

01

version

Proposal

Biogas plant using potato water suspension 252 tonnes/day



Date: 06/07/2026

Validity: months



CONTENT

Overview	3
Raw material potential	4
Biogas plant characteristics	5
Working principle	6
Technological process of biogas production	7
Main equipment	8
Receiving tank and filtrate tank	9
Reactor	10
Reactor central vertical agitator	11
Side agitator	12
Pump equipment	13
Decanter	14
Gasholder	15
Biogas cooling system	16
Biogas compressor	17
Scrubber and activated carbon filter	18
Gas analyser	19
Biogas burner	20
Water supplying and sewerage system	21
Heating system	22
Heat-exchanger	23
Dry cooler (cooling substrate system)	24
Automation and electrical equipment	25
Sensors set	26
Laboratory	27
Specification list	28
 Appendices:	 33
Appendix 1. Material flow diagram	34
Appendix 2. Basic diagram	35
Appendix 3. Plan of biogas plant	36
Appendix 4. Electric power consumption	37
Appendix 5. Prices for equipment and Zorg' services	38



OVERVIEW

Zorg Biogas offers a plant for processing 252 tonnes per day of potato water suspension. A vertical steel CSTR digester with a central agitator provides controlled mixing and temperature regulation. The plant converts the organic material into biogas for use in the existing boiler, reducing the site's demand for purchased natural gas.

The feedstock calculation gives approximately 24,872 Nm³ of biogas per day at 53% methane, equivalent to 13,182 Nm³ of methane per day. On a methane-content basis, this replaces approximately 13,450 Nm³/day of natural gas containing 98% methane. The actual substitution at the boiler depends on fuel quality and operating conditions.

The gas treatment line includes a biological scrubber, cooling, compression and activated carbon filtration. Hydrogen sulphide is reduced from 2,200 ppm upstream of the scrubber to 100 ppm downstream. Activated carbon provides final polishing to the specified outlet value of 0 ppm H₂S. The conditioned gas is supplied at 195 mbar after the carbon filter.

The scrubber uses micronutrients at 6 kg/day. Ferric chloride dosing is omitted. The digester retains its separate microelement dosing system. Automatic monitoring, pressure protection, process instrumentation and laboratory equipment support stable operation and routine process control.

Digestate is separated in a decanter into solid and liquid fractions. Filtrate is collected for transfer to the local wastewater treatment plant, with a specified COD of 12,000 ppm. The supply includes process equipment, engineering, construction supervision, commissioning and operator training.

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 (%)	Biogas (m ³ /year)
Potato water suspension	252	91 980	15	94	37,8	35,53	700	24 872	53	9 078 280

*-DM- Dry matter

**-ODM- organic dry matter

Biogas plant characteristics

Characteristics	Values	Figures
Number of reactors	units	1
Reactor (vCTR)	units	1
Volume:		
Work	m ³	7000
Overall		7339
Temperature	°C	37
Overall dimensions of the digester:		
diameter	m	22,2
height		18,97
Organic load	kgODM/m ³	5,05
Hydraulic retention time (gross/net)	days	29/27
Number of gasholders	units	1
Volume:	m ³	590
Dimensions of the gasholder:		
diameter	m	11,3
height		8,5

Number of personnel

	Shift 1	Shift 2	Shift 3
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 + $H_2O \rightarrow C_5H_7NO_2 + HCO_3$.

Further conversion of obtained dissolved compounds like organic acids and alcohols ($C_5H_7NO_2, HCO_3$) into gases - CH_4, CO_2 . $C_5H_7NO_2 + HCO_3 + H_2O \rightarrow CH_4 + CO_2 + NH_4$.

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 C_1 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

Potato water suspension is collected in the receiving tank and pumped into the digester. The reactor operates at +37°C. A central vertical agitator mixes the contents, while the heating and cooling circuits regulate the process temperature.

The reactor has a total volume of 7,339 m³ and a working volume of 7,000 m³. Microelements are supplied to the digester at 2.9 litres/day. Antifoam reagent is added when required.

Digestate is pumped to the decanter. The solid fraction is collected for storage and transport. Filtrate is directed to the filtrate tank and onward to the local wastewater treatment plant. The specified filtrate COD is 12,000 ppm.

Raw biogas is stored in the external double-membrane gasholder. The membrane support air remains separate from the process gas. Safety devices protect the storage system against overpressure and vacuum.

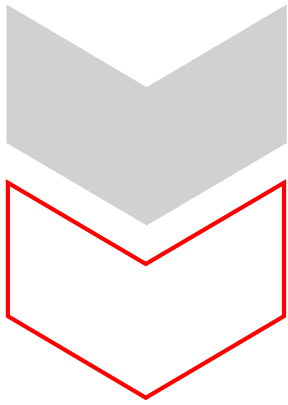
A gas booster raises the pressure to 40 mbar before the biological scrubber. Process air is supplied to the scrubber at 10% of the raw biogas volume. Micronutrient dosing is 6 kg/day. Ferric chloride dosing is not required.

The combined design flow is approximately 27,360 Nm³/day, or 1,140 Nm³/h. The biological scrubber reduces H₂S from 2,200 to 100 ppm. A pressure loss of 5 mbar leaves 35 mbar downstream.

The cooling package removes condensate before the main compressor. The compressor raises the gas pressure to 200 mbar. H₂S remains at 100 ppm until the activated carbon filter, which provides final polishing to the specified value of 0 ppm. The 5 mbar filter pressure loss leaves 195 mbar for delivery to the existing boiler.

The control system monitors process values, equipment status and alarms. Operators can select automatic or manual control, with local and remote access.

MAIN EQUIPMENT





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:	4,37 m
Volume:	244 m ³
Quantity:	1 pcs.

Filtrate tank

Diameter:	8,54 m
Height:	4,37 m
Volume:	244 m ³
Quantity:	1 pcs.

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



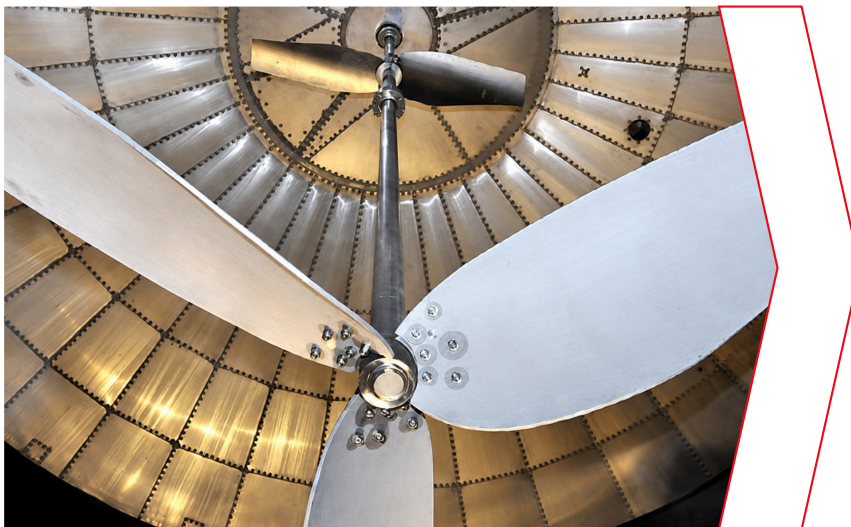
Reactor (RT-01)

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 smooth

Specifications

Height:	18,97 m
Diameter:	22,2 m
Total volume:	7339 m ³
Substrate volume	7000 m ³
Quantity:	1 pcs.

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



Reactor central vertical agitator (AG-01)

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

Specifications

Engine power: 37 kW

Quantity per reactor: 1 pcs

Total quantity: 1 pcs



Side agitator (AG-02, AG-03)

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

Specifications

Receiving tank agitator

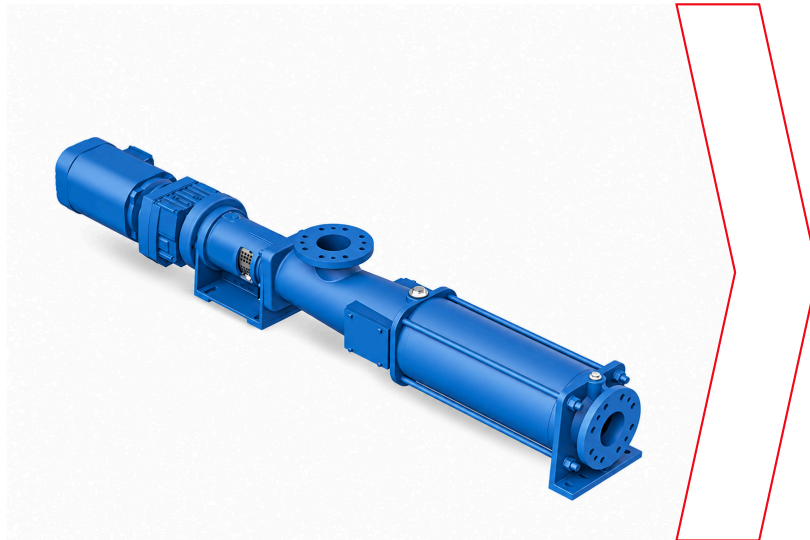
Engine power: 5,5 kW

Quantity per tank: 1 pcs

Filtrate tank agitator

Engine power: 3,0 kW

Quantity per tank: 1 pcs



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:	11 kW
Flow rate:	40 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Substrate digested pump (PU-02)

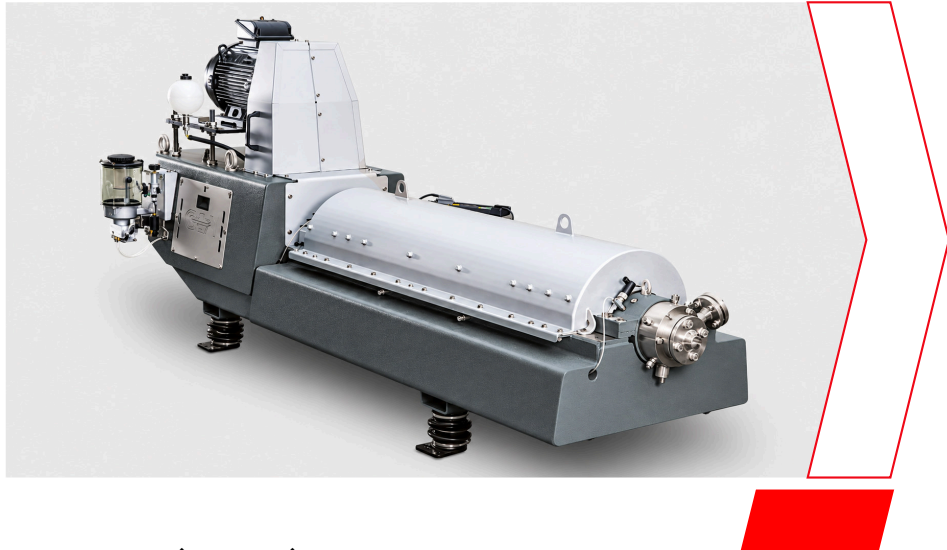
Engine power:	11 kW
Flow rate:	40 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Substrate circulation pump (PU-03)

Engine power:	7,5 kW
Flow rate:	30 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Filtrate pump (PU-04)

Engine power:	11 kW
Flow rate:	40 m3/hour
Pressure:	4 bar
Quantity:	1 pcs



Decanter (DR-01)

This decanter centrifuge has been customized for clear clarification, liquid separation and solids dewatering. The decanter centrifuge can be viewed as a settling pond wrapped around an axis. In the settling pond, solid particles, which are heavier than the liquid, settle to the bottom driven by gravity and build up a sediment layer on the bottom of the pond. In the rotating bowl of the centrifuge, solid particles, which are heavier than the liquid, move to the inner diameter of the bowl driven by centrifugal force and build up another sediment layer on the inner surface of the centrifugal bowl. Since the centrifugal force in the decanter is approximately 3000 x g instead of 1 x g in the gravitation field, separating solids from a liquid in a centrifuge becomes much faster and more efficient.

Specifications

Engine power:	55 kW
Flow rate:	20 m ³ /hour
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 $260 \text{ cm}^3/\text{m}^2 \cdot 1 \text{ bar}$ 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 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:	8,5 m
Diameter:	11,3 m
The total volume :	590 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:	1150 m ³ /hour
Gas inlet temperature:	+35°C
Gas outlet temperature:	+10°C
Electric power:	32 kW
Quantity:	1 pcs



Main biogas compressor (BC-01)

Biogas blower is a device used to move gas and increase pressure thanks to a rotating impeller within a toroidal channel, so there is a progressive increase of energy.

Blower is used to transporting biogas from gasholder storage to consumer for use in the existing boiler.

Specifications

Flow rate:	1320 m ³ /hour
Pressure:	200 mbar
Engine power:	16,0 kW

Quantity:	2 pcs
-----------	-------



Biological scrubber and activated carbon filter

The biological scrubber removes hydrogen sulphide before the cooling package. A booster supplies the gas at 40 mbar. Controlled process-air addition and micronutrient dosing support biological sulphur removal. A 5 mbar pressure drop leaves 35 mbar at the scrubber outlet.

After cooling and compression, the activated carbon filter polishes the gas before delivery to the existing boiler. Gas analysis is used to monitor treatment performance and determine carbon replacement. The specified H₂S concentrations are 2,200 ppm before the scrubber, 100 ppm after it and 0 ppm after activated carbon.

Specifications

Scrubber design capacity	1,150 Nm ³ /h
Process air	10% of raw biogas
Scrubber micronutrients	6 kg/day
Scrubber pressure loss	5 mbar
Activated carbon filter	1,150 Nm ³ /h
Activated carbon charge	300 kg
Carbon filter pressure loss	5 mbar
Gas supply pressure	195 mbar
Scrubber with gas booster: electric power	20 kW



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:	1150 m3/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
Floatswitches
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

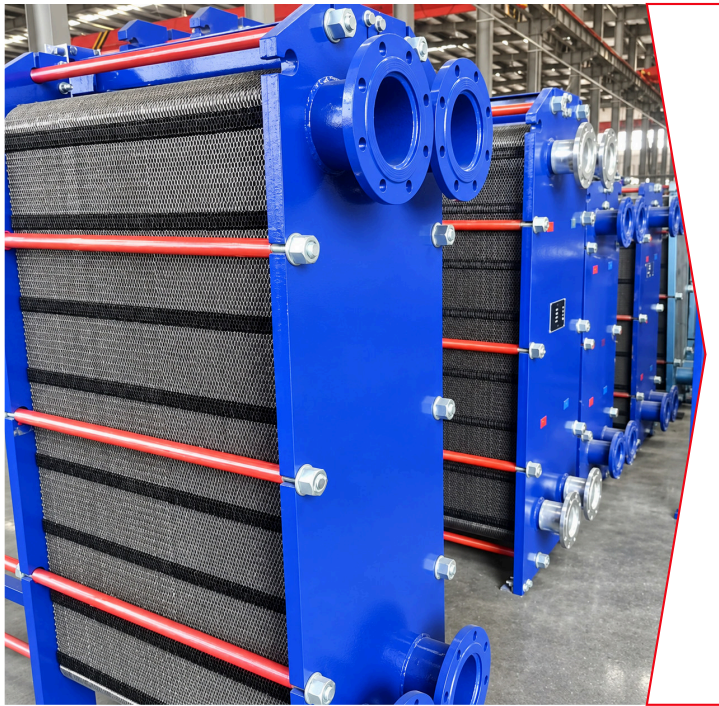


Plate Heat Exchanger (HE-01)

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
Temperature
Working pressure

5 to 100m³/h
up to 90°C
at 4 bar

Capacity of the heat exchanger for substrate
Quantity:

450 kW
1 pcs

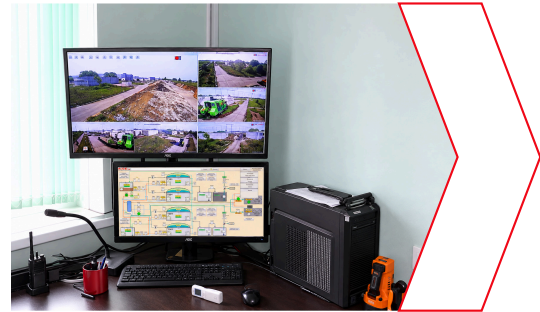
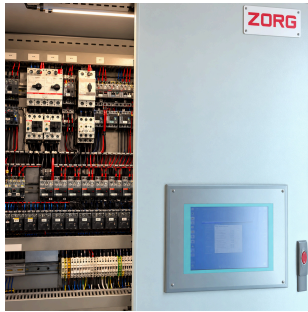


Dry cooler (cooling substrate system)

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

Heat power:	80 kW
Electric power:	3 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



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



Nº	Equipment	Characteristic	Quantity
1	Side agitator (receiving tank)	N=5,5 kW	1
1.1	Airtight motor gearbox		1
1.2	Hydraulic screw (wear-resistant steel)		1
1.3	Mixer control mechanism		1
1.4	Electric motor mount		1
1.5	Set of fasteners		1
2	Reactor central vertical agitator	N=37 kW	1
2.1	Airtight motor gearbox		1
2.2	Hydraulic screw (wear-resistant steel)		1
2.3	Shaft (adapted to the height of the fermenter)		1
2.4	Blade		1
2.5	Frequency converter		1
2.6	Mounting bracket to bottom of the mixer		1
3	Safety valve of digesters		1
4	Side agitator (Filtrate tank)	N=3,0 kW	1
5	Substrate feed pump	40 m3/hour N=11.0 kW	1
6	Substrate digested pump	40 m3/hour N=11.0 kW	1
7	Substrate circulation pump	30 m3/hour N=7,5 kW	1
8	Decanter	N=55 kW	1
9	Filtrate pump	40 m3/hour N=11,0 kW	1

Nº	Equipment	Characteristic	Quantity
10	PVC gas holder	590 m3	1
10.1	Weather protection film	Ø11,3 m	1
10.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant		1
10.3	Air blower	16A, 0,5kW	
10.4	Excess and minimum pressure valve		1
10.5	Dome level sensor		1
10.6	Mounting system		1
10.7	Accessories		1
10.8	Safety valve		1
11	Biogas Cooling System	1150m3/h	1
11.1	Chiller		1
11.2	Heat exchanger		1
11.3	Polypropylene glycol tank		1
12	Activated Carbon Filter		1
12.1	Numbers of charcoal columns	300 kg	1
13	Biogas compressor	Q=1320 m3/h, H=200 mbar, N=16 kW	2
14	Electromagnetic flow meter		1
15	Flare	1150 m3/h	1
16	Gas analyser	set	1
17	Gas equipment included	set	1
17.1	Drainage pump with float	DN=50, Q=1m3/h, H=13 m	2

Nº	Equipment	Characteristic	Quantity
18	The heat supply system	set	1
18.1	Diaphragm expansion tank	V=1000 l,P=6Bar T=120°C	1
18.2	Circulating pump for supplying heat carrier	Q=30 m3/h,H=1bar	1
18.3	Propylene glycol feed pump station heating systems	Q=1,0 m3/h, H=4 bar	1
18.4	Circulation pump for supplying heat carrier to the digester	Q=18 m3/h, H=1.1 bar	1
19	Water supply and sewerage system, complete, disassembled	set	1
20	Automation with electrical equipment	set	1
20.1	Incoming distribution cabinet with a set of automation DB-1		1
20.2	Incoming distribution cabinet with a set of automation DB-2		1
21	Sensors, set		1
21.1	Gas pressure sensor 0,025Bar		2
21.2	Gas pressure sensor 0,4Bar		2
21.3	Pressure sensor(substrate level) 1,0Bar		4
21.4	Pressure sensor (substrate pressure) 2,5bar		4
21.5	Resistive thermometer (gas temperature)		3
21.6	Resistive thermometer with thermo well (fermenter substrate temperature)		3
21.7	Resistive thermometer with thermo-well (digester tank substrate temperature)		3
21.8	Resistive thermometer (heat conductor temperature)		3
21.9	Conductometric sensor of maximum level		3
21.10	Conductometric sensor of water level		3
21.11	Dome position sensor		1
21.12	Coolant pressure sensor	SEN 3276 B065 G1/2 6Bar	2

Nº	Equipment	Characteristic	Quantity
22	Dry cooler 80 kW heat pow.		1
23	Laboratory	set	1
24	Steel enamel tank	244 m3	2
25	Steel enamel tank (Reactor)	7339 m3	1

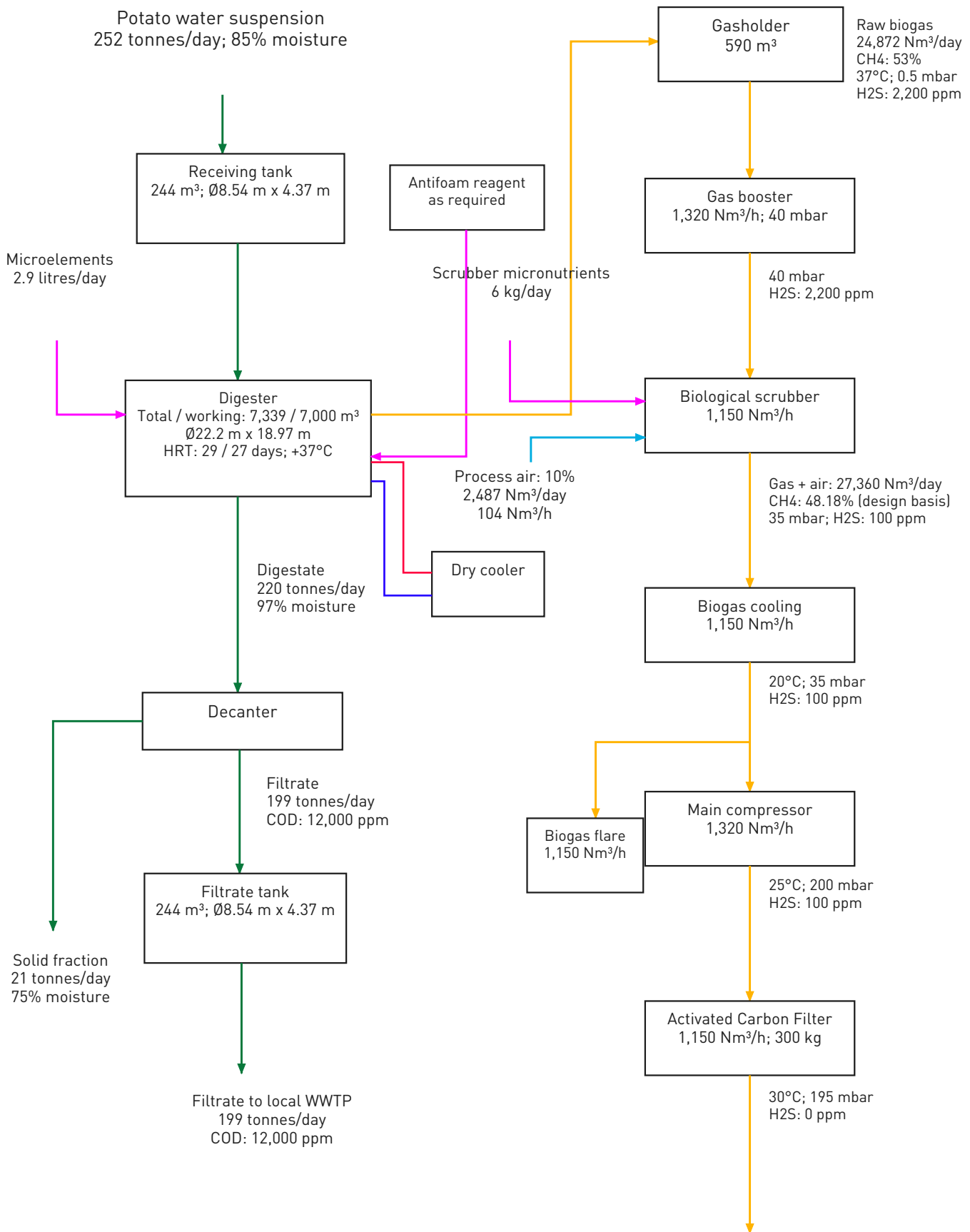
26	Biological scrubber with technical room	1150 Nm³/h	1
26.1	Upstream gas booster	1320 Nm³/h 40 mbar	1

APPENDICES

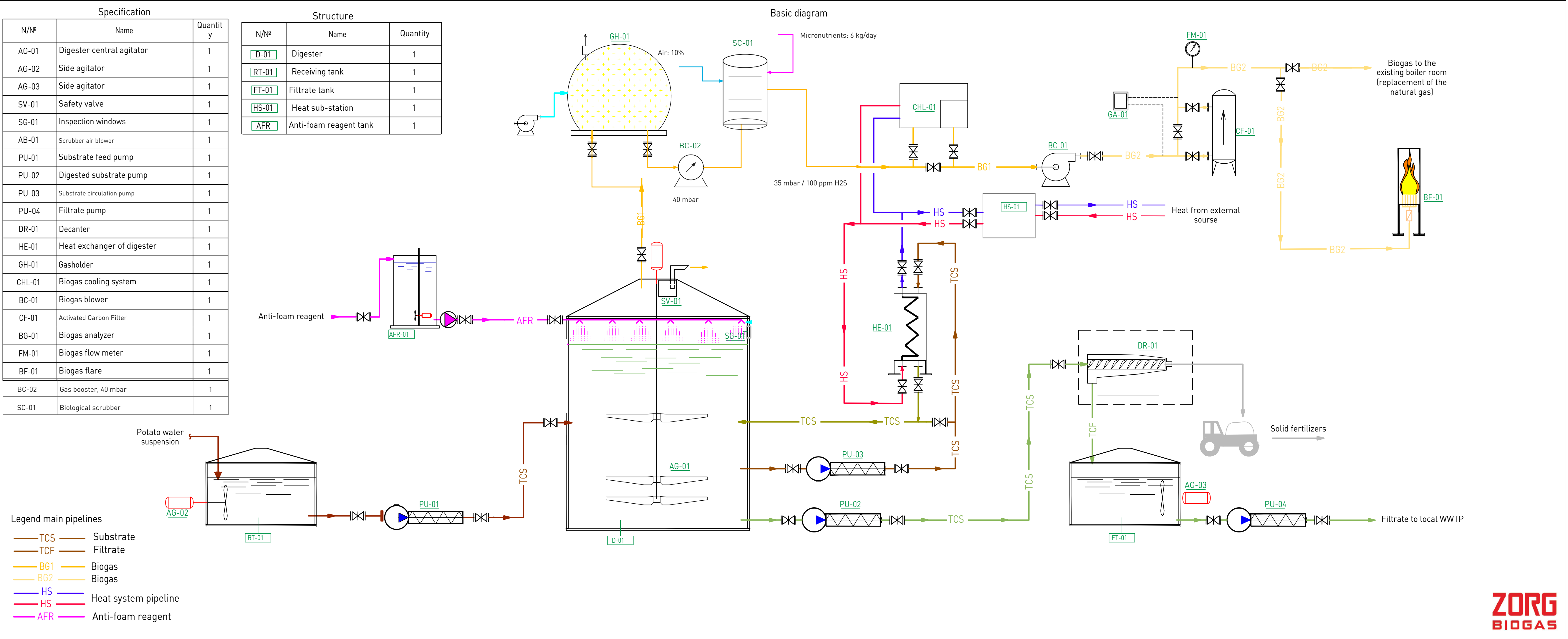


Material flow diagram

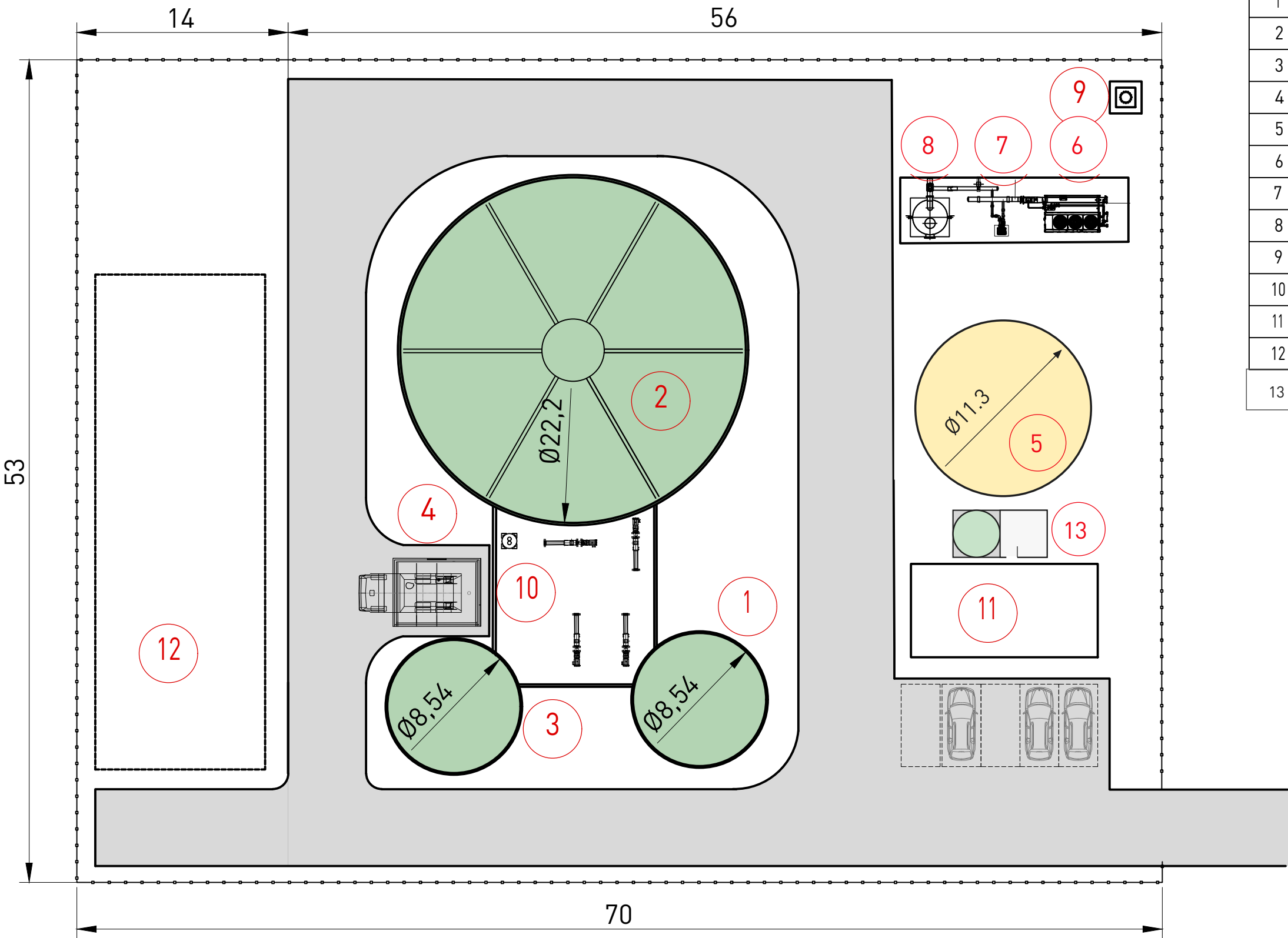
Appendix 1



Process heating: 95 kW
Average electric consumption: 139 kW
Operating basis: ambient +20°C, feedstock +20°C
Gas + air flow is the design basis before biological oxygen consumption;
methane production is unchanged.



Site layout



Explication

N/Nº	Name	Note
1	Receiving tank	RT-01
2	Digester	D-01
3	Filtrat tank	FT-01
4	Decanter platform	DR-01
5	Gasholder	GH-01
6	Biogas cooling system	CHL-01
7	Biogas compressor	BC-01
8	Activated Carbon Filter	CF-01
9	Biogas burner	BF-01
10	Equipment room	ER-01
11	Technical room	TR-01
12	Local wastewater treatment plant	WWTP
13	Scrubber + technical room	SC-01

Appendix 4

Biogas plant					
Name equipment	Instal. Pow. (kW)	Q-y (pcs)	Total installed power (kW)	Working hours per day	Consumption kWh per day
Reactor Vertical agitator	37,0	1	37,0	18,0	666,0
Side mixer in receiving tank	5,5	1	5,5	12,0	66,0
Side mixer in filtrate tank	3,0	1	3,0	12,0	36,0
Biogas cooling system	32,0	1	32,0	24,0	768,0
Biogas compressor	16,0	2	32,0	12,0	384,0
Substrate feed pump	11,0	1	11,0	6,0	66,0
Decanter	55,0	1	55,0	8,0	440,0
Substrate pump to separator	11,0	1	11,0	8,0	88,0
Filtrate pump	11,0	1	11,0	5,0	55,0
Substrate circulation pump to heat exchanger	7,5	1	7,5	12,0	90,0
Air blower for double membrane	1,0	1	1,0	24,0	24,0
Digester cooling system	4,0	1	4,0	24,0	96,0
Circulation pump for supplying heat carrier to the reactor	0,8	1	0,8	24,0	18,0
Circulation pump for supplying heat carrier to the reactor` s cooling system	2,0	1	2,0	24,0	48,0
Circulating pump feeding hot water at technical building	0,1	1	0,1	24,0	1,9
Propylene glycol pump station	0,8	1	0,8	0,5	0,4
Drinage pump	1,0	2	2,0	0,5	1,0
Lighting of the biogas plant territory	1,0	1	1,0	8,0	8,0
Spot light for digesters inspection windows	0,1	1	0,1	0,5	0,0
Working lighting of switchboard	0,1	1	0,1	0,5	0,1
Biological scrubber with gas booster	20,0	1	20,0	24,0	480,0
Total installed power, kW			237		
Total consumed electric energy, kWh per day					3336
Total consumed power, kW					139

Prices for a biogas plant 252 potato pulp /day

Pos	Name	Unit price, EUR	Price sub-total, EUR	
1	Detailed design	48.300	48.300	
2	Supervision	40.000	40.000	
3	Startup and training	40.000	40.000	
4	Living and travel expences	20.000	20.000	
5	Laboratory	18.900	18.900	
6	Central agitator 37kW	105.300	105.300	
7	Side agitator 5,5kW	15.400	15.400	
8	Side agitator 3,0kW	7.000	7.000	
9	Substrate feed pump 11kW	18.900	18.900	
10	Digested substrate pump 11kW	18.900	18.900	
11	Circulation substrate pump 7,5kW	16.100	16.100	
12	Filtrate pump 11kW	18.900	18.900	
13	Substrate gate valve	4.900	49.000	
14	Substrate valve with el.actuator	5.600	22.400	
15	Gasholder 590 m3	39.000	39.000	
16	Biogas chiller	73.500	73.500	
17	Biogas blower	15.400	30.800	
18	Activated Carbon Filter, 300 kg	24.500	15.400	
19	Biogas flare	88.900	88.900	
20	Gas analyzer	18.900	18.900	
21	Gas conditioning unit	31.500	31.500	
22	Over- and under pressure safeguard	8.400	8.400	
23	Water supply and canalization system	25.200	25.200	
24	Heat supply station	31.500	31.500	
25	Dry-cooler (Substrate cooling system for fermenter)	25.900	25.900	
26	Automation and electric cabinet	138.000	138.000	
27	Sensors (set)	25.000	75.000	
28	Biological scrubber	150.000	150.000	
29	Reactor tank 7339 m3	756.800	756.800	
30	Receiving tank 244 m3	62.400	124.800	
31	Flotator	142.400	142.400	
32	Heat exchanger substrate	15.400	15.400	
33	Construction and installation	0	500.000	Client
			2.230.500	
			2.230.500	

Implementation terms and payment

Months	1	2	3	4	5	6	7	8	9	10	10	11	12
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 for the 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 50 kW for start-up, for construction period and 139 kW for normal operation.
- 4) External roads.
- 5) Temporary water supply during the construction and the hydraulic test of reactors at least 300 m³ water per day. It can be a technical quality water from a river, lake, well. Not salty.
- 6) Bacterial seed for the start-up. It can be biomass from another biogas plant. Possibly 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 2000 m³. The rest is filled with the water mentioned above.
- 7) Machinery to transport solid fertilizer from the biogas plant to the agricultural fields (a truck, a frontal loader, a tractor)
- 8) Activated carbon: 0.3 tonne/year x 1,800 EUR/tonne = 540 EUR/year
- 9) Scrubber micronutrients: 6 kg/day (2.19 tonnes/year).
- 10) Anti-foam reagent 1 tonnes annually (all kinds of vegetable oil, for example, palm oil or rapeseed oil)
- 11) Demineralized water to the heating system 2,0 tonnes,
- 12) Spare parts for two years: 80,000 EUR.



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

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

zorg@zorg-biogas.com
www.zorg-biogas.com