ZORG BIOGAS

01

version

Proposal

Biogas plant 780 t silaged pressed sugar beet pulp per day
Electrical power -12,6MW

Date: 29/06/2026
Validity: 6 months

CONTENT

OVERVIEW

Zorg Biogas offers a solution to process silaged pressed sugar beet pulp into biogas. The produced biogas is used as a fuel in cogeneration power plants to produce heat and electrical energy. The proven technology of vertical CSTR reactor with a central agitator is used. To maximize the gas output and to improve the quality of the biofertilizer a post-digester with a gasholder roof is installed after the digesters. The post-digester equipped with a gasholder and serves for the collection of the produced biogas. The vertical shape of the reactors provides the optimal mass and heat transfer, as a result the biogas plant consumes very little electric energy. To compare different concepts of biogas plant it is necessary to pay attention not only to the price, but also to the quality and small but very important details. The temperature is maintained with an accuracy of 0,1ºC. The roof of the reactor and next two rows of rings are made from stainless steel. There is a double filtration of biogas, which save burners life. The biogas plant is equipped with a modern laboratory. Biogas plants has a lot of features, which are known only to the experienced company. For example, operational temperature, foam safety valves, micro-elements and etc.

Zorg will provide detailed engineering, supply all relevant process equipment, and deliver supervision during construction, commissioning, and start-up, including operator training. Civil works, construction, and installation will be executed by the Customer under Zorg's technical supervision and quality control.

The biogas plant can create additional value for sugar producers exporting to the EU by reducing the carbon footprint of sugar production through methane capture from sugar beet pulp. These emission reductions can be independently verified (e.g., by Bureau Veritas), strengthening the producer's environmental credentials and supporting compliance with evolving EU carbon and sustainability requirements. The verified reduction in carbon footprint can strengthen ESG (Environmental, Social and Governance) performance and may help reduce future carbon-related compliance costs, while improving competitiveness in the European market.

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 (%)	Electrical power (kW)
Silaged pressed sugar beet pulp	780	284 700	27	94	210,6	197,96	700	138 575	58	12655

*-DM- Dry matter
**-ODM- organic dry matter

Biogas plant characteristics

Characteristics	Values	Figures
Number of reactors (vCTR)	units	3
Volume:		
Work	m^3	7092
Overall		7422
Temperature	^0C	48
Overall dimensions of the digester:		
diameter	m	22,9
height		18,0
Organic load	kgODM/m3	8,4
Hydraulic retention time (gross/net)	days	28/27
Number of gasholders	units	0
Postdigester	units	1
Volume:		
Work	m^3	4620
Overall		5082
Temperature	^0C	46
Overall dimensions of the digester:		
diameter	m	31,3
height		6,6
Organic load	kgODM/m3	4,3
Hydraulic retention time (gross/net)	days	8/6
Number of gasholders	units	1
Volume:	m^3	2047
Dimensions of the gasholder:		
diameter	m	32,0
height		6,4

Number of personnel

	Shift 1	Shift 2	Shift 3
Chief Engineer	1	-	-
Manager	1	-	-
Operator	1	1	1
Driver	1	1	-
Electrician	1	-	-
Mechanic	1	-	-
Total	9		

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

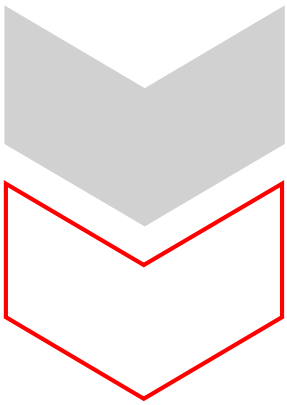
The silage pressed sugar beet pulp is directed into a central loader, from where the silage is distributed to reactors' solid feeders by a conveyor line. The solid feeder is installed next to each of the reactors and loads the substrate by portions with augers sets. .

In the reactors the substrate is brought up to a temperature of +48°C. The constant temperature is sustained for the entire digesting period. To prevent a rise in temperature the biogas plant is equipped with coolers (dry cooling). The reactors' operating regime is thermophilic. The heated substrate in the digesters is blended periodically. Mixing is performed by a central vertical agitator. The average retention time in the reactor is 28 days. After the reactor, the substrate is fed to a postdigester tank. The postdigester is used to extract remaining energy from organic matter and safely store the material before utilization The postdigester tank equipped with gasholder roof to collect produced biogas. The substrate after post digester tank is supplied to a separation area, where it is separated into solid and liquid bio-fertilizer. Solid bio-fertilizer is discharged and transported for storage; liquid filtrate is directed to the technological needs (dilution).

Biogas goes up under overlaps of the reactors and delivered into a gasholder through pipeline. The gasholder system has a two-layer construction. The gas holder's weather protective film protects the gasholder from precipitation and damage by foreign objects. To protect the gasholder from overpressure, digester is equipped with safety valve, which start working at a pressure of 5 mbar and bleeds biogas to the atmosphere. . Then accumulated in the gasholder biogas 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 filter to remove hydrogen sulfide (H_2S). After the filter, biogas goes to cogeneration power plant, where it is used as fuel for production of electricity and heat. Heat from the congenators 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



Central solid feeder (SF-04)

Solid feeder machines have been proven in various situations. Solid feeder has the solid design, which guarantees a maximum functionality and less maintenance, combined to a low energy consumption. Because of the vertically oriented walls, there is no change for the material to get stuck or build bridges. The conveyor chains and the milling-unit allow continuous dosing by various types of materials. Furthermore, the material is loosened by this dosing process. The user is able to control the material flow up to 20m³/h or more, regarding to the own consumption of electrical power by the machine. In addition, the corrosion protection, wear resistance and high quality allow customers to use our product for a long period of time.

Specifications

Height:	**3,2 m**
Length:	**18,0 m**
Width:	**3,6 m**
Volume:	**200 m³**
Quantity:	**1 pcs.**

Reactors` solid feeder (SF-01 ... SF-03)

Solid feeder machines have been proven in various situations. Solid feeder has the solid design, which guarantees a maximum functionality and less maintenance, combined to a low energy consumption. Because of the vertically oriented walls, there is no change for the material to get stuck or build bridges. The conveyor chains and the milling-unit allow continuous dosing by various types of materials. Furthermore, the material is loosened by this dosing process.

Specifications

Height:	**2,6 m**
Length:	**7,0 m**
Width:	**2,8 m**
Volume:	**30 m^3**
Quantity:	**3 pcs.**

Receiving tank and filtrate tank

Reservoir for reception of liquid kinds of raw materials. Tank is equipped with level sensors and side agitators for mixing raw materials. Tanks serve as a buffer for collection substrates and then to supply substrates to points of biogas plant according the technological process.

Specifications

Receiving tank

Diameter:	**8,4 m**
Height:	**3,0 m**
Volume:	**166 m³**
Quantity:	**1 pcs.**

Filtrate tank

Diameter:	**8,4 m**
Height:	**3,0 m**
Volume:	**166 m³**
Quantity:	**1 pcs.**

Plates (tank wall enameled, roof)
Flange, nozzle, lap joint flanges outside
Control glass
Ex light
Manhole
Ladder, stair and walkway
Brackets and clamps for pipe along tank edge (internal/external)

Side agitator (AG-04...AG-09)

Side mixers are used in biogas reactors and receiving tanks for mixing medium and low viscosity substrates. When installed on a metal tank, the stirrer is attached to a support column. The agitator drive is located outside, and a shaft with a screw goes into the reactor through a flange installed in the wall. Installation through a flange prevents the transfer of forces from the agitator to the tank walls. Suitable for use in aggressive environments with a dry matter content of up to 11 %. The special design of the shovel-like blades works good both with mixing different types of substrates and breaking up floating layers and crust.

Specifications

Receiving tank:

Engine power:	7,5 kW
Quantity per tank:	1 pcs
Quantity total:	1 pcs

Filtrate tank:

Engine power:	5,5 kW
Quantity per tank:	1 pcs
Quantity total:	1 pcs

Post-Digester tank:

Engine power:	15 kW
Quantity per tank:	4 pcs
Quantity total:	4 pcs

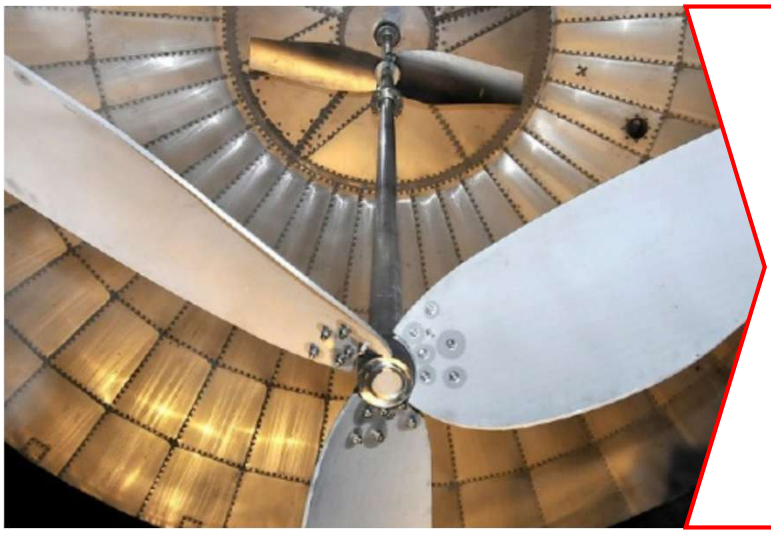
Reactor (RT-01...RT-03)

Reactor is an important part of a biogas plant made of enameled sheet metal. The steel digester is installed on a concrete basis. A layer of enamel protects the surface of the entire metal structure. The enamel is vitreous and very resistant to aggressive pH and mechanical damage. Enameled digester assembled from steel segments. Such a digester is quickly and safely mounted. Steel panels are joined on bolted joints with a special sealant. The enamel coating is layered according to the PUESTA method. This is a special powder that is laid in layers by electrostatic attraction. Thus, uniformity of coating, density and smooth

Specifications

Height:	**18,0 m**
Diameter:	**22,92 m**
Total volume:	**7422 m^3**
Substrate volume	**7092 m^3**
Quantity:	**3 pcs.**

Plates (tank wall enameled, roof)
Flange, nozzle, lap joint flanges outside
2 off control glass 2 x DN 250 with water flush
Ex light
Manhole
Ladder, stair and walkway
Brackets and clamps for pipe along tank edge (internal/external)



Reactor central vertical agitator (AG-01 ... AG-03)

The agitator is fixed to the center of the rigid overlap of the fermenter. Mixer blades are designed in different directions. This design of the blades helps to create a lifting force that lifts the substrate from the bottom of the digester to the top of the tank. The upper blades rotate distributing the substrate along the digester, directing the flow downward. The agitator works constantly, mixing the substrate in the digester all the time

Specifications

Engine power:	**37 kW**
Quantity per reactor:	**1 pcs**
Total quantity:	**3 pcs**

Post-Digester (D-01)

The steel post-digester is installed on a concrete basis. A layer of enamel protects the surface of the entire metal structure. The enamel is vitreous and very resistant to aggressive pH and mechanical damage. Enameled digester assembled from steel segments. Such a digester is quickly and safely mounted. Steel panels are joined on bolted joints with a special sealant. The enamel coating is layered according to the PUESTA method. This is a special powder that is laid in layers by electrostatic attraction. Thus, uniformity of coating, density and smoothness are achieved. Bolts made of stainless steel. All elements (flanges, etc.) are connected through an EPDM membrane to protect the enamel. To reduce heat consumption and maintain a constant temperature, the digester is isolated. Outside the digester is coated with a decorative coating

Specifications

Height:	**6,0 m**
Diameter:	**31,32 m**
Total volume:	**5082 m^3**
Substrate volume	**4620 m^3**
Quantity:	**1 pcs.**

Plates (tank wall enameled, roof)
Flange, nozzle, lap joint flanges outside
2 off control glass 2 x DN 250 with water flush
Ex light
Manhole
Ladder, stair and walkway
Brackets and clamps for pipe along tank edge (internal/external)

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**
Spotligh: **VISULUX UL50 -G -H**	**230V, 50W, IP65**

Pump equipment

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 feed pump

Engine power:	11 kW
Flow rate:	50 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Substrate circulation pump

Engine power:	11 kW
Flow rate:	40 m3/hour
Pressure:	4 bar
Quantity:	3 pcs

Substrate pump

Engine power:	11 kW
Flow rate:	40 m3/hour
Pressure:	4 bar
Quantity:	3 pcs

Discharge pump

Engine power:	11 kW
Flow rate:	60 m3/hour
Pressure:	4 bar
Quantity:	3 pcs

Filtrate pump

Engine power:	18 kW
Flow rate:	60 m3/hour
Pressure:	4 bar
Quantity:	2 pcs

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:	**13,2m**
Diameter:	**32,0 m**
The total volume :	**2047 m^3**
Quantity:	**1 pcs**

Biogas drying and cooling (CHL-01... CHL-06)

Biogas drying 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:	**2900 m^3/hour**
Gas inlet temperature:	**+55°C**
Gas outlet temperature:	**+20°C**
Electric power:	**56 kW**
Quantity:	**2 pcs**

Biogas compressor (BC-01, BC-02)

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:	**6000 m3/hour**
Pressure:	**300 mbar**
Engine power:	**60 kW**
Quantity:	**2 pcs**

Desulphurization system

The desulphurization system is a 3-step system. Stage 1 is adding reagent directly into reactor. Stage-2 is introducing a controlled amount of air (oxygen) into the anaerobic digester. This process creates a microaerobic environment where sulfur-oxidizing bacteria (SOB) utilize H2S and oxygen to produce elemental sulfur, effectively reducing H2S levels in the biogas. Stage 3 – post-treatment with 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 ppm.

Specifications

Charcoal filter

The volume of charcoal:	**1000 kg**
Quantity:	**2 pcs**

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

Gas analyzer - a measuring device to determine the qualitative and quantitative composition of the gas mixture. In a biogas plant's installed absorption gas analyzers, biogas mixture components are absorbed sequentially with various reagents. Automatic gas analyzers continuously measure any physical or physicochemical characteristics of the gas mixture or its individual components. Operation is based on physical methods of analysis, including auxiliary chemical reactions.

Specifications

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

Quantity: **1 pcs**

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

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:	**6000 m^3/hour**
Pressure:	**min 10 mbar- max 60 mbar**
Quantity:	**2 pcs**

Cogeneration power plant (CHP-01 ... CHP-06)

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

Produced electric power:	**2300 kW**
Produced heat power:	**2290 kW**
Emissions:	**NOx < 500 mg/Nm³ (5% O2)**
Generator:	**400V, 50Hz**
Quantity:	**6 pcs**

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

Engine power:	**2,0 kW**
Flow:	**20 m^3/hour**
Pressure:	**1 bar**

Circulating pump feeding heat carrier

Engine power:	**0,8 kW**
Flow:	**3 m^3/hour**
Pressure:	**1 bar**

The pumping station feeding propylene glycol

Engine power:	**0,8 kW**
Flow:	**1 m^3/hour**
Pressure:	**4 bar**

Plate Heat Exchanger (HE-01...HE-03)

As of today, the design of dismountable plate heat exchangers is the most advanced in the field of solving heat exchange problems. Dismountable plate heat exchangers with thermal capacities ranging from 5 kW to 30 MW can be implemented for various technological processes.

The collapsible plate heat exchanger consists of a frame and a set of heat transfer plates. The frame of the heat exchanger consists of movable and fixed plates, upper and lower guides and a rear stand. All heat exchanger plates in the package are identical in size, but are rotated 180 degrees relative to each other. This arrangement ensures alternating hot and cold channels. During the heat exchange process, the working fluids move towards each other (counter currently). The hot medium transfers heat through the plate wall. There are dozens of plate sizes available for the collapsible heat exchanger. And for each plate size, there are several corrugations. The combination of plates with different reliefs (corrugations) increases the number of possible combinations of heat exchange channels. All of this makes it possible to model a plate heat exchanger that is as close as possible to the specified power and losses.

Specifications

Volumetric capacity	**5 to 100 m3/h**
Temperature	**up to 90°C**
Working pressure	**at 4 bar**
Capacity of the heat exchanger for substrate	**600 kW**
Quantity:	**3 pcs**

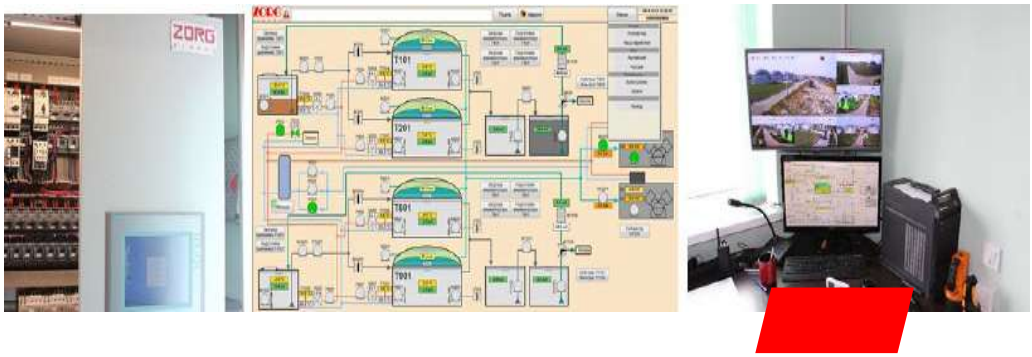
Dry cooler (cooling substrate system)

Device is designed to cool the substrate to working temperature according to technological 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

Substrate in reactors

Heat power:	**100 kW**
Electric power:	**4 kW**
Quantity:	**3 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

Specifications

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

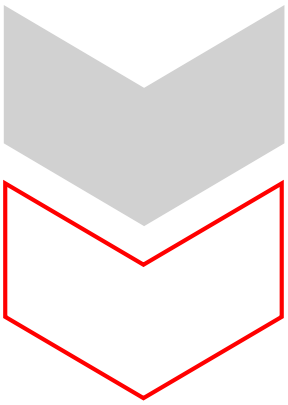
Laboratory

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

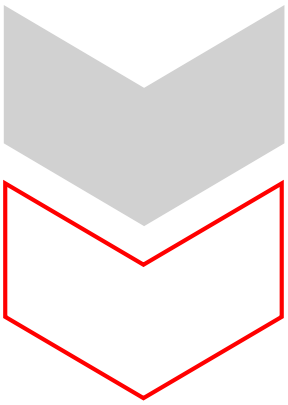


№	Equipment	Characteristic	Quantity
1	**Side mixer**	**N=7,5 kW**	**1**
1.1	Airtight motor gearbox		1
1.2	Hydraulic screw (wear-resistant steel)		1
1.3	Mixer control mechanism		1
1.4	Electric motor mount		1
1.5	Set of fasteners		1
2	**Side mixer**	**N=5,5 kW**	**1**
3	**Reactor central vertical agitator**	**N=37 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	**Post-digester`s side mixer**	**N=15 kW**	**4**
5	**Safety valve of digesters**		**4**
6	**Window with a searchlight**	**set**	**4**
6.1	Inspection window RD300 (mounts and sealant included)	Ø300	6
6.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	3
7	**Substrate feed pump**	**40 m3/hour N=11kW**	**1**
8	**Substrate digested pump**	**40 m3/hour N=11kW**	**3**
7	**Substrate circulation pump**	**40 m3/hour N=11kW**	**3**
9	**Discharge pump**	**40 m3/hour N=11kW**	**3**
10	**Filtrate pump**	**60 m3/hour N=18kW**	**2**
11	**PVC gas holder**	**2047 m3**	**1**

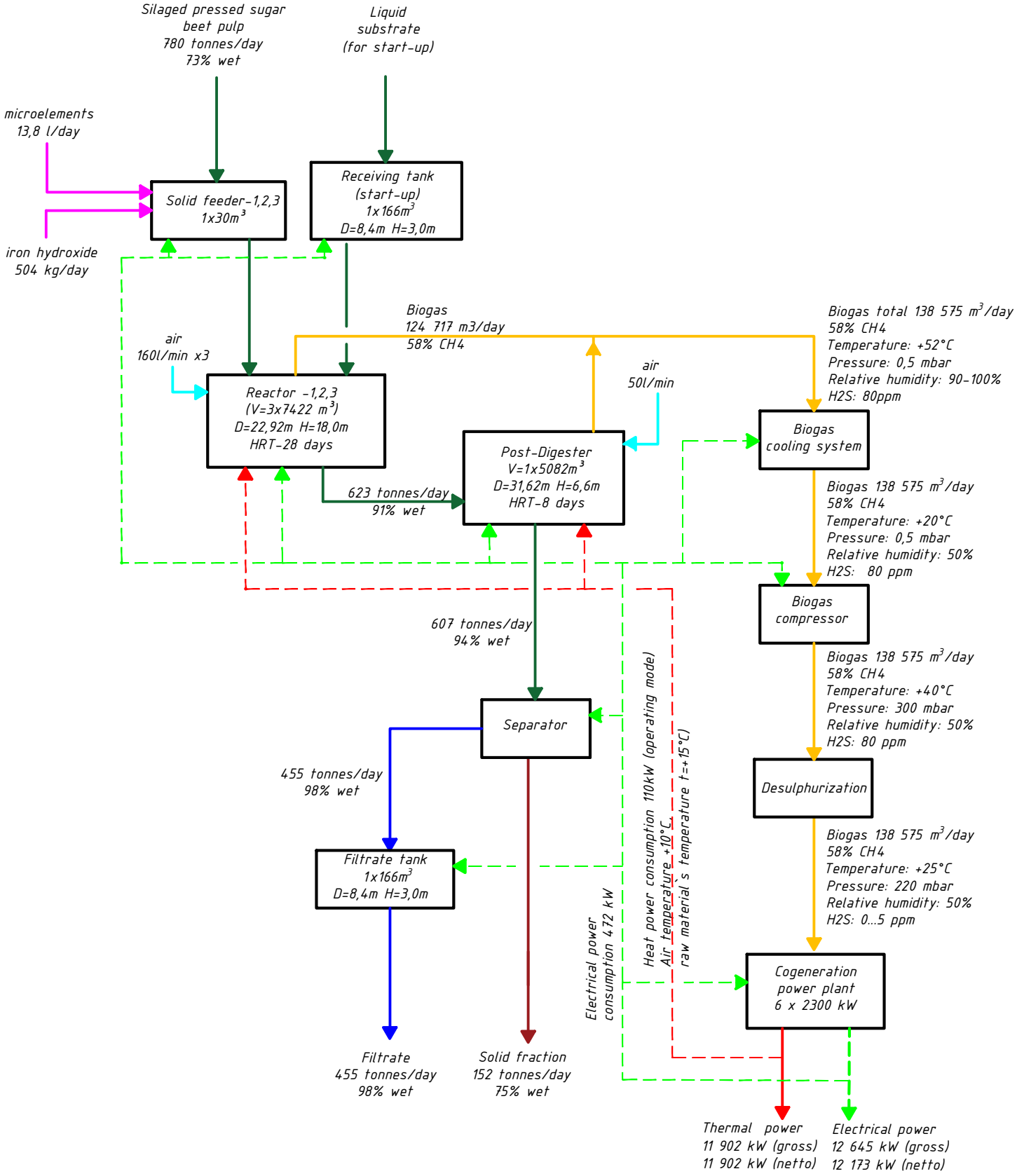
№	Equipment	Characteristic	Quantity
11.1	Weather protection film	Ø32 m	1
11.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant		1
11.3	Air blower	16A, 0,5kW	
11.4	Excess and minimum pressure valve		1
11.5	Dome level sensor		1
11.6	Mounting system		1
11.7	Accessories		1
11.8	Safety valve		1
12	**Biogas Cooling System**	**2900 m3/h**	**2**
12.1	Chiller		2
12.2	Heat exchanger		2
12.3	Polypropylene glycol tank		2
13	**Desulphurization system (Charcoal columns/filter)**	**1000 kg**	**2**
14	**Biogas compressor**	**Q=6000m3/h, H=300mBar, N=60 kW**	**2**
15	**Electromagnetic flow meter**		**1**
16	**Flare**	**2900 m3/h**	**2**
17	**Gas analyser**	**set**	**1**
18	**Gas equipment included**	**set**	**1**
18.1	Drainage pump with float	DN=50, Q=1m3/h, H=13 m	2
19	**Cogeneration power plant**	**2300 kW**	**6**
20	**The heat supply system**	**set**	**1**
20.1	Diaphragm expansion tank	V=1000 l,P=6Bar T=120°C	1
20.2	Circulating pump for supplying heat carrier	Q=30 m3/h,H=1bar	2
20.3	Propylene glycol feed pump station heating systems	Q=1,0 m3/h, H=4 bar	1
20.4	Circulation pump for supplying heat carrier to the digester	Q=18 m3/h, H=1.1 bar	4
20.5	Plate dismountable heat exchanger	600 kW	3

№	Equipment	Characteristic	Quantity
21	**Water supply and sewerage system, complete, disassembled**	**set**	**1**
22	**Automation with electrical equipment**	**set**	**1**
22.1	Incoming distribution cabinet with a set of automation DB-1		1
22.2	Incoming distribution cabinet with a set of automation DB-2		1
23	**Sensors, set**		**1**
23.1	Gas pressure sensor 0,025Bar		3
23.2	Gas pressure sensor 0,4Bar		2
23.3	Pressure sensor(substrate level) 1,0Bar		7
23.4	Pressure sensor (substrate pressure) 2,5bar		7
23.5	Resistive thermometer (gas temperature)		4
23.6	Resistive thermometer with thermo well (fermenter substrate temperature)		4.
23.7	Resistive thermometer with thermo-well (digester tank substrate temperature)		4
23.8	Resistive thermometer (heat conductor temperature)		4
23.9	Conductometric sensor of maximum level		5
23.10	Conductometric sensor of water level		5
23.11	Dome position sensor		1
23.12	Coolant pressure sensor	SEN 3276 B065 G1/2 6Bar	6
24	**Dry cooler 100 kW heat pow.**		**3**
25	**Laboratory**	**set**	**1**
26	**Steel enamel tank**	**166 m3**	**2**
27	**Steel enamel tank**	**7422 m3**	**3**
27	**Steel enamel tank**	**5028 m3**	**1**

APPENDICES



Material flow diagram

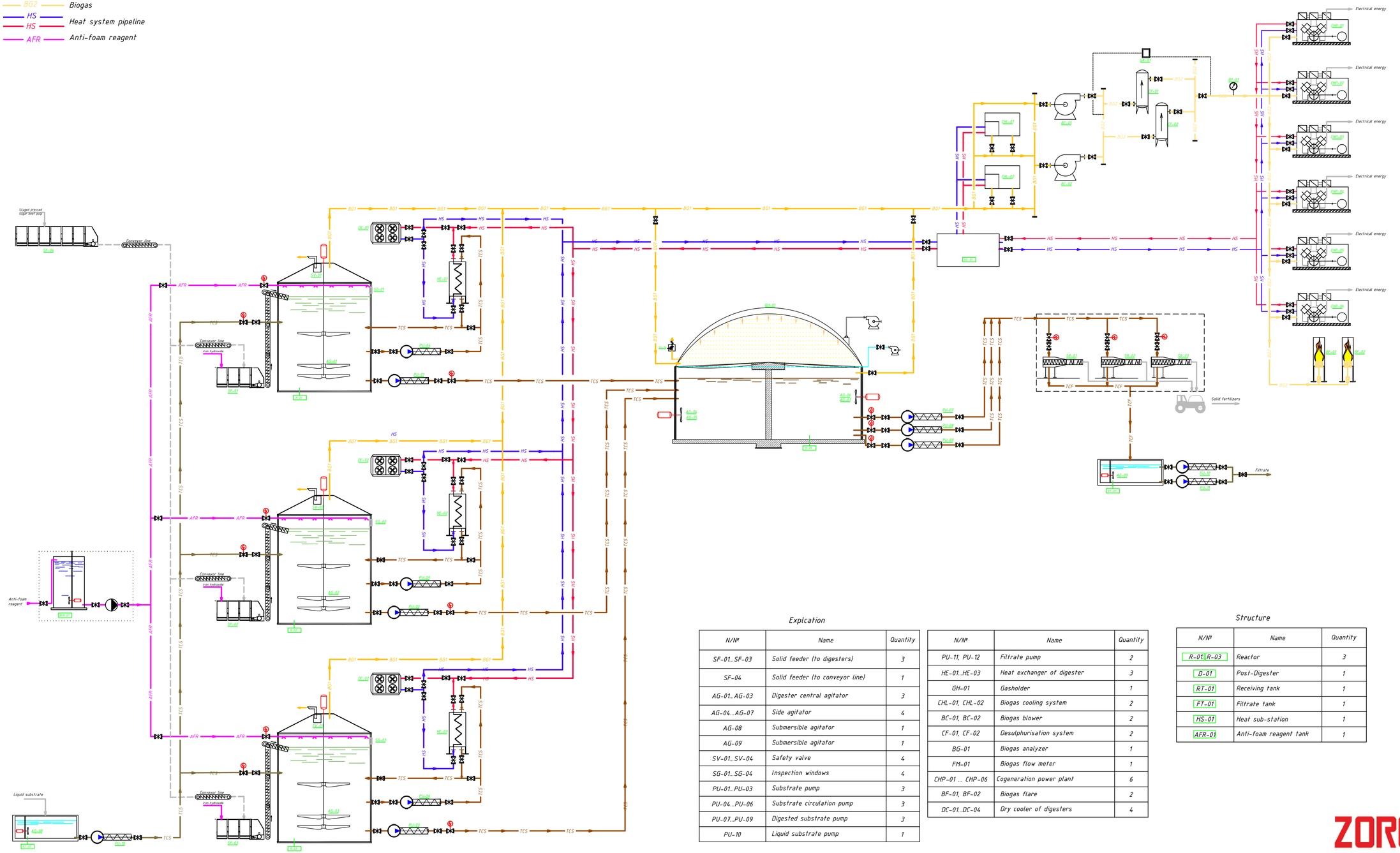


ZORG BIOGAS

Legend main pipelines

- TCS — Substrate
- TCF — Filtrate
- BG1 — Biogas
- BG2 — Biogas
- HS — HS — Heat system pipeline
- AFR — Anti-foam reagent

Basic diagram



Explcation

N/№	Name	Quantity
SF-01...SF-03	Solid feeder (to digesters)	3
SF-04	Solid feeder (to conveyor line)	1
AG-01...AG-03	Digester central agitator	3
AG-04....AG-07	Side agitator	4
AG-08	Submersible agitator	1
AG-09	Submersible agitator	1
SV-01...SV-04	Safety valve	4
SG-01...SG-04	Inspection windows	4
PU-01...PU-03	Substrate pump	3
PU-04....PU-06	Substrate circulation pump	3
PU-07...PU-09	Digested substrate pump	3
PU-10	Liquid substrate pump	1

N/№	Name	Quantity
PU-11, PU-12	Filtrate pump	2
HE-01...HE-03	Heat exchanger of digester	3
GH-01	Gasholder	1
CHL-01, CHL-02	Biogas cooling system	2
BC-01, BC-02	Biogas blower	2
CF-01, CF-02	Desulphurisation system	2
BG-01	Biogas analyzer	1
FM-01	Biogas flow meter	1
CHP-01 ... CHP-06	Cogeneration power plant	6
BF-01, BF-02	Biogas flare	2
DC-01...DC-04	Dry cooler of digesters	4

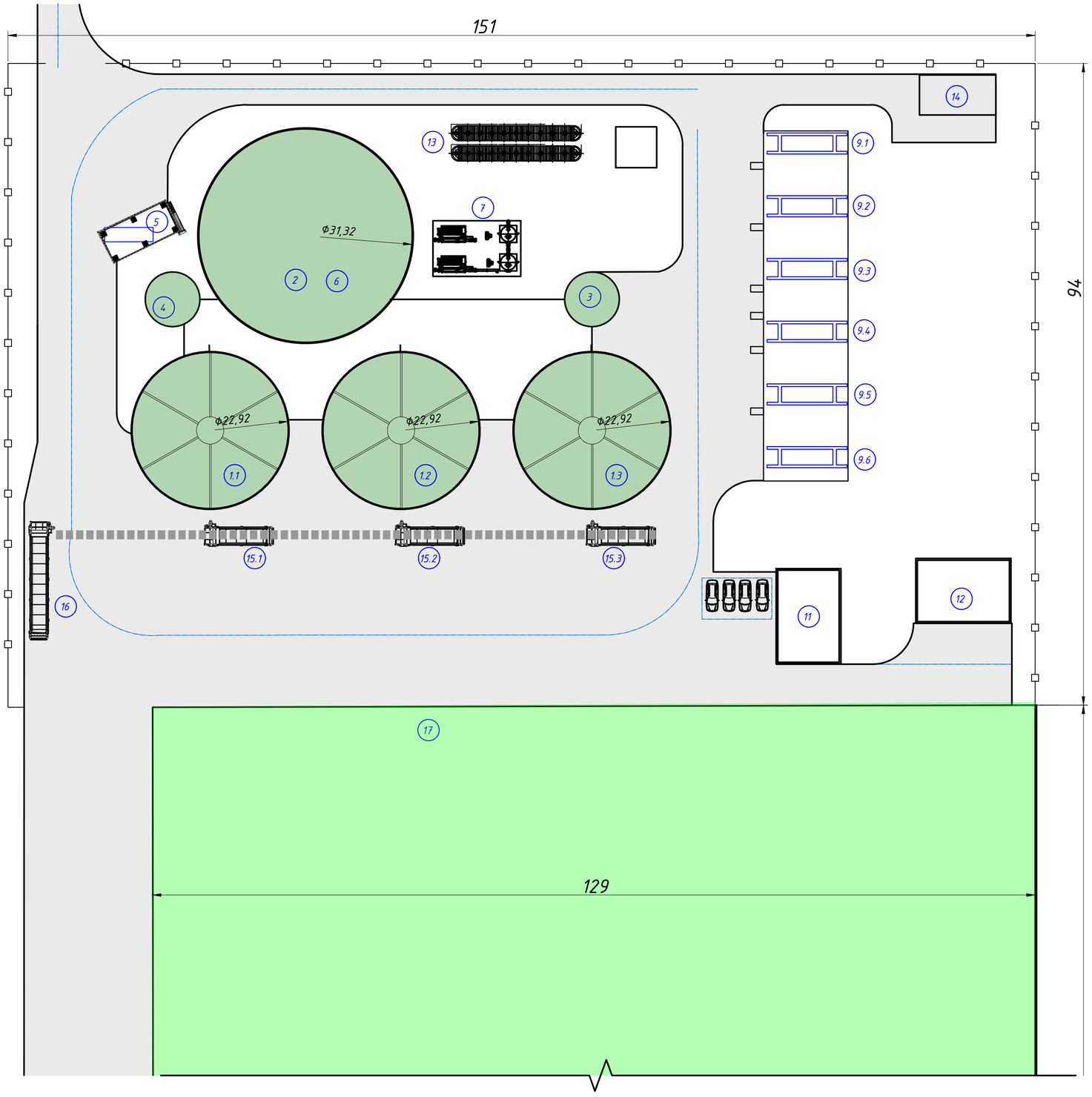
Structure

N/№	Name	Quantity
R-01...R-03	Reactor	3
D-01	Post-Digester	1
RT-01	Receiving tank	1
FT-01	Filtrate tank	1
HS-01	Heat sub-station	1
AFR-01	Anti-foam reagent tank	1

ZORG BIOGAS

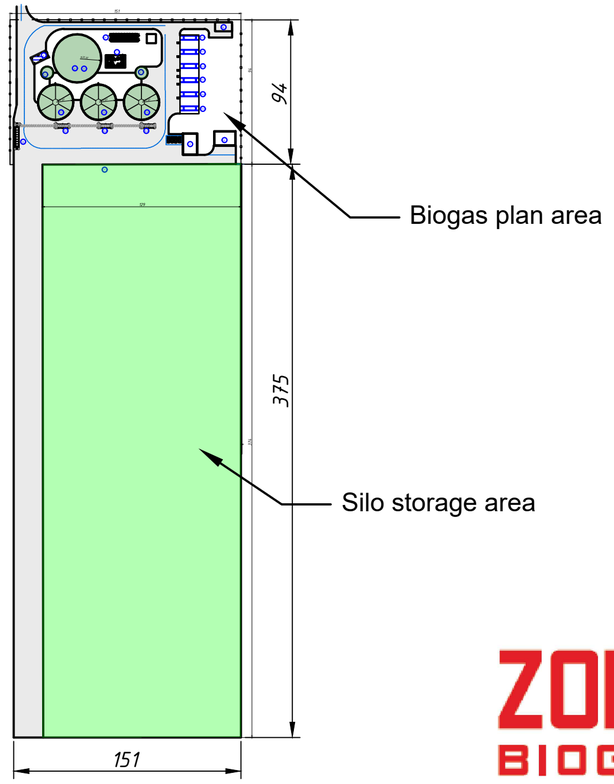
420x630

Plan of biogas plant



Explication

N/№	Name	Note
1.1, 1.2, 1.3	Reactor	
2	Post-Digester	
3	Receiving tank	
4	Filtrate tank	
5	Separation area	
6	Gasholder	
7	Biogas preparation area	
8	Biogas burner	
9.1...9.6	CHP	
10	Equipment room	
11	Technical room	
12	Warehouse	
13	Fire water tank	
14	Transformer substation	
15.1...15.3	Solid feeder	
16	Solid feeder to conveyor line	
17	Silo storage	



Area of the biogas plant - 1.42ha

Area of the silos - 4.8ha

ZORG BIOGAS

Appendix 4

Biogas plant					
Name equipment	**Instal. Pow. (kW)**	**Quantity (pcs)**	**Total installed power (kW)**	**Working hours per day**	**Consumption kWh per day**
Loader V=200 m^3	26,0	1	26,0	8,0	208,0
Conveyor line	45,0	1	45,0	8,0	360,0
Loader V=30 m^3	22,0	3	66,0	8,0	528,0
Screw set.	46,0	3	138,0	8,0	1104,0
Reactors vertical agitator	37,0	3	111,0	18,0	1998,0
Post-Digester side agitator	15,0	4	60,0	18,0	1080,0
Submersible mixer in receiving tank	7,5	1	7,5	12,0	90,0
Submersible mixer in filtrate tank	3,0	1	3,0	12,0	36,0
Biogas cooling system	56,0	2	112,0	24,0	2688,0
Biogas compressor	60,0	2	120,0	12,0	1440,0
Separator	7,5	3	22,5	8,0	180,0
Substrate feed pump	11,0	1	11,0	2,0	22,0
Substrate circulation pump	11,0	3	33,0	12,0	396,0
Substrate pump to digester	11,0	3	33,0	3,0	99,0
Substrate pump to separator	11,0	3	33,0	8,0	264,0
Filtrate pump	18,5	2	2,0	4,0	8,0
Air compressor for gasholder lock	1,5	1	1,5	1,0	1,5
Air blower for double membrane	1,0	1	1,0	24,0	24,0
Digester cooling system	4,0	4	16,0	24,0	384,0
Circulation pump for supplying heat carrier to the digester	0,8	3	2,3	24,0	54,0
Circulation pump for supplying heat carrier to the digester cooling system	2,0	6	12,0	24,0	288,0
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	1	1,0	0,5	0,5
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
CHP self-consumption	22,0	6	132,0	0,5	66,0
Total installed power, kW			**991**		
Total consumed electric energy, kWh per day					**11329**
Total consumed power, kW					**472**

ZORG BIOGAS

Prices for a biogas plant using 780 tonnes pressed sugar beet pulp/day

Pos	Name	Number of units	Unit price, EUR	Sub-total, EUR	
1	Detailed design	1	175.000	175.000	
2	Supervision	1	80.000	80.000	
3	Startup and training	1	80.000	80.000	
4	Living and travel expences	1	60.000	60.000	
5	Delivery of the equipment	85	5.000	425.000	
6	Laboratory	1	27.000	27.000	
7	Central solid feeder 200m3	1	215.000	215.000	
8	Screw set	1	135.000	135.000	
9	Conveyor line	1	350.000	350.000	
10	Solid feeder 30m3	3	125.000	375.000	
11	Screw set	3	145.000	435.000	
12	Central agitator 37kW	3	168.000	504.000	
13	Side agitator 7,5kW	1	32.000	32.000	
14	Side agitator 7,5kW	1	32.000	32.000	
15	Side agitator 15kW (post digester)	4	48.000	192.000	
16	Substrate feed pump 11kW	1	29.000	29.000	
17	Digested substrate pump 11kW	3	29.000	87.000	
18	Circulation substrate pump 11kW	3	29.000	87.000	
19	Discharge substrate pump 11kW	3	29.000	87.000	
20	Filtrate pump 18kW	2	46.000	92.000	
21	Substrate gate valve	20	7.000	140.000	
22	Substrate valve with el.drive	20	8.000	160.000	
23	Gasholder 2047 m3	1	97.000	97.000	
24	Biogas chiller 2900m3/h	2	195.000	390.000	
25	Biogas blower 6000 m3/h	2	62.000	124.000	
26	Desulphurization column with active coal 1000 kg	2	55.000	124.000	
27	Biogas flare 2900 m3/h	2	185.000	370.000	
28	Gas analyzer	1	27.000	27.000	
29	Gas conditioning unit	1	140.000	140.000	
30	Water supply and canalization system	1	75.000	75.000	
31	Heat supply station	1	135.000	135.000	
32	Dry-cooler (Substrate cooling system for fermenter)	4	37.000	148.000	
33	Automation and electric cabinet	1	480.000	480.000	
34	Sensors (set)	6	27.000	162.000	
35	Reactor 7422 m3	3	947.000	2.841.000	
36	Post-Digester tank 5082 m3	1	415.000	415.000	
37	Receiving tank 166 m3	1	120.000	120.000	
38	Filtrater tank 166 m3	1	120.000	120.000	
33	Heat exchanger substrate	3	22.000	66.000	
34	Gen sets MWM TCG3020V20 - 2300 kW with drycoolers, pumps, heat exchangers, exhaust silencers, oil tanks, HAS el cabinets	6	980.000	5.880.000	
35	Silage storage 290 000 m3	1	1.500.000	1.500.000	Client
36	Construction and installation	1	2.000.000	2.000.000	Client
	by ZORG, EUR			15.513.000	
	TOTAL Zorg + Client, EUR			**19.013.000**	

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Implementation terms and payment

Year	2026						2027								
Months	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09
Project documentation	50%			50%											
Equipment			30%	20%	20%	20%	10%								
Delivery															
CHP	30%									70%					
Delivery CHP															
Construction															
Supervision						50%			50%						
Biogas plant start-up													50%	50%	

Contracts

Project implementation is executed simultaneously under several contracts

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

List of exclusions :

1) Topographic and geological surveys 3000-7000 EUR
2) Electric transformer and the external electric line for start-up, for construction period and for normal operation.
3) External roads to the biogas plant.
4) Temporary water supply during the construction and the hydraulic test of reactors at least 7422 m3 water. It can be a technical quality water from a river, lake, well. Not salty.
5) Bacterial seed for the start-up. It can be biomass from another biogas plant. Possible also cow manure, any kind of manure, sludge from city sewage treatment plant. Customer needs to bring the seed one-time during a 1–2-week period and to fill with it at least 15-20% of the reactor volume 2200-1500m3. The rest is filled with the water item above.
6) Machinery to transport raw material to and from storage to the solid feeders (a truck, a frontal loader, a tractor).
7) Activated carbon 2 tonne per 2 years x 4800 EUR/tonne = 9600 EUR
8) Microelements 5037l per year x 25 EUR/l= 125 925EUR
9) Fe(OH)3– 184 tonnes per year x 800 EUR/tonne = 147 168 EUR
10) Demineralized water to the heating system 10,0 tonnes,
11) Spare parts for 2 years - 180 000 EUR

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