ZORG BIOGAS

01

version

# Quotation

Biogas plant 1000kW

Date: 23/10/2023

Validity: 3 months

# CONTENT

# OVERVIEW

We offer a solution to process  corn silage into biogas to power in a high-load digester.
The proposed technology is the only of its kind. Reactor is 3 times smaller and 2 times cheaper than the old mass-market CSTR

## Raw material potential

| Substrate | Quantity (tonnes/day) | Quantity (tonnes/year) | DM content: (%) | ODM content (%) | DM quantity (tonne s/ day) | ODM quantity (tonnes / day | Biogas yield ($m^3$ / tonneODM) | Biogas ($m^3$ /day) | Methane content (%) | Biogas ($m^3$ / year) |
|---|---|---|---|---|---|---|---|---|---|---|
| Corn silage | 48 | 17 520 | 37 | 96 | 17.76 | 17.05 | 670 | 11 423 | 52 | 4 169 395 |

# Biogas plant characteristics

| Characteristics | Values | Figures |
|---|---|---|
| Number of digesters | units | 1 |
| Digester | | |
| a) volume: | | |
| Work | $m^3$ | 1519 |
| Overall | $m^3$ | 1709 |
| b) Organic load | kgODM/ $m^3$ | 11.22 |
| c) Hydraulic retention time (gross) | days | 35/31 |
| d) Overall dimensions of the digester (diameter / height) | m | 22.0/4.5 |
| e) Temperature | $^0C$ | +52 |
| Gasholder (external) | | |
| a) Volume | $m^3$ | 860 |
| b) Number of gasholders | units | 1 |
| c) Dimensions of the gasholder (diameter / height) | m | 12.5/9.3 |

# Biogas plant working principle

The technology is based on the biochemical conversion of organic materials from high molecular weight compounds to low molecular weight compounds. The first stage of this process is hydrolysis. Hydrolysis produces organic acids and alcohols.
Organic compounds + H2O→ C5H7NO2+HCO3.
Further conversion of obtained dissolved compounds like organic acids and alcohols (C5H7NO2,HCO3) into gases - CH4, CO2.
C5H7NO2 + HCO3 + H2O → CH4+CO2+NH4.
Biological process of consecutive (phasic) conversion of organic compounds take place in anaerobic environment i.e. in oxygen-free tank (biological reactor). At the first stage of fermentation, substrate hydrolysis take place under acidogenic bacteria influence. At the second stage, elementary organic compounds come through hydrolysis oxidation by means of hetero-acidogenic bacteria with production of acetate, carbon dioxide, and free hydrogen. The other part of the organic compound including acetate forms C1 compounds (elementary organic acids). Produced substances are the feedstock for methanogenic bacteria of the third type. This stage flows in two processes of A and B type the character which depends on caused by different bacteria type. These two types of bacteria convert the compound obtained during the first and second stages into methane CH4, water H20 and carbon dioxide CO2. Methanogenic bacteria are more sensitive to the living environment compared to acidogenic bacteria. They require a complete anaerobic environment and a longer reproduction period. The speed and scale of anaerobic fermentation depends on bacteria metabolic activity. That is why the biogas plant chemical process includes hydrolysis stage, oxidation, and methanization stage. For that kind of substrate, these processes take place in the same reactor

# Technological process of biogas production

Corn silage is transported to a biogas plant area and discharged into a loader. The loader input substrates by portion to digesters using augers. In the digester the substrate is brought up to a temperature of +52°C. Constant temperature is sustained for the entire digesting period. To prevent a rise in temperature (for example, in summer), the biogas station is equipped with a coolers (dry cooling). The digester operating regime is thermophilic. The heated substrate in the digester is blended periodically. Mixing is performed by vertical mixers. The average time of processing in the digester is 31 days. After the digester, the substrate is fed by pump to a separator area where it is separated into solid and liquid bio-fertilizer. Solid bio-fertilizer is discharged to the separation area and transported for storage; liquid filtrate is directed to a liquid residue storage tank. Biogas goes up under overlap and delivered into an external gas holder through pipeline.

The gas holder's weather protective film protects the gasholder from precipitation and damage by foreign objects. The weather protective film is fixed firmly by a special system. To protect the gasholder from overpressure, digesters are equipped with safety valves, which start working at a pressure of 5 mbars and bleeds biogas to the atmosphere.

Then accumulated in gasholders biogs goes through a gas pipeline to a biogas cooler with a condensate discharge unit and then to a compressor, where the pressure is raised up to 80-150 mbar to meet engine requirements. After the compressor, biogas is fed to activated coal filters to remove hydrogen sulfide (H2S). After filters, biogas goes to a cogeneration power plant? where it is used as fuel for production of electricity and heat energy to biogas plant self consumption needs. Heat from the cogenerators is fed to a heat exchanger for heating the digesters. Heating equipment is used for distribution of heat between biogas plant facilities.

All technological processes are controlled and operated by an automatic system. Biogas plant work is monitored at the central control room monitor. The control room is equipped with a central control unit, which allows the switching of any biogas plant module into automatic or manual mode with local or remote control.

# MAIN EQUIPMENT

# Solid feeder (SF-01)

Solid wastes is supplied directly to biogas digester by means of screw loader. Bunker is equipped with turbo auger, which have a system of soft start. It saves energy and guarantees smooth operation of drive during 24 hours a day. Very strong structure with acid resistant cover made of alloy steel allows system units to work under heavy loads. Application of a special scraper equipped with adjustable knifes increases efficiency. Special drive with reliable planetary gearbox guarantees stable operation under maximum loads and turning moments, and hydraulic control of the discharge door secures turbo auger and transporter cleaning.

## Specifications

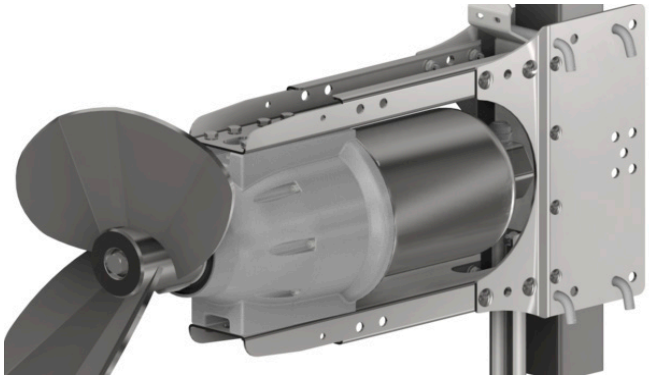
| | |
|---|---|
| **Length:** | 5.0 m |
| **Width:** | 2.4 m |
| **Height** | 3.4 m |
| **Volume:** | 25 $m^3$ |
| **Quauntity:** | 1 pcs |

# Filtrate tank (FT-01)

Reinforced concrete reservoir for reception of liquid kinds of raw materials. The reservoirs are equipped with level sensors and submersible agitators for mixing substrate.

## Specifications

| | |
|---|---|
| **Diameter:** | 6.0 m |
| **Height** | 2.0 m |
| **Total volume:** | 56 $m^3$ |
| **Quantity:** | 1 pcs |



# Submersible mixer (AG-04)

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid substrate as manure and similar substrates. The electro-motor driven submersible agitator is designed for submersion operations in potentially explosive environments of Ex zone 2 and complies with Directive 94/9 EC. The submersible agitator can be attached to most sliding masts by means of the motor support. A mounting option for a hauling cable is provided on the motor support for height adjustment purposes.

Due to the 4-roller guidance of the motor support, the agitator can be lifted and lowered without friction and the square mast, even if the pull of the hauling cable is slightly angular. The motor support is designed for a 100 x 100 mm square sliding mast as standard, but can also be used for an 80 x 80 mm sliding mast by changing the rollers. The strain relief of the connecting cable can be positioned in the extension of the motor or towards the top on the motor support, depending on the requirements. This enables universal utilization with the most various installation kits.

The geared motor is made of spheroidal graphite iron(GGG40) and painted, the propeller is galvanized and the motor support is made of stainless steel. The submersible motor agitator is designed as a water pressure-tight monoblock unit for driving the three-vane propeller. The submersible agitator is of modular design, submersible electro-motor with flange-mounted planetary gear and bearing flange for holding the propeller. The conical shaft in the bearing flange is mounted in the oil bath by two angular roller bearings and sealed off from the agitating substrate with a mechanical seal.

## Specifications

| | |
|---|---|
| **Nominal power** | N= 3.0 kW |
| **Quantity:** | 1 pcs |

# Digester (D-01)

Digester is a tank of cylindrical form (for better mixing during the fermentation). It is built of cast-in-situ reinforced concrete based on sulphate-resistant cement with thickness of walls and bottom - 0,25m. In the center of the digester there is a column with chapiter. Overlap of digester is reinforce concrete plate. On the tank's wall and in the bottom there is to be installed pipelines for heating, intended for assurance and maintenance of the optimal fermentation process temperature at thermophilic conditions. For heat conservation and reduction of heat energy consumption, the digester walls, overlap and bottom are insulated outside with 100 mm slabs of extruded polystyrene foam. Over the heater, the substructure walls and bottom are insulated with roll damp proofing. Superstructure and substructure heat insulation is protected by shaped sheet from the outside mechanical damages and rodents. The digester bottom has a slope 1%.

## Specifications

| | |
|---|---|
| **Height :** | 4,5 m |
| **Diameter :** | 25,0 m |
| **The total volume :** | 1709 $m^3$ |
| **The substrate volume :** | 1519 $m^3$ |
| **Quantity:** | 1 pcs |

# Digester vertical mixer (AG-01 ... AG-03)

Mixers are designed and engineered to guarantee high energy efficiency. We use gear units and motors from respected European manufacturers. This guarantees the long life of our mixers. All motors and gear units are available with ATEX certifications.
Agitators are designed for mixing substrates with a high solids content of 13-18%. The blades of the mixers are set at an optimum angle, and the external motor of the mixer is mounted on a special support.

## Specifications

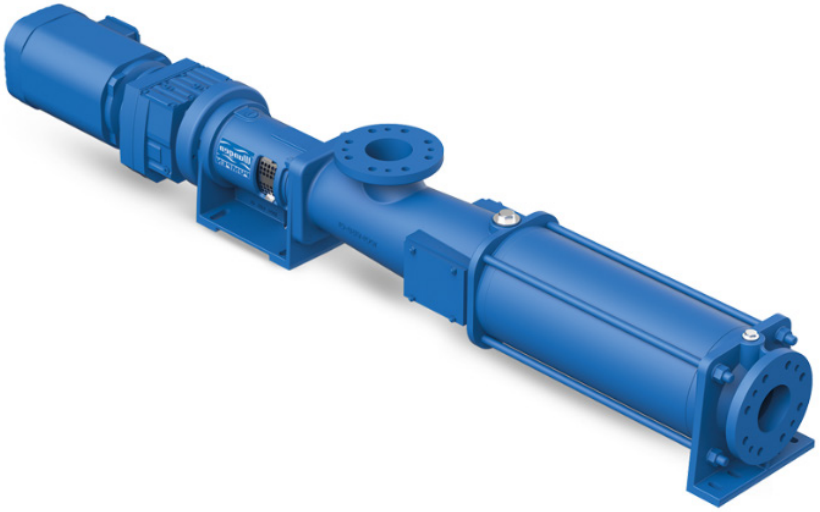
| | |
|---|---|
| **Engine power:** | N=15 kW |
| **Quantity per digester:** | 3 pcs |

# Window with spotlight (SG-01)

Inspection windows are designed for visual control of processes inside the fermenter. Spotlights were made in explosion-proof with automatic disconnection. Inspection windows are equipped with a cleaning washing system.

## Specifications

**Inspection windows Ø300**
**Spotlight VISULUX UL50 -G -H**
**230V, 50W, IP65**



# Pump equipment (PU-01, PU-02)

Pumps are used to transport substrate to the equipment and facilities in the biogas plant and away. Biogas plant design allows to access easily to all pumps. Pumps are driven by helical geared motor. Stator has hopper inlet for optimum filling of the pumping chamber, wear-protected, robust universal joint with feeding screw, robust bearing pedestal with close-coupled drive and self-centering of the drive shaft. Pumps have modular design for high flexibility, low life-cycle-costs.

## Specifications

| | |
|---|---|
| **Substrate pump to separator (PU-01)** | |
| **Flow rate:** | 25 m3/hour |
| **Engine power:** | 5,5 kW |
| **Pressure:** | 4 bar |
| **Quantity:** | 1 pcs |

| | |
|---|---|
| **Filtrate pump (PU-02)** | |
| **Flow rate:** | 25 m3/hour |
| **Engine power:** | 5,5 kW |
| **Pressure:** | 4 bar |
| **Quantity:** | 1 pcs |


# Separator (SR-01)

The Press Screw Separator covers a broad spectrum of applications, from agriculture to biogas and bioethanol plants. The innovative technology separates substrates in its solid and liquid elements. The secret of the versatility of the press screw separator is that it can adjust to different dry matter contents and Thick liquids (20% dry matter content). Slotted screens have different assortment and width of table cells and give possibility work with small solids and fiber contents. In the slotted screen, the solids are screened out from the liquid. The solids build up a layer which also acts as a filter to separate finer particles from the liquid. The auger flights convey this layer to the solids outlet. The screen surface is cleaned and a new filter layer is formed. The design of the screens is not conducive to plugging. The pressure in the first part of the screen is low but increases with the solid consistency to the solid output. The consistence of the gained solid can be varied with the help of a  output regulator by the amount and position of counter weights. This way the required consistency of the final product for either further storage, use as fertilizer or the basis for compost can be reached. The liquid phase can easily be drained through a pipe or hose system.

## Specifications

| | |
|---|---|
| **Engine power** | **3.0 kW** |
| **Flow rate** | **5-8 m3 / h** |
| **Quantity** | **1 pcs** |
| **Equipment** | |
| **Frame** | |
| **Screw** | |
| **Sieve for the filtration** | |
| **Counterweights** | |
| **The design of the protective room** | |

# Gasholder (GH-01)

The gasholder provides for biogas storage and for equalizing pressure and biogas composition. The gasholder system has a two-layer construction. The external material consists of a weather-proof film of PVC-coated polyester fabrics with UV protection. Both sides are finished with an external N/5cm, internal membrane PELD (gasholder) membrane.

The gasholder has a methane permeation maximum of 260 cm3/m2 * 1 bar biogas resistance. The gasholder film temperature range allows operation from -30°C to +60°C.

The internal film is stretched under normal biogas pressure. Air is blown into the space between the external and internal membranes to pressurize the internal membrane and form the shape of the external membrane.

The biogas pressure in the gasholder is 2-5 mbar. The membranes are designed and cut out on NC machines. Welding is executed by high frequency currents. These steps yield substantial improvements for quality and service life compared to handmade membranes welded by standard welding equipment.

To prevent damage to the gasholder as a result of overpressure conditions, a safety valve is installed. To survey the internal membrane, an inspection window is installed on the external membrane.

## Specifications

| | |
|---|---|
| **Height :** | 9.3 m |
| **Diameter :** | 12.5 m |
| **The total/working volume :** | 860 $m^3$ |
| **Quantity:** | 1 pcs |

# Biogas dryer and cooling (CHL-01)

Biogas dryer and cooling are provided with special equipment as GAS COOLER and AIR-COOLED LIQUID CHILLER. Biogas plants thanks to an extensive range of dedicated Biogas solutions, low pressure heat exchangers, a comprehensive range of water chillers and RWD Dry Coolers. Designed as one-way shell-and-tube heat exchanger. Process gas inside of the tubes; cooling water in the shell. All parts in contact with the process gas made of stainless steel 316Ti or 316L; heat exchanger shell made of stainless steel/ Designed with gas outlet chamber outlet connection radial; inspection opening axial Official acceptance according to PED 2014/68/EU in accordance with ADMerkblätter and factory pressure test.

## Specifications

| | |
|---|---|
| **Gas volume flow** | 476 $m^3$/ h |
| **Gas inlet temperature** | +50 C |
| **Gas outlet temperature** | +20 C |
| **Cooling power** | 100 kW |
| **Engine power** | 32 kW |

# Biogas compressor (BC-01)

Biogas blower is a device used to move gas and increase pressure thanks to a rotating impeller within a toroidal channel, so there is a progressive increase of energy.
Blower is used to transporting biogas from gasholder storage to consumer (biogas upgrading plant in our case).

## Specifications

| | |
|---|---|
| **Flow rate:** | 550 $m^3/h$ |
| **Pressure:** | 150 mbar |
| **Engine power:** | 4.5 kW |
| **Quantity:** | 1 pcs |

# Desulphurization system (CF-01)

The desulphurization system is a two-step purification of biogas to remove sulfur. Stage 1 - adding iron hydroxide into digester. Stage 2 - activated charcoal filtration, as activated charcoal has the capability to absorb sulfur. After passing through activated charcoal filters, the sulfur concentration is reduced to 0...5 ppm.

## Specifications

| | |
|---|---|
| **The volume of charcoal** | 200 kg |
| **Numbers of charcoal columns** | 1 pcs |

# Cogeneration Power Plant (CHP-01)

A cogeneration power plant (CHP) is used for producing electricity and heat. CHP is a very efficient technology for generating electricity and heat together. A CHP plant is an installation where there is simultaneous generation of usable electric power and heat in a single process, and it can provide a secure and highly efficient method of generating electricity and heat at the point of use. Due to the utilization of heat from electricity generation and the avoidance of transmission losses, due to electricity being generated on site, CHP typically achieves a 35 per cent reduction in primary energy usage compared with power stations and heat only boilers. This allows for economic savings where there is a suitable balance between heat and power loads. Another important factor, showing the benefits of cogeneration and CHP, is its low environmental impact. CHP produces lower quantities of pollutant emissions and heat pollution of the atmosphere. The current mix of CHP installations achieves a reduction of over 10 per cent in CO2 emissions in comparison with combined-cycle gas turbines.

## Specifications Jenbacher JMC320

| | |
|---|---|
| Produced electric power | 1000 kW |
| Produced heat power | 1056 kW |
| Emissions | NOx < 500 mg/Nm³ (5% O2) |
| Generator | 400V, 50Hz |
| | |
| Quantity: | 1 pcs |

# Flare (BF-01)

Flare is designed for the temporary or periodical complete combustion of the biogas produced by biogas plants without the possibility of its use as an energy source. The burn system consists of a burner and additional equipment. The burner is designed on the principle of injection and consists of a combustion nozzle with an injector with an air supply control system, flame protection tube, fitting and burner control system. The biogas combustion system is made of stainless steel.

The supporting structure holds the burner and vertically mounted socket. The burn control system is installed in a case, which is mounted on the supporting structure of the combustion system and contains all the elements for monitoring and controlling ignition and flame.

## Specifications

| | |
|---|---|
| **Flow rate** | 476 m³/h |
| **Quantity:** | 1 pcs |


# Gas analyzer (CH4, CO2, H2S, O2) (GA-01)

The gas analyzer is a combined measuring device. It consists of a fixed Control block and a mobile gas measuring device. The Control block is designed for the automatic measurement and monitoring of the amount* and composition of gases produced in biogas plants. The device measures the gas compositions at the individual measuring locations sequentially. The mobile gas measuring device is usually docked to the Control box via the docking station (stationary measurements).
As an option, mobile measurements can be taken at selected measuring locations. The gas measuring device is removed from the Control docking station to carry out the measurement. When it is replaced in the docking station, the calculated measurement values are transmitted to the Control block and displayed.

## Specifications

**Set includes**

Device for wall mounting
LCD display menu
Flow meter / control valve
Sensors

Defined gases methane % (CH4), carbon dioxide % (CO2), hydrogen sulfide ppm (H2S)

# Water supplying and sewerage system

Water supplying system provides biogas plant feed water, water for network circuits, the domestic water and fire safety systems. As used centrifugal single stage pumps as main pumping elements. These pumps are designed for pumping waste water, household / domestic water and sewage. Pressure Boosting Systems are designed for pure water pressure boosting in industrial plants. The booster comprises 2 to 3 (connected in parallel pumps) installed on a common base frame, and provided with all the necessary fittings.

## Specifications

Drain pump
Pressure 4m
Flow 2-3 m3 / h
Engine 0,24 kW

Equipment
Pump case control
Stove-base
gauges
Check valves
Float switches
Brackets
Valves

# Heating system

Heating equipment is using for biogas plant heating and for sustaining constant temperature in the fermenter.  Heating equipment includes circulation pumps, heat exchanger, heating manifold and pipes. The heat from the boiler is transferred to the biogas plant by using heat exchanger, and then is pumped through of biogas plant by circulation pumps. A heat carrier prepares water with an additive of ethylene glycol. Inlet temperature in the fermenter is 60C, the outlet is 40C.

## Specifications

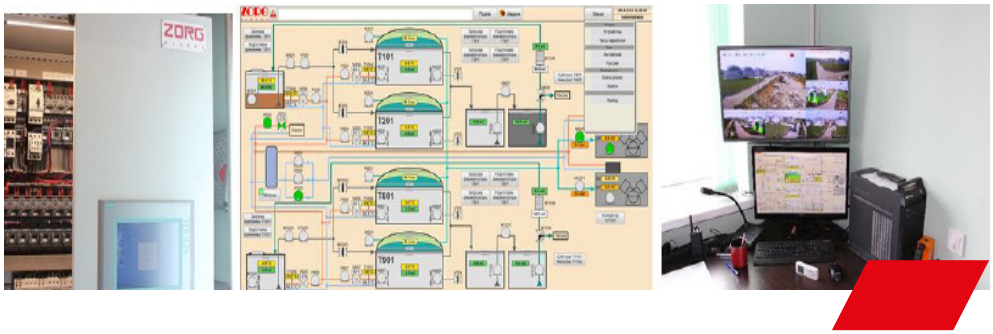
| | |
|---|---|
| Circulating pump feeding heat carrier heating | |
| Flow | 30 m3 / h; |
| Pressure | 1 bar |
| | |
| Circulating pump feeding heat carrier to the digester | |
| Flow | 18 m3 / h; |
| Pressure | 1.1 bar |
| | |
| The pumping station feeding propylene glycol | |
| Flow | 0.8 m3 / h; |
| Pressure | 4 bar |

# Dry cooler (cooling substrate system) (DC-01)

Device is designed to cool the substrate to working temperature according to techno-logical regime. When use high temperature substrate, there is a chance of uncontrolled heating. The cooler is connected to the heating pipes, heat exchangers and it will be activated if it is need.

## Specifications

| | |
|---|---|
| **Power (cooling)** | 100 kW |
| **Length:** | 3,0 m |
| **Width:** | 2,5 m |
| **Height:** | 1,5 m |
| **Power electrical** | 4 kW |
| **Quantity:** | 1 pcs |




# Automation and electrical equipment

Process control equipment is used for supervision and regulation operation of the plant and for the limitation of damage. In case of emergency (for example, breakdown of the electrical power supply) the biogas plant is automatically transferred to safe operating conditions by the process instrumentation. Critical electrically driven devices are supplied with emergency power. An automatic system allows the supervision of the plant in real time and to recognize and correct aberrations immediately; to run the plant at its optimum saving resources and costs; and to record for the electronic database operation parameters. The automatic system consists of a control cabinet and sensors for parameter control of technological processes and execution devices.

The control cabinet is designed based on the industrial controller Siemens CPU315-DP2, using periphery distributing system Simatic ET200S, and operator panel OP277 Touch with touch-sensitive controls. Communications is executed by PROFIBUS and MPI with physical interface RS-485. The control program is designed based on the Simatic Step7. The control cabinet is a modular design. The upper part has a power box with central and front-end processor. The periphery distributing system, Simatic ET2005, is installed with input - output units. The lower part with interface relay and clips is installed for connecting execution devices. The entire plant is controlled by a single operator.

## Specifications

**Incoming control case with automatic set ASE-1, 2, 3**
**Base Siemens CPU315-DP2 controller**
**Peripherals Simatic ET200S**
**Control panel OP277 touchscreen**
**Communication PROFIBUS and MPI**
**Interface RS-485**
**Control system Simatic Step7**

# Sensors set

Sensors are used to measure physical quantities (temperature, pressure, level of moisture) data collection.
installation kits

**Conductometric sensor**
**Pressure Sensor / level**
**Ultrasonic sensor**
**Gas Pressure Sensor**
**Temperature converters with protective sleeves**
**The moisture sensor and the gas temperature**

# Laboratory

Monitoring and control of parameters of raw materials and fermentation processes is important for the efficient operation of a biogas plant. The laboratory allows you to assess the content of dry matter in the input raw materials, fermented mass, determine the ratio of volatile organic acids to total inorganic carbon (FOS/TAC parameter), determine the degree of substrate fermentation in fermenters, the level of biogas output, and evaluate the efficiency of separator.

## Equipment

**Analytical scales**
**Moisture analyzer**
**Automatic titrator**
**Laboratory pH meter**
**Centrifuge**
**A set of flasks**

# EQUIPMENT SPECIFICATION LIST

| № | Equipment | Characteristic | Quantity |
|---|---|---|---|
| **1** | **Solid feeder** | **V=25 m3** | **1** |
| 1.1 | Container bunker | 2x30kW | 1 |
| 1.2 | Feeding screws | set. | 1 |
| **2** | **Submersible mixer** | **N=3.0kW** | **1** |
| 2.1 | Airtight motor gearbox | | 1 |
| 2.2 | Hydraulic screw (wear-resistant steel) | | 1 |
| 2.3 | Mixer control mechanism | | 1 |
| 2.4 | Electric motor mount | | 1 |
| 2.5 | Set of fasteners | | 1 |
| **3** | **Digester vertical mixer** | **N=15 kW** | **3** |
| 3.1 | Airtight motor gearbox | | 3 |
| 3.2 | Hydraulic screw (wear-resistant steel) | | 3 |
| 3.3 | Shaft (adapted to the height of the fermenter) | | 3 |
| 3.4 | Blade | | 3 |
| 3.5 | Frequency converter | | 3 |
| 3.6 | Mounting bracket to bottom of the mixer | | 3 |
| **4** | **Safety valve of digesters** | | **1** |
| **5** | **Window with a searchlight** | **set** | **1** |
| 5.1 | Inspection window RD300 (mounts and sealant included) | Ø300 | 2 |
| 5.2 | Spotlight (mount system bundled) VISULUX UL50 -G -H | 230V, 50W, IP65 | 1 |
| **6** | **Substrate digested pump** | **25 m3/hour N=5.5 kW** | **1** |

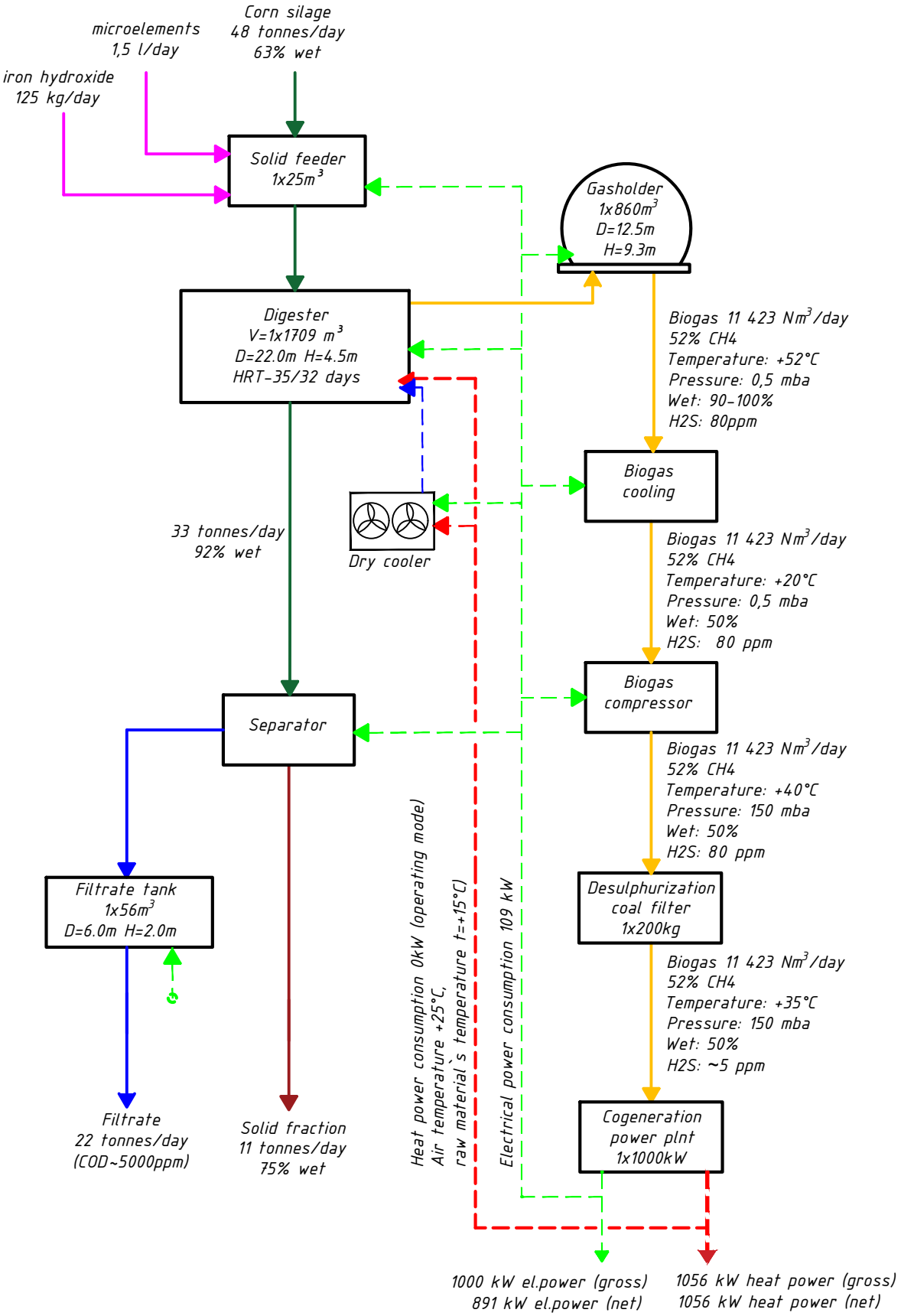
| № | Equipment | Characteristic | Quantity |
|---|---|---|---|
| **7** | **Separator** | **N=3.0kW, Q=5-8m3/h** | **1** |
| 7.1 | Body | | 1 |
| 7.2 | Substrate Supply Pipe 4 ’’ | | 1 |
| 7.3 | Engine - Gearbox | N=3.0 kW | 1 |
| 7.4 | Frame | | 1 |
| 7.5 | Screw | | 1 |
| 7.6 | Sieve for filtration | | 1 |
| **8** | **Filtrate pump** | **25 m3/hour N=5.5kW** | **1** |
| **9** | **PVC external gas holder** | **Ø12.4m** | **1** |
| 9.1 | Weather protection film | Ø12.4m | 1 |
| 9.2 | Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm bio-gas resistant | | 1 |
| 9.3 | Air blower | 16A, 0,5kW | 1 |
| 9.4 | Excess and minimum pressure valve | | 1 |
| 9.5 | Dome level sensor | | 1 |
| 9.6 | Mounting system | | 1 |
| 9.7 | Accessories | | 1 |
| 9.8 | Safety valve | | 1 |
| **10** | **Biogas Cooling System** | **476 m³/h** | **1** |
| 10.1 | Chiller | | 1 |
| 10.2 | Heat exchanger | | 1 |
| 10.3 | Polypropylene glycol tank | | 1 |
| **11** | **Desulphurization system** | | **1** |
| 11.1 | Numbers of charcoal columns | **200 kg** | 1 |

| № | Equipment | Characteristic | Quantity |
|---|---|---|---|
| **12** | **Biogas compressor** | **Q=550m³/h<br>H=150mBar<br>N=1.5kW** | **1** |
| **13** | **Biogas analyzer (CH4 , CO2 , H2S, O2 )** | | **1** |
| **14** | **Electromagnetic flow meter** | | **1** |
| **15** | **Flare** | **476 m3/h** | **1** |
| **16** | **Cogeneration power plant** | **1000kW** | **1** |
| **17** | **Gas equipment included** | **set** | **1** |
| 17.1 | Drainage pump with float | DN=50<br>Q=1m³/h<br>H=13 m | 2 |
| **18** | **The heat supply system** | **set** | **1** |
| 18.1 | Diaphragm expansion tank | V=1000 l<br>P=6Bar T=120°C | 1 |
| 18.2 | Circulating pump for supplying heat carrier | Q=30 m³/h<br>H=1bar | 1 |
| 18.3 | Propylene glycol feed pump station<br>heating systems | Q=1,0 m³/h,<br>H=4 bar | 1 |
| 18.4 | Circulation pump for supplying heat carrier<br>to the digester | Q=18 m3/h,<br>H=1.1 bar | 1 |
| **19** | **Water supply and sewerage system, complete, disassembled** | **set** | **1** |
| **20** | **Automation with electrical equipment complete, disassembled** | **set** | **1** |
| 20.1 | Incoming distribution cabinet<br>with a set of automation DB-1 | | 1 |
| 20.2 | Incoming distribution cabinet<br>with a set of automation DB-2 | | 1 |
| **21** | **Sensors, set** | | **1** |
| 21.1 | Gas pressure sensor 0,025Bar | | 1 |
| 21.2 | Gas pressure sensor 0,4Bar | | 1 |
| 21.3 | Pressure sensor(substrate level) 1,0Bar | | 2 |
| 21.4 | Pressure sensor (substrate pressure) 2,5bar | | 2 |

| № | Equipment | Characteristic | Quantity |
|---|---|---|---|
| 21.5 | Resistive thermometer (gas temperature) | | 2 |
| 21.6 | Resistive thermometer with thermo well (fermenter substrate temperature) | | 2 |
| 21.7 | Resistive thermometer with thermo-well (digester tank substrate temperature) | | 2 |
| 21.7 | Resistive thermometer (heat conductor temperature) | | 2 |
| 21.9 | Conductometric sensor of maximum level | | 2 |
| 21.10 | Conductometric sensor of water level | | 2 |
| 21.11 | Dome position sensor | | 1 |
| 21.12 | Coolant pressure sensor | SEN 3276 B065 G1/2 6Bar | 2 |
| 21.13 | Humidity and gas temperature sensor | ESFTF-I | 2 |
| **22** | **Dry cooler 100kW heat pow.** | | **1** |
| **23** | **Laboratory** | | **1** |

# APPENDICES

# Material flow diagram

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## Explication

| N/№ | Name | Quantity |
|---|---|---|
| SF-01 | Solid feeder | 1 |
| SV-01 | Safety valve | 1 |
| SG-01 | Inspection windows | 1 |
| AG-01 .... AG-03 | Vertical Paddle agitator of Digester | 3 |
| AG-04 | Submersible agitator of the filtrate tank | 1 |
| PU-01 | Substrate pump from Digesters tos eparator | 1 |
| PU-02 | Filtrate pump | 1 |
| SR-01 | Separator | 1 |
| GH-01 | Gasholder | 1 |
| CHL-01 | Biogas cooling system | 1 |
| BC-01 | Biogas blower | 1 |
| CF-01 | Desulphurisation system | 1 |
| BG-01 | Biogas analyzer | 1 |
| FM-01 | Biogas flow meter | 1 |
| CHP-01 | Cogeneration poer plant | 1 |
| BF-01 | Biogas flare | 1 |
| DC-01 | Dry cooler | 1 |

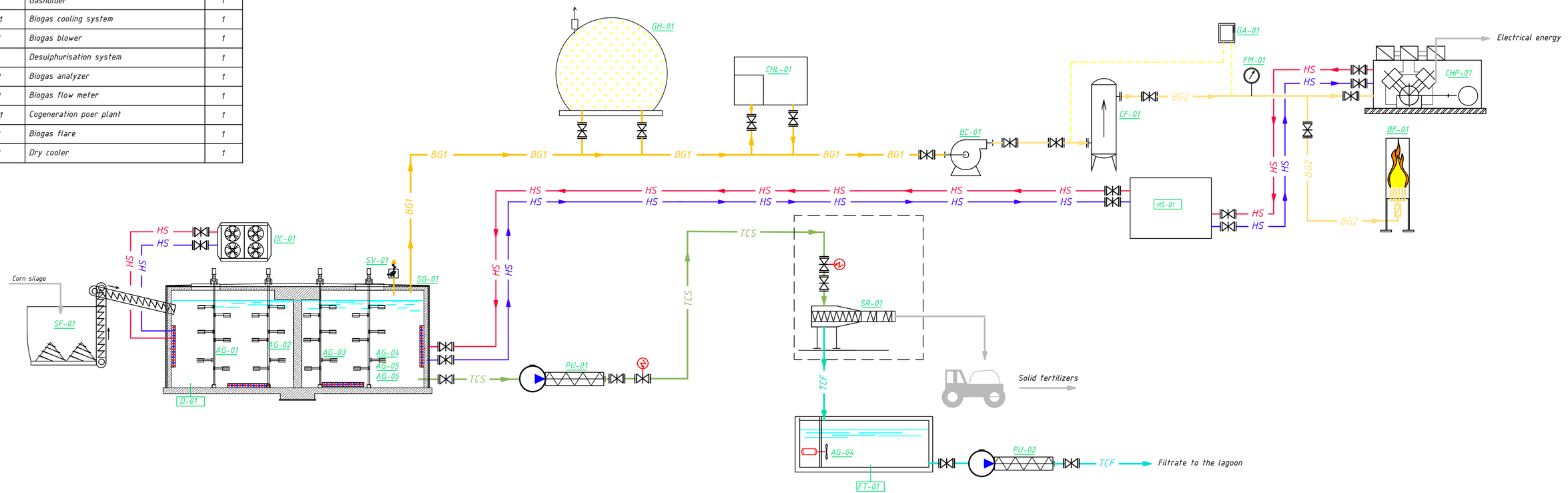
## Structure

| N/№ | Name | Quantity |
|---|---|---|
| D-01 | Digester | 1 |
| FT-01 | Filtrate tank | 1 |
| HS-01 | Heat sub-station | 1 |

## Legend main pipelines

- TCS — Substrate
- TCF — Filtrate
- BG1 — Biogas
- BG2 — Biogas
- HS — HS — Heat system pipeline

## Basic diagram

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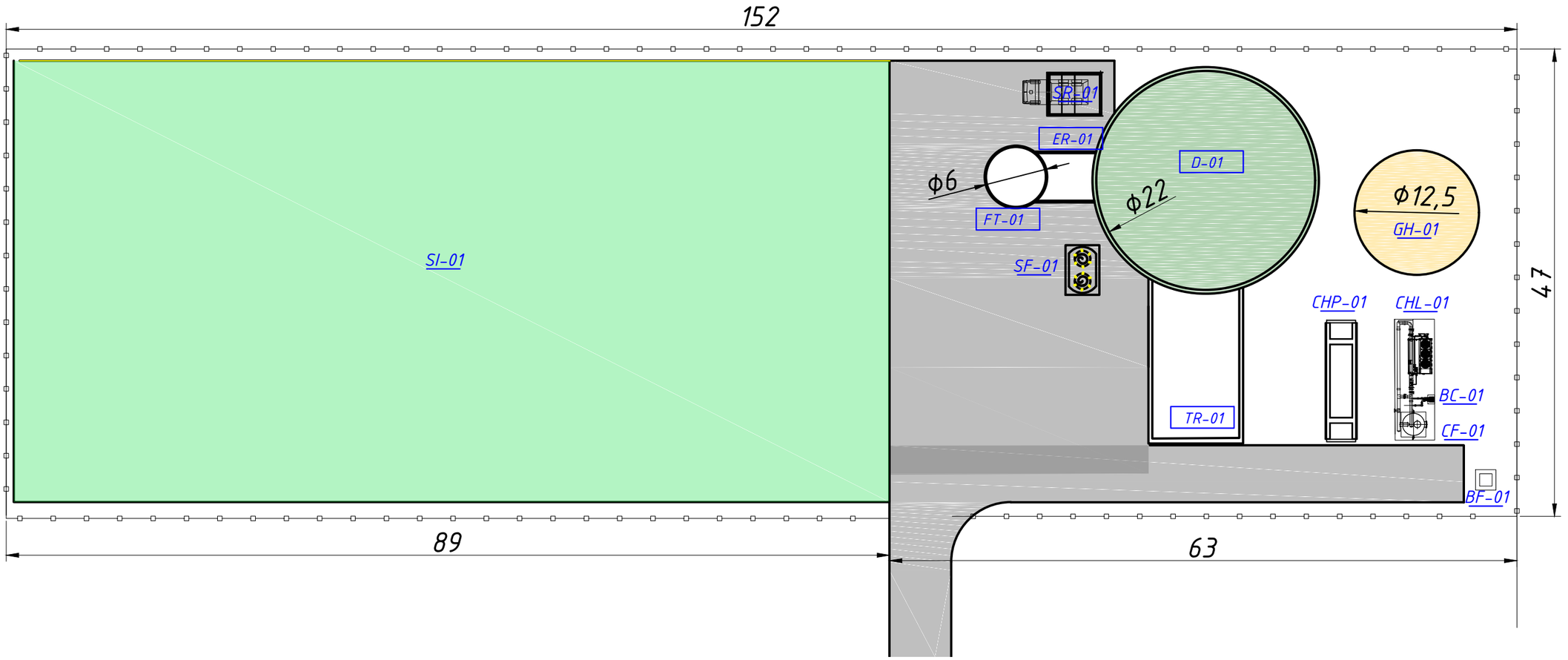
# Plan




## Explication

| N/№ | Name | Note |
|---|---|---|
| SF-01 | Solid feeder | |
| D-01 | Digester | |
| FT-01 | Filtrat tank | |
| SR-01 | Separator platform | |
| GH-01 | Gasholder | |
| CHL-01 | Biogas cooling system | |
| BC-01 | Biogas compressor | |
| CF-01 | Carbon filter (desulphurization) | |
| BF-01 | Biogas burner | |
| ER-01 | Equipment room | |
| TR-01 | Technical room | |
| CHP-01 | Cogenration power plant | |
| SI-01 | Silo storage | |

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**Appendix 4**

| Biogas plant | | | | | |
|---|---|---|---|---|---|
| **Name equipment** | **Instal. Pow. (kW)** | **Q-y (pcs)** | **Total installed power (kW)** | **Working hours per day** | **Consumption kWh per day** |
| Loader V=25 $m^3$ | 60,0 | 1 | 60,0 | 4,0 | 240,0 |
| Screw set. | 26,0 | 1 | 26,0 | 4,0 | 104,0 |
| Digester Vertical mixer | 15,0 | 3 | 45,0 | 18,0 | 810,0 |
| Submersible mixer in filtrate tank | 3,0 | 1 | 3,0 | 12,0 | 36,0 |
| Biogas cooling system | 32,0 | 1 | 32,0 | 24,0 | 768,0 |
| Biogas compressor | 4,5 | 1 | 4,5 | 24,0 | 108,0 |
| Separator | 3,0 | 1 | 6,0 | 8,0 | 48,0 |
| Substrate pump to separator | 5,5 | 1 | 6,0 | 8,0 | 48,0 |
| Filtrate pump | 5,5 | 1 | 4,0 | 3,0 | 12,0 |
| Air blower for double membrane | 1,0 | 1 | 1,0 | 24,0 | 24,0 |
| Digester cooling system | 4,0 | 1 | 4,0 | 24,0 | 96,0 |
| CHP self-consumption | 9,8 | 1 | 9,8 | 24,0 | 235,2 |
| Circulation pump for supplying heat carrier to the digester | 0,8 | 1 | 0,8 | 24,0 | 18,0 |
| Circulation pump for supplying heat carrier to the digester cooling system | 2,0 | 1 | 2,0 | 24,0 | 48,0 |
| Circulating pump feeding hot water at technical building | 0,1 | 1 | 0,1 | 24,0 | 1,9 |
| Propylene glycol pump station | 0,8 | 1 | 0,8 | 0,5 | 0,4 |
| Drinage pump | 1,0 | 2 | 2,0 | 0,5 | 1,0 |
| Lighting of the biogas plant territory | 1,0 | 1 | 1,0 | 8,0 | 8,0 |
| Spot light for digesters inspection windows | 0,1 | 1 | 0,1 | 0,5 | 0,0 |
| Working lighting of switchboard | 0,1 | 1 | 0,1 | 0,5 | 0,1 |
| Total installed power, kW | | | **208** | | |
| Total consumed electric energy, kWh per day | | | | | **2607** |
| Total consumed power, kW | | | | | **109** |

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## Equipment price

| Pos. | Description | Quantity | Unit Price, EUR | Total Price, EUR |
|---|---|---|---|---|
| 1 | Solid Feeder 25m3 | 1 | 97 000,00 | 97 000,00 |
| 2 | Screw conveyor | 1 | 80 000,00 | 80 000,00 |
| 3 | Gasoholder external 860m³ | 1 | 86 000,00 | 86 000,00 |
| 4 | Over- and underpressure safeguard | 1 | 4 200,00 | 4 200,00 |
| 5 | Sight glasses/viewing windows with projector | 1 | 3 900,00 | 3 900,00 |
| 6 | Digester vertical mixer 15,0kW | 3 | 48 000,00 | 144 000,00 |
| 7 | Frame fo pos.6 | 3 | 5 000,00 | 15 000,00 |
| 8 | Substrate supply pump to separator unit N=5,5 kW | 1 | 19 100,00 | 19 100,00 |
| 9 | Filtrate pump N=5,5kW | 1 | 19 100,00 | 19 100,00 |
| 10 | Substrate separation unit 4,0 kW | 1 | 36 700,00 | 36 700,00 |
| 11 | Submersible mixer 3,0 kW (Filtrate tank) | 1 | 9 000,00 | 9 000,00 |
| 12 | Biogas cooling system 500 m3/hour | 1 | 75 000,00 | 75 000,00 |
| 13 | Biogas blower 500 m3/hour | 1 | 5 700,00 | 5 700,00 |
| 14 | Desulfurization system 200 kg | 1 | 22 500,00 | 22 500,00 |
| 15 | Gas analyzer | 1 | 7 000,00 | 7 000,00 |
| 16 | Gas conditioning unit 500 m3/hour | 1 | 10 300,00 | 10 300,00 |
| 17 | Biogas burner 500 m3/hour | 1 | 41 700,00 | 41 700,00 |
| 18 | Heat supply station, as a unit, knocked-down. | 1 | 54 500,00 | 54 500,00 |
| 19 | Automatic with electric equipment, as a unit | 1 | 145 000,00 | 145 000,00 |
| 20 | Sensors (set) | 1 | 25 000,00 | 25 000,00 |
| 21 | Water supply and canalization system, as a unit. | 1 | 27 300,00 | 27 300,00 |
| 22 | Digester dry-cooler 100 kW | 1 | 26 100,00 | 26 100,00 |
| | **TOTAL (EXW, Memmingen, Germany):**<br>**Nine hundred fifty four thousand one hundred 00 Euros** | | | **954 100,00** |

ZORG BIOGAS

# Price

| Name | Price (EXW, Memmingen) |
|---|---|
| Project documentation | 62 000 Euro |
| Supervision | 20 000 Euro |
| Start-up, training | 20 000 Euro |
| Equipment | 954 100 Euro |
| Cogeneration power plant (Jenbacher JMC320 in-container 1 x 1063kW) | 535 000 Euro |
| Delivery (5 containers x 10 000Euro) | 50 000 Euro |
| Construction and instalation | 800 000 Euro |
| Laboratory | 27 000 Euro |
| Total | 2 468 100 Euro |

## Implementation terms and payment

| Months | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project documentation | 50% | | 50% | | | | | | | | | | | |
| Equipment supply | | | | 50% | | | 25% | | 25% | | | | | |
| CHP | | | | 50% | | 20% | | | 20% | | 10% | | | |
| Construction | | | | 50% | | 20% | | 20% | | 10% | | | | |
| Supervision | | | | 50% | | 20% | | 20% | | 10% | | | | |
| Plant start-up | | | | | | | | | | | | 50% | 25% | 25% |

## Contracts

**Project implementation is executed simultaneously under several contracts**

- Engineering contract
- Equipment supply contract
- Supervision contract
- Start-up and training contract

ZORG BIOGAS

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