adicomp
ADVANCED AIR & GAS SOLUTIONS

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# UVG *Technical Description - Biogas upgrading (Biomethane)*

## OIL-INJECTED ROTARY SCREW GAS COMPRESSORS AND TREATMENT SYSTEMS FOR BIOGAS, LANDFILL GAS AND WET-GAS IN GENERAL

Capacity up to 2000Nm$^3$/h
Available discharge pressures from 5.0bar(g) to 25bar(g)
Nominal power from 11.0 to 400kW

# Adicomp's experience,
## gas compression and treatment.

Adicomp during the last 15 years has gained a lot of experience in compression and treatment of Biogas, Landfill gas, Natural gas, Methane, Nitrogen, Argon, Hydrogen and Syngas also supplying several hundred installations everywhere around the word, the company has improved its know-how implementing solutions suitable for all the different climate conditions, from the low temperatures of Finland and Russia to the hot weather of Australia and Mexico. For this reason we can say that:

## WE ARE LEADER IN COMPRESSION AND TREATMENT SOLUTIONS

Thanks to its own peculiar type of oil injected rotary screw gas compressor and to the well proven technology for the removal of gas contaminants like water, dust and siloxanes, Adicomp is proud to affirm that we are leader in Europe for supplying a "TURNKEY" installations for gas compression and treatment systems.

## biogas upgrading

Raw biogas produced from anaerobic digestion or from landfill site normally consist of 50-60% of $CH_4$ and a 45-35% of $CO_2$, the rest of the gas can be composed by O2 , N2 and other contaminants like hydrogen sulfide (H2S), siloxanes (SiO), ammonia ($NH_3$), water vapor, dust etc.. Making bio-methane from biogas the $CO_2$ presence must be separated and $O_2$ removed. At the same time the other components have to be reduced to reach the standard methane quality for being injected into the distribution grid.
There are several method to upgrading biogas into bio-methane, some of them require that biogas has to be compressed at a certain pressure for being treated (membranes technology, PSA (pressure swing adsorption) technology, with potassium chloride etc.).
Adicomp is specialized to provide complete compression and treatment station using is own well proven oil-flooded screw packages.
Beside compressing biogas we can remove both the water content down to 5°C dew-point at pressure and obtain the residual oil content down to 0,01mg/$m^3$. We have also the technology to reduce practically to zero percent the eventual siloxanes contained into biogas also. We normally propose a single stage oil-injected rotary screw compressor packages but in case of an higher pressure is required, we may also offer two-stage rotary screw compressors with oil-flooded screws to optimize the energy consumption.

# UVG for biogas upgrading,
## biogas and landfill gas applications.

***MAIN FEATURES***

- Completely automatic by an electronic control system.
- Direct coupled.
- VSD (Variable Speed Drive) Inverter technology.
- Suitable for ATEX Zone 1&2 or not classified zones.
- Air cooled standard (water cooled system is also available as option).
- For various options see by page 6.

Wet-gas compression and treatment stations designed into an easy handling skid composed of an oil-injected rotary screw gas compressor, directly coupled to an electric motor through a flexible coupling, inverter controlled and complete with the following systems:

- **At the suction**: gas tight filter with water separator and automatic condensate drainer equipped with safety switch.
- **At the discharge:** after-cooler with water separator and automatic condensate drainer equipped with safety switch, a final gas/refrigerated-water heat exchanger is usually installed too.

The wet gas is aspired through a suction filter acting also as a water separator with automatic condensate discharge system, then the gas passes through a suction control valve.
All components in contact with the gas are made in stainless steel or duly protected, due to the presence of $CO_2$ and aggressive contaminants into the gas.
During the gas compression process, oil is injected inside the rotary screw chamber to perform three main functions: lubrication, sealing and heat absorption. Working in a closed circuit from a gas/oil receiver, oil is pressurized to flow through an oil cooler, then filtered before being injected again into the screw compression chamber.
The gas goes instead through the minimum pressure/no-return valve into an air-cooled after-cooler and a gas/refrigerated-water heat exchanger (OW option), then through into a water separator with automatic drainer. Normally a set of coalescent filters is also installed to remove the residual oil content from the gas down to 0,01mg/m$^3$, then the gas goes through a gas/gas heat exchanger before leaving the package.
When the (IW) suction gas/water heat exchanger & (OW) discharge gas/water heat exchanger options (see by page 6) are required to remove the humidity from the wet-gas before and after the compression, a suitable chiller is needed to produce the right quantity of refrigerated water (3-5°C) to treat the gas (normally the chiller is placed into a safe zone). Normally a mechanical by-pass valve is used to recirculate the gas in excess into suction to reduce the capacity from the value achieved at minimum speed of the electric motor, down to 0%. Sometimes it's necessary to install a pneumatic controlled by-pass valve to have a more accurate control.
When the system stops the gas is depressurized by blowing it back into the digester or bleeding it out into the atmosphere.

# principal characteristics

### COMPRESSOR ELEMENT AND TRANSMISSION

The lubricated single-stage oil-injected rotary screw compressor is composed of two rotors: a 5-lobe male and a 6-slot female one with asymmetrical profiles. Rotation of the rotors produces compression of the gas with continuity and without pulsations. The compressor element is driven directly by an electric motor through a flexible elastomer joint. The compression is developed in a single stage and the heat of the compression is removed by the oil injected between the two rotors. Furthermore the oil lubricates the rotating mechanical parts and ensures the seal between the rotors.

### GAS CIRCUIT COMPOSITION

- Gas tight suction filter complete with automatic drainer and safety device;
- Stainless steel gas/oil receiver with oil separators;
- Minimum pressure/no-return valve;
- Water separators with automatic condensate drainer and safety device;
- Gas cooler with large exchange surface cooled by separate fans;
- Gas/refrigerated-water heat exchanger;
- Gas/gas heat exchanger;
- A set of coalescent type oil-removal filters.

### OIL CIRCUIT

The oil is kept in circulation exclusively by the differential pressure of the gas between the gas/oil receiver and the compressor element at suction. The oil circuit is composed as follows:

- Stainless steel gas/oil receiver with high efficiency oil separator cartridges;
- High efficiency type oil filters;
- Thermostatic valve to maintain the right operating temperature;
- Oil cooler with large exchange surface cooled by separate fans.

### GAS/OIL RADIATOR COOLING CIRCUIT

The cooling circuit is composed of the oil cooler and by the final compressed gas cooler combined into a single radiator air-cooled by separate axial electric motor fans. Water-cooled oil cooler and final water-cooled gas cooler are also available as option.

### MAIN ELECTRIC MOTOR

The electric motor used is from IE1 to IE3 efficiency with F class of insulation and shielded bearings, over a certain size, to withstand to class B over temperatures and with a degree of protection IP55. We usually install (Ex nA) motors for ATEX zone 2 and (Ex de) motors for ATEX zone 1. Standard electric motors are used for not classified zones.

### SAFETY DEVICES AND GAUGES

- Suction pressure gauge.
- Pressure/Vacuum switch at suction.
- Temperature sensors at the compressor's gas/oil mixture discharge.
- Pressure switch on oil receiver for high pressure.
- Stainless steel conveyed safety valve on the oil receiver.
- EMC filter inverter on-board protection.
- Oil pressure gauge.
- Temperature gauge on the final discharge pipe.
- High water level switch on suction filter separator.
- High water level switch on discharge separator.

### *CAPACITY AND PRESSURE REGULATION*

Adicomp BVG compression stations for biogas upgrading are based on reliable and proven frequency converter (Inverter technology) to control the capacity precisely of the gas demand. This means that the rotation speed of the compressor block is matched exactly to the requirement and the result is the constant pressure on the network all time.
This feature minimize the power consumption and reduces the wear and tear on the compressor also.
With a speed range of the compressor block from 100% down to 50%, the BVG gas compression stations feature the market widest turn-down range and quickest adaptation to the gas demand changes. Within a very narrow limit of 0.7bar(g) the following capacity regulations are obtained:

- By the variable speed of the main electric motor controlled by the inverter from 100% down to about 50% of the speed range;
- By passing the gas into suction with a mechanic or pneumatic special by-pass valve from about 50% down to 0% of the nominal capacity;
- When the system stops the gas is depressurized by blowing back the gas into the digester or bleeding it out into the atmosphere;

### *ELECTRIC & ELECTRONIC CONTROL PANEL*

All various CE&UL switches and protection devices are fitted into a special control panel that is supplied separately by the compressor station. The S1-20 electronic control system is also fitted into the panel and it is capable of processing the requested pressure, temperature and signals in real time as well as the functional parameters by means of transducers inside the station and in combination with the inverter.
Regulation of the off-load/loaded operation with timed automatic stopping for greater operating economy. A correct program of the operations guarantees the constant gas flow requested without any pressure jumps.
The electronic system makes possible to:

- Control the operating conditions of the main components of the compression station;
- Change the programmed working conditions;
- Determine any maintenance work in an automatic manner, as regards the environmental and operating conditions of the station, thereby rendering service more secure and less onerous;

By a luminous monitor of the electronic panel S1-20 and the Inverter Keypad on the control board panel, it's possible to display the working conditions of the machine and the triggering of any of the alarm and blocking devices provided, more specifically:

- Display indicating the working pressure.
- Display indicating the working temperature
- Symbol LEDs.
- Failure and status messages.
- Maintenance messages.
- Main and auxiliary switches.
- Start button.
- Programmed stop button.
- Emergency stop button.
- IP55 enclosure with ventilating fan and heaters
- Operating motor frequency
- Current absorbed
- Power absorbed
- Motor speed.
- Operating frequency.
- Many more functions selecting the parameters requested.
- Inlet water temperature (chiller display).
- Outlet water temperature (chiller display).
- Many more functions selecting the parameters requested.

# options available

### *(OF) - OPEN FRAME (STANDARD VERSION)*

Open frame version suitable for indoor installation.

### *(S) - SILENCED & (SS) SUPER SILENCED*

Sound proof enclosure, suitable for indoor installation (no weather proof) with a noise level from 70dB to 80dB at 1m. With the super silenced option we also install soundproofing air conveyors and increased sound absorbing materials.

### *(WP) - WEATHER PROOF*

The compressor station is designed and built for an ambient temperature from -20°C to 40° C. Electric oil heaters thermostatically controlled keep the internal temperature above 5°C in presence of cold climate and work in combination with pneumatic actuators that are used to open and close the inlet/outlet cooling air flow system of the canopy when the compressor stops. While the compressor is working the temperature inside the canopy is kept above 0°C by recycling warm air flow through the oil cooler.

### *(CF) - FINE FILTRATION*

Biogas must be completely exempt from oil contamination before going though membranes, PSA or potassium chloride bed, in order not to damage the treatment systems.
To achieve the right quality standard of the gas, a set of coalescent filters that assures a residual oil content of 0,01mg/$m^3$ are installed, filtering the gas at low and constant temperature of 5°C in spite of any ambient conditions.

### *(CH) - WATER CHILLER*

Adicomp proposes chillers which has been designed specifically for industry.
Result of over 20 years in the industrial chilling market, with hundreds of thousands of refrigerating machines installed worldwide, they perfectly match the needs of a wide range of industries.
This thanks to:

- Generous operating limits, both as regards the water inlet and outlet temperature.
- A robust construction with high ambient temperature limits, allowing operation in all conditions worldwide.
- An extensive range of accessories which allows them to be personalized to all individual applications.
- A fully packaged and easy to use solution, with integrated pump and tank, perfectly suited to the needs of the industrial User.

Lowest operating costs thanks especially to energy efficient scroll compressors, the oversized evaporator and the unique evaporator-in-tank configuration, these chillers achieve leading energy efficiency levels.

### *(IW) - SUCTION GAS/WATER HEAT EXCHANGER*

When the presence of the water (humidity) into the biogas is high and the presence of $H_2S$ is above 1000mg/$m^3$, it's recommended to install at suction a gas/refrigerated-water heat exchanger capable to bring the gas temperature down to about 5°C.
Removing in this way both the most of water content into the gas by water separator with automatic drain and slightly at the same time the $H_2S$' presence due to its property of solubility in water.

### *(OW) - DISCHARGE GAS/WATER HEAT EXCHANGER*

At outlet side this option consists in a further cooling of the gas, downstream of the after-cooler, by a stainless steel compressed gas/refrigerated water heat exchanger, a water separator and an automatic drainer. This option brings the compressed gas dew-point temperature in pressure down to about 5°C such eliminating most of the water content and allowing the coalescent filter to work at the best.

### *(HR) - HEAT RECOVERING*

Almost all the heat generated by a rotary screw compressor can be recovered and used to reduce energy general costs. Saving Energy means automatically reducing $CO_2$ emissions, which is not only beneficial for the environment but also for the health.
Our unit can be equipped with a heat recovering system to achieve the maximum Energy saving benefit from the compressor. It consists in a water/oil heat exchanger capable to transfer the heat from the compressor oil to sanitary, central heating or industrial process water. It is thermostatically controlled both at the oil as well as at the water side. Up to 80% of the compressor's heat energy can be recovered by this system.

### *(SR) - SILOXANE REMOVAL SYSTEM*

If the content of siloxanes (SiO) is high in the biogas or better in the landfill gas, they must be removed completely before feeding bio-methane into upstream grid.
Adicomp uses to install twin stainless steel columns that contain active carbons suitable for removing siloxanes, both complete with pressure gauges and conveyed type gas safety valves. Four valves are also present to switch manually the duty of the columns and for the depressurization of the system. A progressive dust filter with a filtration grade of 1µm is normally supplied and installed external the package to block the dust of the carbons.

### *(CC) - ACTIVE CARBON COLUMN (OIL REMOVAL)*

If the filtration al low constant temperature is still not acceptable to give sufficient assurance about the purity of the gas from oil contamination Adicomp can propose an adequately sized active carbon column to be placed downstream the gas/gas heat exchanger that also absorbs the oil aerosol. It also becomes a safety device.

### *(MB) MODBUS & (PB) PROFIBUS REMOTE CONTROL SYSTEMS*

Every Adicomp compressor can be connected through a Modbus or a Profibus gateway for data transmission. Modbus and Profibus added to the S1-20 main controller, can perform the following operations:

- Read any parameter inside the table from P01 to P10.
- Write on any settable parameter inside the table from P01 to P10. Usually it is used to modify the working pressure PU and PL.
- There are 3 working inputs (start – stop – reset).
- "Get", "Set", "Cmd" commands to manage both the information and functions.

As option an I/O Box provides additional general purpose I/O (input/output) connections, in particular n°8 digital and n°4 analog inputs.
These connections can be used to monitor sensor devices and better manage the alarms.
A single alarm for each channel allows an improved fault remote monitoring.
Four analog devices like PT100 or pressure transducers can be added and "read" via Modbus or Profibus systems.

# Customized solutions, some references.

***UVG160-10ED-INV (OF)***

Biogas compressors for a bio-methanization plant by PSA in China Suitable for ATEX zone 2, open frame for indoor installation, complete with gas treatment system for oil removal

***SPECIFICATIONS:***

Power: 200kW (de-rated)
Inlet pressure: 60 - 100mbar(g)
Outlet pressure: 10bar(g)
Ambient temperature: 3°/40°C
Capacity: 0<370<966Nm³/h


***UVG90-14.5MD-INV (OF)***

Biogas compressors for a bio-methanization plant by membranes in Austria.
Designed for classified Atex zone1, completely water cooled, open frame for indoor installation.

***SPECIFICATIONS:***

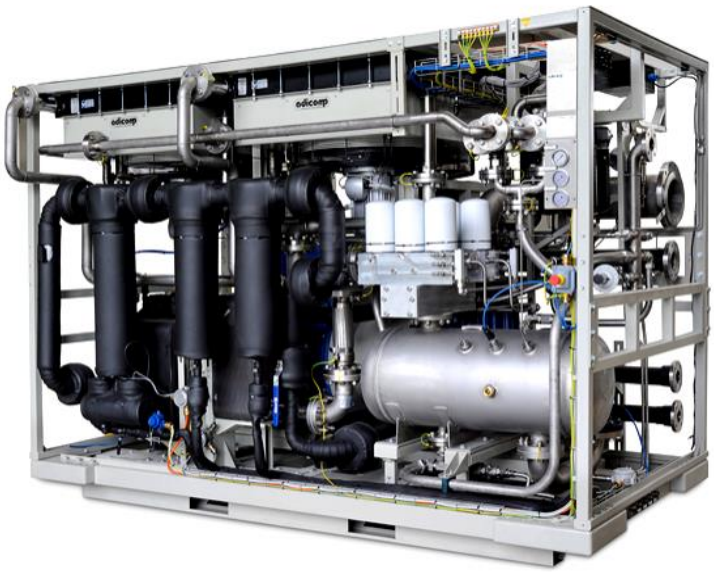
Power: 90kW
Inlet pressure: 50-150mbar(g)
Outlet pressure: 14.5bar(g)
Ambient temperature: 3°/40°C
Capacity: 0<310<550Nm³/h

***UVG250-15ND-INV (OF)***

Biogas compressors for bio-methane plant in combination with a biogas upgrading system through membranes in UK. Designed for classified ATEX zone2, open-frame on skid mounted into a container, complete with gas treatment system for oil removal.

***SPECIFICATIONS:***

Power: 315kW (de-rated)
Inlet pressure: 27<200mbar(g)
Outlet pressure: 15bar(g)
Capacity: 0<920<1491Nm³/h



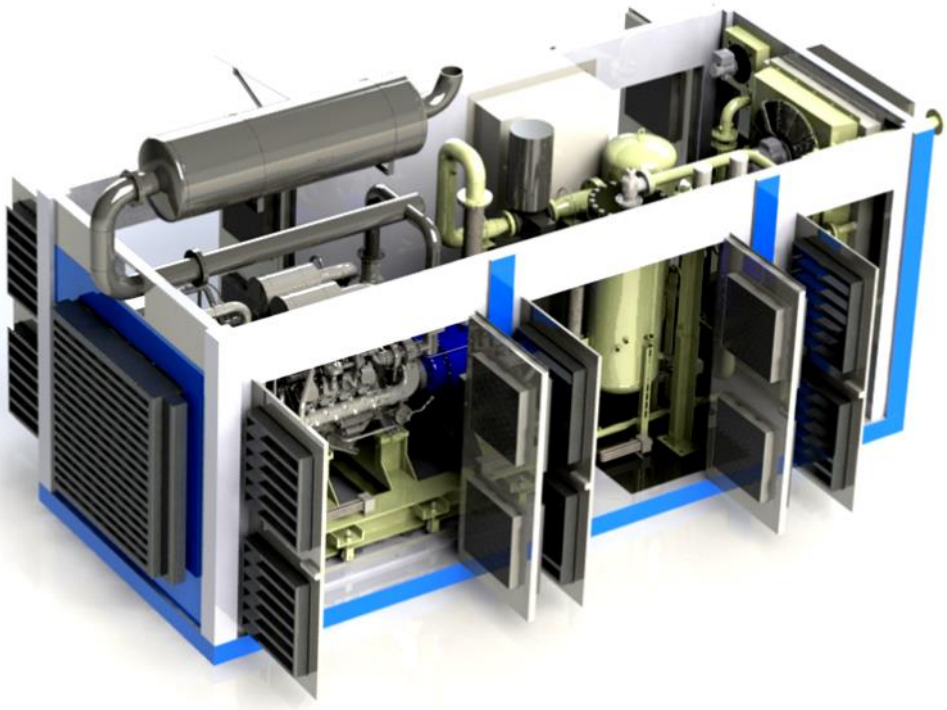
# Adicomp's overview,
# other products available.

## ELECTRIC DRIVEN OIL-INJECTED ROTARY SCREW BOOSTER

For natural gas, bio-methane and well-head gas with suction pressure up to ***8bar(g)*** and discharge pressure up to ***25bar(g).*** Full range of power up to ***400kW.*** They are also available in containerized versions for extreme climate conditions.

## GAS-ENGINE DRIVEN OIL-INJECTED ROTARY SCREW BOOSTER

For natural gas and well-head gas with suction pressure up to ***8bar(g)*** and discharge pressure up to ***25bar(g).*** Full range of power up to ***400kW.*** These versions are also available in containerized versions for extreme climate conditions.



# Adicomp's overview,
# other products available.

## TWO-STAGE OIL-INJECTED ROTARY SCREW COMPRESSOR

Electric motor driven compressors for gas and air applications with suction pressure from atmospheric up to ***1bar(g)*** and discharge pressure up to ***40bar(g).*** Full range of power up to ***400kW.***

## FULL RANGE OF MULTISTAGE RECIPROCATING PISTON COMPRESSORS

Electric motor driven compressors for several different kind of gas applications like nitrogen, natural gas, bio-methane process gas etc., available in container or open frame versions with a discharge pressure up to ***350bar(g).*** Full range of power up to ***400kW.***

## FULL RANGE OF DRYING AND BOOSTING PACKAGES

For biogas treatment, drying and boosting systems that are suitable to be installed outdoor and with a capacity up to ***2000m³/h*** and a pressure up to ***200mbar(g).***

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