

TECHNOLOGIES

ECO-SORBTM VPSA
BIOGAS UPGRADING SYSTEM



ECO-SORB™ VPSA BIOGAS UPGRADING SYSTEM

ECO-SORB™ VPSA is an innovative biogas upgrading system for the production of biomethane which may be injected into the mains gas grid in compliance with the requirements of the SNAM Grid Code, for direct usage as high quality fuel in the form of compressed gas or BIO-LNG.

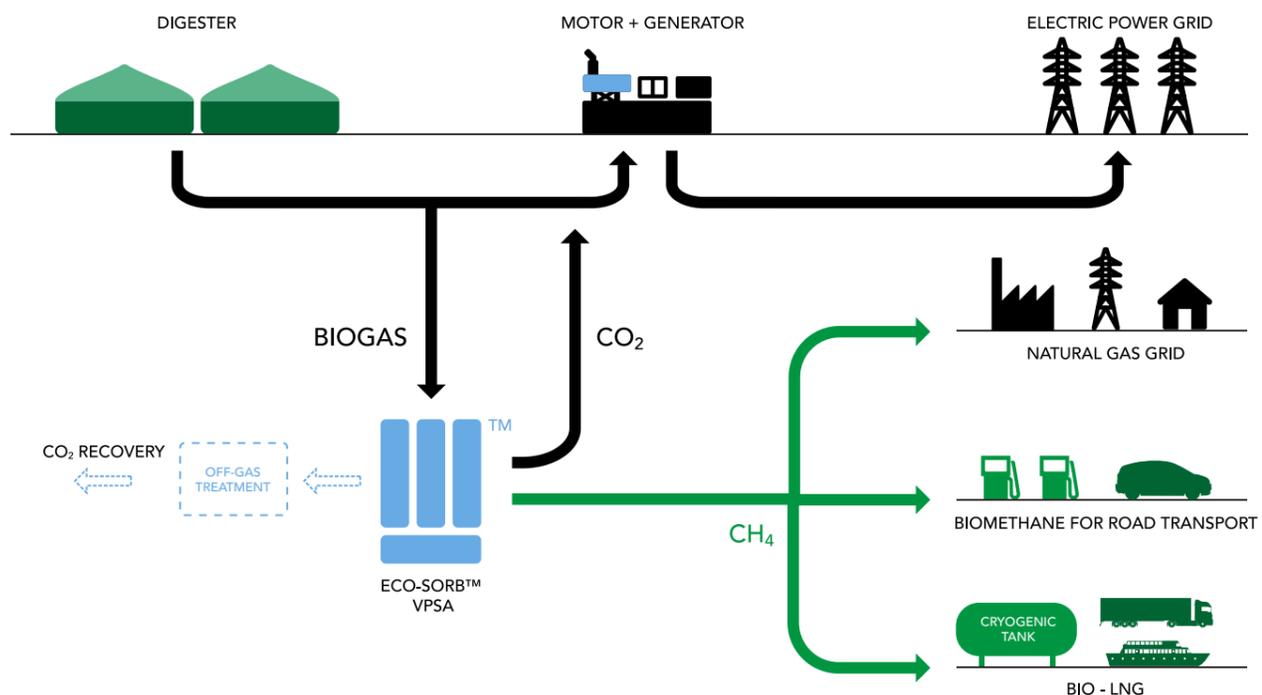
THE ECO-SORB™ VPSA PROCESS

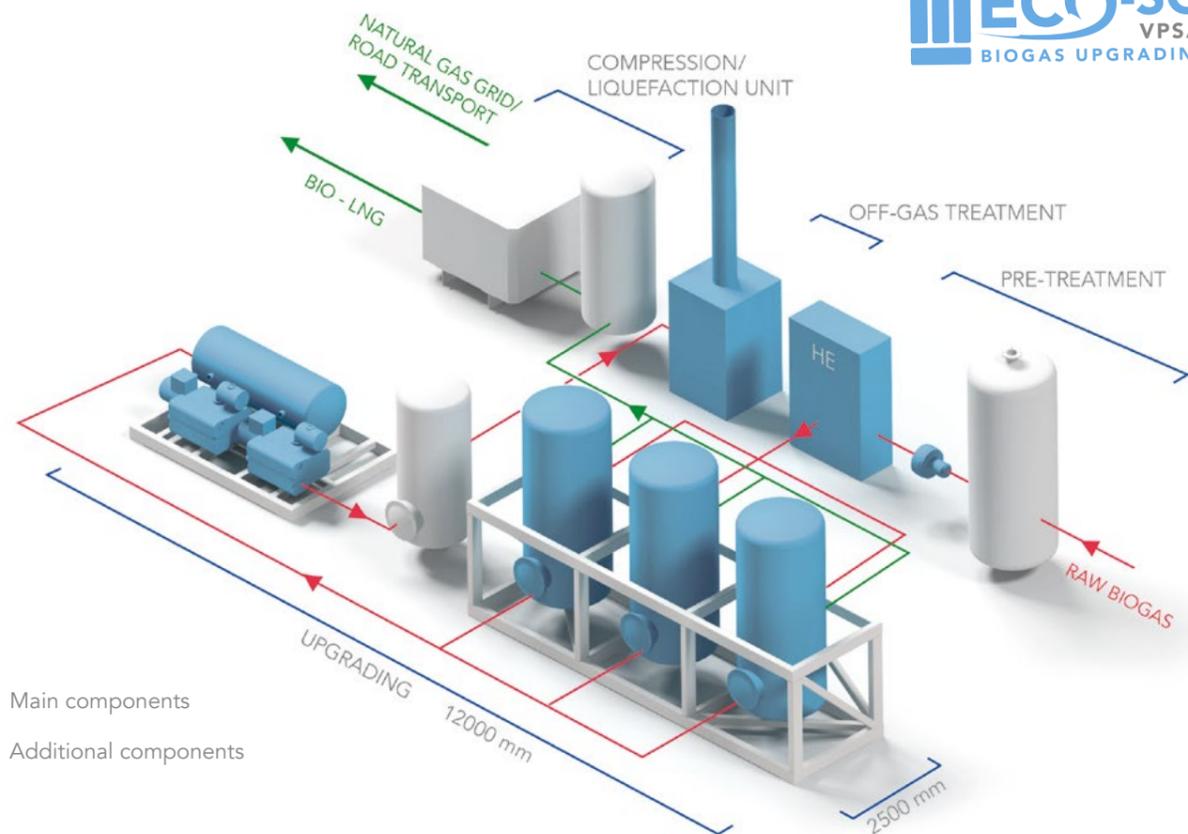
The system is based on a revised and optimised variant of the PSA process, but operates at ambient pressure, avoiding the design and operational complications associated with pressurised tanks and systems.

PSA technology is one of the most widely used processes for these applications, and is based on the preferred adsorption of the treated gas into a solid porous material.

In the ECO-SORB™ VPSA system, the adsorbent bed consists of synthetic zeolites selected through lengthy, in-depth testing for their ability to selectively adsorb CO₂ (which may, if necessary, be recovered from the off-gas), H₂S and H₂O.

The adsorbent bed is regenerated with a high vacuum cycle. The process is continuous and is not affected by variations in operating conditions.





MAIN COMPONENTS

- Pre-treatment unit for the removal of secondary components such as moisture and part of the sulphide content of the gas.
- Upgrading unit with three adsorption reactors containing molecular sieves and connected in parallel to ensure a continuous output flow. CO₂ and H₂S remain adsorbed in the zeolite bed, leaving purified biomethane. The upgrading process is performed simultaneously in all three reactors, so that at any given time, one reactor is actively adsorbing, one reactor is undergoing regeneration under high vacuum and one reactor is being restored to operating pressure.
- Off-gas treatment unit (off-gas is rich in CO₂ and has a very low methane content) for the elimination of H₂S with a catalytic oxidizer.

ADDITIONAL COMPONENTS (OPTIONAL)

- Additional upgrading reactor, if intensive recovery of methane from off-gas (containing max. 1% residual methane) is required.
- Finishing unit to control peaks in H₂S content due to deviations in the characteristics of the biogas fed into the system.
- Compression unit to increase the pressure of the outgoing flow of biomethane to the value required by the application.
- Quality analysis and flow metering unit compliant with the requirements of the SNAM Grid Code.
- Polishing and liquefaction unit for biomethane as fuel for lake, river and truck transport applications.

Further devices and systems for reducing the content of pollutants which exceed permitted limits or compromise the efficiency of the system and/or the quality of the biomethane produced (such as fine particulate, chlorine, siloxane compounds or other substances) may be specifically defined and supplied if necessary.

ADVANTAGES OF THE ECO-SORB™ VPSA SYSTEM

Productivity

Excellent performance even in the case of fluctuations in the composition upstream of the system, and with high concentrations of H₂S and other contaminants.

Low costs

Low investment and operating costs (low energy consumption, no base reagents used in process and extraordinary simplicity of the system itself).

Simplicity

Easy to install and transport.

Flexibility

Adapts easily to changing characteristics of the biogas fed into the system. Simple control over the quantity of biomethane produced (in all operating conditions from very low load usage to 110% load).

Availability

An advanced control system ensures superior performance and year-round availability of peak system productivity.

Simple maintenance

Maintenance consists solely of quick, simple routine tasks that can be carried out by the operators themselves. The system is designed to allow easy access to all the components and instruments installed on the skids. It can be remotely controlled if required.

Reliability

All components used have been tested and specifically modified for ECO-SORB™ VPSA technology to ensure high system reliability. Control system with specifically optimised software allows the total automation and active control of the installation.

Standard components

Commercially available components and equipment are used to ensure the longevity of the system.

Modular, compact construction

ECO-SORB™ VPSA may be supplied in prefabricated form or pre-assembled on skids. In both cases, the system is tested in the factory before shipment. This design philosophy reduces the times and costs necessary for construction and installation in the field. The system may be expanded after initial installation simply adding new modules.

Durability

The use of zeolites, which are extremely resilient adsorbent materials, ensures an extended service lifetime.

Short start cycle

Immediate process start and stop: provided that the system shut-downs are performed correctly, the start cycle lasts less than a quarter of an hour.

Scalability

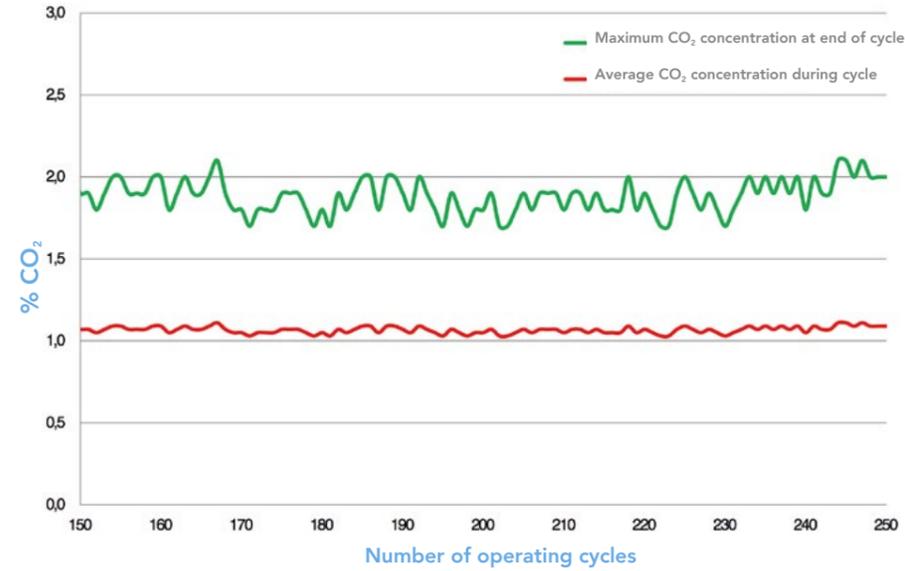
Suitable for small and medium sized installations (100-1000 Nm³/h biogas production), and may also be used solely to treat surplus biogas production for cases with smaller available volumes (<100 Nm³/h).

BIOGAS FROM OFMSW - OUR RESULTS

	RAW BIOGAS	BIOMETHANE
CH ₄	58%	> 98%
CO ₂	40%	< 2%
H ₂ S	200 - 250 ppm ^(*)	< 3 ppm
O ₂	0.5%	< 0.5%

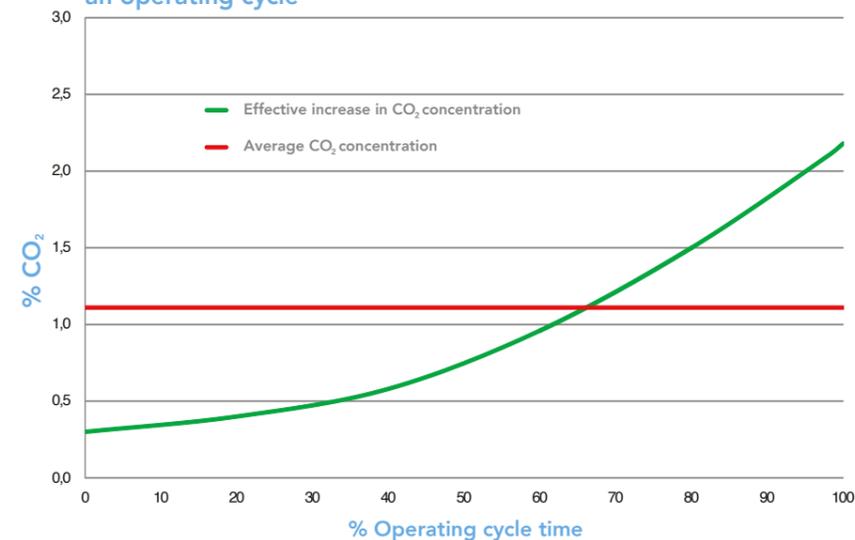
^(*)Pre-treated biogas during anaerobic digestion.

Typical graph of CO₂ concentration in biomethane



Graph A shows the maximum concentration of CO₂ output from the ECO-SORB™ VPSA system at the end of each work cycle (green line) and the average concentration during the cycle (red line).

Typical graph of CO₂ concentration in biomethane during an operating cycle



Graph B shows CO₂ concentration (green line) during the operating cycle of a VPSA reactor: concentration is close to zero at the start of the cycle, and increases to around 2% by the end of the cycle; average concentration throughout the operating cycle is approx 1% (red line).

BIOGAS FROM SEWAGE SLUDGE

Typical values for an ECO-SORB™ VPSA system for biogas upgrading from wastewater treatment. Source: CNR-IIA Report "Monitoring of a validation unit for the biogas upgrading from sewage sludge to biomethane".

PARAMETER	UNI TR 11537 EN16723-2	BIOGAS	ECOSORB™ VPSA
HIGHER HEATING VALUE [MJ/m ³]	34.95-45.28	24.8-26.3	36.7 ± 0.7
WOBBE INDEX [MJ/m ³]	47.31-52.33	26.3-28.6	49.7 ± 2.0
RELATIVE DENSITY	0.5548-0.8	0.85-0.89	0.55 ± 0.02
METHANE NUMBER	> 65	-	> 97
DEW POINT AT 7000 [KPA]	< -5 °C	> 60°C	< -5 °C
OXYGEN	< 0.6%	< 0.5%	< 0.5%
CARBON DIOXIDE	< 3%	31%	< 2%
HYDROGEN	< 0.5%	< 0.5%	< 0.5%
HYDROGEN SULPHIDE [mg/m ³]	< 6.6	> 1000	2-5
TOTAL SULPHUR [mg/m ³]	< 150	> 1000	2-5
CARBON MONOXIDE	< 0.1%	< 0.1%	< 0.1%
SILICON [mg/m ³]	< 0.3	> 2	< 0.04
AMMONIA [mg/m ³]	< 3	0.25	0.25
AMMINE [mg/m ³]	< 10	< 10	< 10
FLUORINE [mg/m ³]	< 3	0.17	< 0.02
CHLORINE [mg/m ³]	< 1	26.8	< 0.1



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