operation of the purifier: Inlet biogas flow rate, inlet and outlet biogas pressures, inlet and outlet  $H_2S$  concentrations, condensation (drip water), and pH of drip water.

Isolation valves (supplied by others) are recommended for field installation in the inlet and outlet piping of each tank. Drip traps are recommended for installation in the available drain connection to provide for safe condensate removal. It also provides the means to verify that the media is kept moist.

Installation location should accommodate Media Removal methods and ensure easy access above the purifier. Due to its size and function, the gas purifier should be installed outdoors. Insulation is required in cold weather climates.

## Operation

The 236 Series Gas Purifier utilizes a bed of iron sponge as the active media for H<sub>2</sub>S removal. In the Gas purification process, hydrogen sulfide is removed by passing sour gas through the purifier. As the biogas goes through the purifier and reacts with the media, H<sub>2</sub>S is removed by reacting with the (Fe<sub>2</sub>O<sub>3</sub>). The chemical reaction results in forming ferric sulfide (Fe<sub>2</sub>S<sub>3</sub>), water and heat.

The chemical reaction is as follows:  

$$2\text{Fe}_2\text{O}_3 + \text{H}_2\text{O} + 6\text{H}_2\text{S} = 2\text{Fe}_2\text{O}_3 + \text{H}_2\text{O} + \text{Heat}$$

After some time, the sponge material is fully reacted. Spent sponge can then be regenerated through a reaction with atmospheric oxygen which converts Fe<sub>2</sub>S<sub>2</sub> back to Fe<sub>2</sub>O<sub>3</sub> and produces elemental sulfur.

The regeneration reaction is as follows:  

$$2\text{Fe}_2\text{S}_3 + 3\text{O}_2 = 2\text{Fe}_2\text{O}_3 + 6\text{S} + \text{Heat}$$

Caking of the bed with the elemental sulfur limits the sponge life. H<sub>2</sub>S levels and pressure drop should be continuously measured at the outlet of the purifier. When maximum allowable concentrations of H<sub>2</sub>S and pressure drop are beyond recommended levels, the media needs to be regenerated or replaced.

### Manual Regeneration

Manual Regeneration is achieved by exposing it to natural aeration. The sponge can be the media regenerated up to two times before it requires replacement. Each time the sponge is regenerated, it lasts up to 70% of its prior sponge life.

### Continuous Regeneration

The most economical method for long-term operation, low maintenance cost and increased sponge efficiency is continuous or "On-Line" regeneration. In the Continuous Regeneration System, a controlled amount of air is injected into the gas at the purifier inlet. A water spray wash system is in place for high-temperature safety control and to keep the iron sponge moist for improved regeneration.

A Soda Ash Slurry Injection System assists in maintaining pH balance. The "On-Line" regeneration system significantly extends the bed life of the media allowing minimal maintenance and operating cost.

NOTE: It is important to note that any variation to the original design conditions, along with variables such as moisture content and pH level will affect H<sub>2</sub>S removal efficiency.

### Air Injection System

A NEMA 4X (Optional NEMA 7 or 316 SS) Fiberglass construction control panel housing the following components:

- An explosion-proof solenoid valve that will activate the air injection line.
- A pressure regulator that regulates constant air flow.
- An air flow meter to ensure that only 2.5% - 5% of the total flow rate is injected into the purifier.

### Water Spray Wash System

A temperature switch is provided to continuously monitor the iron sponge bed temperature. Explosion-proof solenoid valves are supplied to activate the water spray wash system. Water is used to ensure proper moisture content in the media. The water supply will automatically be activated if the temperature in the vessel reaches 120°F (49°C). This ensures that the sponge remains in a hydrated condition, and excess heat generated by the exothermic regeneration reaction is stabilized.

### Soda Ash Injection System

To achieve the most efficient H<sub>2</sub>S removal operation the pH level of the system must not fall below 7.5 pH. Soda ash is introduced into the system from a separate mixing tank to improve the pH level.

## Specifications

### Materials

TANK - Reinforced FRP fiberglass with NFPA 820 fire resistant coating.

COVER GASKETS - Teflon®

IRON SPONGE MEDIA - Impregnated wood chips.

NOTE: Spent media can generally be disposed of in a sanitary landfill with a light earth cover. Consult your environmental agency for possible local requirements.

### Iron Sponge Performance

MODEL 236-XX-0: Manual Regeneration  
Estimated 5 lbs of sulfur removed per cubic foot of iron sponge before manual regeneration.

The sponge can be regenerated up to two times before it requires replacement. Each time the sponge is regenerated, it lasts up to 70% of its prior sponge life.

MODEL 236-XX-1: Continuous  
Regeneration Estimated 10.5 lbs of sulfur removed per cubic foot of iron sponge.

### Support Requirements

A concrete foundation should be provided to support the purifier.

Consult factory for clearance requirements.

## Specifications

### Sizes

Manual Regeneration  
Continuous Regeneration  
8 ft. Diameter  
12 ft. Diameter

### Operating Temperature Range

32°F - 120°F (0 - 49°C)

### Maximum Working Pressure

0" - 18" WC

NOTE: This unit is not rated for vacuum conditions. Consult factory if vacuum is required.

### Sizing Requirements

Configured for:  
8 ft. diameter x 10 ft. height or  
12 ft. diameter x 12 ft. height.

Inlet and Outlet flanges are provided based on pipeline size.

The overall dimension of the unit may vary depending on the following important and required parameters:

- Flow Rate
- Inlet H<sub>2</sub>S concentration in ppm
- Desired outlet concentration
- Indoor or Outdoor installation

### Flanged Connections

2" - Flanged drain

### Inlet & Outlet Flanges

Drilled ANSI Class 150 FF dimensions  
Consult Factory for available sizes.

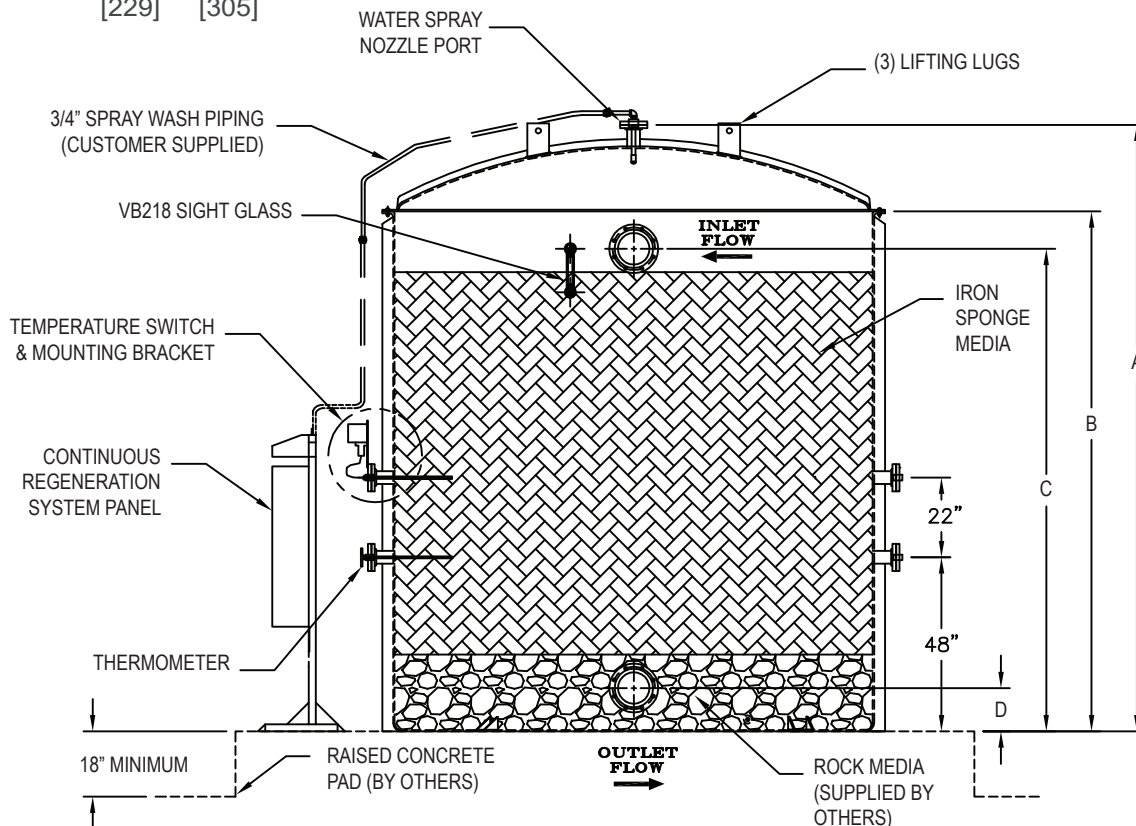
### Approx. Shipping Weights:

8 - foot diameter vessel  
Without insulation: 1800 lbs (855 kg)  
With insulation: 2600 lbs (1180 kg)

12 - foot diameter vessel  
Without insulation: 2550 lbs (1160 kg)  
With insulation: 3900 lbs (1810 kg)

### Dimensions, inches [mm]

Size Code	08	12
Vessel Diameter	8'	12'
<b>A</b>	135 [3429]	181 [4597]
<b>B</b>	120 [3048]	144 [3658]
<b>C</b>	114 [2896]	133 [3378]
<b>D</b>	9 [229]	12 [305]



NOTE: Inlet and outlet pipe locations are subject to change, depending on the size of the pipe and flange.

## Ordering Information

Model	Description	
236	Waste Gas Purifier	
	Code	Vessel Diameter
	08	8 Foot Diameter
	12	12 Foot Diameter
	Code	Configuration
	0	Manual Regeneration
	1	Continuous Regeneration System
	Code	Control Panel Enclosure
	0	Not Required
	1	NEMA 4, Steel
	2	NEMA 7 Explosion Proof, Aluminum
	3	NEMA 4X, Stainless Steel
	Code	Power Supply (If Applicable)
	0	Not Required
	1	110/ 120 VAC 50/ 60 Hz, Single Phase
	2	220/ 240 VAC 50/ 60 Hz, Single Phase
	Code	Optional Systems (May Select More Than One)
	0	None
	1	Insulated Tank
	MR	Media Removal System
	Inlet and Outlet Flange Connections ANSI 150 FF Drilled Connections	
	Code	Size
	04	4" (100mm)
	06	6" (150mm)
	08	8" (200mm)
	10	10" (250mm)
	12	12" (300mm)

236      08      1      1      1      MR      10      (Example)

Example: 236 Gas Purifier; 8 foot diameter; Continuous Regeneration Configuration; NEMA 4 Steel;

Power supply 110/120 VAC 50/60 Hz, Single Phase; with Media Removal System & 10" Inlet/Outlet Flange, ANSI 150 FF Drilled Connections