ZORG BIOGAS

01

version

Proposal

Biogas plant
900 tones distillery stillage per day

Date: 03/12/2025
Validity: 3 months

CONTENT

Zorg Biogas offers a solution for processing distillery stillage into biogas. The produced biogas will replace natural gas in the existing boiler. The amount of the produced biogas will replace natural gas and corresponds to 1,502 MMBTU per day.

The proven vertical CSTR reactor with a central agitator is used. The vertical design ensures optimal mass and heat transfer and less electrical energy consumption. When comparing different biogas plant concepts, it is important to consider not only the price but also the quality and small yet crucial details. The temperature is maintained with the accuracy of 0.1 °C. The reactor roof and the upper two rows of rings are made out of stainless steel. Biogas undergoes double filtration, which prolongs burners` life. The plant is equipped with the modern laboratory. This technology uses a two-stage stillage cooling system to ensure effective control and regulation of the inlet process temperature.

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.

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 / tonneODM)	Biogas (m^3 /day)	Methane content (%)
Distillery stillage	900	328 500	12,5	94	112,5	105,75	700	74 025	60

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

Biogas plant characteristics

Characteristics	Values	Figures
Number of reactors (vCTR)	units	3
Volume:		
Work	m^3	7840
Overall		8200
Temperature	^0C	52
Overall dimensions of the digester:		
diameter	m	23,05
height		19,67
Organic load	kgODM/m3	4,5
Hydraulic retention time (gross/net)	days	27/26
Number of gasholders	units	1
Volume:	m^3	1500
Dimensions of the gasholder:		
diameter	m	15,4
height		11,8

Number of personnel

	Shift 1	Shift 2	Shift 3
Plant manager	1	-	-
Operator	1	1	1
Total	4		

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

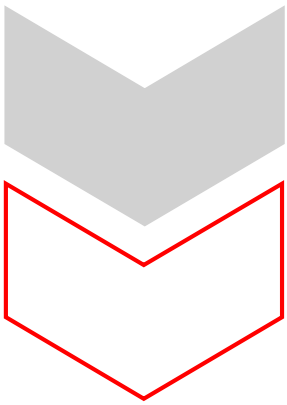
Technological process of biogas production

The distillery stillage directed into receiving tanks. The distillery stillage temperature must be controlled and sustained in a necessary range. From the receiving tanks stillage pumps to reactors evenly by pumps.

In the reactor the substrate is brought up to a temperature of +52°C. Constant temperature is sustained for the entire digesting period. To prevent a rise in temperature the biogas plant is equipped with a 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 time of processing in the reactor is 26 days After the reactor, the substrate goes to decanters, where it is separated into solid and liquids. Solid bio-fertilizer is discharged from the separation area and transported for storage; liquid filtrate is directed to post-treatment facilities. .

Produced biogas goes up under overlaps 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 (H2S). After the filter, biogas goes to to CHP, where it is used as fuel for production of electricity and heat. Heat from the congenators is fed to a heat exchangers for heating the 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



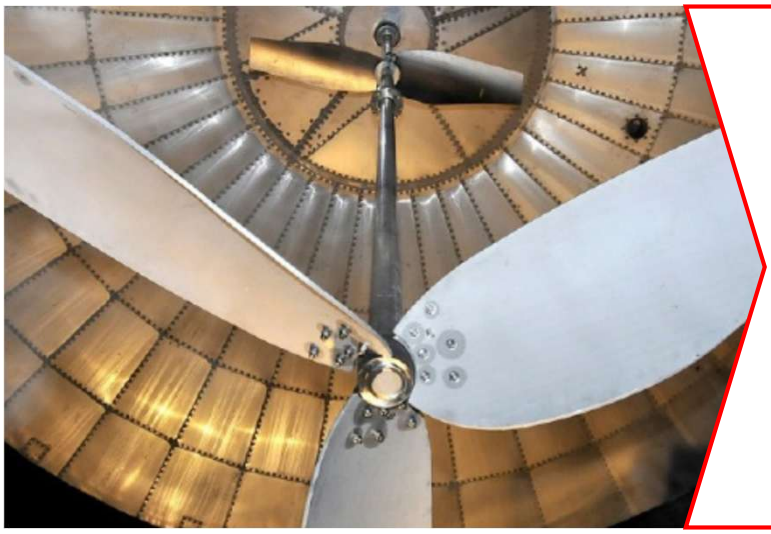
Reactor (R-01...R-03)

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:	**19,67 m**
Diameter:	**23,05 m**
Total volume:	**8200 m^3**
Substrate volume	**7840 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:	**35 kW**
Quantity per reactor:	**1 pcs**
Total quantity:	**3 pcs**

Window with spotlight (SG-01 ... SG-03)

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**	**120V, 50W, IP65**

Pump equipment

Pumps are used for transporting the substrate to and from the biogas plant units. Kinematic viscosity is a real physical factor that affects the pump curves and, consequently, their selection. Viscosity is essentially the resistance to flow. Both viscosity and liquid density influence how the fluid behaves inside the pump. Based on these parameters, appropriate types of pumps are selected for a given substrate. A cylindrical gear pump is used for transferring viscous liquids at low speed. Two sets of intermeshing gears are offset within the pump head. The liquid enters the spaces between the gear teeth along the outer casing to generate pressure and flow. This pump design enables pressure generation up to 20 bar with reduced noise levels. Screw pumps are used for transferring flowable liquid substrates, sludge, and mechanically thickened sludge, as well as substrates with a predominantly high dry solids (DS) content of up to 15%.The design of the biogas plant ensures easy access to all pumps for convenient maintenance and necessary repair work..

Specifications

Substrate digested pump (PU-01... PU-03)

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

Substrate circulation pump (PU-04...PU-06)

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

Substrate feed pump (PU-07, PU-08)

Engine power:	22 kW
Flow rate:	80 m3/hour
Pressure:	4 bar
Quantity:	2 pcs

Filtrate pump (PU-09, PU-10)

Engine power:	22 kW
Flow rate:	80 m3/hour
Pressure:	4 bar
Quantity:	2 pcs

Decanter (D-01, D-02)

Horizontal, cylindrical/conical solid bowl centrifuge for the continuous dewatering of sludge. The clarified liquid phase flows to the cylindrical end of the bowl where it exits over weir rings and through oversized discharge ports. The easily interchangeable weir rings allow for precise adjustment of the pool depth inside the bowl. The dewatered solids are conveyed to the conical end of the bowl where they are discharged through ports via centrifugal force. Bowl inside: Tack-welded stainless-steel strips in longitudinal direction. Bowl outside: Tungsten carbide stripes. Solids housing is protected with PU-liner. Solids discharge: Ports are protected with hard metal wear bushings. All wear bushings, hard metal wear segments, and wear liners in the solids housing are replaceable on site. Electric motor with V-belt drive. Initial and operating speed settings via frequency inverter. A special coupling step within the gear enables entirely independent operation of the scroll drive from the bowl drive.

Specifications

Engine power:	**55 kW**
Flow rate:	**20 m3/hour**
Quantity:	**2 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:	**8,54 m**
Height:	**4,27 m**
Volume:	**244 m³**
Quantity:	**1 pcs.**

Filtrate tank

Diameter:	**8,54 m**
Height:	**4,27 m**
Volume:	**244 m³**
Quantity:	**1 pcs.**

Plates (tank wall enamelled, 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)

Paddle giant agitator (AG-04) for receiving tank

Paddle agitator with high agitator power is designed and engineered to high effectiveness also with high-viscosity media. Container bearing consisting of special, extremely wear resistant bearing plastics. All relevant components can be replaced without having to drain the container or replacing the agitator shaft. The functional principle supports the agitation of setting layers. Degassing of the substrate is made easier. We use gear units and motors from respected European manufacturers. This guarantees the long life of our mixers. All motors and gear units are available with ATEX certifications.

Specifications

Engine power:	**5,5 kW**
Quantity per tank:	**1 pcs**
Total quantity:	**1 pcs**

Side agitator (AG-05) for filtrate tank

Side mixers are used in buffer 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

Engine power:	**3,0 kW**
Quantity per tank:	**1 pcs**
Quantity total:	**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 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:	**15,4 m**
Diameter:	**11,8 m**
The total volume :	**1500 m^3**
Quantity:	**1 pcs**

Biogas dryer and cooling (CHL-02, CHL-02)

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:	**3100 m^3/hour**
Gas inlet temperature:	**+55°C**
Gas outlet temperature:	**+35°C**
Electric power:	**55 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 (the existing boiler room in our case).

Specifications

Flow rate:	**3200 m3/hour**
Pressure:	**150 mbar**
Engine power:	**36 kW**
Quantity:	**2 pcs**

Desulphurization system

The desulphurization system is a 3-step system. Stage 1 is adding iron chloride. Stage 2 - biological. Adding a certain portion of air to the reactor. Air by special bacteria, converting H2S 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

The volume of charcoal:	**500 kg**
Quantity:	**2 pcs**

Charcoal filter (CF-01...CF-06)

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:	**3200 m^3/hour**
Pressure:	**min 10 mbar-max 60 mbar**
Quantity:	**1 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, HE-04, HE-05)

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 distillery stillage and filtrate	**900 kW**
Quantity:	**3 pcs**
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

Input substrate

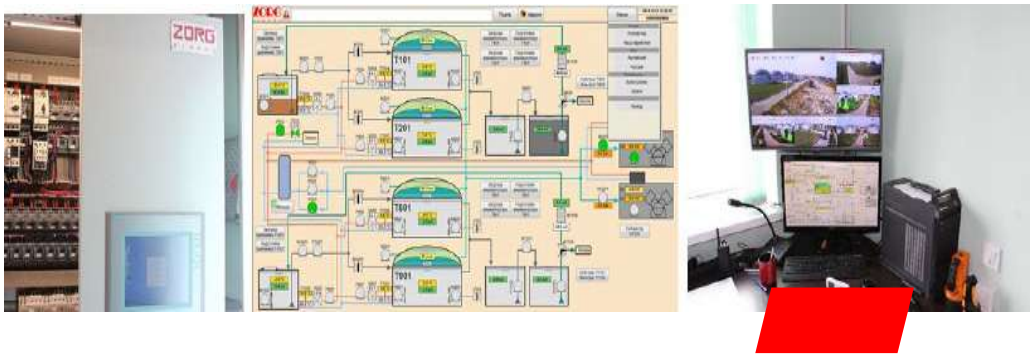
Heat power:	300 kW
Electric power:	12 kW
Quantity:	2 pcs

Substrate in reactors

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

Filtrate

Heat power:	300 kW
Electric power:	12 kW
Quantity:	1 pcs



Automation and electrical equipment

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

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

Specifications

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

Sensors set

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

Specifications

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

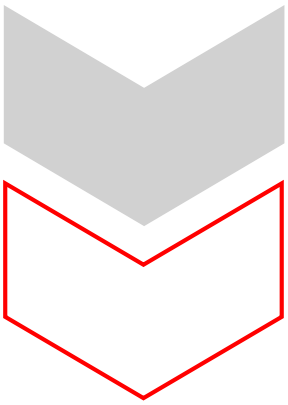
Laboratory

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



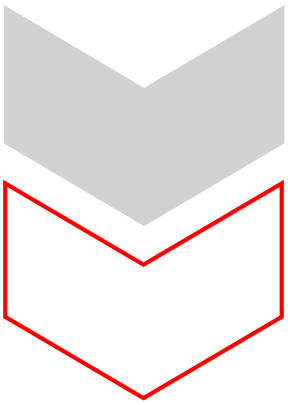
№	Equipment	Characteristic	Quantity
1	**Side mixer**	**N=3,0 kW**	**1**
1.1	Airtight motor gearbox		1
1.2	Hydraulic screw (wear-resistant steel)		1
1.3	Mixer control mechanism		1
1.4	Electric motor mount		1
1.5	Set of fasteners		1
2	**Reactor central vertical agitator**	**N=35 kW**	**3**
2.1	Airtight motor gearbox		3
2.2	Hydraulic screw (wear-resistant steel)		3
2.3	Shaft (adapted to the height of the fermenter)		3
2.4	Blade		3
2.5	Frequency converter		3
2.6	Mounting bracket to bottom of the mixer		3
3	**Safety valve of digesters**		**3**
4	**Window with a searchlight**	**set**	**3**
4.1	Inspection window RD300 (mounts and sealant included)	Ø300	6
4.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	3
5	**Paddle agitator**	**5,5kW**	**1**
6	**Substrate feed pump**	**80 m3/hour N=22kW**	**2**
7	**Substrate digested pump**	**40 m3/hour N=11kW**	**3**
8	**Substrate circulation pump**	**40 m3/hour N=11kW**	**3**
9	**Filtrate pump**	**80 m3/hour N=22kW**	**2**

№	Equipment	Characteristic	Quantity
11	**Decanter**	**N=55 kW**	**2**
12	**PVC gas holder**	**1500 m3**	**1**
12.1	Weather protection film	Ø15,4 m	1
12.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant		1
12.3	Air blower	16A, 0,5kW	
12.4	Excess and minimum pressure valve		1
12.5	Dome level sensor		1
12.6	Mounting system		1
12.7	Accessories		1
12.8	Safety valve		1
13	**Biogas Cooling System**	**3100 m3/h**	**2**
13.1	Chiller		2
13.2	Heat exchanger		2
13.3	Polypropylene glycol tank		2
14	**Desulphurization system (Charcoal columns/filter)**	**500 kg**	**2**
15	**Biogas compressor**	**Q=3200m3/h, H=150mBar, N=36 kW**	**2**
16	**Electromagnetic flow meter**		**1**
17	**Flare**	**3100 m3/h**	**1**
18	**Gas analyser**	**set**	**1**
19	**Gas equipment included**	**set**	**1**
19.1	Drainage pump with float	DN=50, Q=1m3/h, H=13 m	2

№	Equipment	Characteristic	Quantity
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	3
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	3
20.5	Plate dismountable heat exchanger	600 kW	3
20.6	Plate dismountable heat exchanger	900 kW	3
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		10
23.4	Pressure sensor (substrate pressure) 2,5bar		10

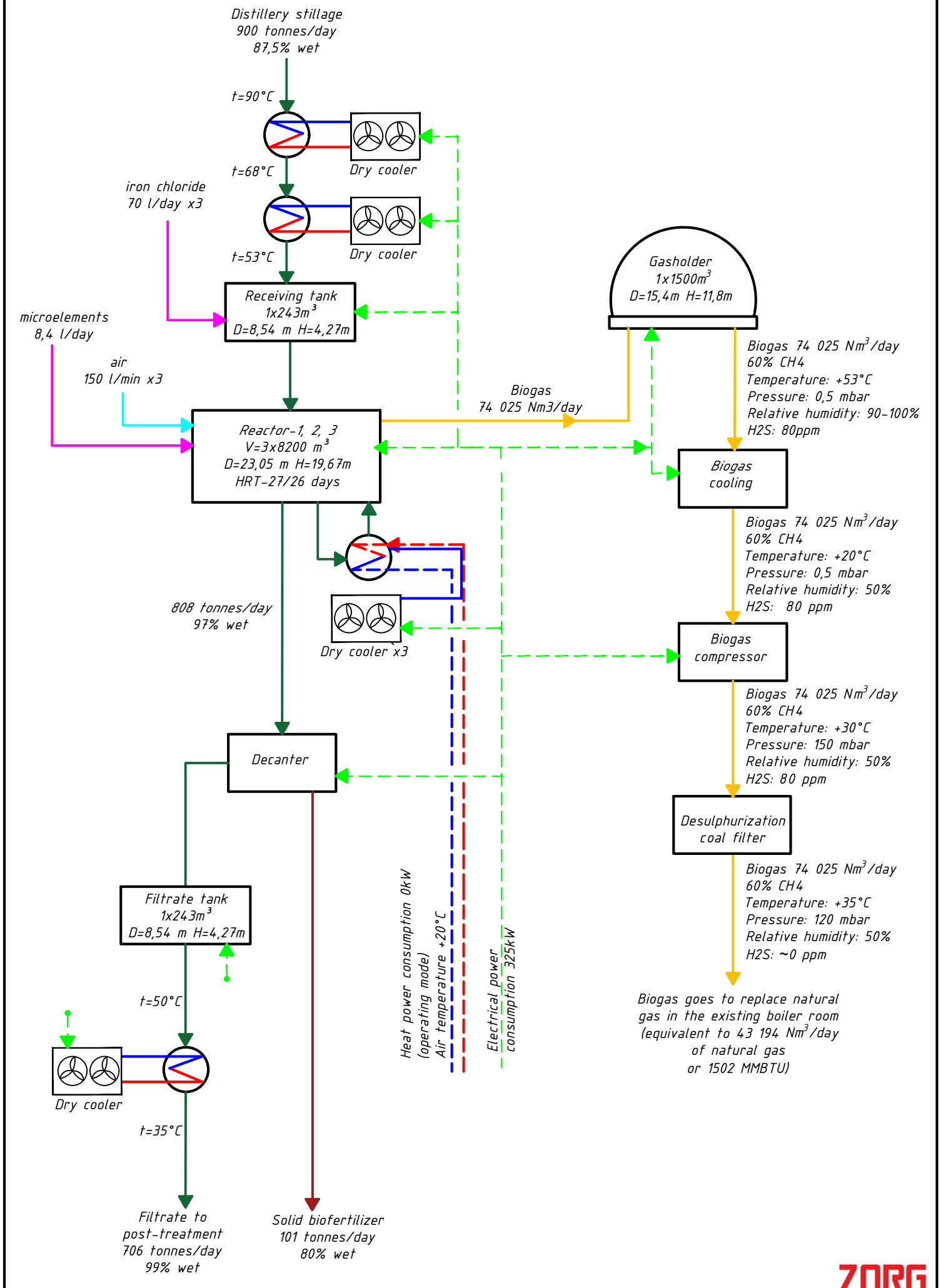
№	Equipment	Characteristic	Quantity
23.5	Resistive thermometer (gas temperature)		5
23.6	Resistive thermometer with thermo well (fermenter substrate temperature)		5
23.7	Resistive thermometer with thermo-well (digester tank substrate temperature)		5
23.8	Resistive thermometer (heat conductor temperature)		6
23.9	Conductometric sensor of maximum level		10
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	**Dry cooler 300 kW heat pow.**		**3**
26	**Laboratory**	**set**	**1**
27	**Steel enamel tank**	**244 m3**	**2**
28	**Steel enamel tank**	**8200 m3**	**3**

APPENDICES



Material flow diagram

Appendix 1



ZORG BIOGAS

Basic diagram

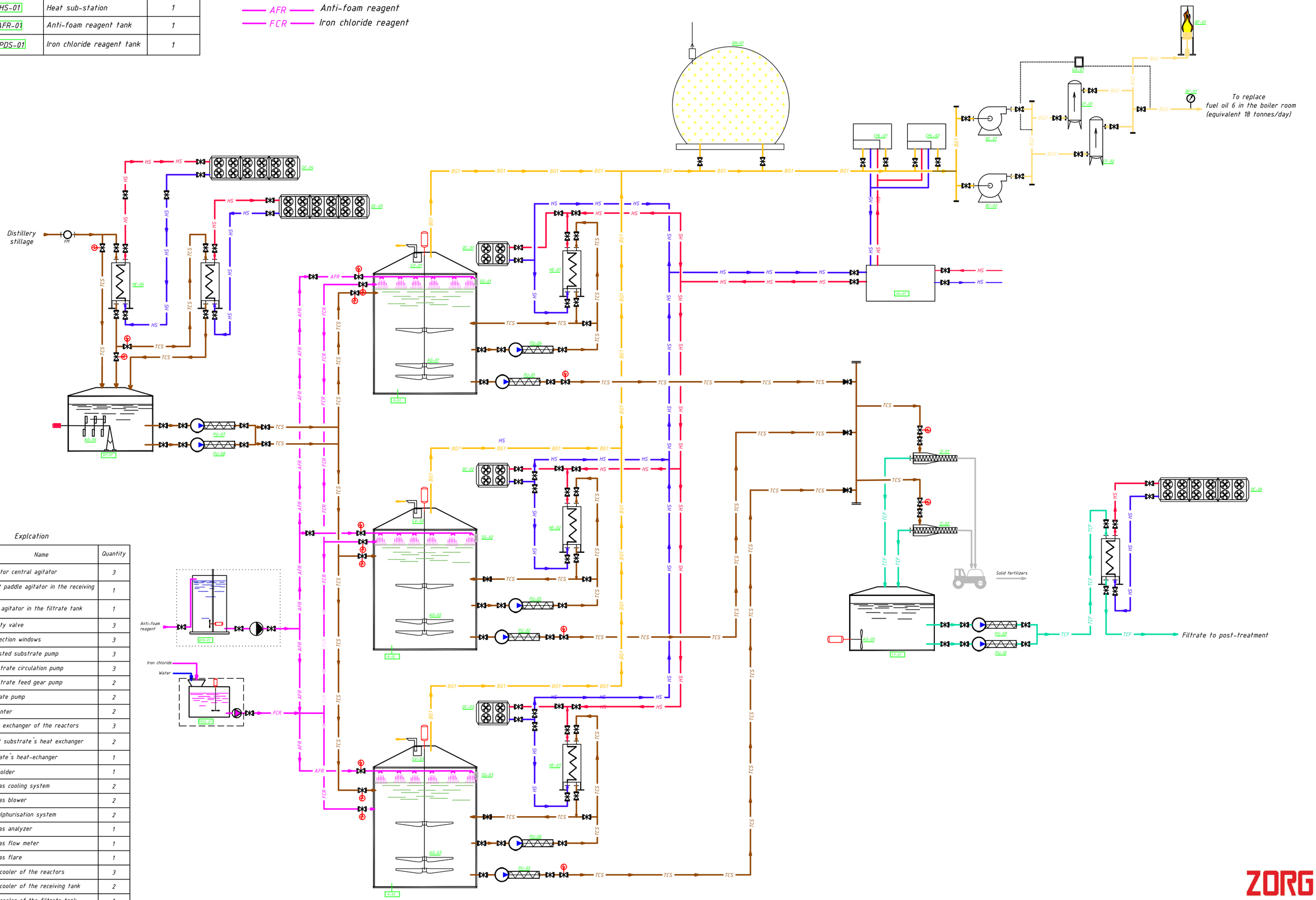
Appendix 2

Structure

N/№	Name	Quantity
R-01, R-02, R-03	Reactor	3
RT-01	Receiving tank	1
FT-01	Filtrate tank	1
HS-01	Heat sub-station	1
AFR-01	Anti-foam reagent tank	1
FPDS-01	Iron chloride reagent tank	1

Legend main pipelines

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

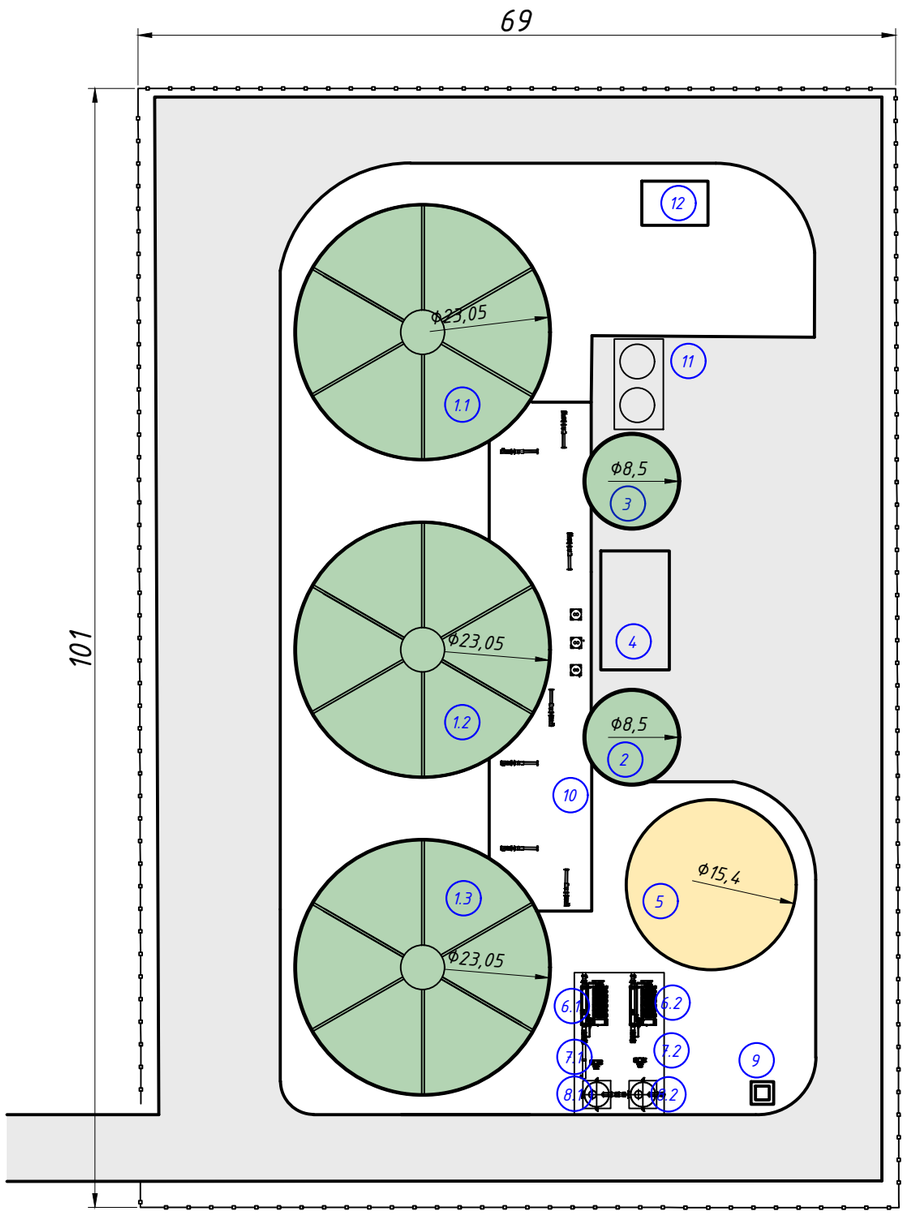


Explcation

N/№	Name	Quantity
AG-01, AG-02, AG-03	Reactor central agitator	3
AG-04	Giant paddle agitator in the receiving tank	1
AG-05	Side agitator in the filtrate tank	1
SV-01 ... SV-03	Safety valve	3
SG-01 ... SG-03	Inspection windows	3
PU-01...PU-03	Digested substrate pump	3
PU-04 ... PU-06	Substrate circulation pump	3
PU-07, PU-08	Substrate feed gear pump	2
PU-09, PU-10	Filtrate pump	2
D-01, D-02	Decanter	2
HE-01 ... HE-03	Heat exchanger of the reactors	3
HE-04, HE-05	Input substrate`s heat exchanger	2
HE-06	Filtrate`s heat-echanger	1
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
BF-01	Biogas flare	1
DC-01 ... DC-03	Dry cooler of the reactors	3
DC-04, DC-05	Dry cooler of the receiving tank	2
DC-06	Dry cooler of the filtrate tank	1

ZORG BIOGAS

Plan of biogas plant



Explication

N/№	Name	Note
1.1, 1.2, 1.3	Reactor	R-01, R-02, R-03
2	Receiving tank	RT-01
3	Filtrate tank	FT-01
4	Decanters` area	D-01, D-02
5	Gasholder	GH-01
6,1, 6.2	Biogas cooling system	CHL-01, CHL-02
7.1, 7.2	Biogas compressor	BC-01, BC-02
8.1, 8.2	Carbon filter (desulphurization)	CF-01, CF-02
9	Biogas burner	BF-01
10	Equipment room	ER-01
11	Reagents area	AFR-01
12	Electrical room (switchboard)	

ZORG BIOGAS

Biogas plant					
Name equipment	**Instal. Pow. (kW)**	**Q-y (pcs)**	**Total installed power (kW)**	**Working hours per day**	**Consumption kWh per day**
Reactor Central agitator	35,0	3	105,0	18,0	1890,0
Submersible mixer in receiving tank	7,5	1	7,5	8,0	60,0
Submersible mixer in filtrate tank	5,5	1	5,5	8,0	44,0
Biogas cooling system	56,0	2	112,0	12,0	1344,0
Biogas compressor	36,0	2	72,0	12,0	864,0
Decanter	55,0	2	110,0	12,0	1320,0
Substrate feed pump	22,0	3	66,0	5,0	330,0
Substrate pump to decanter	11,0	3	33,0	12,0	396,0
Substrate circulation pump to heat exchanger	11,0	3	33,0	12,0	396,0
Filtrate pump	22,0	2	44,0	8,0	352,0
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
Stilage cooling system	12,0	2	24,0	8,0	192,0
Filtrate cooling system	12,0	1	12,0	8,0	96,0
Digester cooling system	4,0	3	12,0	24,0	288,0
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	3	6,0	24,0	144,0
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	4	4,0	0,5	2,0
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			**653**		
Total consumed electric energy, kWh per day					**7808**
Total consumed power, kW					**325**

ZORG BIOGAS

Appendix 5

Prices for quipment and services for a biogas plant 900 tonnes corn stillage per day

Pos	Name	Number of units	Unit price, EUR	Discounts*	Discounted unit price, EUR	Discounted price sub-total, EUR	
1	Detailed design	1	125 000	0%	0	125 000	
2	Supervision	1	80 000	0%	0	80 000	
3	Startup and training	1	80 000	0%	0	80 000	
4	Living and travel expences	1	80 000	0%	0	80 000	
5	Delivery of the equipment	45	8 000	0%	0	360 000	
6	Laboratory	1	27 000	0%	0	27 000	
7	Central agitator 35kW	3	168 000	0%	0	504 000	
8	Paddle agitator	1	28 000	0%	0	28 000	
9	Side agitator 3,0kW	1	22 000	0%	0	22 000	
10	Substrate feed gear pump 22kW	2	45 000	0%	0	90 000	
11	Digested substrate pump 11kW	3	27 000	0%	0	81 000	
12	Circulation substrate pump 11kW	3	27 000	0%	0	81 000	
13	Filtrate pump 22kW	2	32 000	0%	0	64 000	
14	Substrate gate valve	52	1 050	0%	0	54 600	
15	Substrate valve with el.actuator	20	6 000	0%	0	120 000	
16	Decanter 55kW	2	185 000	0%	0	370 000	
17	Gasholder 1500 m3	1	125 000	0%	0	125 000	
18	Biogas chiller 3100 m3/h	2	195 000	0%	0	390 000	
19	Biogas blower 3200 m3/h	2	58 000	0%	0	116 000	
20	Desulphurization column with active coal 500 kg	2	45 000	0%	0	116 000	
21	Biogas 3100 m3/h	1	185 000	0%	0	185 000	
22	Gas analyzer	1	27 000	0%	0	27 000	
23	Gas conditioning unit	1	120 000	0%	0	120 000	
24	Over- and under pressure safeguard	3	12 000	0%	0	36 000	
25	Sight glasses/viewing windows with projector	3	7 000	0%	0	21 000	
26	Water supply and canalization system	1	75 000	0%	0	75 000	
27	Heat supply station	1	75 000	0%	0	75 000	
28	Dry-cooler (substrate)	3	65 000	0%	0	195 000	
29	Dry-cooler (destillery stillage)	2	95 000	0%	0	190 000	
30	Dry-cooler (filtrate)	1	95 000	0%	0	95 000	
31	Automation and electric cabinet	1	360 000	0%	0	360 000	
32	Sensors (set)	5	27 000	0%	0	135 000	
33	Reactor 8200 m3	3	988 000	0%	0	2 964 000	
34	Receiving tank 244 m3	1	95 000	0%	0	95 000	
35	Filtrate tank 244 m3	1	95 000	0%	0	95 000	
33	Heat exchanger substrate	3	22 000	0%	0	66 000	
34	Heat exchanger (stillage)	1	45 000	0%	0	45 000	
35	Heat exchanger (filtrate)	1	45 000	0%	0	45 000	
36	Construction and installation (concerete foudnations, thermal insulation, deco covering, inox substrate and gas pipes, cables, tools and machinery lease)	1	2 000 000	0%	0	2 000 000	Client
			by ZORG, EUR			7 737 600	
			by Client, EUR			2 000 000	
			TOTAL Zorg + Client, EUR			**9 737 600**	

;

Implementation terms and payment

Year	2026												2027
Months	1	2	3	4	5	6	7	8	9	10	11	12	1
Project documentation	50%		50%										
Approvals and permits													
Equipment				30%		25%	25%	20%					
Delivery						25%	25%	25%	25%				
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 150 kW for start-up, for construction period and 350 kW 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 500 m3 water per day. 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 1400-1600m3. The rest is filled with the water item 5 above.
6) Activated carbon 1 tonne per 2 year x 4800 EUR/tonne = 4800 EUR
7) Microelements 8,4lx 365= 3066 l per year x 25 EUR/l= 76 650 EUR
8) FeCl3 – 77 tonnes per year x 900 EUR/tonne = 69 300EUR
9) Demineralized water to the heating system 3,0 tonnes,
10) Spare parts for 2-3 years - 180 000 EUR

ZORG BIOGAS

Business center “Twin Yards”
Walter-Gropius-Straße 23,
DE-80807, München, Germany

Mob. +49 1511 457 29 45 (WhatsApp, Viber, Telegram)

igor.reddikh@zorg-biogas.com
www.zorg-biogas.com