

Proposal

Biogas plant 278 tonnes spent grain/day



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OVERVIEW

Zorg Biogas offers a solution to process spent grains from beer brewery into biogas. The produced biogas is used to replace natural gas in the existing boiler. A proven technology of vertical CSTR reactor with a central agitator is used.. The vertical shape 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 0,1°C. 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.

The offered biogas plant will process 278 tonnes spent grains a day. The produced biogas will replace 14600 m³/day natural gas (41 MWh thermal energy a day or 141 MMBTU per day)

Raw material potential

Substrate	Quantity (tonnes/day)	Quantity (tonnes/year)	DM content (%)	ODM content (%)	DM quantity (tonnes / day)	ODM quantity (tonnes / day)	Biogas yield (m ³ / tonneDDM)	Biogas (m ³ / day)	Methane content (%)	Biogas (m ³ / year)
Spent grain	278	101470	21,8	95,8	60,6	58	432	25081	58	9154685

Biogas plant technical performances

Characteristics	Values	Figures
Number of digester	units	1
Digester volume		7900
Work	m ³	8220
Overall		
Organic load	kgODM/ m ³	7,1
Hydraulic retention time	days	25
Temperature in the digester	°C	52
Overall dimensions of the digester (diameter / height)	m	23.05/19.71
Number of gasholder	units	1
Gasholder volume	m ³	410
Overall dimensions of the gasholder (diameter / height)	m	10.1/7.5

Number of personnel

Personnel is "0" people.

Biogas plant is fully automated and remotely controlled from a smartphone or a notebook.



WORKING PRINCIPLE

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 → C₅H₇N₀₂+H-CO₃.

Further conversion of obtained dissolved compounds like organic acids and alcohols (C₅H₇N₀₂,HCO₃) into gases - CH₄, CO₂. C₅H₇N₀₂ + 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 H₂O 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 spent grain is transported to the territory of the biogas plant to the loading conveyor auger. The conveyor auger feeds the spent grain in equal portions into the upper part of the digester under the working level of the substrate. In the digester, the substrate is fermented at temperature of + 52 C. Thus, a constant temperature is maintained in the digester throughout the entire fermentation process. Heating and maintaining the temperature is provided by an external heat exchanger and the reactor cooling system. The substrate is mixed with a vertical mixer. The average fermentation time is 25 days. Biogas rises and collects under the conical roof of the digester. To prevent excess pressure above acceptable, the digester are equipped with a safety valves that starts to operate at a pressure of 10 mbar and releases biogas into the atmosphere.

The biogas from the digester enters the external gasholder. In a gasholder, pressure and biogas composition are averaged. Through pipelines, biogas from gasholder enters the biogas cooling system. The cooling system is a heat exchanger with its own cooling circuit. After cooling the biogas to + 22C, condensate formed is removed from the cooling

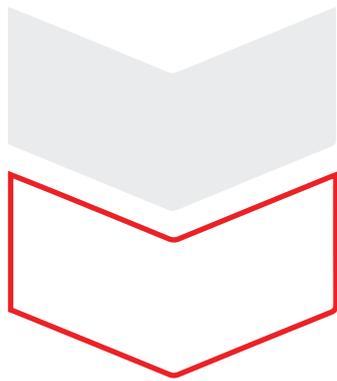
system. Than biogas is heated to + 25 ° C to reduce the relative humidity of the biogas.

After cooling biogas flows through the pipeline to the compressor, where its pressure rises to 150-300 mbar for supplying to purification from hydrogen sulphide in activated carbon columns and then to a boiler room.

The digested substrate is fed to the separator by pump. The separator separates the digested substrate into digestate and clarified wastewaters. Digestat is unloaded onto a site or a trailer, larified wastewaters enter a buffer tank, from where part are pumped to dilution and rest are pumped out for further use or treatment.

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

MAIN EQUIPMENT





Digester

Digester is an important part of a biogas plant made of enameled sheet metal. The metal 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-

ness 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 :	19.71 m
Diameter :	23.05m
The total volume :	8220 m ³
Quantity:	1 pcs.



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, ro-

bust 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

Clarified wastewater pump

Flow rate: 30 -40 m3/hour
Pressure: 4Bar
Quantity: 1 pcs

Heat exchanger supply pump

Flow rate: 30 -40 m3/hour
Pressure: 4Bar
Quantity: 1 pcs

Separator supply pump

Flow rate: 30 -40 m3/hour
Pressure: 4Bar
Quantity: 1 pcs

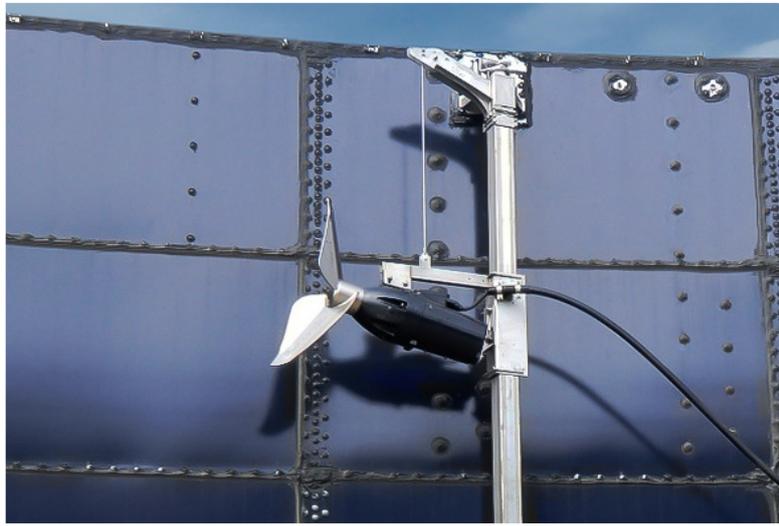


Buffer tank

Reservoir for reception of liquid kinds of raw materials. Tank is equipped conical roof, relief valves and level control systems (visual and electronic)

Specifications

Diameter:	5.12 m
Height	5.67 m
Total volume:	119 m ³
Working volume:	100 m ³
Quantity:	1 psc



3. Submersible mixers

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid Corn (maize) silage 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=3,3 kW

Height:

adapted to the height of digester

Material: stainless steel 8 mm



Digester central agitator

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:
Quantity (per digester):

N=35 kW
1pcs



Spiral Heat Exchanger

Using as modular design for slurry, sludge and biological mass and for mediums that are badly contaminated and burden by solids with a distinctive fouling behavior. The main component of the Spiral Heat Exchanger is an aluminum cast member made of a no corrosive alloy. A number of left-handed and right-handed components, one on top of the other, from a compact, high-capacity heat exchanger. To avoid hard alteration of the direction of the flow, the spiral channel has an anti-clockwise curvature (left-hand element) and a clockwise curvature (right-hand element).

Specifications

Volumetric capacity from Temperature	5 to 30 m ³ / h up to 90 ° C;
Working pressure	at 4 bar
Capacity of the heat exchanger	100 kW
Quantity	1 pcs



Window with spotlight

Inspection windows are designed for visual control of processes inside the fermenter and post-digester. Spotlights were made in explosion-proof with automatic disconnec-

tion. Inspection windows are equipped with a cleaning washing system.

Specifications

Inspection windows Ø300
Spotlight VISULUX UL50 -G -H
230V, 50W, IP65
Quantity: 3 pcs



Separator

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 counterweights. 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	7,5 kW
Flow rate	20-35 m³ / h
Quantity	1 pcs.
Equipment	
Frame	
Screw	
Sieve for the filtration	
Counterweights	
The design of the protective room	



Gasholder

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 $260 \text{ cm}^3/\text{m}^2 \cdot 1 \text{ bar}$ biogas resistance. The gasholder film temperature range allows operation from -30°C to $+60^\circ\text{C}$.

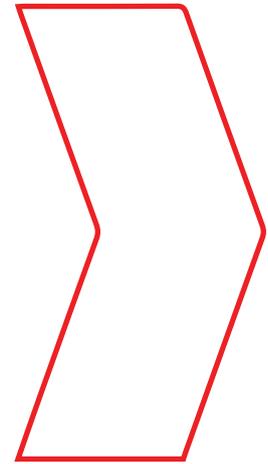
The internal film is stretched under normal biogas pressure. Air is blown into the space between the external and internal membranes to pressurize the internal membrane and form the shape of the external membrane.

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 hand-made 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 :	7.5 m
Diameter :	10.1 m
The total volume :	410 m ³
Quantity:	1pcs



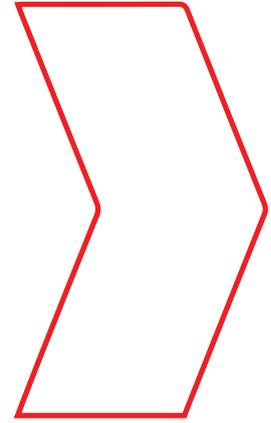
Biogas dryer and cooling

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	1050 m ³ / h
Gas inlet temperature	+52 C
Gas outlet temperature	+22 C
Engine power	30 kW
Quantity:	1 pcs



Biogas compressor

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 (co-generation power plant in our case)

Specifications

Flow rate	1050 m ³ /h
Pressure	300 mbar
Engine	8.5 kW
Quantity	2 pcs



Desulphurization system

The desulphurization system is a one-step purification of biogas to remove sulfur. The system cleans biogas of sulfur using 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

The volume of charcoal	2000 kg
Numbers of charcoal columns	2 pcs



Flare

The 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

1050 m³/h

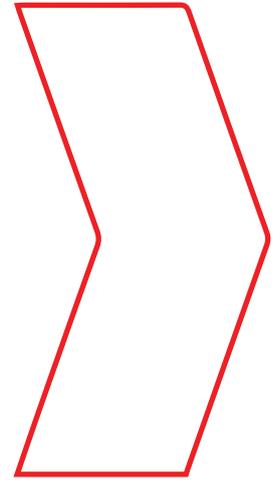


Dry cooler (digester cooling)

The device is designed to cool the heat-carrier in heat supply system. When using highly temperature substrates, there is a chance of uncontrolled self-heating of the digester. The cooler is connected to the heating pipes, and when it is active according to temperature sensors, the same lines of heating supply are used. One cooler works with related spiral heat exchanger to cool the input substrates. Another one works with second heat exchanger to control temperature inside the digester.

Specifications

Power:	100 kW
Engine power:	4.0 kW
Quantity:	1 pcs



Gas analyzer (CH₄, CO₂, H₂S)

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

The water supply system provides biogas plant with water for technological needs, water for heating-cooling system, water for drinking and domestic use, and water for fire safety systems. As used, centrifugal single-stage pumps are the main pumping elements. These pumps are designed for pumping wastewater, water for drinking and domestic use, and sewage.

Pressure Boosting Systems are designed for pure water pressure boosting in industrial plants. The booster is comprised of 2 to 3 pumps connected in parallel and installed on a common base frame and provided with all required fittings.

Specifications

Water supply pump

Pressure	2.5 bar
Flow	25 m ³ /h
Engine	3.0 kW

Submersible pump

Pressure	1.1 bar
Flow	15 m ³ / h
Engine	3,5 kW

Submersible pump with power cable

Pressure	1.1 bar
Flow	1,7l / s
Engine	0,9 kW

Equipment

Pump case control

Stove-base

gauges

Check valves

Float switches

Brackets

Valves



Heating system

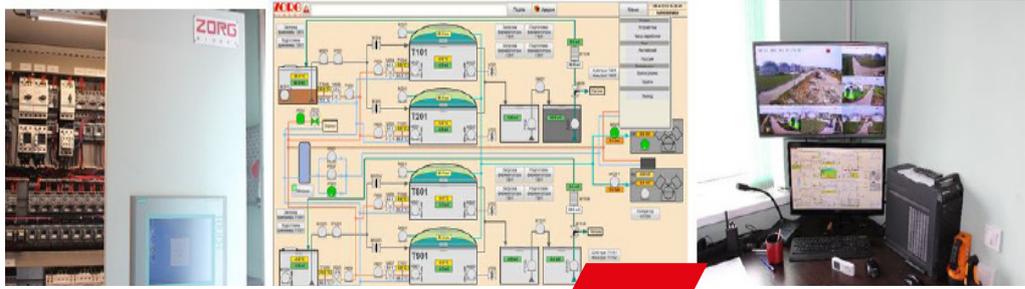
The heating equipment is used for biogas plant heating and for sustaining a constant temperature in the fermenter. The heating equipment includes circulation pumps, heat exchangers, heating manifolds, and tubes. The heat from the boiler is transferred to biogas plant walls by using a heat exchanger and is pumped through the interior of the biogas plant by circulation pumps. The system prepares water with added ethyl glycol. The inlet and outlet temperature in the fermenter are 60C and 40C respectively.

Specifications

Circulating pump feeding heat carrier
Flow 12 m³ / h;
Pressure 1.1 bar
Engine 3.5 kW

Circulating pump feeding heat carrier
Flow 0.6 m³ / h;
Pressure 1 bar,
Engine 0.165 kW

The pumping station feeding propylene glycol
Flow 1,0m³ / h;
Pressure 4 bar,
Engine 0.775 kW



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

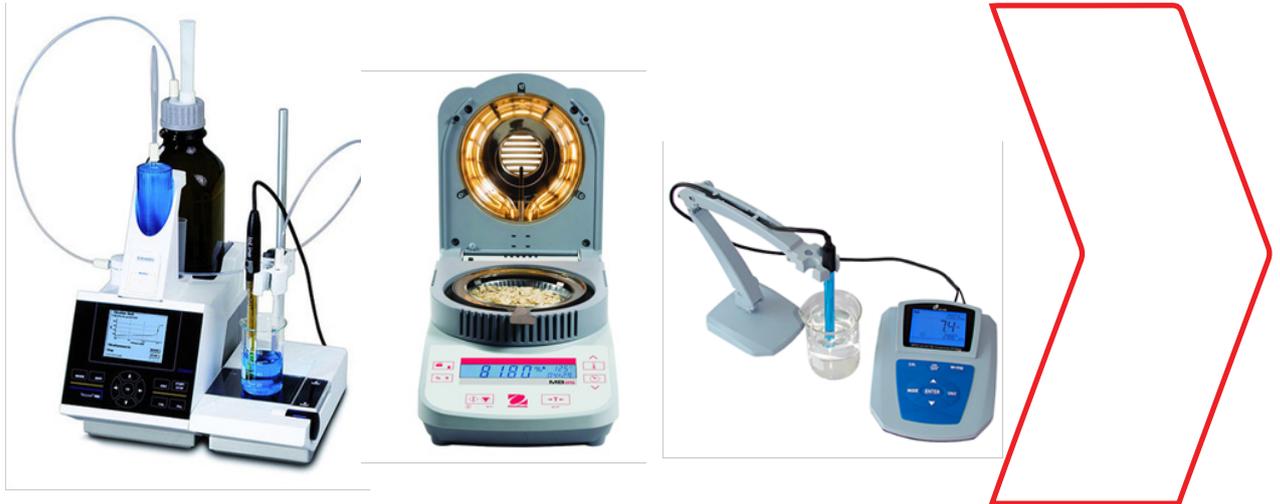


Sensors

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

Specifications

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



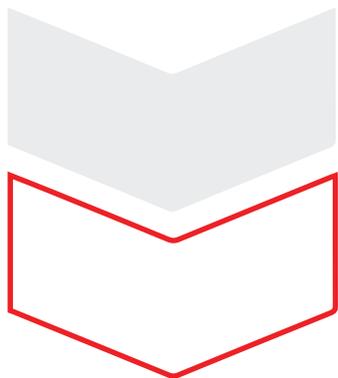
Laboratory

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 digesters, the volume of biogas output, and evaluate the efficiency of separator.

Equipment

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

SPECIFICATION LIST



Nº	Equipment	Characteristic	Q-ty
1	Digester (steel enamel tank)	V=8220 m³	1
1.1	Windows with spotlight, complete, disassembled	set	1
1.2	Flanges to connection engineering communication	set	1
1.3	Service sites (for mixers gear, valves and connections)	set	1
2	Buffer tank (steel enamel tank)	V=119 m³	
2.1	Manholes	set	
2.2	Flanges to connection engineering communication	set	
2.3	Service sites (for mixers gear, valves and connections)	set	
2.4	Fixing for engineering communication	set	
3.1	Digester vertical agitator	N=35 kW	1
3.1.1	Airtight motor gearbox		1
3.1.2	Hydraulic screw (wear-resistant steel)		1
3.1.3	Shaft (adapted to the height of the fermenter)		1
3.1.4	Frequency converter		1
3.2	Submersible mixer	N=3,3 kW	1
3.2.1	Frequency converter		
3.2.2	Shaft (adapted to the height of the tank)		
4	Clarified wastewater pump	Q= 40 m³/h	1
5	Separator	N=7.5 kW	1
5.1	Frame		1
5.2	Screw		1
5.3	Sieve for the filtration		1
5.5	Counterweights		1
5.2	Separator supply pump	Q= 40 m³/h	1
6	Circulation substrate pump	Q= 40 m³/h	1
7	External heat exchanger	100 kW	1

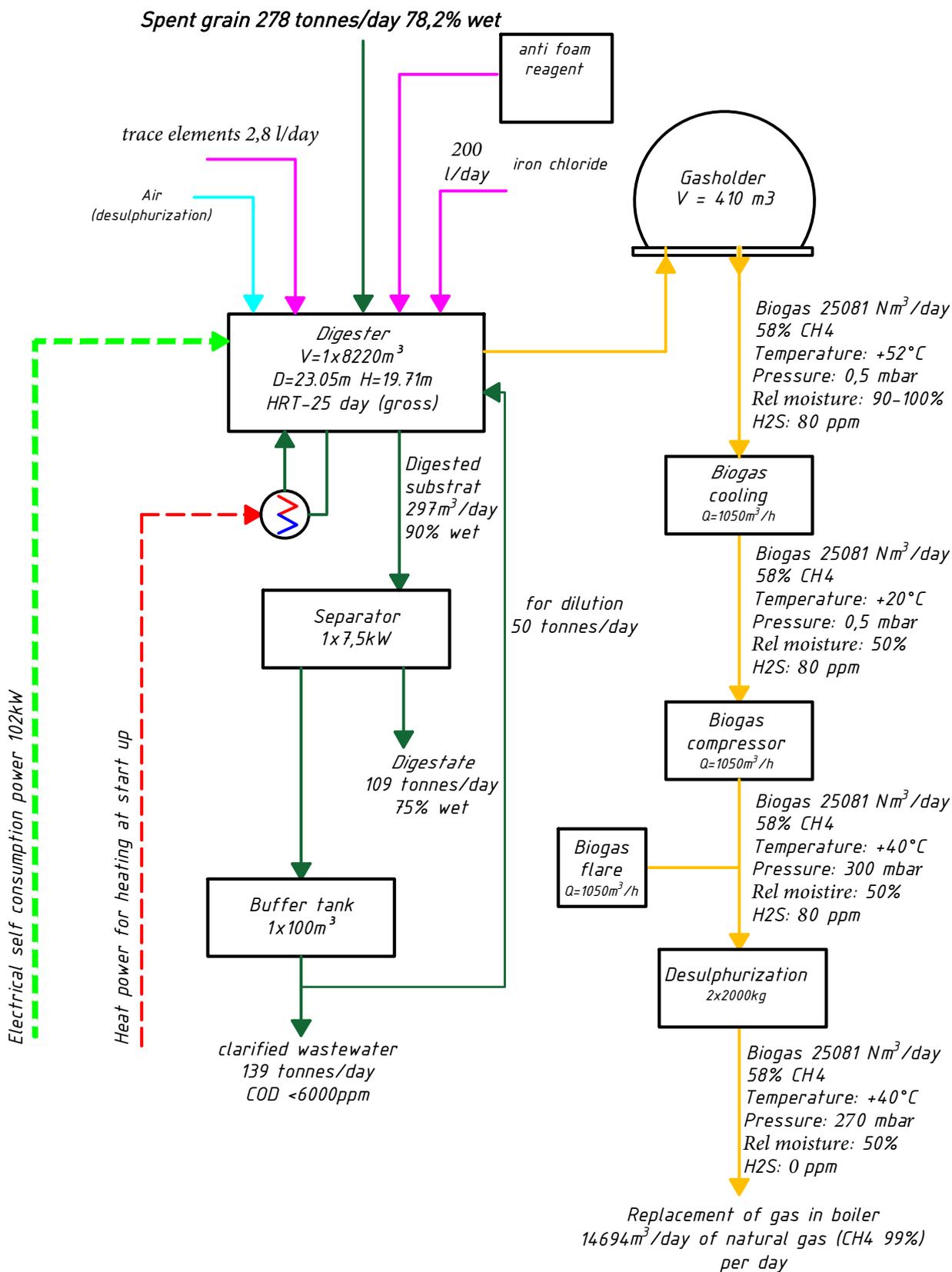
Nº	Equipment	Characteristic	Q-ty
8	Dry cooler	100kw	1
9	PVC external gas holder	Ø10.1 m	1
9.1	Weather protection film	Ø10.1 m	1
9.2	Gasholder film PELD methane permeation max.260 cm ³ /m ² *d*1 bar, 650 N/5cm biogas resistant		1
9.3	Air blower	16A, 0,5kW	1
9.5	Excess and minimum pressure valve		1
9.6	Dome level sensor		1
9.7	Mounting system		1
9.8	Accessories	set	1
10	Digester safety valve		1
11	Biogas compressor	Q=1050m³/h N=8,5kW	2
12	Biogas Cooling System	1050 m³/h	1
12.1	Chiller		1
12.2	Heat exchanger		1
12.3	Polypropylene glycol tank		1
13	Desulphurisation system		1
13.1	Filter with activated charcoal	2000 kg	2
14	Biogas analyzer (CH₄ , CO₂ , H₂S)		set
15	Electromagnetic flow meter		1
16	Flare	1050 m³/h	1
16.1	Compressor		1
16.2	Manual locking element		1
16.3	Deflagration fuse		1
16.4	On-site control cabinet		1
16.5	Auto ignition system		1

Nº	Equipment	Characteristic	Q-ty
17	The heat supply system		1
17.1	Diaphragm expansion tank	V=1000 l P=6Bar T=120°C	1
17.2	Circulating pump for supplying heat carrier	Q=12 m ³ /h N=3,5 kW	1
17.3	Circulation pump for supplying heating water to the office building	N=0,165 kW	1
18	Electric boiler for start up		1
19	Automation with electrical equipment complete, disassembled		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
19.3	Incoming distribution cabinet with a set of automation DB-3		1
20	Sensor set		1
20.1	Conductivity sensor	31SCM50	4
20.2	Pressure / level sensor	SEN-3251 B025 G1 1Bar	2
20.3	Ultrasonic sensor	SPA-380-08	2
20.4	Gas pressure sensor	G1/2 0,4Bar	3
20.5	Thermal converter		3
20.6	Thermowells for thermocouples	TR10-B	2
20.7	Thermal converter heating circuit	TR3	2
20.8	Substrate pressure sensor	G1 4Bar	3
19.9	Substrate pressure sensor	G1 2,5Bar	3
19.10	Coolant pressure sensor	G1/2 6Bar	2
19.11	Immersion level sensor	LS-10 0,6Bar 4-20 mA	2
20.12	Humidity and gas temperature sensor	ESFTF-I	2

APPENDIXES



Material flow diagram



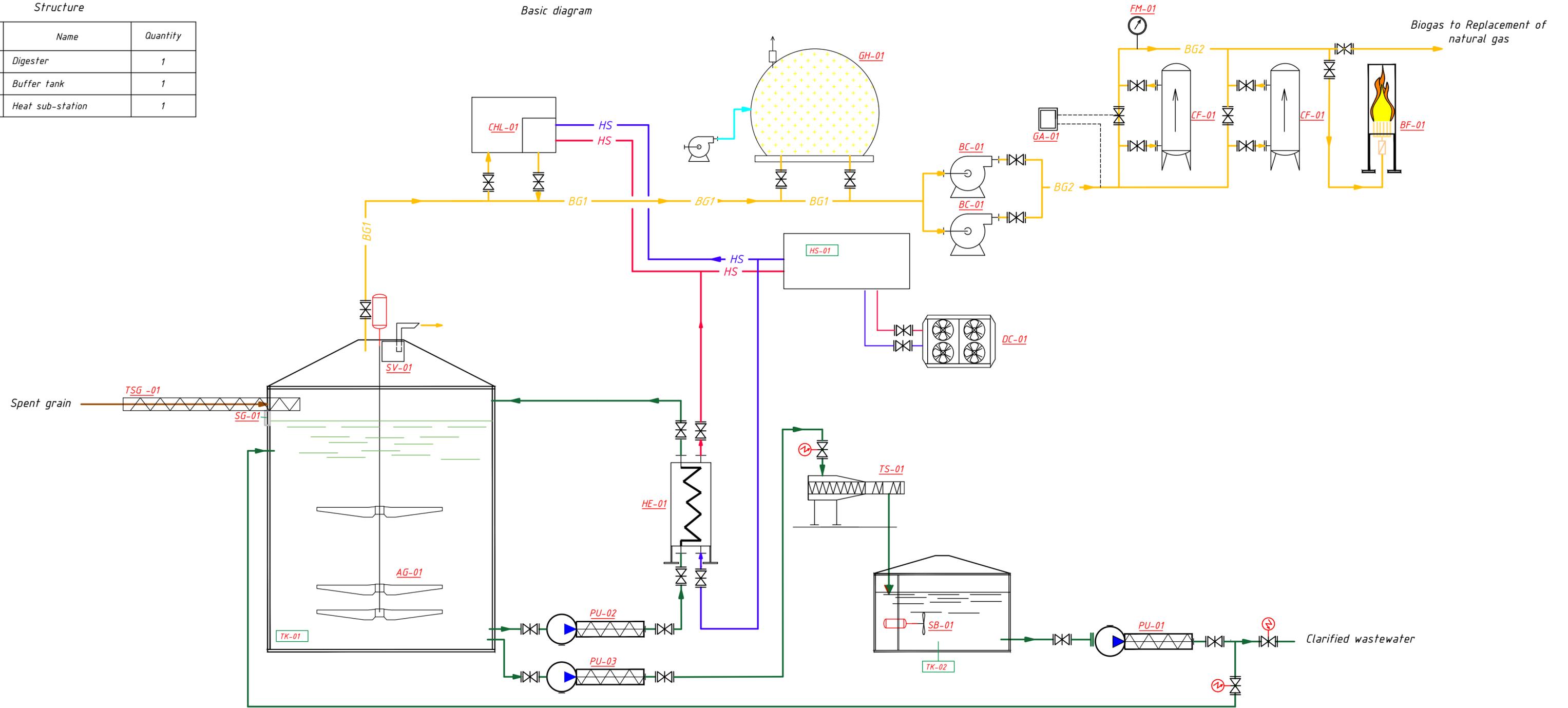
Specification

N/Nº	Name	Quantity
AG-01	Digester central agitator	1
SV-01	Safety valve	1
SG-01	Inspection windows	1
PU-02	Substrate circularion pump	1
PU-01	Clarified wastewater pump	1
PU-03	Separator supply pump	1
HE-01	Heat exchanger of digester	1
GH-01	Gasholder	1
CHL-01	Biogas cooling system	1
BC-01	Biogas blower	2
CF-01	Desulphurisation system	2
BG-01	Biogas analyzer	1
FM-01	Biogas flow meter	1
BF-01	Biogas flare	1
DC-01	Dry cooler	1
TS-01	Separator	1
TSG-01	Loading auger with spent grain	1
SB-01	Submersible mixer	1

Structure

N/Nº	Name	Quantity
TK-01	Digester	1
TK-02	Buffer tank	1
HS-01	Heat sub-station	1

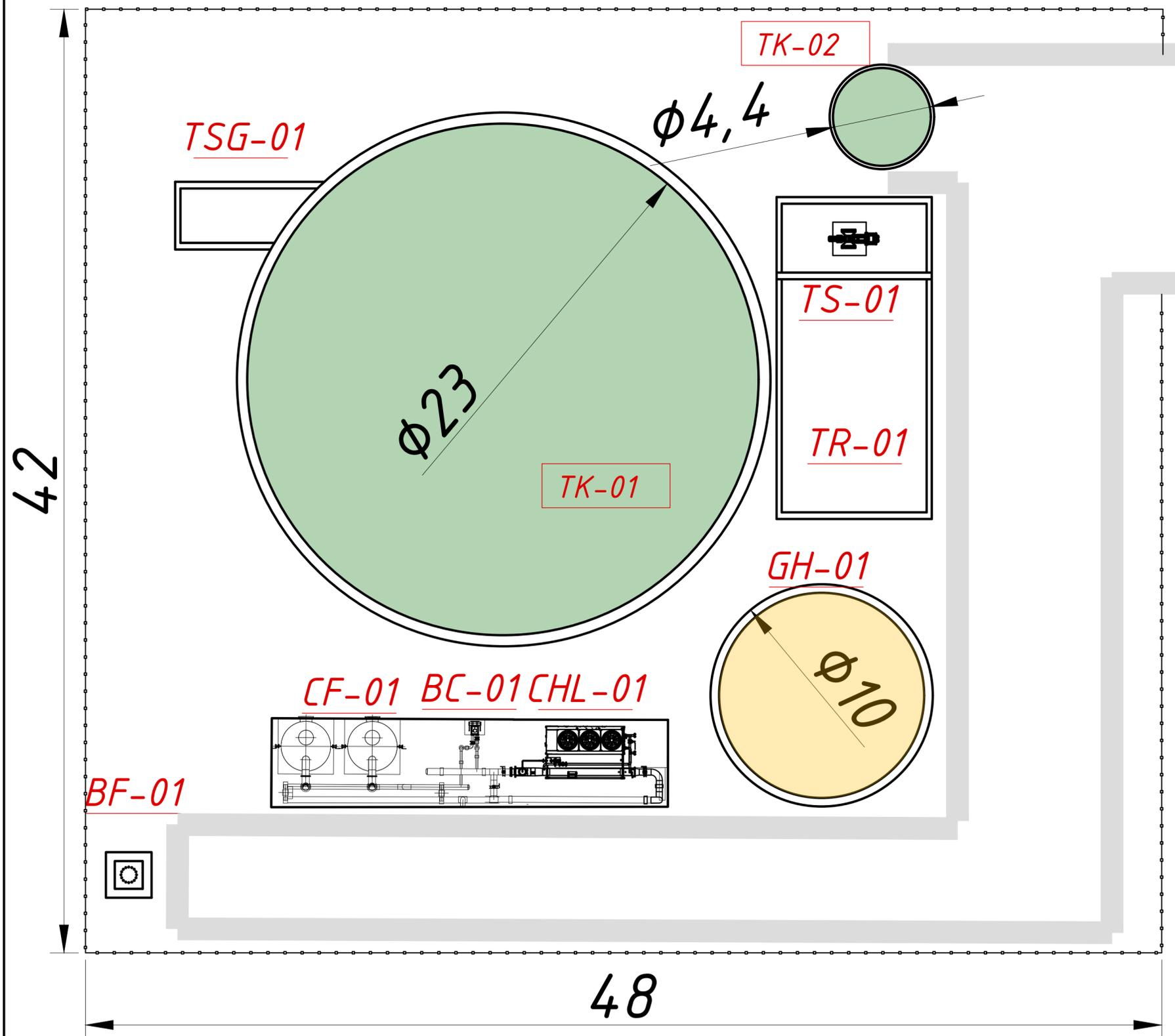
Basic diagram



Legend main pipelines

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

Plan



Explication

N/N°	Name	Note
TK-01	Digester	
TK-02	Buffer tank	
GH-01	External gasgolder	
CHL-01	Biogas cooling system	
BC-01	Biogas compressor	
CF-01	Carbon filter (desulphurization)	
BF-01	Biogas flare	
TR-01	Technical room	
TS-01	Separator	
TSG-01	Loading auger with spent grain	

Average consumed electric power

Name equipment	Pow.instal (kW)	Q-y (pcs)	Total installed power (kW)	Working hours per day	Consumption kWh per day
Digester central agitator	35,0	1	35,0	16,0	560,0
Loading auger with spent grain	22,0	1	22,0	10,0	220,0
Submersible mixer	3,3	1	3,3	6,0	19,8
Separator supply pump	11,5	1	11,5	12,0	138,0
Substrate circulation pump	11,5	1	11,5	12,0	138,0
Clarified wastewater pump	11,5	1	11,5	12,0	138,0
Biogas compressor	8,5	2	17,0	12,0	204,0
Circulation pump for supplying heat carrier	2,5	1	2,5	12,0	30,0
Circulation pump for supplying heat carrierr to digester	1,5	1	1,5	24,0	36,0
Biogas cooling system	30,0	1	30,0	24,0	720,0
Circulating pump feeding network water at technical building	0,5	1	0,5	24,0	12,0
Circulating pump feeding hot water at technical building	0,1	1	0,1	only ambient temp +10°C	
Propylene glycol pump station	0,5	1	0,5	0,5	0,3
Water circulation pump	2,2	1	2,2	2,0	4,4
Dry cooler (temperature control of digester)	4,0	1	4,0	24,0	96,0
Air compressor for gasholder lock	1,5	1	1,5	1,0	1,5
Air blower for duble membrane	1,0	1	1,0	24,0	24,0
Separator	7,5	1	7,5	12,0	90,0
Drinage pump	1,2	1	1,2	0,5	0,6
Biogas analyzer	1,0	1	1,0	24,0	24,0
Total installed power, kW			165,3		
Total consumed electric energy, kWh per day					2456,6
Average consumed electric power, kW					102

Equipment price

Pos.	Description	Quantity	Unit Price, EUR	Total Price, EUR
1	Decanter 7,5kW	1	152 000,00	152000,00
2	External Gas-Holder D=10,1m V=410m ³	1	66 000,00	66 000,00
3	Over- and underpressure safeguard	1	6 000,00	6 000,00
4	Sight glasses/viewing windows with projector	1	5 000,00	5 000,00
5	Submersible mixer 3,3kW	1	8 000,00	8 000,00
6	Digester central agitator 35kW	1	148 000,00	148 000,00
7	Separator supply pump N=11,5kW	1	29 000,00	29 000,00
8	Digested substrate pump N=11,5kW	1	29 000,00	29 000,00
9	Substrate circulation pump N=11,5kW	1	29 000,00	29 000,00
10	External heat exchanger	1	127000,00	127 000,00
11	Biogas cooling system 1050m ³ /hour	1	122 000,00	122 000,00
12	Biogas blower 1050m ³ /hour	2	33 500,00	67 000,00
13	Desulfurization system 2000 kg	2	67 500,00	135 000,00
14	Gas analyzer	1	28 000,00	28 000,00
15	Gas conditioning unit 1050m ³ /hour	1	14 000,00	14 000,00
16	Biogas burner 1050 m ³ /hour	1	76 000,00	76000,00
17	Heat supply station, as a unit, knocked-down.	1	19 000,00	19 000,00
18	Dry cooler (digester cooling) 100 kW	1	24 000,00	24 000,00
19	Automatic with electric equipment, as a unit	1	180 000,00	180 000,00
20	Sensors (set)	1	27 000,00	27 000,00
21	Water supply and canalization system, as a unit.	1	13 000,00	13 000,00
22	Loading auger with spent grain (set: 2x horizontal, 1vertical)	1	121 000,00	121 000,00
23	Steel enamel tank (buffer tank V=100m ³)	1	137 000,00	137 000,00
24	Steel enamel tank (Digester) V=8220m ³	1	979 000,00	979 000,00
TOTAL (EXW, Memmingen, Germany):				2 541 000,00
Euro				

Price

Name	Price (EXW, Memmingen)
➤ Project documentation	128 000 Euro
➤ Supervision	52 000 Euro
➤ Start-up, training	53 000 Euro
➤ Equipment	2 541 000 Euro
➤ Laboratory	31 000 Euro
➤ Delivery in EU (20trucks x 5000Euro)	100 000 Euro
➤ Construction and instalation*	1 200 000 EUR
Total	4 105 000 Euro

* - Construction and installation includes excavation, concrete foundations, control and power cables, lighting, pipes, thermal insulation of the reactor and pipes, technical building, construction machinery and instrument rent, reactor assembly, equipment montage, hydraulic and dry testing

Implementation terms and payment

Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Project documentation	50%			50%												
Permissions and approvals																
Equipment supply				50%			30%				20%					
Construction						30%		20%		20%		20%	10%			
Supervision						50%						50%				
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

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