ZORG BIOGAS

01

version

Proposal

Biomethane plant
using 19 000 tonnes straw pellets/year

Date:11/07/2025

Validity: 3months

CONTENTS

OVERVIEW

We offer a solution to process straw pellets to biogas in a high-load reactor (HLR). The proposed HLR technology is superior to the conventional CSTR. HLR is the only techology that is able to work with 100% straw. Other technologies like CSTR can use max 10-15% straw. For 19 tonnes pellets per year a single HLR reactor 4000 m3 is enough.

Zorg' responsibility is limited to design, equipment supply, supervision, startup and train-ing. Client makes civil construction, installation himself.

Raw material potential

Substrate	Quantity (tonnes/day)	Quantity (tonnes/year)	**DM *content:** (%)	**ODM** content** (%)	DM quantity (tonne s/ day)	ODM quantity (tonnes / day	**Biogas yield** (m^3 /	Biogas (m^3 /day)	**Methane content** (%)	Biome-thane (m^3 / day)	Biome-thane (m^3 / year)
Pellets	52	19 000	90	92	46,9	43,1	620	26 723	53	14 235	5 195 800

***-DM-** Dry matter

****-oDM-** organic dry matter

Biogas plant technical performances

Characteristics	Values	Figures
Number of digesters	units	1
Digester		
a) volume:		
Work	m^3	3837
Overall	m^3	3989
b) Organic load	kgODM/ m^3	11.23
c) Hydraulic retention time (gross)	days	35
d) Overall dimensions of the digester (diameter / height)	m	22/10.5
e) Temperature	^0C	+52
Gasholder		
a) Volume	m^3	500
b) Number of gasholders	units	1
c) Dimensions of the gasholder (diameter / height)	m	10.8 /8.4

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 C1 compounds (elementary organic acids). Produced substances are the feedstock for methanogenic bacteria of the third type. This stage flows in two processes of A and B type the character which depends on caused by different bacteria type. These two types of bacteria convert the compound obtained during the first and second stages into methane CH_4, water H_2O and carbon dioxide CO_2. Methanogenic bacteria are more sensitive to the living environment compared to acidogenic bacteria. They require a complete anaerobic environment and a longer reproduction period. The speed and scale of anaerobic fermentation depends on bacteria metabolic activity. That is why the biogas plant chemical process includes hydrolysis stage, oxidation, and methanization stage. For that kind of substrate, these processes take place in the same reactor

Technological process of biogas production

Then straw pellets are directed into loaders. Straw is transported to a biogas plant area and discharged into a loader. The loader input substrates by portion to a reactor using augers. 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 (for example, in summer), the biogas station is equipped with a cooler (dry cooling). The reactor`s operating regime is thermophilic. The heated substrate in the reactor is blended periodically. Mixing is performed by vertical mixers. The average time of processing in the reactors is 35 days. After the reactor, the substrate is supplied by pump to a separator area where it is separated into solid and liquid bio-fertilizer. Solid bio-fertilizer is discharged to the separation area and transported for storage; liquid filtrate is directed to a technological process.

Biogas goes up under overlap and delivered into a gas holder. The gas holder's weather protective film protects the gasholder from precipitation and damage by foreign objects. The weather protective film is fixed firmly by a special system. To protect the gasholder from overpressure, digester is equipped with safety valve, which start working at a pressure of 5 mbars and bleeds biogas to the atmosphere. Then accumulated in gasholders biogs 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 filters to remove hydrogen sulfide (H2S). After filters, biogas goes to biogas upgrading plant where raw biogas treats through the

removal of CO2 and other soluble gases

to produce primarily methane gas (~99%) which is clean and dry.

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

Loader (SF-01)

Solid feeder machines have been proven in various situations. Solid feeder has the solid design, which guarantees a maximum functionality and less maintenance, combined to a low energy consumption. Because of the vertically oriented walls, there is no change for the material to get stuck or build bridges. The conveyor chains and the milling-unit allow continuous dosing by various types of materials. Furthermore, the material is loosened by this dosing process. The user is able to control the material flow up to 10-15m³/h or more, regarding to the own consumption of electrical power by the machine. In addition, the corrosion protection, wear resistance and high quality allow customers to use our product for a long period of time

Specifications

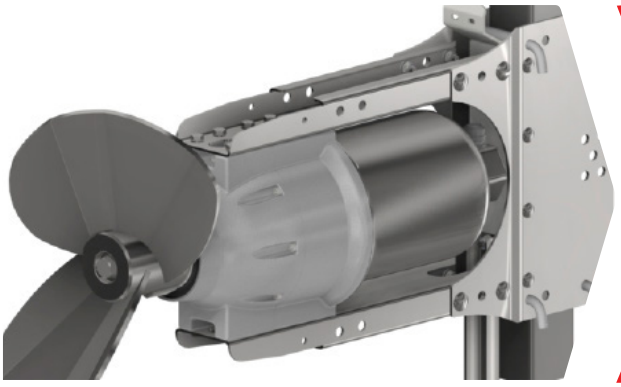
Length:	5.0 m
Width:	2,3 m
Height	2,0 m
Volume:	20.0 m³
Quantity:	1 pcs.

Receiving tank (RT-01) and filtrate tank (FT-01)

Reinforced concrete reservoir. Pre tank is for reception of liquid kinds of raw materials. Tank is equipped with level sensors and submersible agitator for mixing raw materials.

Specifications

Receiving tank (RT-01)	
Diameter:	6,0 m
Height	2,5 m
Total volume:	71 m^3
Filtrate tank (FT-01)	
Diameter:	6,0 m
Height	2,5 m
Total volume:	71 m^3



Submirsible mixer

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid substrate as manure, poltry dung 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

Receiving tank (RT-01)	
Nominal power	N= 3.0 kW
Quantity:	1 pcs
Filtrate tank (FT-01)	
Nominal power	N= 3.0 kW
Quantity:	1 pcs

Height:
adapted to the height of digester
Material: stainless steel 8 mm

Reactor (R-01)

Reactor is a tank of cylindrical form (for better mixing during the fermentation). It is built of cast-in-situ reinforced concrete based on sulphate-resistant cement with thickness of walls and bottom - 0,25m. In the center of the digester there is a column with chapiter. Overlap of reactor is reinforce concrete plate. On the tank's wall and in the bottom there is to be installed pipelines for heating, intended for assurance and maintenance of the optimal fermentation process temperature at thermophilic conditions. For heat conservation and reduction of heat energy consumption, the reactor walls, overlap and bottom are insulated outside with 100 mm slabs of extruded polystyrene foam. Over the heater, the substructure walls and bottom are insulated with roll damp proofing. Superstructure and substructure heat insulation is protected by shaped sheet from the outside mechanical damages and rodents.
The reactor bottom has a slope 1%.

Specifications

Height:	10.5 m
Diameter:	22.0 m
Overall volume:	3989 m^3
Quantity:	1 pcs

Reactor`s vertical mixer (AG-01 ... AG-05)

Mixers are designed and engineered to guarantee high energy efficiency. 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.
Agitators are designed for mixing substrates with a high solids content of 13-18%. The blades of the mixers are set at an optimum angle, and the external motor of the mixer is mounted on a special support.

Nominal power	N= 15,0 kW
Quantity:	5 pcs

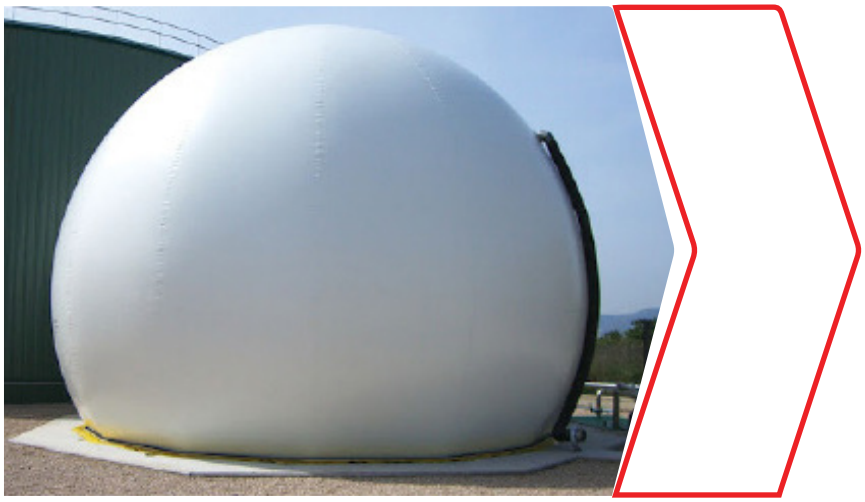
Height:
adapted to the height of digester
Material: stainless steel 8 mm

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

Specifications

Inspection windows Ø300
Spotlight VISULUX UL50 -G -H
230V, 50W, IP65

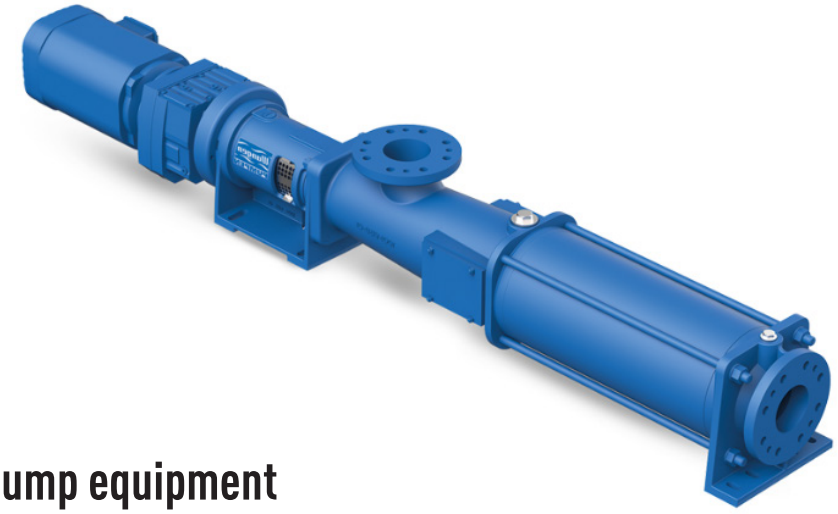


Gasholder

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 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 :	8.4 m
Diameter :	10.8 m
The total volume :	500 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, 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 pump	
Flow rate:	40 m3/hour
Engine power:	11.0 kW
Pressure:	4 bar
Quantity:	1 pcs
Substrate pump to separator	
Flow rate:	10-25 m3/hour
Engine power:	11.0 kW
Pressure:	4 bar
Quantity:	1 pcs
Filtrate pump	
Flow rate:	40 m3/hour
Engine power:	11.0 kW
Pressure:	4 bar
Quantity:	1 pcs

Separator (SR-01)

Separator separates water from solids. It operates continuously and automatically according to the press screw separator principle and separates thin and viscous compounds. Solid matter / liquid compound is pumped from the inlet chamber by the press screw into the horizontal screen. Some of the water flows due to the force of gravity through the screen. Press screw conveys the rest of the water with solid particles (also smallest particles) into the press zone in the last section of the screen. Here a permanent regenerative, compact solid matter is generated and is then pressed out through the outlet of the machine, which can be easily filled into containers. Separated fluid slows through outlet underneath the machine. On the grounds of narrow tolerance the inside of the screen is permanently kept clean.

Specifications

Engine power	**7.5 kW**
Flow rate	**10-25 m3 / h**
Quantity	**1 pcs**

Equipment
Frame
Screw
Sieve for the filtration
Counterweights
The design of the protective room

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	1200 m3/ h
Gas inlet temperature	+50 C
Gas outlet temperature	+20 C
Engine power	46 kW
Quantity	1 pcs

Biogas compressor (BC-01, BC-02)

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

Blower is used to transporting biogas from gasholder storage to consumer

Specifications

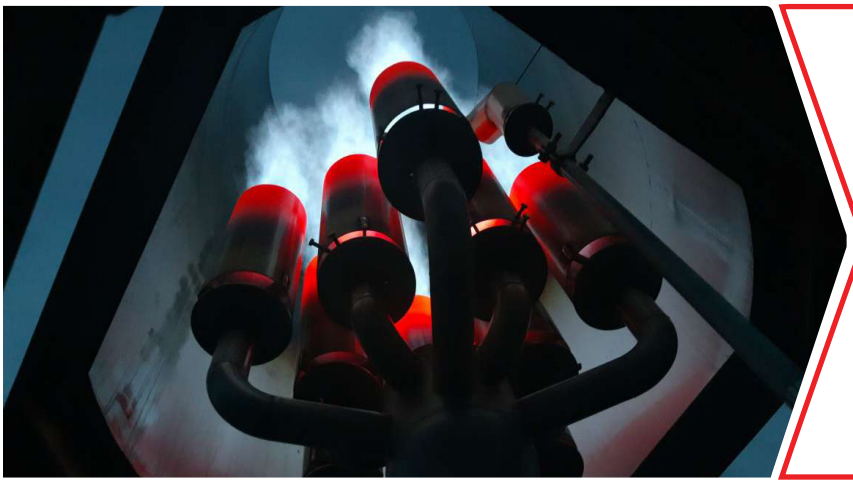
Flow rate	1200 m^3/h
Pressure	150 mbar
Engine	10 kW
Quantity	2 pcs

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	200 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	1200 m³/h
Quantity:	1 pcs

Gas analyzer (CH4, CO2, H2S, O2)

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.

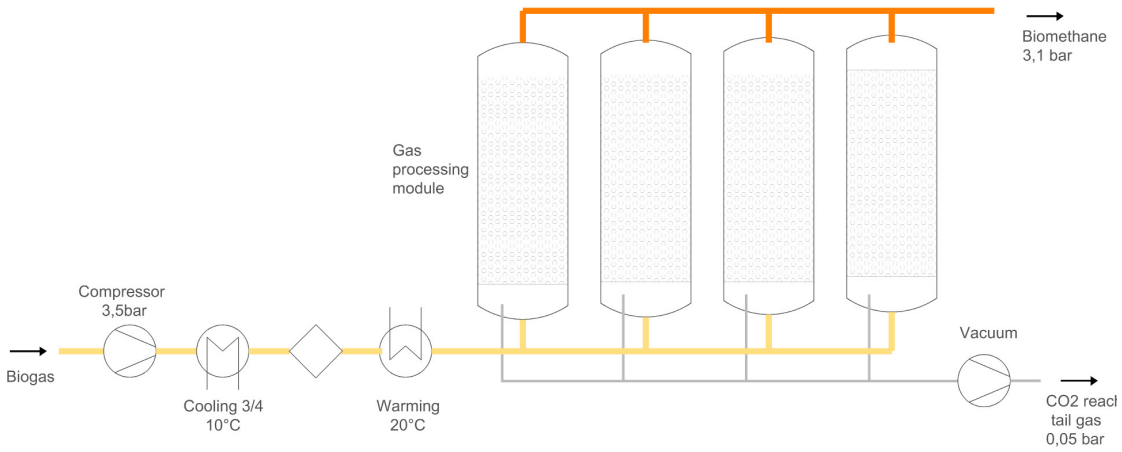
Specifications

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

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

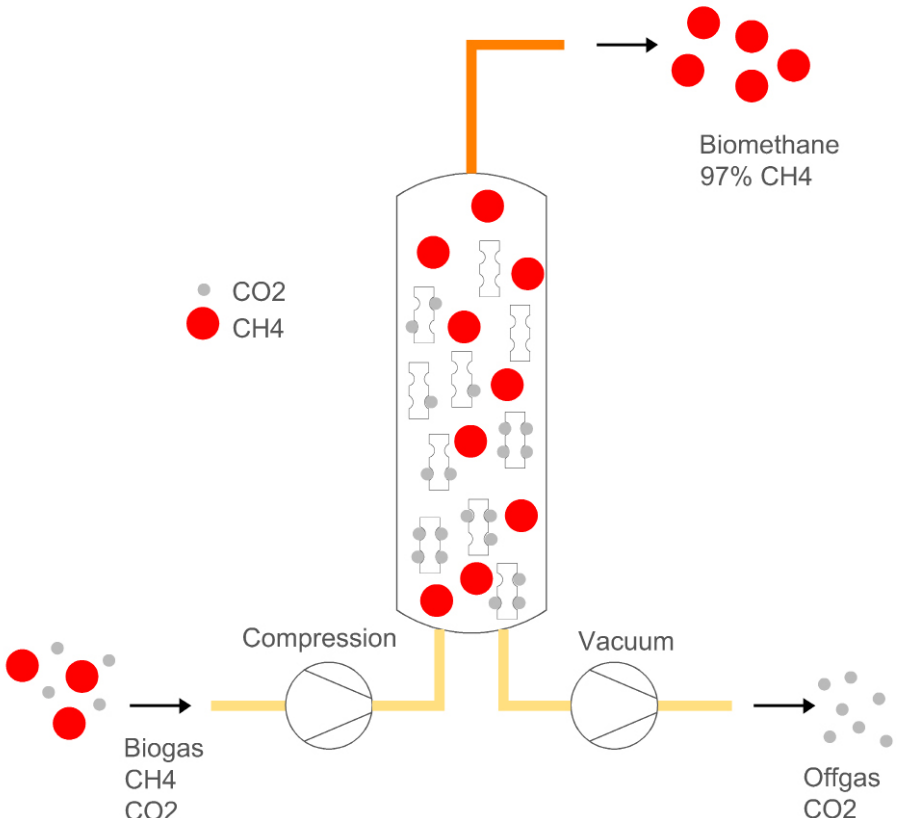
Biogas upgrading plant

The biogas upgrading plant is used to purify biogas, landfill gas or sewage gas. The CO2 content is separated from the main gas stream with this plant and thus a product gas of natural gas quality is generated, which can be fed into the natural gas grid via a downstream feed-in plant. The gas mixture is separated by means of pressure swing adsorption (PSA), a physical process for separating gas mixtures under pressure by means of adsorption. The separation effect occurs because one of the components to be separated (CO2) adsorbs more strongly than the other (CH4). This results in an enrichment of the less adsorbent component (CH4) in the gas phase. The desulphurised and dried biogas is fed into the adsorbers under pressure. The gas flows through the adsorbers from bottom to top, whereby the CO2 is adsorbed. At the outlet of the adsorber, biomethane that meets the specifications is extracted. At the end of the adsorption time, the adsorber is saturated with CO2. By lowering the pressure into a vacuum, the adsorber is regenerated and is then ready for adsorption again. The advantage of this technology is the absence of the use of additional chemical reagents and less consumption of electrical energy (compared to installations of other manufacturers).



Biogas upgrading plant nominal conditions

	Biogas	Biomethane	CO_2 reach tail gas
Flow (Nm³/h)	1114	593	521
CH_4 (Vol %)	53.0	99.0	2,97
CO_2 (Vol %)	40,03	0,60	94,63
H_2O (Vol %)	6.59	Dew-point < -65°C	2,01
N_2 (Vol %)	0,19	0,29	0,07
O_2 (Vol %)	0.19	0,10	0,33
H_2S (ppm)	<3	-	-
Temperature (°C)	20	25	40
Pressure (bar)	0,09	3,0	0,05
Wobbe Index (kWh/Nm³)	5.51	14,6	0,27



Specifications

Flow rate	1114 m³/h
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

Air supply system

Air supply system ensures retention of the protective dome digester. This is achieved by installing a pneumatic lock and maintain the required pressure therein.

Specifications

Flow rate	200l/min
Max. Pressure	8Bar
Speed	2850 rev/min
Receiver capacity	9,5l

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 water network
Flow 19 m3 / h;
Pressure 0,65 bar

Circulating pump feeding network water to electric boiler
Flow rate 4.6 m3 / h;
Pressure 0.8 bar

Circulating pump feeding network water heating
Flow 4.6 m3 / h;
Pressure 1 bar,

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

Circulating pump feeding water network in the digester
Flow 4.6 m3 / h;
Pressure 1.1 bar

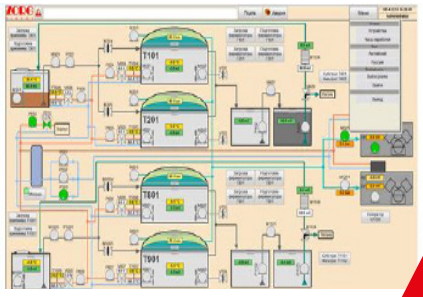
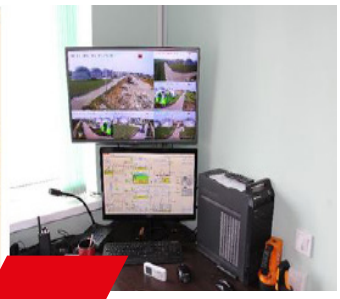
Three-way valves, control actuators, diaphragm expansion vessel

Dry cooler (cooling substrate system) (DC-01)

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

Power (cooling)	100 kW
Length:	3,0 m
Width:	2,5 m
Height:	1,5 m
Power electrical	4 kW
Quantity:	1 pcs

Automation and electrical equipment

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

The control cabinet is designed based on the industrial controller Siemens CPU315-DP2, using periphery distributing system Simatic ET200S, and operator panel OP277 Touch with touch-sensitive controls. Communications is executed by PROFIBUS and MPI with physical interface RS-485. The control program is designed based on the Simatic Step7. The control cabinet is a modular design. The upper part has a power box with central and front-end processor. The periphery distributing system, Simatic 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

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

SPECIFICATION LIST

№	Equipment	Characteristic	Q-ty
1	**Loader**	**N=20 m3**	**1**
1.1	Container bunker		1
1.2	Feeding screws	set.	1
1.3	Chopper	set.	1
2	**Vertical mixer (digester)**	**N=15 kW**	**5**
2.1	Airtight motor gearbox		5
2.2	Hydraulic screw (wear-resistant steel)		5
2.3	Mixer control mechanism (high-quality structural galvanized steel)		5
2.4	Electric motor mount (high-quality structural galvanized steel)		5
2.5	Set of fasteners (coating - hot dip galvanized)		5
3	**Safety valve of digester**		**1**
4	**Window with a searchlight, complete, disassembled**	**set**	**1**
4.1	Inspection window RD300 (mounts and sealant included)	Ø300	2
4.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	1
5	**PVC external gas holder**	**Ø10.8 m**	**1**
5.1	Weather protection film	Ø10.8 m	1
5.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant		1
5.3	Air blower	16A, 0,5kW	1
5.4	Excess and minimum pressure valve		1

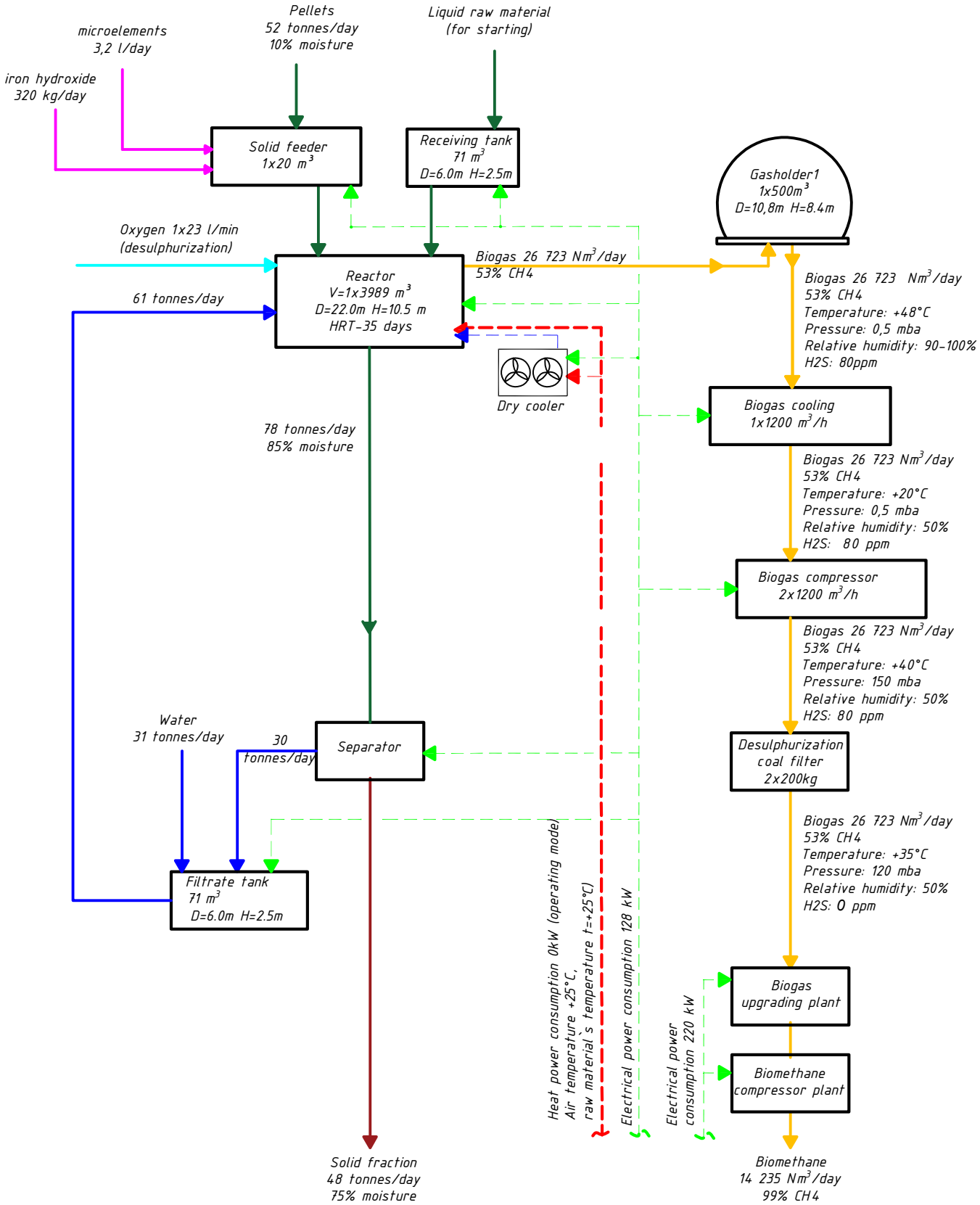
№	Equipment	Characteristic	Q-ty
5.5	Dome level sensor		1
5.6	Mounting system		1
5.7	Accessories		1
6	**Substrate pump**	**40 m3/hour N=11 kW**	**1**
8	**Substrate pump to Separator**	**25 m3/hour N=11 kW**	**1**
9	**Separator for separating the substrate, complete, disassembled (existing)**	**N=7,5 kW, Q=10-25 m3/h**	**1**
9.1	Body		1
9.2	Substrate Supply Pipe 4 ”		1
9.3	Engine - Gearbox	N=7,5 kW	1
9.4	Frame		1
9.5	Screw		1
9.6	Sieve for filtration		1
10	**Filtrate pump**	**40 m3/hour N=11 kW**	**1**
11	**Biogas compressor**	**Q=31200m^3/h H=150mBar N=10 kW**	**1**
12	**Biogas Cooling System**	**1200 m^3/h**	**1**
12.1	Chiller		1
12.2	Heat exchanger		1
12.3	Polypropylene glycol tank		1

№	Equipment	Characteristic	Q-ty
13	**Submersible mixer (Pre-tank)**	**N=3.0 kW**	**1**
13.1	Airtight motor gearbox		1
13.2	Hydraulic screw (wear-resistant steel)		1
13.3	Mixer control mechanism (high-quality structural galvanized steel)		1
13.4	Electric motor mount (high-quality structural galvanized steel)		1
13.5	Set of fasteners (coating - hot dip galvanized)		1
14	**Submersible mixer (Filtrat tank (existing))**	**N=2.0 kW**	**1**
14.1	Airtight motor gearbox		1
14.2	Hydraulic screw (wear-resistant steel)		1
14.3	Mixer control mechanism (high-quality structural galvanized steel)		1
14.4	Electric motor mount (high-quality structural galvanized steel)		1
14.5	Set of fasteners (coating - hot dip galvanized)		1
15	**The heat supply system, complete, disassembled**	**set**	**1**
16	**Dry cooler 100kW heat pow.**		**1**
17	**Water supply and sewerage system, complete, disassembled**		**1**
18	**Automation with electrical equipment complete, disassembled**		**1**
18.1	Incoming distribution cabinet with a set of automation DB-1		1
18.2	Incoming distribution cabinet with a set of automation DB-2		1

№	Equipment	Characteristic	Q-ty
19	**Sensor set**		**1**
19.1	Conductivity sensor		2
19.2	Pressure / level sensor		2
19.3	Ultrasonic sensor	SPA-380-08 (0-6m)	1
19.4	Gas pressure sensor	SEN 3276 B156 G1/2 0,4Bar	1
19.5	Thermal converter	TR10-B-M-DZ ZKTA-2-QRZZM-150-DCK-CE-R-00735-ZZ	1
19.6	Thermowells for thermocouples	TR10-B	1
19.7	Thermal converter heating circuit	TR30-P-Z-Z-A-ZZZ-13R-DBB-ZZZZ-B000025-ZZ	1
19.8	Substrate pressure sensor	SEN-3251 B055 G1 4Bar	2
19.9	Substrate pressure sensor	SEN-3251 B045 G1 2,5Bar	2
19.10	Coolant pressure sensor	SEN 3276 B065 G1/2 6Bar	1
20	**Desulphurization column 200kg**		**2**
21	**Flare**	**1200 m3/hour**	**1**
22	**Laboratory**	**set**	**1**

ANNEXES

Material flow diagram



ZORG BIOGAS

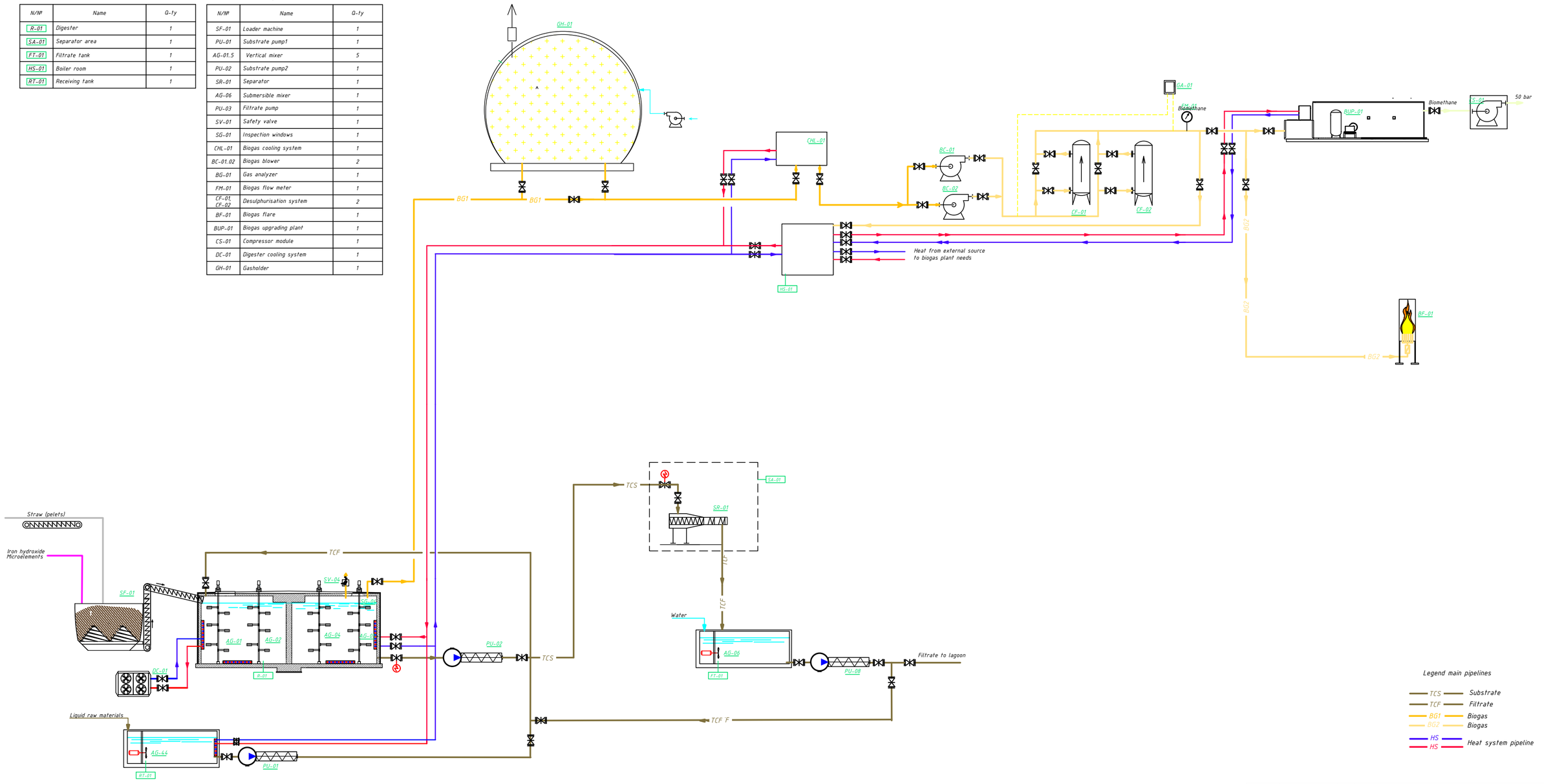
Structure

N/№	Name	Q-ty
R-01	Digester	1
SA-01	Separator area	1
FT-01	Filtrate tank	1
HS-01	Boiler room	1
RT-01	Receiving tank	1

Specification

N/№	Name	Q-ty
SF-01	Loader machine	1
PU-01	Substrate pump1	1
AG-01.5	Vertical mixer	5
PU-02	Substrate pump2	1
SR-01	Separator	1
AG-06	Submersible mixer	1
PU-03	Filtrate pump	1
SV-01	Safety valve	1
SG-01	Inspection windows	1
CHL-01	Biogas cooling system	1
BC-01.02	Biogas blower	2
BG-01	Gas analyzer	1
FM-01	Biogas flow meter	1
CF-01, CF-02	Desulphurisation system	2
BF-01	Biogas flare	1
BUP-01	Biogas upgrading plant	1
CS-01	Compressor module	1
DC-01	Digester cooling system	1
GH-01	Gasholder	1

Basic diagram

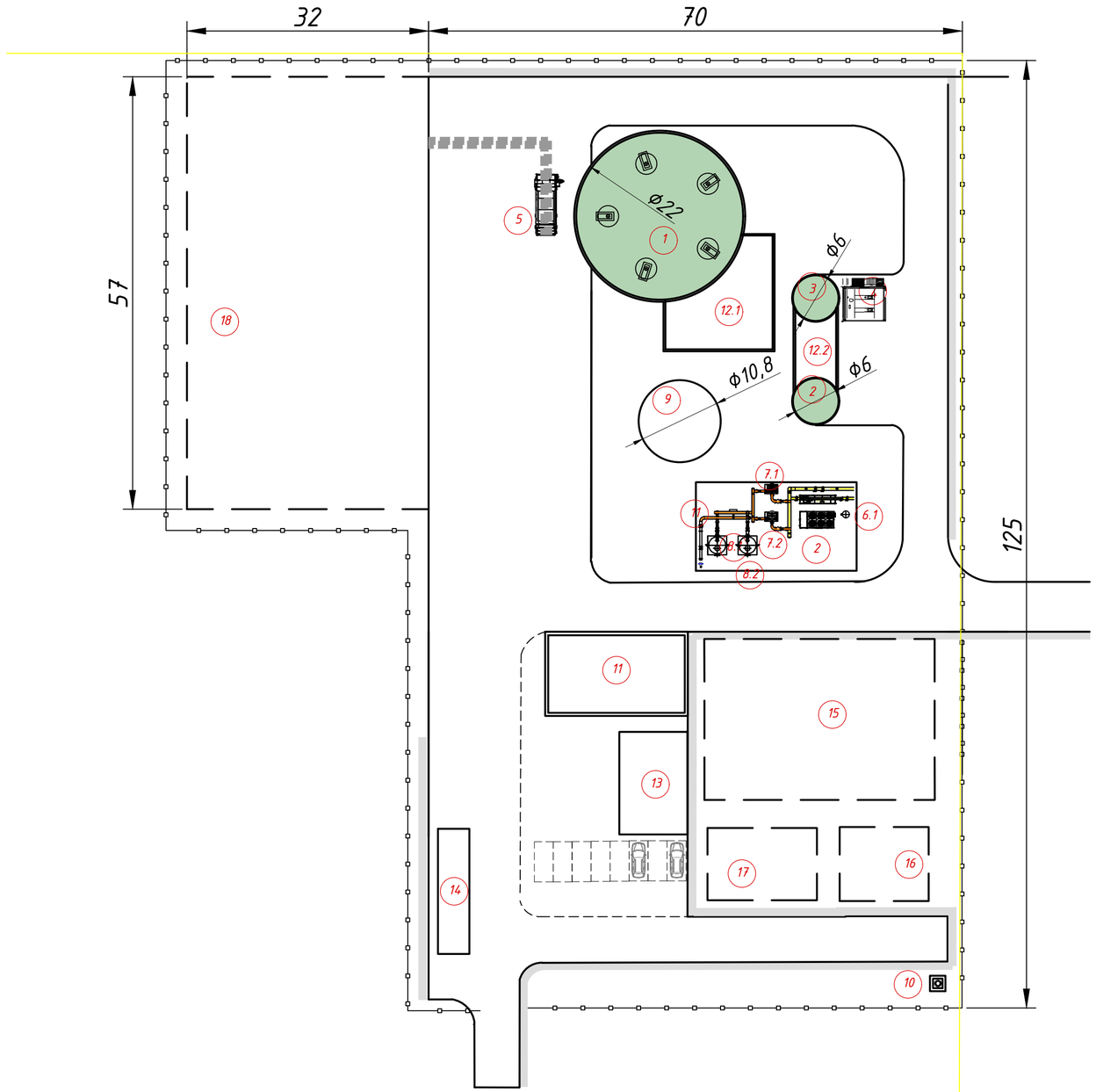


Legend main pipelines

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

Basic diagram	Zorg Biogas

Preliminary layout proposal



Explication

N/№	Name	Note
1	Reactor(HLR)	R-01
2	Receiving tank	RT-01
3	Filtrate tank	FT-01
4	Separation area	SR-01
5	Solid feeder	SF-01
6.1	Biogas cooling system	CHL-01
7.1 , 7.2	Biogas compressor	BC-01, BC-02
8.1, 8.2	Carbon filter (desulphurization)	CF-01, CF-02
9	Gasholder	GH-01
10	Biogas flare	BF-01
11	Technical room (operator room)	
12.1 , 12.2	Equipment room	
13	Warehouse	
14	Truck scale	
15	Biogas upgrading plant	BUP-01
16	Biomethane compressor plant	BCP-01
17	Gas station	GS-01
18	Straw pellets` storage	

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Annex 4

Biogas plant					
Name equipment	**Instal. Pow. (kW)**	**Q-y (pcs)**	**Total installed power (kW)**	**Working hours per day**	**Consumption kWh per day**
Loader V=20 m^3	12,0	1	12,0	7,0	84,0
Screw set.	12,0	1	12,0	7,0	84,0
Reactor Vertical agitator	15,0	5	75,0	18,0	1350,0
Submersible mixer in receiving tank	3,0	1	3,0	0,5	1,5
Submersible mixer in filtrate tank	3,0	1	3,0	12,0	36,0
Biogas cooling system	46,0	1	46,0	24,0	1104,0
Biogas compressor	10,0	2	20,0	12,0	240,0
Separator	7,5	1	7,5	5,2	39,0
Substrate pump to separator	11,0	1	11,0	5,2	57,2
Liquid substrate pump	11,0	1	11,0	0,3	3,3
Filtrate pump	11,0	1	11,0	1,1	12,1
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
Circulation pump for supplying heat carrier to the digester	0,8	1	0,8	24,0	18,0
Circulation pump for supplying heat to the technical building	0,8	1	0,8	only ambiant temp +15°C	
Digester cooling system	4,0	1	4,0	at t>55°C	
Circulation pump for supplying network water to the digester cooling system	2,2	1	2,2		
Circulating pump feeding hot water at technical building	0,1	1	0,1	24,0	1,9
Propylene glycol pump station	0,8	1	0,8	0,5	0,4
Drinage pump	1,0	1	1,0	0,5	0,5
Lighting of the biogas plant territory	1,2	1	1,2	8,0	9,6
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			**225**		
Total consumed electric energy, kWh per day					**3067**
Total consumed power, kW					**128**

Biogas upgrading plant (uprox. self consumption)					
Name equipment	**Instal. Pow. (kW)**	**Q-y (pcs)**	**Total installed power (kW)**	**Working hours per day**	**Consumption kWh per day**
Biogas upgrading plant (1114Nm3/h)	173,0	1	173,0	24,0	4152,0
Compressor module (593 Nm3/h) 50bar	47,0	1	47,0	24,0	1128,0
Total installed power, kW			**173,0**		
Total consumed electric energy, kWh per day					**5280**
Average consumed electric power, kW					**220**

Total average consumed electric power, kW					**348**

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Prices for equipment and services for biogas plant (14235 m3/day biomethane)

Pos	Name	Number of units	Unit price, EUR	Discounts*	Discounted unit price, EUR	Discounted price sub-total, EUR	
1	Project documention	1	75 000	0%	75 000	75 000	
2	Supervision	1	50 000	0%	50 000	50 000	
3	Startup and training	1	50 000	0%	50 000	50 000	
4	Living and travel expences	1	50 000	0%	50 000	50 000	
5	Delivery of the equipment (container)	10	8 000	0%	8 000	80 000	
6	Laboratory	1	28 000	0%	28 000	28 000	
7	Solid feeder (dosing buffer machine) 20 m3	1	87 000	0%	87 000	87 000	
8	Screw conveyor	1	92 000	0%	92 000	92 000	
9	Digester vertical agitator 15 kW	5	84 000	0%	84 000	420 000	
10	Frame for Digester vertical agitator pos 3	5	6 000	0%	6 000	30 000	
11	Substrate pump 11 kW	1	29 000	0%	29 000	29 000	
12	Digested substrate pump 11 kW	1	29 000	0%	29 000	29 000	
13	Filtrate supply pump 11 kW	1	29 000	0%	29 000	29 000	
14	Substrate separation unit 7.5 kW	1	58 000	0%	58 000	58 000	
15	Submersible agitator for receiving tank 3 kW	1	12 000	0%	12 000	12 000	
16	Submersible agitator for filtrate tank 3 kW	1	12 000	0%	12 000	12 000	
17	Over- and under pressure safeguard	1	7 000	0%	7 000	7 000	
18	Sight glasses/viewing windows with projector	1	6 000	0%	6 000	6 000	
19	Water supply and canalization system	1	35 000	0%	35 000	35 000	
20	Heat supply station	1	35 000	0%	35 000	35 000	
21	Dry-cooler cooling system for reactors	1	35 000	0%	35 000	35 000	
22	Automation and electric cabinet	1	178 000	0%	178 000	178 000	
23	Motorized valves (set)	6	9 000	0%	9 000	54 000	
24	Sensors (set)	3	25 000	0%	25 000	75 000	
25	Gasholder	1	85 000	0%	85 000	85 000	
26	Biogas chiller (Biogas cooling system) 1200 m3/h	1	115 000	0%	115 000	115 000	
27	Biogas blower 1200m3/h	2	23 000	0%	23 000	46 000	
28	Desulphurization column with active coal 500 kg	2	38 000	0%	38 000	76 000	
29	Biogas burner	1	117 000	0%	117 000	117 000	
30	Gas analyzer	1	27 000	0%	27 000	27 000	
31	Gas conditioning unit	1	45 000	0%	45 000	45 000	
32	Biogas upgrading plant 1150 m3/hour	1	1 150 000	0%	1 150 000	1 150 000	
33	Compressor 50 bar	1	250 000	0%	250 000	250 000	
34	Construction	1	1 000 000	0%	1 000 000	1 000 000	Client
35	Weight control (truck scale)	1	50 000	0%	50 000	50 000	Client
		TOTAL by ZORG, EUR				3 467 000	
		TOTAL by Client, EUR				1 050 000	
		TOTAL by ZORG+Client, EUR				**4 517 000,00**	

Implementation terms and payment

Months	1	2	3	4	5	6	7	8	9	10	11	12	13
Project documentation	50%	50%											
Approvals and permits													
Equipment supply			30%	20%	20%	20%		10%					
Construction													
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**

List of exclusions for 5,2 m^3/year biomethane plant:

1) Import taxes and local duties in Chile. The importer needs to apply the Ministry of Economy of Chile. To get waiving of the import duties. Biogas plant is a plant for renewables.
2) Project report, civil permits and authorizations, adaptation of the project documentation by a licensed local engineering organisation for the permit purposes. Namely the organisation puts their stamp and acts act the face of the project. The design documentation is not changed in fact. 10 000 – 15 000 EUR
3) Topographic and geological surveys 3000-7000 EUR
4) Electric transformer and the external electric line 370 kW for start-up
5) External roads
6) Temporary water supply during the construction and the hydraulic test of reactors at least 400 m3 water per day. It can be a technical quality water from a river, lake, well. Not salty.
7) Bacterial seed for the start-up. It can be biomass from another biogas plant. Possibley 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 600-900 m3. The rest is filled with the water item 6 above.
8) Machinery to transport straw pellets to and from pellets` storage to the solid feeders (a truck, a frontal loader, a tractor)
9) Machinery to transport filtrate and the digested mass from the biogas plant to the agricultural fields (a truck, a frontal loader, a tractor)
10) Activated carbon 1,3 tonne per year x 4800 EUR/tonne = 6240 EUR
11) Iron hydroxide– 117 tonnes per year x 80 EUR/tonne = 9 360 EUR
12) Anti-foam reagent 7 tonnes annually (all kinds of vegetable oil, for example, palm oil or rapeseed oil)
13) Microelements 1 168 l per year total x 25 EUR/l= 29 200 EUR
14) Demineralized water to the heating system 1 tonnes
15) Spare parts for two years 100 000 EURO

ZORG BIOGAS

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