

MICRO MODULAR BIOMETHANE PLANT - for research, development and educational work

Introduction

By using own sources of renewable energy, agriculture can significantly contribute to the economy of production and lowering of GHG emissions. With the introduction of biomethane use in agriculture, it can also partly reduce the energy dependence on fossil fuels and significantly reduce GHG emissions. Micro biomethane modular plant is result of joint development work of Omega Air and Agricultural Institute of Slovenia, Department of Agricultural Engineering and Energy. Also this is the first such micro-device (plug and play type) to enable the production of biomethane on a larger scale (cleaning and upgrading biogas to the biomethane phase, below 30 Nm³/day of biomethane) and measuring the different physical and chemical properties of biogas and biomethane for research, development and educational work. In its current form it is intended for students and professionals who are being introduced to the field of biomethane for energy use.

Biogas cleaning and upgrading to phase of biomethane

Various impurities are removed from raw biogas in first phase of biogas cleaning. In second stage following separation of methane and other gases by Pressure Swing Adsorption (PSA). Biogas is compressed and fed into adsorbent vessels, where CO₂ and other gas impurities are extracted by adsorption on adsorbent material under higher pressure. By alternately increasing and lowering the pressure in the adsorbent vessels, biogas purification and the release of bound impurities are achieved. When the adsorbent is saturated, it is recycled by reducing the pressure - the process is reversible. After the process of purification and upgrading of biogas to the biomethane phase is completed, biomethane is obtained at the exit of processing system, with a minimum purity in the range of 97 - 99 % methane (CH₄). Physical and chemical properties of biogas at input and biomethane at output are continuously measuring with computer controlled electronic measuring system.



Picture: Parts of modular micro biogas plant: **1** – digester, **2** – energetic container with units for: processing of input substrate, cleaning of biogas (first stage), biogas powered cogeneration (electrical and thermal energy production), thermal energy storage and electronic regulation of process of biogas production, **3** – biogas holder integrated in container for mechanical protection, **4** – hydrolysing unit for hydrolysis of solid biomass, **5** – dosing system for adding solid biomass connected with milling unit for mechanical preprocessing of solid biomass with milling.



Picture: Biomethane modular unit (number **6**) – container with adsorbent vessels (Pressure Swing Adsorption – PSA) and computer controlled electronic measuring system for continuously measuring physical and chemical properties of biogas and biomethane



Picture: Micro adsorbent vessels for cleaning and upgrading of raw biogas to biomethane phase

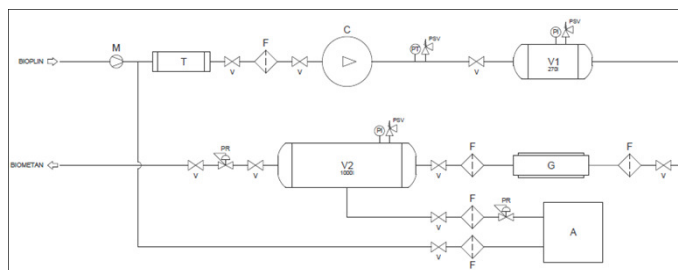
Field of use: Renewable energy sources

Current state of technology: Fully developed product (TRL 9)

Inventors: JEJČIČ Viktor (Agricultural Institute of Slovenia), ŠKRJANEC Igor (Omega Air d.o.o.) and SOJER Edvard (Omega Air d.o.o.)

Conclusion

With the wider introduction of micro biomethane units in agriculture we can partly reduce the energy dependence of agriculture on fossil fuels and significantly reduce greenhouse gas emissions. Biomethane can be used as a fuel for tractors and working machines on methane or also used on engines on two fuels (diesel fuel and methane). In addition to energy (biomethane) at the exit of the biomethane plant is produced digestate, used as a quality organic fertilizer.



Scheme: biogas upgrading to biomethane
M – blower, **T** – pressure vessel with activated carbon, **V** – valve, **F** – filter, **C** – compressor, **PI** – pressure sensor, **PSV** – safety valve, **V1** – pressure vessel 270 l, **V2** – pressure vessel 1000 l, **G** – generator, removing of CO₂, **A** – measuring system for gas composition, **PR** – pressure regulator

Contact: Kmetijski inštitut Slovenije / Agricultural Institute of Slovenia, Hacquetova ulica 17, 1000 Ljubljana, Slovenia
dr. Viktor Jejčič, Oddelek za kmetijsko tehniko in energetiko / Department of Agricultural Engineering and Energy
T: +386 1 280 51 02; E: viktor.jejcic@kis.si; info@kis.si; www.kis.si