01

version

Proposal

Biogas plant
526 kW (netto)600 kW(gross)
using chicken dung

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OVERVIEW

We offer a solution to process chicken dung into biogas and power in a single-stage CSTR digester.
For 526 kW (netto)/ 600 kW (gross) electrical power just 1 CSTRs x 1926 m3 is enough.

Chicken dung have their own characteristics. This raw material contains a large amount of protein, which during fermentation forms ammonium, which inhibits fermentation (inhibits the reaction). To use the chicken dung as a mono-raw material, the ammonium must be neutralized. To solve the ammonium problem, Zorg offers a unique solution that does not require the addition of other carbon raw materials:
– The biogas passes through a scrubber, which purifies the biogas from sulfur.
- After the scrubber, acidic (sulfurous) water is formed, which is returned back to the anaerobic reactor.
Ammonium is bound to ammonium sulfate - a valuable fertilizer. Purification of biogas from sulfur is necessary in any case. Without this, the generator will not work for long. And solving the ammonium problem with a scrubber is a good solution without additional capital costs and, most importantly, without the use of chemistry.

Zorg makes the detailed engineering, supplies equipment and provides supervision during construction as well as training and start-up.

The construction and installation are done by Client under Zorg' supervision

Raw material potential

Substrate	Quantity (tonnes/day)	Quantity (tonnes/year)	DM content (%)	oDM content (%)	DM quantity (tonnes/day)	oDM quantity (tonnes/day)	Biogas yirld (m^3/tonnesODM)	Biogas (m^3/day)	Methane content (%)	Biomethane (m^3/year)
Chicken dung	50	18 250	30	75	15,0	11,25	515	6 188	60	2 258 620

**-DM- dry matters
***-oDM- organic dry matters

Biogas plant characteristics

Characteristics	Values	Figures
Reactor	units	1
Volume:		
Work	m^3	1663
Overall		1926
Temperature	^0C	38
Overall dimensions of the digester:		
diameter	m	20,49
height		5,67
Organic load	kgODM/m3	6,77
Hydraulic retention time (gross/net)	days	33/29
Number of gasholders	units	1
Volume:	m^3	587
Dimensions of the gasholder:		
diameter	m	21,0
Height		4,2

Number of personnel

	Shift 1	Shift 2	Shift 3
Operator	1	1	1
Driver	1	1	-
Total	5		

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 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

Chicken dung is directed into a loader. The loader input substrates by portion to a reactor using augers.

Liquid raw material is loaded into a receiving tank. The receiving tank is equipped with a submersible mixer, level sensors. Substrate from the receiving tank is loaded into the reactor by portion with pump.

In the reactor the substrate is brought up to a temperature of +38°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 operating regime is thermophilic. The heated substrate in the digester is blended periodically. Mixing is performed by vertical agitators. The average time of processing in the reactors is 35 days. After the reactor, the substrate is fed by pump to a separator area where it is separated into solid and liquid bio-fertilizer. Solid bio-fertilizer is discharged from the separation area and transported for storage; liquid filtrate is directed to a lagoon. Biogas goes up under overlap and delivered into a gasholder through pipeline. 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, digesters are equipped with safety valves, which start working at a pressure of 5 mbars and bleeds biogas to the atmosphere.

Air is supplied in portions to the digester for biogas bio-purification from hydrogen sulfide.

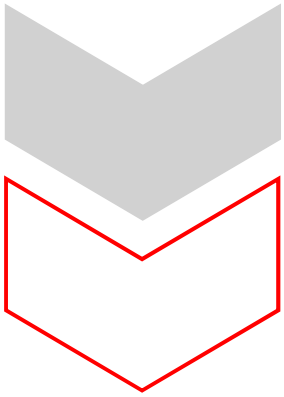
Desulfurization system is two-stage purification of sulfur that is contained in the biogas:

-by scrubber – the first stage;

-coal column - the second stage. Accumulated in 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 filters to remove hydrogen sulfide (H2S). After filters, the biogas goes to the cogenerator to produce electric and heat energy.

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



Solid feeder (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 15 m^3/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

Height:	**2,0 m**
Length:	**5,0 m**
Width:	**2,3 m**
Volume:	**20 m^3**
Quantity:	**1 pcs.**

Reactor (R-01)

The fermenter is an important part of the biogas plant, made of sheet metal with an enamel coating. Metal reactors are installed on a concrete base. The enamel layer protects the surface of the entire metal structure. The enamel is glassy and very resistant to aggressive pH and mechanical damage. The enameled fermenter is assembled from steel segments. Such a fermenter is quickly and safely mounted.The steel fermenter has the following advantages:

- Steel panels are joined at bolted joints with a special sealant. Thus, the impermeability of the substrate through the joint is achieved, and certain panels can be replaced;
- The enamel coating is layered using the PUESTA method. This is a special powder that is laid in layers by electrostatic attraction.
- Bolts are made of stainless steel;
- All elements (flanges, etc.) are connected through an EPDM membrane to protect the enamel.

To reduce heat consumption and maintain a constant temperature, the fermenter is insulated. The outside of the fermenter is covered with a decorative coating

Specifications

Height:	**5,67 m**
Diameter:	**20,49m**
Total volume:	**1926 m^3**
Substrate volume	**1663 m^3**
Quantity:	**1 pcs.**

Reactor`s mixer Paddle-giant (AG-01..02)

The inclined paddle high-power mixer Paddle-giant is designed and engineered for high efficiency with all types of raw materials (including highly viscous media). The operating mode is designed to maximize the preservation of bacterial populations (to achieve optimal gas output).
The mixer bearing is made of special, extremely wear-resistant and rust-proof plastic. All components can be replaced without the need to drain the reactor or replace the mixer shaft. The operating principle is ideal for breaking up floating layers and supports the mixing of solidification layers. Degassing of the substrate is simplified.
This type of mixer is suitable for minor fluctuations in filling levels. In the production of mixers, gearboxes and motors from well-known European manufacturers are used. This guarantees a long service life of our mixers. All motors and gearboxes are available with ATEX certificates.

Specifications

Engine power:	**15 kW**
Quantity per reactor:	**2 pcs**
Total quantity:	**2 pcs**

Window with spotlight (SG-01, SG-02)

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**	**230V, 50W, IP65**

Pump equipment (PU-01...PU-03)

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

Liquid substrate pump (PU-01)

Engine power:	5,5 kW
Flow rate:	25 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Substrate pump (PU-02)

Engine power:	11 kW
Flow rate:	5-20 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Filtrate pump (PU-03)

Engine power:	5,5 kW
Flow rate:	25 m3/hour
Pressure:	4 bar
Quantity:	1 pcs

Separator (SR-01)

The Press Screw Separator covers a broad spectrum of applications, from agriculture to biogas and bioethanol plants. The innovative technology separates substrates in its solid and liquid elements. The secret of the versatility of the press screw separator is that it can adjust to different dry matter contents and Thick liquids (20% dry matter content). Slotted screens have different assortment and width of table cells and give possibility work with small solids and fiber contents. In the slotted screen, the solids are screened out from the liquid. The solids build up a layer which also acts as a filter to separate finer particles from the liquid. The auger flights convey this layer to the solids outlet. The screen surface is cleaned and a new filter layer is formed. The design of the screens is not conducive to plugging. The pressure in the first part of the screen is low but increases with the solid consistency to the solid output. The consistence of the gained solid can be varied with the help of a output regulator by the amount and position of counter weights. This way the required consistency of the final product for either further storage, use as fertilizer or the basis for compost can be reached. The liquid phase can easily be drained through a pipe or hose system.

Specifications

Engine power:	**4,0 kW**
Flow rate:	**5-20 m3/hour**
Quantity:	**1 pcs**

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

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

Reinforced concrete reservoir for reception of liquid kinds of raw materials. The reservoirs are equipped with level sensors and submersible agitators for mixing substrate.

Specifications

Receiving tank (RT-01)

Diameter:	**6,0 m**
Height:	**2,3 m**
Total volume:	**32 m^3**
Quantity:	**1 pcs**

Filtrate tank (FT-01)

Diameter:	**6,0 m**
Height:	**2,3 m**
Total volume:	**32 m^3**
Quantity:	**1 pcs**

Submersible mixer (AG-03... AG-04)

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid substrate as manure and similar substrates. The electro-motor driven submersible agitator is designed for submersion operations in potentially explosive environments of Ex zone 2 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

Submersible mixer for the receiving tank	**(AG-03)**
Nominal power:	**3,0 kW**
Quantity:	**1 pcs**

Submersible mixer for the filtrate tank FT-01	**(AG-04)**
Nominal power:	**3,0 kW**
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 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:	**4,2 m**
Diameter:	**21,0 m**
The total volume :	**587 m^3**
Quantity:	**1 pcs**

Biogas Scrubber (SC-01)

The biogas scrubber works by bringing the gas stream into close contact with a liquid containing a scrubbing agent. As a result of this contact, the target gaseous components, such as H2S, dissolve and remain in the water. This results in the transfer of components from the gas phase to the liquid phase, also known as absorption. The solubility of the particles in the liquid determines how the gaseous components dissolve in this phase. The scrubbers are made of glass fiber reinforced polyester (GRPV). The completely smooth inner surface of the polyester ensures perfect evacuation and high chemical resistance to the various products to be stored. Specially designed for gas streams generated in industry and biogas plants. Each scrubber is manufactured using the resins most suitable for each specific product, and all equipment has a factory warranty and a production certificate.

Specifications

Gas volume flow:	**260 m^3/hour**
Diameter:	**4,5m**
Height:	**12m**
Electric power:	**1,5 кВт**
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:	**260 m^3/hour**
Gas inlet temperature:	**+38°C**
Gas outlet temperature:	**+10°C**
Electric power:	**18,0 кВт**
Quantity:	**1 pcs**

Biogas compressor (BC-01, BC-02)

Biogas blower is a device used to move gas and increase pressure thanks to a rotating impeller within a toroidal channel, so there is a progressive increase of energy.
Blower is used to transporting biogas from gasholder storage to consumer (biogas upgrading plant in our case).

Specifications

Flow rate:	**260 m3/hour**
Pressure:	**150 mbar**
Engine power:	**4 kW**
Quantity:	**2 pcs**

Desulphurization system

The desulphurization system is a 2-step system. Stage 1 is cleaning by the scrubber. After 1 step the sulphur contcentration is 50 ppm. Stage 2 - activated charcoal filtration, as activated charcoal has the capability to absorb sulfur. After passing through activated charcoal filters, the sulfur concentration is reduced to 0 ppm.

Specifications

Charcoal filter	**(CF-01)**
The volume of charcoal:	**200 kg**
Quantity:	**1 pcs**

Cogeneration Power Plant (CHP-01)

A cogeneration power plant (CHP) is used for producing electricity and heat. CHP is a very efficient technology for generating electricity and heat together. A CHP plant is an installation where there is simultaneous generation of usable electric power and heat in a single process, and it can provide a secure and highly efficient method of generating electricity and heat at the point of use. Due to the utilization of heat from electricity generation and the avoidance of transmission losses, due to electricity being generated on site, CHP typically achieves a 35 per cent reduction in primary energy usage compared with power stations and heat only boilers. This allows for economic savings where there is a suitable balance between heat and power loads. Another important factor, showing the benefits of cogeneration and CHP, is its low environmental impact. CHP produces lower quantities of pollutant emissions and heat pollution of the atmosphere. The current mix of CHP installations achieves a reduction of over 10 per cent in CO2 emissions in comparison with combined-cycle gas turbines.

Specifications

Produced electric power:	**600 kW**
Produced heat power:	**632kW**
Generator:	**115 V, 60 Hz**
Количество:	**1 шт.**

Emissions
NOx <500 mg / Nm³ (5% O2)

Flare

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:	**260 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:	**3,5 kW**
Flow:	**28 m^3/hour**
Pressure:	**1 bar**

Circulating pump feeding heat carrier

Engine power:	**2,0 kW**
Flow:	**12m^3/hour**
Pressure:	**1 bar**

The pumping station feeding propylene glycol

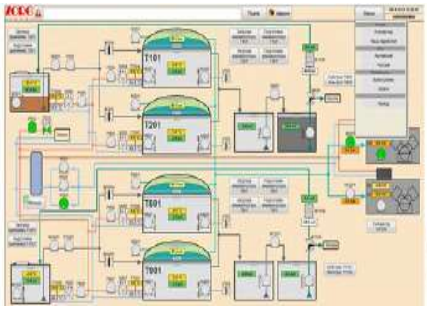
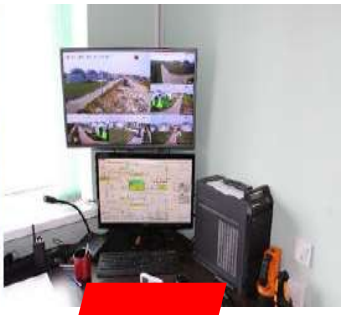
Engine power:	**0,7 kW**
Flow:	**1 m^3/hour**
Pressure:	**4 bar**

Dry cooler (cooling substrate system)

Device is designed to cool the substrate to working temperature according to technological regime. When use high temperature substrate, there is a chance of uncontrolled heating. The cooler is connected to the heating pipes, heat exchangers and it will be activated if it is need.

Specifications

Heat power:	100 kW
Electric power:	4 kW
Quantity:	1 pcs

Automation and electrical equipment

Process control equipment is used for supervision and regulation operation of the plant and for the limitation of damage. In case of emergency (for example, breakdown of the electrical power supply) the biogas plant is automatically transferred to safe operating conditions by the process instrumentation. Critical electrically driven devices are supplied with emergency power. An automatic system allows the supervision of the plant in real time and to recognize and correct aberrations immediately; to run the plant at its optimum saving resources and costs; and to record for the electronic database operation parameters. The automatic system consists of a control cabinet and sensors for parameter control of technological processes and execution devices.
The control cabinet is designed based on the industrial controller Siemens CPU315-DP2, using periphery distributing system Simatic ET200S, and operator panel OP277 Touch with touch-sensitive controls. Communications is executed by PROFIBUS and MPI with physical interface RS-485. The control program is designed based on the Simatic Step7. The control cabinet is a modular design. The upper part has a power box with central and front-end processor. The periphery distributing system, Simatic 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.

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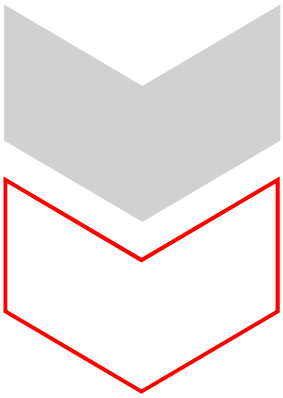
Equipment

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

Equipment specification list



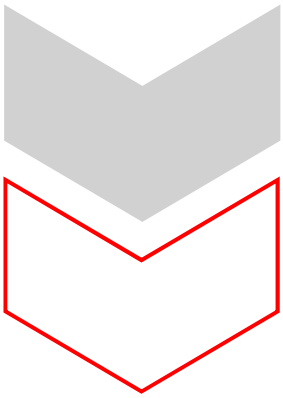
№	Equipment	Characteristic	Quantity
1	**Loader**	V=20m3	1
1.1	Container bunker		1
1.2	Feeding screws	set.	1
2	**Submersible mixer**	N=3,0 kW	2
2.1	Airtight motor gearbox		2
2.2	Hydraulic screw (wear-resistant steel)		2
2.3	Mixer control mechanism		2
2.4	Electric motor mount		2
2.5	Set of fasteners		2
3	**Reactor`s agitator**	N=15 kW	2
3.1	Airtight motor gearbox		2
3.2	Hydraulic screw (wear-resistant steel)		2
3.3	Shaft (adapted to the height of the fermenter)		2
3.4	Blade		2
3.5	Frequency converter		2
3.6	Mounting bracket to bottom of the mixer		42
4	**Safety valve of digesters**		1
5	**Window with a searchlight**	set	1
5.1	Inspection window RD300 (mounts and sealant included)	Ø300	2
5.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	1
6	**Substrate digested pump**	5-20 m3/hour N=11.0 kW	1

№	Equipment	Characteristic	Quantity
7	**Separator**	N=4,0 kW, 5-20m3/h	1
7.1	Body		1
7.2	Substrate Supply Pipe 4 ’’		1
7.3	Engine - Gearbox	N=4,0 kW	1
7.4	Frame		1
7.5	Screw		1
7.6	Sieve for filtration		1
8	**Liquid substrate pump**	25 m3/hour N=5,5 kW	1
9	**Filtrate pump**	25 m3/hour N=5,5 kW	1
10	**PVC gas holder**	587 m3	1
10.1	Weather protection film	Ø21,0m	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	**Scrubber**	260 m3/h	1
12	**Biogas Cooling System**	260 m3/h	1
12.1	Chiller		1
12.2	Heat exchanger		1
12.3	Polypropylene glycol tank		1
13	**Desulphurization system**		1
13.1	Numbers of charcoal columns	200 kg	1

№	Equipment	Characteristic	Quantity
14	Biogas compressor	Q=260m3/h, H=150mBar, N=3kW	2
15	Electromagnetic flow meter		1
16	Flare	240 m3/h	1
17	Gas equipment included	set	1
17.1	Drainage pump with float	DN=50, Q=1m3/h, H=13 m	2
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		1
21.2	Gas pressure sensor 0,4Bar		1
21.3	Pressure sensor(substrate level) 1,0Bar		2
21.4	Pressure sensor (substrate pressure) 2,5bar		2

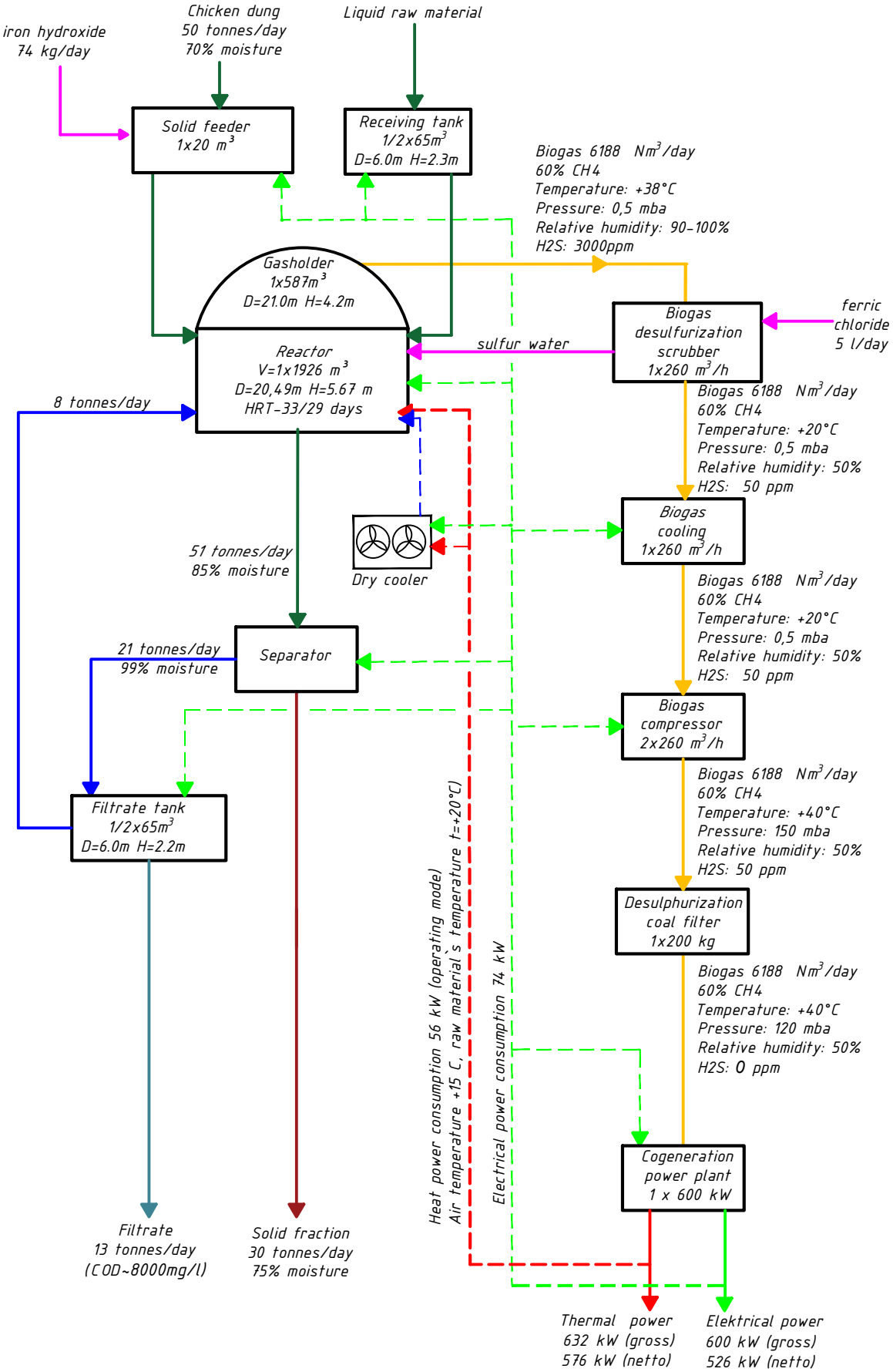
№	Equipment	Characteristic	Quantity
21.5	Resistive thermometer (gas temperature)		3
21.6	Resistive thermometer with thermo well (fermenter substrate temperature)		3
21.7	Resistive thermometer with thermo-well (digester tank substrate temperature)		3
21.8	Resistive thermometer (heat conductor temperature)		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	7
21.13	Humidity and gas temperature sensor	ESFTF-I	1
22	Dry cooler 100kW heat pow.		1
23	Cogeneration power plant	set	1
25	Laboratory	set	1

APPENDICES



Material flow diagram

Appendix 1



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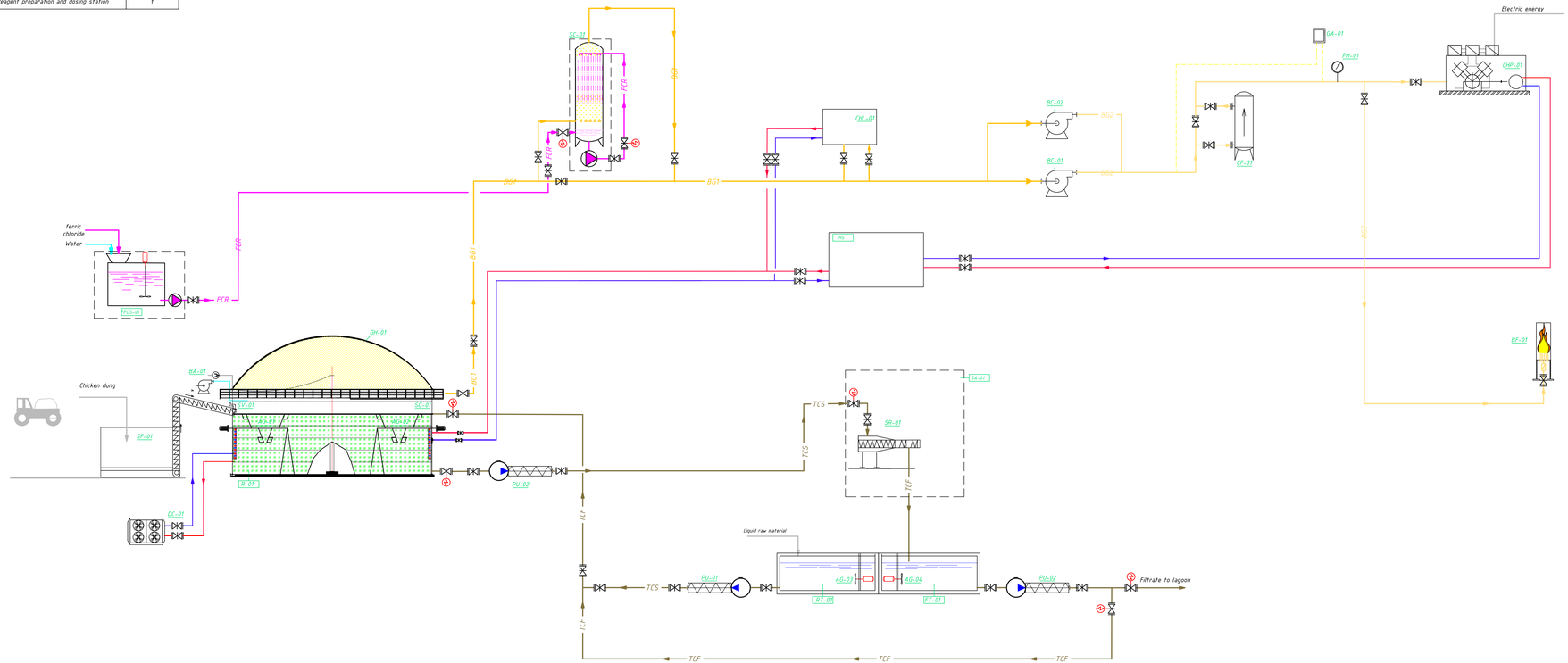
Specification

N/№	Name	Q-ty
SF-01	Loader machine	1
AG-03	Receiving tank`s submersible mixer	1
AG-01.02	Vertical mixer	2
AG-04	Filtrate tank`s submersible mixer	1
SV-01	Safety valve	1
SG-01	Inspection windows	1
PU-01	Substrate pump	1
PU-02	Substrate pump (to separator)	1
SR-01	Separator	1
PU-02	Filtrate tank	1
GH-01	Gasholder	1
SC-01	Scrubber	1
CHL-01	Biogas cooling system	1
BC-01, BC-02	Biogas blower	2
CF-01	Desulphurisation system	1
BG-01	Gas analyzer	1
FM-01	Biogas flow meter	1
CHP-01	Cogeneration power plant	1
BF-01	Flare	1
DC-01	Digester cooling system	1

Structure

N/№	Name	Q-ty
R-01	Digester	1
SA-01	Separator area	1
RT-01	Receiving tank	1
FT-01	Filtrate tank	1
HS	Boiler room	1
FPDS	Reagent preparation and dosing station	1



Legend main pipelines

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

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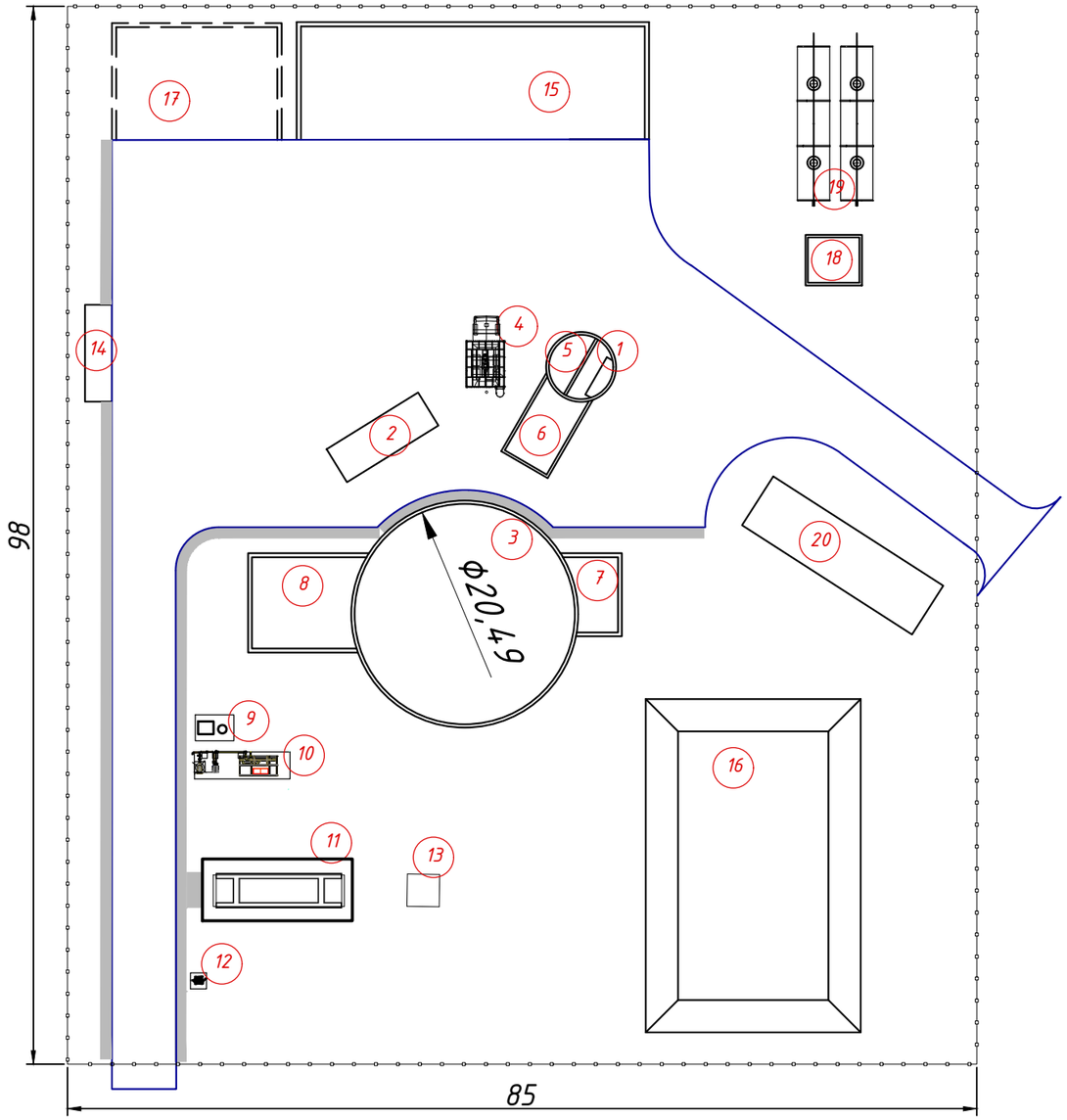
Plan



Explication

N/№	Name	Q-ty
1	Receiving tank (RT-01)	
2	Solid feeder(SF-01)	
3	Reactor (R-01)	
4	Separator (SA-01)	
5	Filtrate tank (FT-01)	
6	Equipment room	
7	Technical room 1	
8	Technical room 2	
9	Reagent preparation and dosing station and Scrubber	
10	Gas preparation	
11	Cogeneration power plant (CHP-01)	
12	Flare (BF-01)	
13	Transformer	
14	Operator's room	
15	Fermented mass storage	
16	Lagoon	
17	Drying and granulation area (perspective)	
18	Fire pump station	
19	Fire tank	
20	Rainwater treatment plants	

Appendix 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	8,0	96,0
Screw set.	12,0	1	12,0	8,0	96,0
Reactor's mixer paddle gigant	15,0	2	30,0	18,0	540,0
Submersible mixer in receiving tank	3,0	1	3,0	12,0	36,0
Submersible mixer in filtrate tank	3,0	1	3,0	12,0	36,0
Biogas cooling system	18,0	1	18,0	24,0	432,0
Biogas compressor	4,0	2	8,0	12,0	96,0
Separator	4,0	1	4,0	6,4	25,6
Substrate pump to separator	11,0	1	11,0	6,4	70,4
Liquid substrate pump	5,5	1	5,5	0,5	2,8
Filtrate pump	5,5	1	5,5	0,8	4,4
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
Scrubber	1,5	1	1,5	24,0	36,0
Circulation pump for supplying heat carrier to the digester	0,8	1	0,8	24,0	18,0
Cogeneration power plant	10,0	1	10,0	24,0	240,0
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			**137**		
Total consumed electric energy, kWh per day					**1767**
Total consumed power, kW					**74**

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Prices for equipment and services for biogas plant 50 tonnes dung per day

Pos	Name	Number of units	Unit price, EUR	Discounts*	Discounted unit price, EUR	Discounted price sub-total, EUR	
1	Project documention	1	49 000	0%	49 000	49 000	
2	Supervision	1	20 000	0%	20 000	20 000	
3	Startup and training	1	20 000	0%	20 000	20 000	
4	Living and travel expences	1	12 000	0%	12 000	12 000	
5	Delivery of the equipment (container)	5	12 000	0%	12 000	60 000	
6	Laboratory	1	25 000	0%	25 000	25 000	
7	Reactor V=1926 m³ (including ladders, platforms, hatches, pipe flanges, supports, fasteners, etc.)	1	187 000	0%	187 000	187 000	
8	Solid feeder (dosing buffer machine) 20 m3	1	75 000	0%	75 000	75 000	
9	Screw conveyor	1	65 000	0%	65 000	65 000	
10	Digester horizontal agitator 15 kW	2	68 000	0%	68 000	136 000	
11	Frame for Digester agitator pos 10	2	7 000	0%	7 000	14 000	
12	Substrate pump 5,5 kW	1	22 000	0%	22 000	22 000	
13	Digested substrate pump 11 kW	1	29 000	0%	29 000	29 000	
14	Filtrate supply pump 5.5 kW	1	22 000	0%	22 000	22 000	
15	Substrate separation unit 4 kW	1	52 000	0%	52 000	52 000	
16	Submersible agitator for receiving tank 3 kW	1	12 000	0%	12 000	12 000	
17	Submersible agitator for filtrate tank 3 kW	1	12 000	0%	12 000	12 000	
18	Over- and under pressure safeguard	1	7 000	0%	7 000	7 000	
19	Sight glasses/viewing windows with projector	1	6 000	0%	6 000	6 000	
20	Water supply and canalization system	1	19 000	0%	19 000	19 000	
21	Heat supply station	1	15 000	0%	15 000	15 000	
22	Dry-cooler cooling system for reactor	1	16 000	0%	16 000	16 000	
23	Automation and electric cabinet	1	135 000	0%	135 000	135 000	
24	Motorized valves (set)	5	8 000	0%	8 000	40 000	
25	Sensors (set)	3	20 000	0%	20 000	60 000	
26	Gasholder	1	65 000	0%	65 000	65 000	
27	Scrubber 260 m3/h	1	180 000	0%	180 000	180 000	
28	Reagent preparation and dosing station 1 m3	1	45 000	0%	45 000	45 000	
29	Biogas chiller (Biogas cooling system) 260 m3/h	1	64 000	0%	64 000	64 000	
30	Biogas blower 260m3/h	2	5 000	0%	5 000	10 000	
31	Desulphurization column with active coal 200 kg	1	32 000	0%	32 000	32 000	
32	Biogas flare	1	48 000	0%	48 000	48 000	
33	Gas analyzer (portative)	1	7 500	0%	7 500	7 500	
34	Gas conditioning unit	1	27 200	0%	27 200	27 200	
35	Cogeneration power plant MWM 600 kW	1	325 000	0%	325 000	325 000	
36	Construction	1	400 000	0%	400 000	400 000	Client
			TOTAL by ZORG, EUR			1 913 700	
			TOTAL by Client, EUR			400 000	
			TOTAL by ZORG+Client, EUR			**2 313 700,00**	

Implementation terms and payment

Months	08.25	09.25	10.25	11.25	12.25	01.26	02.26	03.26	04.26	05.26	06.26
Project documentation	50%	50%									
Obtaining permits											
Equipment supply				30%		20%	20%	30%			
CHP unit				30%					70%		
Construction											
Supervision					20%	20%	20%	20%	20%		
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 526 kW biogas plant:

1) 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
2) Topographic and geological surveys 3000-7000 EUR
3) Electric transformer and the external electric line 130 kW for start-up
4) External roads
5) Temporary water supply during the construction and the hydraulic test of reactors at least 200 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. 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 weeks period and to fill with it at least 15-20% of the reactor volume 288-385 m3. The rest is filled with the water item 7 above.
7) Machinery to transport Chicken dung to and from storage to the solid feeders (a truck, a frontal loader, a tractor)
8) Machinery to transport filtrate and the digested mass from the biogas plant to the agricultural fields (a truck, a frontal loader, a tractor)
9) Activated carbon 0,2 tonne per two years x 4800 EUR/tonne = 960 EUR
10) Fe(Cl)3 – 1,8 m3 per year x 900 EUR/m3= 1620 EUR
11) Demineralized water to the heating system 0.5 tonnes
12) Spare parts for two years 50 000 EURO

ZORG BIOGAS

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