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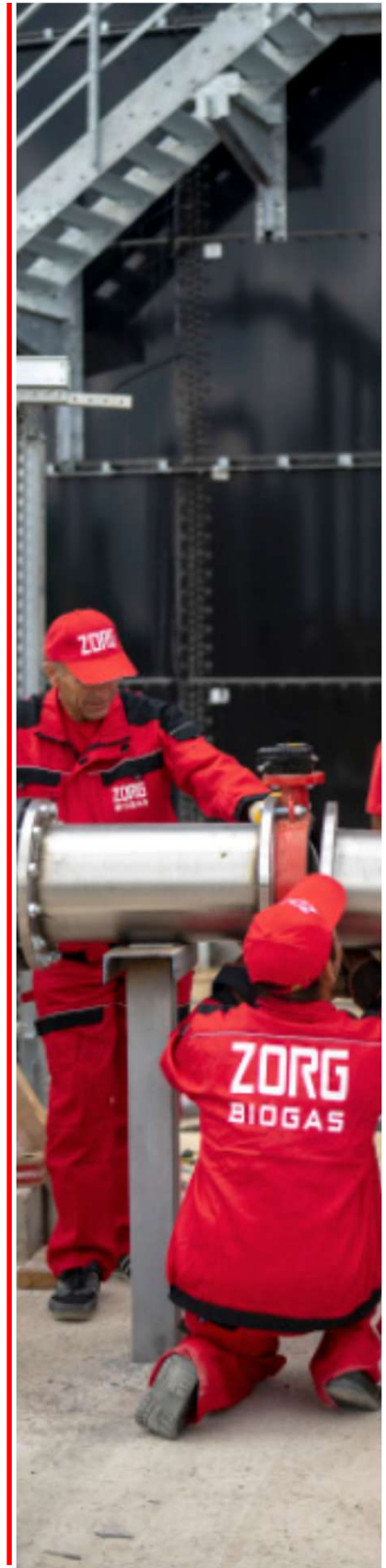
version

Proposal

Biogas plant 130 tonnes whey/day



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OVERVIEW

We propose a solution for processing milk whey to produce 4,186 m³ of biogas per day. Biogas will be used in the factory's boiler for the replacing natural gas.

The process is based on the technology of mesophilic anaerobic digestion in a steel CSTR reactor. To compare different concepts of biogas plants 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 0,1°C. There is a double filtration of biogas, which saves burners and engines life.

Biogas plants has a lot of features, which are known only to the experienced company. For example, operational temperature, foam safety valves and etc.

Raw material potential

57	Quantity (tonnes/day)	Quantity (tonnes/year)	DM content: (%)	ODM content (%)	DM quantity (tonnes / day)	ODM quantity (tonnes / day)	Biogas yield (m ³ / tonneODM)	Biogas (m ³ /day)	Methane content (%)
Milk whey	130	47 450	5	92	6,5	5,98	700	4 186	60

*-DM- Dry matter

**-ODM- organic dry matter

Biogas plant characteristics

Characteristics	Values	Figures
Number of reactors	units	1
Volume:		
Work	m ³	3031
Overall		3367
Temperature	°C	38
Overall dimensions of the digester:		
diameter	m	26,74
height		6,0
Organic load	kgODM/m ³	1,97
Hydraulic retention time (gross/net)	days	25/23
Number of gasholders	units	1
Volume:	m ³	1236
Dimensions of the gasholder:		
diameter	m	27,0
height		5,4

Number of personnel

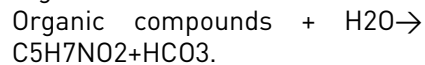
	Shift 1	Shift 2	Shift 3
Operator	1	1	1
Total	3		



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.



Further conversion of obtained dissolved compounds like organic acids and alcohols ($\text{C}_5\text{H}_7\text{NO}_2, \text{HCO}_3$) into gases - CH_4, CO_2 . $\text{C}_5\text{H}_7\text{NO}_2 + \text{HCO}_3 + \text{H}_2\text{O} \rightarrow \text{CH}_4 + \text{CO}_2 + \text{NH}_4$.

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 CH_4 , water H_2O and carbon dioxide CO_2 . 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

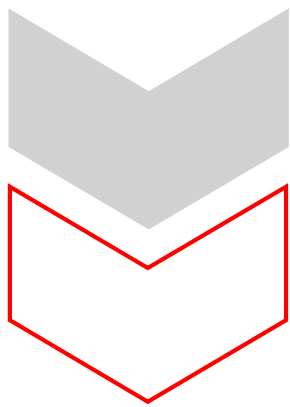
Milk whey is supplied to biogas plant and directed into receiving tank . From the tank substrate is supplied by pump by portion into a reactor. In the reactor the substrate is brought up to a temperature of +37°C. Constant temperature is sustained for the entire digesting period. To prevent a rise in temperature (for example, in summer), the biogas plant is equipped with a cooler (dry cooling). The reactor operating regime is mesophilic. The heated substrate in the digesters is blended periodically. Mixing is performed by submersible agitators. The average time of processing in the reactor is 25 days. After the reactor, the substrate is fed by a pump.

Biogas goes up under a double membrane overlap (gasholder). 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 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 (H₂S). After the filter, biogas goes to the boiler house's where it is used as fuel.

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





Receiving tank (RT-01)

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:	8,0 m
Height:	3,0 m
Volume:	150 m³
Quantity:	1 pcs.



Submersible mixer (AG-01...AG-05)

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. 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 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

Agitator of the receiving tank:

Nominal power:	5,5 kW
Quantity:	1 pcs

Agitator of the reactor:

Nominal power:	15 kW
Quantity:	2 pcs



Reactor (RT-01)

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 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:	26,74 m
Total volume:	3367 m³
Substrate volume	3031 m³
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)



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 feed pump (PU-01)

Engine power:	5,5 kW
Flow rate:	30 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Substrate pump (PU-02)

Engine power:	5,5 kW
Flow rate:	30 m3/hour
Pressure:	4 bar
Quantity:	1 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 $260 \text{ cm}^3/\text{m}^2 * 1 \text{ bar}$ biogas resistance. The gasholder film temperature range allows operation from -30°C to $+60^\circ\text{C}$.

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:	5,4 m
Diameter:	27,0 m
The total volume :	1236 m³
Quantity:	1 pcs

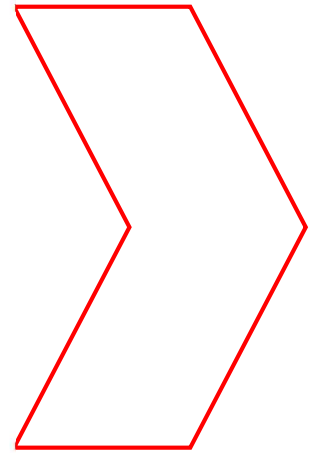


Biogas dryer and cooling (CHL-01)

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:	180 m³/hour
Gas inlet temperature:	+38°C
Gas outlet temperature:	+20°C
Electric power:	18 kW
Quantity:	1 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:	200 m ³ /hour
Pressure:	300 mbar
Engine power:	3,0 kW

Quantity:	2 pcs
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Desulphurization system

The desulphurization system is a 3-step system. Stage 1 is adding Ferrum Hydroxide. Stage 2 - biological. Adding a certain portion of air to the fermenter. Air by special bacteria, converting H_2S into S. After 1 and 2 steps the sulphur concentration is 80 ppm. Stage 3 - 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	(CF-01)
The volume of charcoal:	100 kg
Quantity:	1 pcs



Gas analyzer (CH₄, CO₂, H₂S) (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

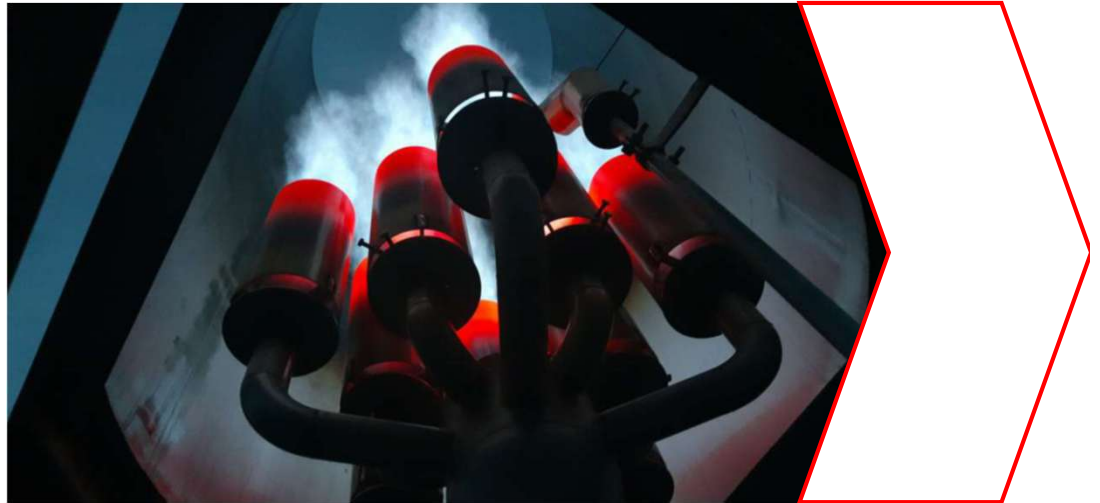
Set includes

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

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:	190 m³/hour
Pressure:	min 10 mbar- max 60 mbar

Quantity:	1 pcs
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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 used 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

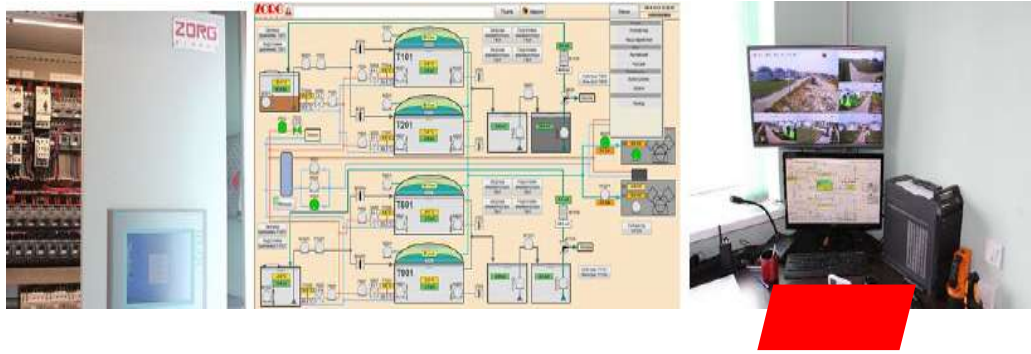


Dry cooler (cooling substrate system)

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

Heat power:	80 kW
Electric power:	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 ET200S, 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

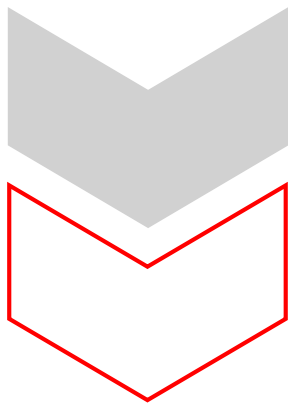
Ultrasonic sensor

Gas Pressure Sensor

Temperature converters with protective sleeves

The moisture sensor and the gas temperature

Equipment specification list

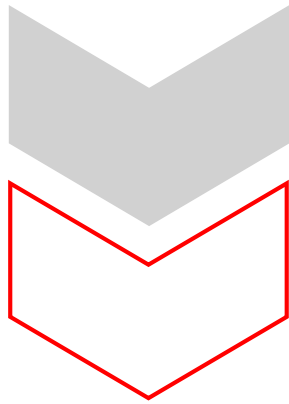


Nº	Equipment	Characteristic	Quantity
1	Submersible mixer	N=5,5kW	1
2	Reactor submersible agitator	N=15 kW	2
2.1	Airtight motor gearbox		2
2.2	Hydraulic screw (wear-resistant steel)		2
2.3	Shaft (adapted to the height of the fermenter)		2
2.4	Blade		2
2.5	Frequency converter		2
2.6	Mounting bracket to bottom of the mixer		2
3	Safety valve of digesters		1
4	Window with a searchlight	set	1
4.1	Inspection window RD300 (mounts and sealant included)	Ø300	2
4.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	1
5	Substrate feed pump	30 m3/hour N=5,5 kW	1
6	Substrate digested pump	30 m3/hour N=5,5 kW	1
7	PVC gas holder	1/5D	1
7.1	Weather protection film		1
7.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant	D27m	1
7.3	Air blower		1
7.4	Excess and minimum pressure valve		1
7.5	Dome level sensor		1
7.6	Mounting system		set
7.7	Accessories		set
7.8	Safety valve		1

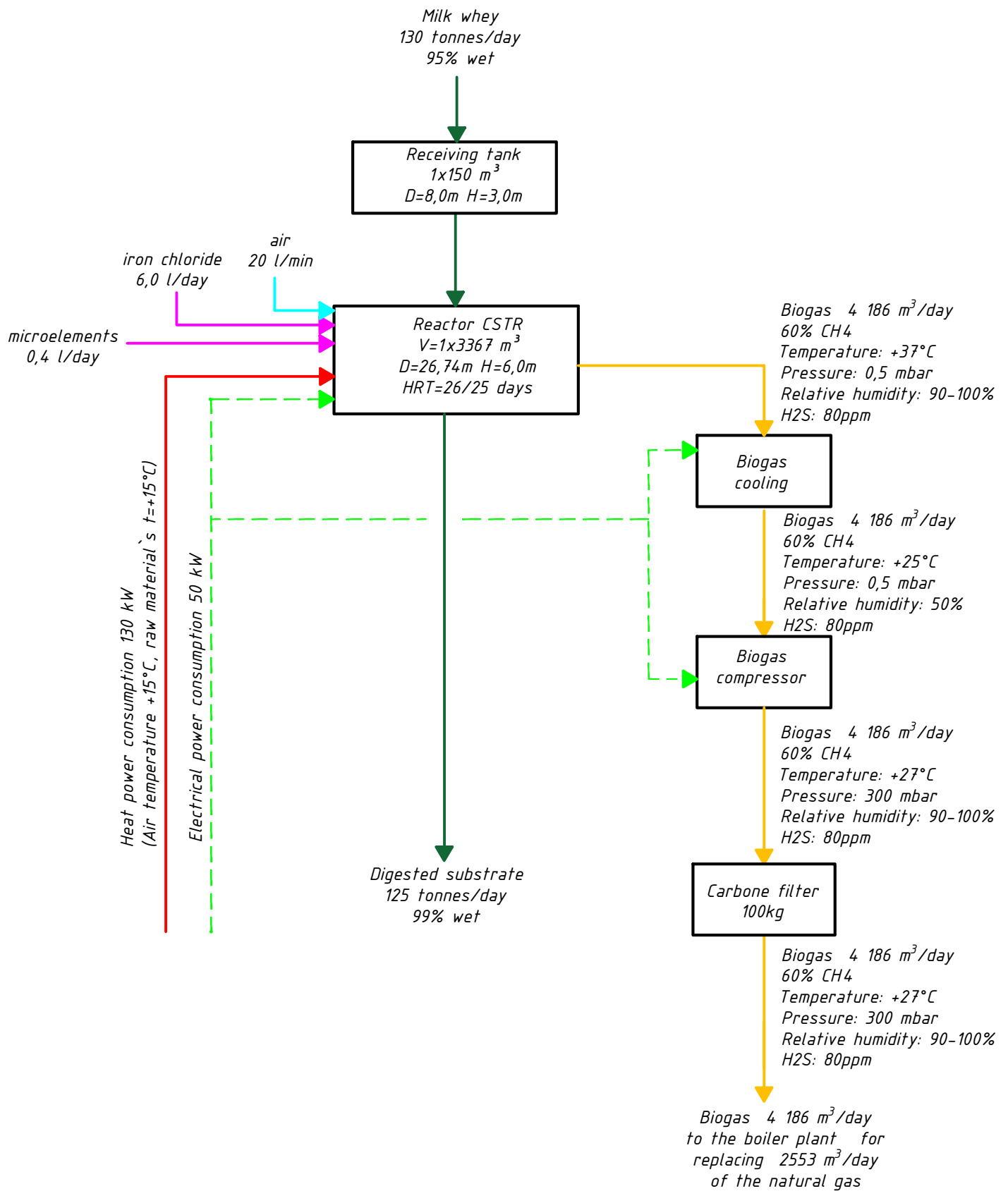
Nº	Equipment	Characteristic	Quantity
8	Desulphurization system		1
8.1	Numbers of charcoal columns	100 kg	1
9	Biogas chiller	180 m3/h	1
10	Biogas compressor	Q=200m3/h, H=300mBar, N=3 kW	2
11	Electromagnetic flow meter		1
12	Flare	180 m3/h	1
13	Portable gas analyser	set	1
14	Gas equipment included	set	1
14.1	Drainage pump with float	DN=50, Q=1m3/h, H=13 m	2
15	The heat supply system	set	1
15.1	Diaphragm expansion tank	V=1000 l,P=6Bar T=120°C	1
15.2	Circulating pump for supplying heat carrier	Q=30 m3/h,H=1bar	1
15.3	Propylene glycol feed pump station heating systems	Q=1,0 m3/h, H=4 bar	1
15.4	Circulation pump for supplying heat carrier to the digester	Q=18 m3/h, H=1.1 bar	1
16	Water supply and sewerage system, complete, disassembled	set	1
17	Automation with electrical equipment	set	1
17.1	Incoming distribution cabinet with a set of automation DB-1		1
17.2	Incoming distribution cabinet with a set of automation DB-2		1

Nº	Equipment	Characteristic	Quantity
18	Water supply and sewerage system, complete, disassembled	set	1
19	Automation with electrical equipment	set	1
19.1	Incoming distribution cabinet with a set of automation DB-1		1
19.2	Incoming distribution cabinet with a set of automation DB-2		1
20	Sensors, set		1
20.1	Gas pressure sensor 0,025Bar		2
20.2	Gas pressure sensor 0,4Bar		2
20.3	Pressure sensor(substrate level) 1,0Bar		2
20.4	Pressure sensor (substrate pressure) 2,5bar		2
20.5	Resistive thermometer (gas temperature)		2
20.6	Resistive thermometer with thermo well (fermenter substrate temperature)		2
20.7	Resistive thermometer with thermo-well (digester tank substrate temperature)		2
20.8	Resistive thermometer (heat conductor temperature)		2
20.9	Conductometric sensor of maximum level		2
20.10	Conductometric sensor of water level		2
20.11	Dome position sensor		1
20.12	Coolant pressure sensor	SEN 3276 B065 G1/2 6Bar	2
21	Dry cooler 80 kW heat pow.		1
22	Steel enamel tank (Reactor)	V=3367 m3	1

APPENDICES



Material flow diagram



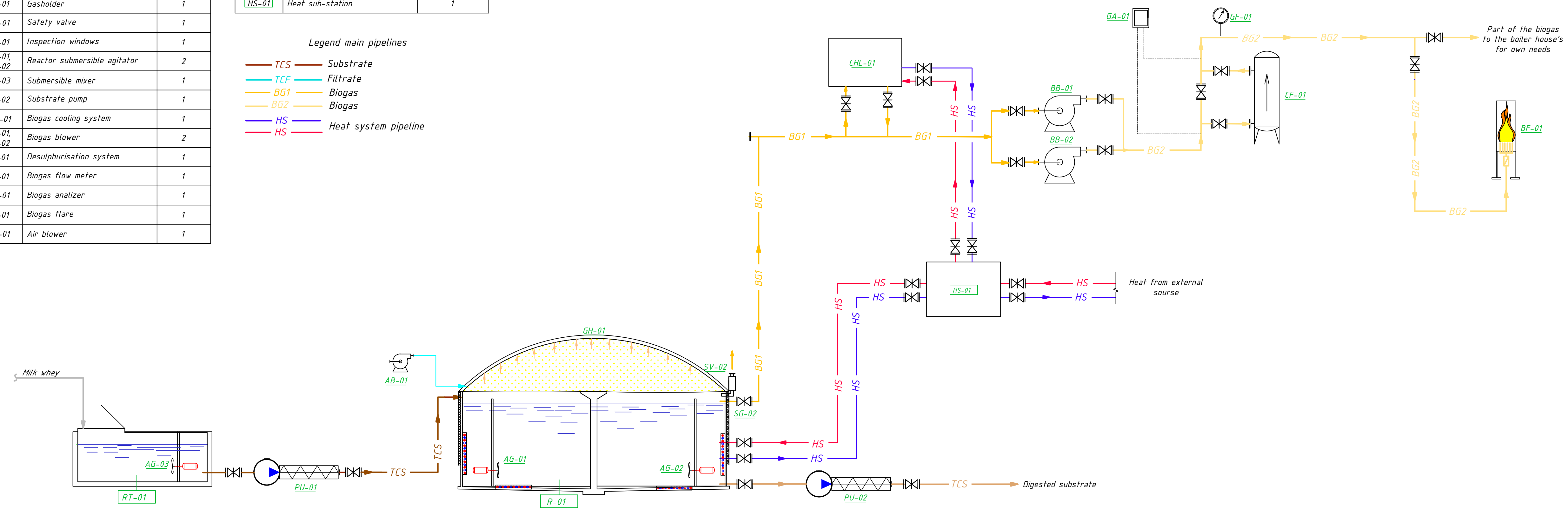
Explication		
N/№	Name	Quantity
PU-01	Substrate feed pump	1
PU-02	Digested substrate pump	1
GH-01	Gasholder	1
SV-01	Safety valve	1
SG-01	Inspection windows	1
AG-01, AG-02	Reactor submersible agitator	2
AG-03	Submersible mixer	1
PU-02	Substrate pump	1
CHL-01	Biogas cooling system	1
BB-01, BB-02	Biogas blower	2
CF-01	Desulphurisation system	1
GF-01	Biogas flow meter	1
GA-01	Biogas analyzer	1
BF-01	Biogas flare	1
AB-01	Air blower	1

Structure		
N/№	Name	Quantity
RT-01	Receiving tank	1
R-01	Reactor	1
HS-01	Heat sub-station	1

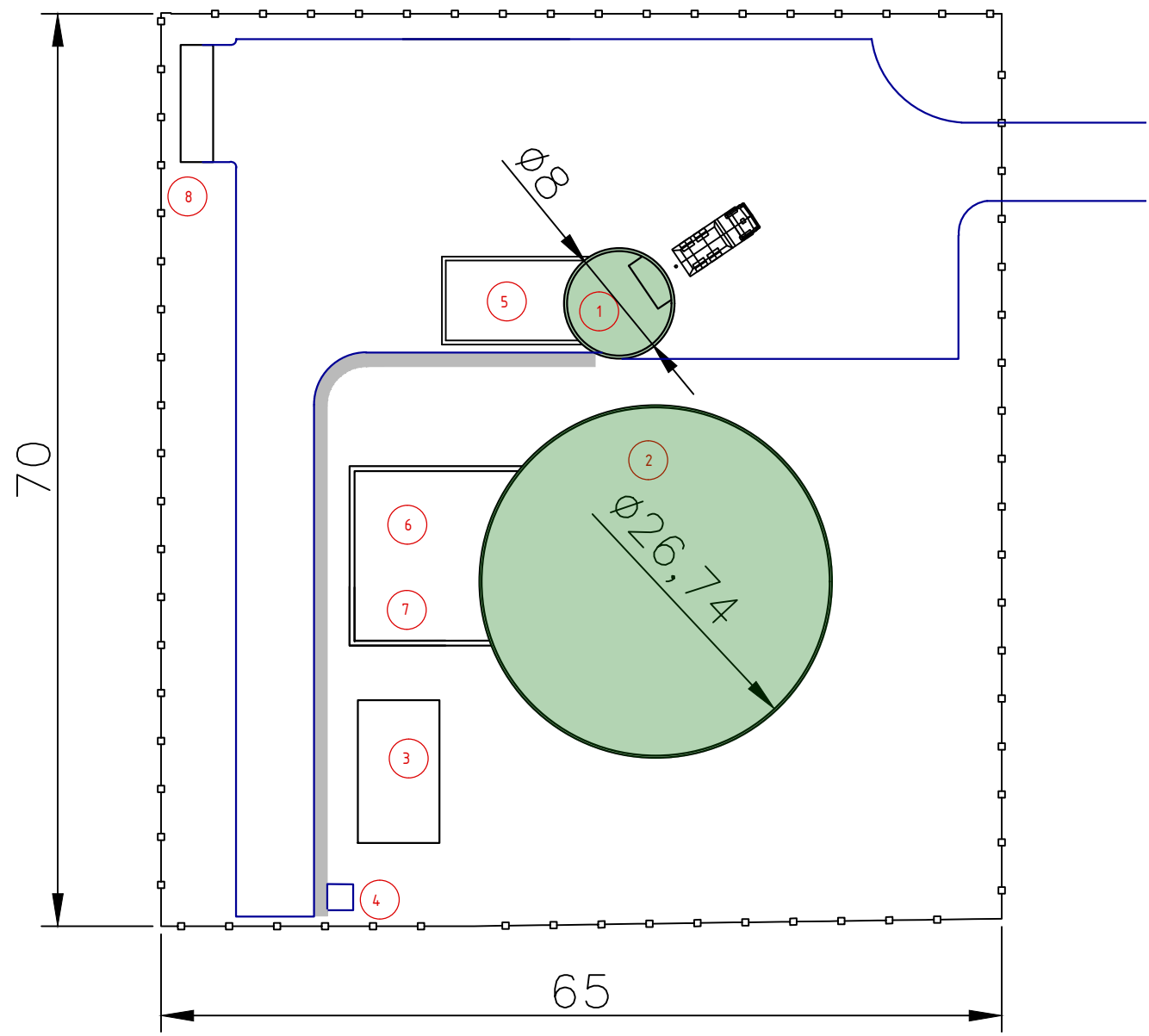
Legend main pipelines

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

Basic diagram



Plan



Explication

N/№	Name	Note
1	Receiving tank (RT-01)	
2	Reactor (R-01)	
3	Gas preparation	
4	Flare (BF-01)	
5	Equipment room №1	
6	Boiler room	
7	Equipment room №2	
8	Operator's room	

Appendix 4

Biogas plant					
Name equipment	Instal. Pow. (kW)	Quantity (pcs)	Total installed power (kW)	Working hours per day	Consumption kWh per day
Reactor submersible agitator	15,0	2	30,0	16,0	480,0
Biogas chiller	18,0	1	18,0	24,0	432,0
Biogas compressor	3,0	2	6,0	12,0	72,0
Substrate feed pump	5,5	1	5,5	5,0	27,5
Digested substrate pump	5,5	1	5,5	5,0	27,5
Air blower for double membrane	1,0	1	1,0	24,0	24,0
Digester cooling system	4,0	1	4,0	12,0	48,0
Circulation pump for supplying heat carrier to the reactor	1,5	1	1,5	24,0	36,0
Circulation pump for supplying heat carrier to the reactor`s cooling system	1,5	1	1,5	24,0	36,0
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			77		
Total consumed electric energy, kWh per day					1194
Total consumed power, kW					50

Prices for the biogas plant 130 tonnes whey/day

Pos	Name	Number of units	Unit price, EUR	Price sub-total, EUR
1	Project documentation	1	45.000	45.000
2	Supervision	1	50.000	50.000
3	Startup and training	1	30.000	30.000
4	Living and travel expences	1	35.000	35.000
5	Delivery of the equipment	8	8.000	64.000
6	Submersible agitator 15kW of the reactor	2	27.000	54.000
7	Submersible agitator 5,5 kW of Receiving tank	1	17.000	17.000
8	Substrate feed pump 5,5kW	1	21.000	21.000
9	Digested substrate pump 5,5kW	1	21.000	21.000
10	Gasholder 1/5D D27m V=1236 m3	1	65.000	65.000
11	Biogas chiler 180 m3/h	1	36.000	36.000
12	Biogas blower 300 m3/h	2	4.200	8.400
13	Desulphurization column with active coal 100 kg	1	25.000	25.000
14	Biogas flare 190 m3/h	1	35.000	35.000
15	Gas conditioning unit	1	28.000	28.000
16	Gas analyzer (portable)	1	7.000	7.000
17	Over- and under pressure safeguard	1	6.000	6.000
18	Heat supply station	1	25.000	25.000
19	Water supply and canalization system	1	15.000	15.000
20	Sensors (set)	3	25.000	75.000
21	Automation and electric cabinet	1	119.000	119.000
22	Digester Enameled steel tank V=3367m ³ (including servise stairs, platforms, manholes, pipe flanges, suppotrs, fixing etc.)	1	295.000	295.000
23	Construction and installation	1	300.000	300.000
			by ZORG, EUR	1.076.400
			TOTAL Zorg + Client, EUR	1.376.400

Client

Implementation terms and payment

Year	2026						2027				
Months	07	08	09	10	11	12	01	02	03	04	05
Project documentation	50%	50%									
Approvals and permits											
Equipment			30%		20%	20%	30%				
Equipment delivery											
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 for biogas plant:

- 1) Project report, civil permits and authorizations, adaptation of the project documentation by a licensed local engineering organization for the permit purposes. Namely the organization puts their stamp, and acts act the face of the project. The design documentation is not changed in fact. 10 000 – 15 000 EUR
- 2) Topographic and geological surveys 3000-7000 EUR
- 3) Electric transformer and the external electric line for start-up, for construction period and for normal operation.
- 4) External roads.
- 5) Temporary water supply during the construction and the hydraulic test of reactors at least 3367 m³ water. It can be a technical quality water from a river, lake, well. Not salty.
- 6) Activated carbon 0,1 tonne per year x 4800 EUR/tonne = 480 EUR
- 7) Demineralized water to the heating system 1,0 tonnes,
- 8) Microelements 146 l per year total x 25 EUR/l
- 9) Iron chloride 2,2 t per year total x 800 EUR/t
- 10) Spare parts 60 000 EUR for 2 years.



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