

## Technology for improving biogas value

### Features

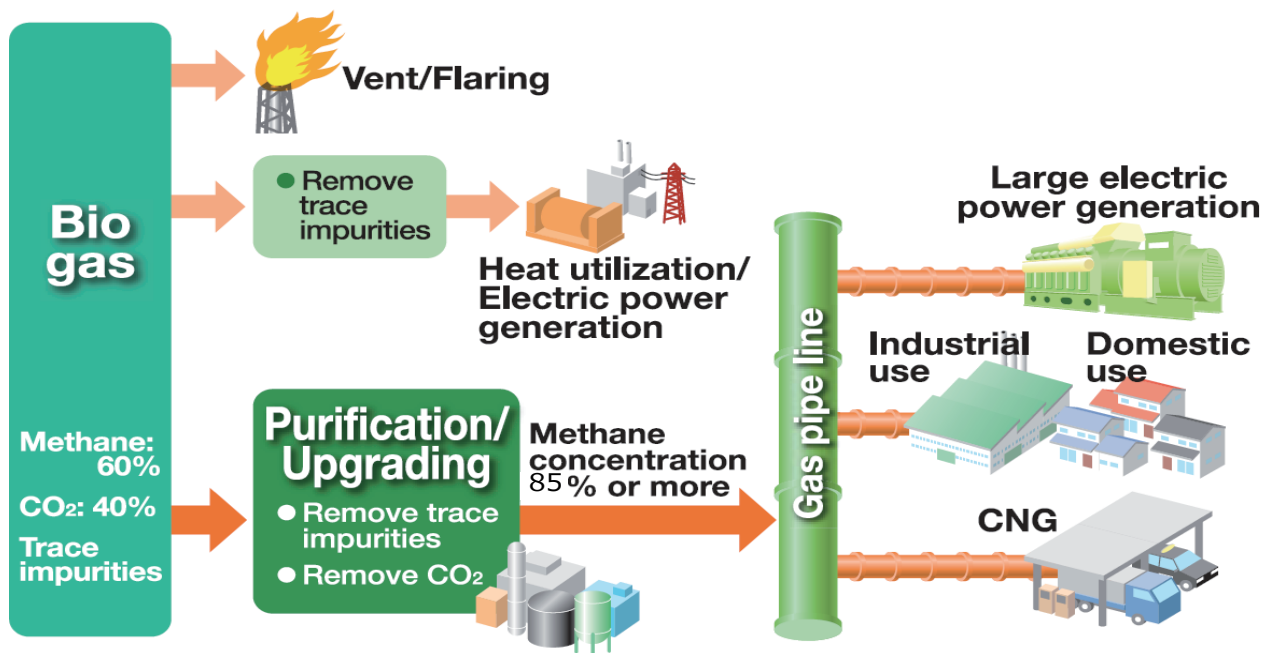
Equipment for manufacturing high purity methane, by purifying biogas generated or manufactured from organic waste materials is recommended.

- ◆ Resources disposed of in the past, such as waste liquid from palm oil extraction or cassava processing, as well as sewage and raw waste, can be used effectively.
- ◆ Purified methane (biomethane) can be used as a natural gas substitute fuel and used as automobile fuel, as well as industrial fuel. Since they are derived from waste materials, greenhouse gas emissions can be reduced when compared to ordinary natural gas.

### Basic Concept or Summary

#### ◆ Summary

Biogas is renewable energy derived from a biological fermentation process of organic waste materials and raw waste, such as sewage sludge or agricultural residue, which is considered carbon neutral. They are used primarily as fuel for boilers and gas engines that require no purification, however a trend of purifying biogas to produce a natural gas substitute fuel (fuel for utility gas and natural gas vehicles (NGV)) has been spreading in the recent years, driven by the perspective for reducing the environmental burden. Osaka Gas offers biogas purification equipment that adopts proprietary technology for manufacturing biomethane, by removing carbon dioxide (CO<sub>2</sub>) from biogas (60% CH<sub>4</sub> and 40% CO<sub>2</sub>).



Biogas purification and utilization flow

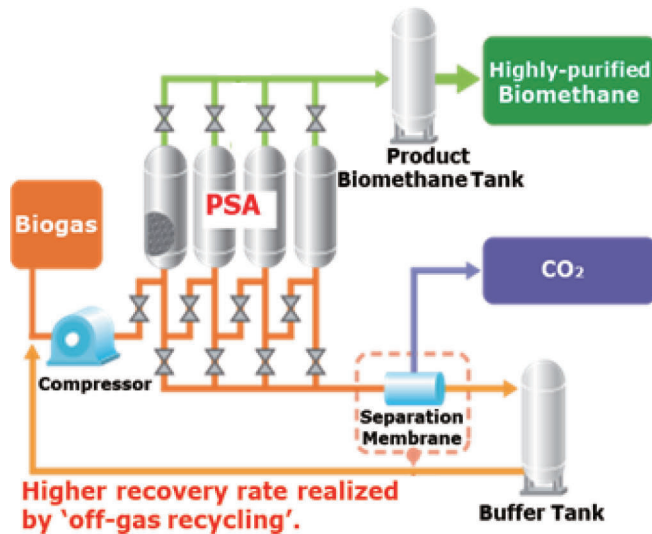
#### ◆ Principle

This equipment adopts the hybrid biogas purification system, a proprietary technology of Osaka Gas. The following two technologies are combined to achieve a high methane recovery rate of 99%.

- The “PSA” (Pressure Swing Absorption) is an absorbent (Daigas Group product) that selectively absorbs CO<sub>2</sub>, removing CO<sub>2</sub> from biogas to extract methane gas.
- The “gas separation membrane” recovers methane from the exhaust gas that is primarily composed of CO<sub>2</sub> extracted by the PSA.

Biogas is purified through the flow described below, to manufacture biomethane.

- Biogas is separated by the PSA into biomethane gas and CO<sub>2</sub> rich off-gas.
- The off-gas that contains CH<sub>4</sub> is separated by the separation membrane into the CH<sub>4</sub> rich recycled gas and CO<sub>2</sub> rich permeable membrane gas.
- The CO<sub>2</sub> rich permeable membrane gas is expelled outside the system.
- The CH<sub>4</sub> rich recycled gas is redirected to the PSA. A CH<sub>4</sub> recovery rate of 99% is achieved through this recycling system.



#### Higher Methane Recovery Rate

Company A	Company B	Company C	Osaka Gas Target
Membrane	PSA	High-pressure Water Adsorption	'Hybrid Biogas Upgrading'
98%	93%	98%	>99%

- ◆ Facility specifications
  - Biogas treatment quantity  
300 to 2,000 Nm<sup>3</sup>/h
  - Biogas receiving conditions (negotiable)  
CH<sub>4</sub> concentration: 50 to 60 vol%  
Hydrogen Sulfide : ≤ 200 ppm  
Moisture content: Saturation at normal temperature or lower
  - Product biomethane specification  
CH<sub>4</sub> concentration: 87 to 98 vol%
  - Intended countries and regions  
Southeast Asia and Japan



#### Effects or Remarks

5 million Nm<sup>3</sup> of biomethane gas is manufactured annually with the condition that the biogas is treated at the rate of 1,000 Nm<sup>3</sup>/h. Using this as a natural gas alternative fuel contributes to a CO<sub>2</sub> reduction of 10,000 tons annually.

#### Installation in Practice or Schedule

**Domestic** Purification and fuel use of raw waste derived biogas: 1 unit

**Overseas** Manufacturing of fuel for natural gas vehicles (NGV) at Agriculture of Basin Company Limited in Thailand: 1 unit

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