ZORG BIOGAS

01

version

Proposal

Dry fermentation of pre-sorted municipal solid waste into power 1100kW (netto)/1170 kW(gross)

Date:11/09/2025
Validity: 3 months

CONTENT

OVERVIEW

Herewith we offer a solution to process municipal pre-sorted solid waste into biogas with further power generation. The technology is based on a dry fermentation method, a single-step batch process. The reactors look like garages or boxes with doors. Pre-sorted MSW is loaded into each reactor in several days and then digested without adding a new feedstock. After the cycle is finished the compost is un-loaded. After the digestion it's recommended to install an additional screening drum 20 mm to remove the remaining pieces of plastic and paper. After the 15-20 day storage on the open air under a shed the compost becomes a valuable fertilizer.

Inside of a reactor there is no moving parts. No screw loaders, no mixers, no substrate pumps. Percolate liquid is sprayed from the nozzles in the roof of the reactor. The percolate penetrates inside of MSW and collected at the bottom channel. The penetration inside is possible because the impurities like plastic and paper serve as a scarifier.One of the two main advantages of the batch type dry fermentation is that there is very little equipment. Nothing can be broken. The maintenace costs are very low. And electric energy consumption is very low.10 times lower then other methods like in plug-flow reactors or wet CSTR reactors.

The other name for dry fermentation is also anaerobic composting.

The technology is proven already for 25 years. In Germany there more than 100 MSW dry fermentation biogas plants. 90% of plants with MSW are using exactly this technology.

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 (%)	Biogas (m^3/year)
Municipal solid waste MSW	120	43 800	40	50	48,0	24,00	500	12 000	55	4 380 000

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

Biogas plant characteristics

Characteristics	Values	Figures
Quantity of feedstock	(tonnes/day)	120
Wet	%	60
Biogas production	m3/day	12 000
Methane content, CH4	%	55
Number of digesters	pcs.	10
Volume:		
Work	m^3	1248
Overall		1872
Temperature	^0C	52-55
Overall dimensions of the digester:		
LxWxH	m	6x52x6
Bigestion time(gross/net)	days	24
Number of gasholders	units	1
Volume:	m^3	250
Dimensions of the gasholder:		
diameter Height	m	8,7 6,8

Number of personnel

	Shift 1	Shift 2	Shift 3
Chief engineer	1	-	-
Operator	1	1	1
Driver	1	1	-
Total	6		

Biogas plant working principle

Dry fermentation is a single-step batch process. The different stages of degradation (i.e., hydrolysis, acid and methane formation) take place in the same garage-type digester. In a batch system, biomass is added to the reactor at the start of the process. The reactor is then sealed for the duration of the process (retention time), the biomass is left to ferment in the digester until the end of retention time. 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 an anaerobic environment i.e. in an oxygen-free tank (biological reactor). In the first stage of fermentation, substrate hydrolysis takes place under acidogenic bacteria influence. In the second stage, elementary organic compounds come through hydrolysis oxidation by means of heteroacidogenic bacteria with the 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 feed stock for methanogenic bacteria in the third stage. This stage flows in two processes of A and B type. The character depends on the 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 particular to their living environment compared to acidogenic bacteria. They require a complete anaerobic environment and need a longer reproduction period. The speed and scale of anaerobic fermentation depends on the bacteria's metabolic activity.

That is why the biogas plant chemical process includes hydrolysis oxidation, and methanization stages. For that kind of substrate these processes take place within the same garage-type digester.

Technological process of biogas production

Feedstocks are transported to the biogas plant area and loaded into digesters one-by-one. Because of the large contact surfaces (floor and wall heating), the fermentation substrate is very quickly heated to the target temperature of approx. 55 °C. After closing and sealing the gate, blowing with CO2 (from BUP or CHP) has to be done. After removing oxygen from the digester, spraying with preheated percolate is started. As a result of these procedures, the reactor quickly collects heat and reaches the necessary conditions for anaerobic fermentation. The fermentation process is maintained at a temperature of approx. 55 °C for approx. 24 days. During this period, a great quantity of available biodegradable organic elements is converted to biogas.

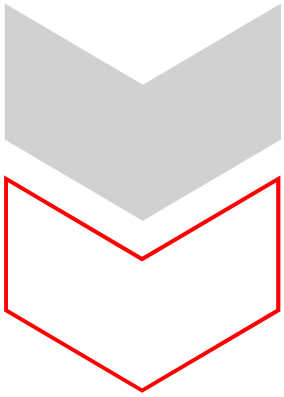
During the anaerobic phase, the process is monitored for the parameters of temperature, gas production, gas quality (CH4, CO2, H2S, O2) and percolate supply or amount. As necessary, temperature and the amount of percolate introduced are readjusted fully automatically. In batch operation, the substrate is anaerobically fermented throughout the entire retention time in the digester without additional mixing or agitating. Because no pumps, agitators, or other mixing or conveying equipment is needed, the technology is characterized by extremely high tolerance to mechanical impurities in the substrate. Susceptibility to malfunction or the requisite maintenance or repair expenditure during the gas process is therefore also very low, which applies as well to the operation of the entire facility. To accelerate the anaerobic fermentation process after the digester gates are sealed and immediately stimulate biogas production, the newly filled gas zone of the box digester is once again specifically inertised with gas. This process method occurs early resulting in high gas yields of good quality. At the end of the fermentation cycle, the rinse process is reinitiated in the digester (see above description). The garage-type digesters are equipped with percolate sprinklers with nozzles developed especially by Zorg, to ensure a particularly even and effective percolate distribution over the biomass. The sprayed percolate provides an optimal continuous moistening of the substrate to guarantee the greatest possible gas yields. Leaching percolate is drawn off at the digester floor through a drainage channel with additional side drainage, purified through a separate filter system, tempered in a percolate tank, temporarily stored, and when required, resprayed over the substrate to moisten it. At approx. 55 °C, the fermentation process takes place in the digester within the temperature range of thermophilic bacteria; temperature is modulated by floor and wall heating. Such design ensures optimal heat transfer to the substrate.

Because the heating pipes were already incorporated into their concrete walls during construction of the digesters, no interventions within the digesters themselves are required.

All of this combines to facilitate optimal temperature control within the digesters. After the pre-treatment of the biogas, the biogas is compressed to the necessary pressure for

Biogas is supplied to the cogeneration power plants, where it is used as fuel for production of electricity and heat. Heat from the cogenerators is fed to a heat exchanger for heating the digesters. Heating equipment is used for distribution of heat between biogas plant facilities.

MAIN EQUIPMENT



Digester (D-01..10)

The digesters are gas-tight concrete garage-type chambers, where raw materials are loaded using a front loader.
The digesters are located side by side with a common wall to save building materials. The number of reactors is selected in such a way as to have a continuous loading of the daily feed of raw materials to the biogas plant.
The temperature in the insulated digester is controlled by heated floors and walls, as well as the temperature of the bacterial liquid supplied for irrigation (percolate). Heating pipes are installed in the walls and floor of the fermenter during construction, so there are no protruding elements in the digester. The digesters are equipped with hydraulically operated gas tight steel gates.

Specifications

Height:	**6,0 m**
Length:	**52,0 m**
Width:	**6,0 m**
Total volume:	**1872 m^3**
Quantity:	**10 pcs.**

Digester gate (DG-01..10)

Digesters have hydraulically operated, gas-tight, steel gates. They have a seal which, when inflated towards the cement entry wall, make the entrance gas-tight. Before the gates are opened, the air in the seal is released. The inflatable seal lies within the gate's edge and is therefore protected from damage. The system is run under light overpressure at 20 hPA, thus categorically preventing any potential form of gas-air explosion, even in the case of leakage.

Specifications

Height:	**5,5 m**
Width:	**5,0 m**
Quantity:	**10 pcs.**

Spray nozzle (set)

In the tunnels the set of spray nozzles is using for spraying the percolate. The spray nozzles have the non clogging nozzle without swirl insert, dust suppression and can use for broadcast spraying, wide area spray (G1'').
(The number of nozzles in one set depends on the geometric dimensions of the tunnel).

Specifications

Connection diameter:	**1”**
Nozzle's diameter::	**100mm**
Quantity (set):	**10**

(1 set- 48 spray nozzles)

Pump equipment (PU-01...PU-06)

Pumps are used to transport percolate to digesters and back to the percolate tank. Design of a biogas plant provides fast access to all pumps as required. The clear benefit is in the low lifecycle costs. This universally usable pump works with almost every low and extremely high viscous mediums.
Good pumping performance is provided in high pressure operation with high operational reliability.
Pumps are modular for high flexibility, low stocking of spare parts, short downtimes for maintenance and repairs, while providing pulse-free transfer, and a long
service life, even with difficult media.

Specifications

Engine power:	**5,5-22 kW**
Flow rate:	**25-80 m3/hour**
Pressure:	**6 bar**
Quantity:	**6 pcs**

Percolate tank (PT-01)

Percolate tank is concrete tank with heat system for storing and circulating percolate to digesters. A heating system is installed on internal walls. The tank is equipped with submersible mixers and pump station.

Specifications

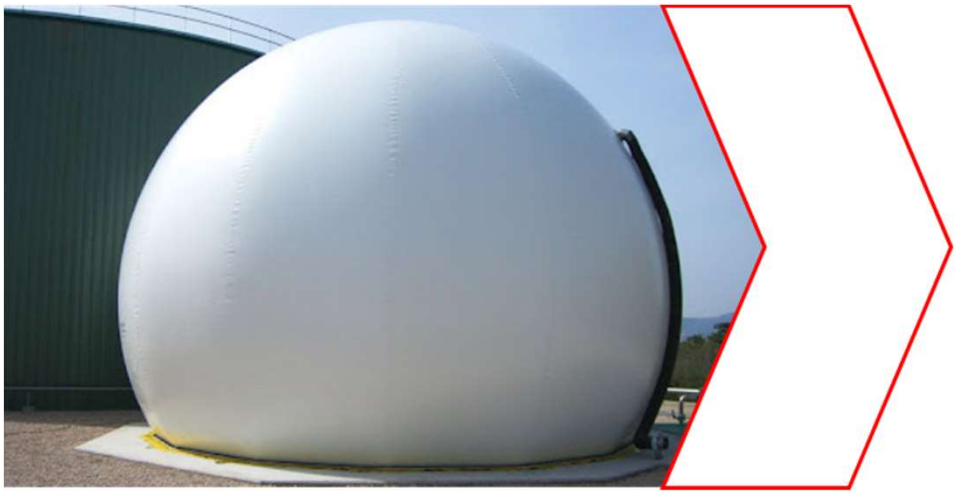
Diameter:	**11,0 m**
Height:	**4,2 m**
Total volume:	**399 m^3**
Quantity:	**1 pcs**

Submersible mixer (AG-01)

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 percolate tank	**(AG-01)**
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:	**6,8 m**
Diameter:	**8,7 m**
The total volume :	**250 m^3**
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:	**510 m^3/hour**
Gas inlet temperature:	**+55°C**
Gas outlet temperature:	**+10°C**
Electric power:	**30,0 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:	**510 m3/hour**
Pressure:	**150 mbar**
Engine power:	**4,2 kW**
Quantity:	**2 pcs**

Desulphurization system

The desulphurization system is a 2-step system. Stage 1 is using Scrubber. After 1 steps the sulphur contcentration is 80 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**

Scrubber for biogas (SC-01)

The scrubber for biogas works due to the close contact of the gas flow with the liquid with the washing reagent. As a result of this contact, the target gaseous components, for example H2S, dissolve and remain in the water. Thus, there is a transfer of components from the gas phase to the liquid phase, which is also called absorption. The solubility of particles in a liquid determines the extent to which gaseous components are dissolved in this phase. Scrubbers are made of fiberglass-reinforced polyester (PRFV). The completely smooth inner surface made of polyester provides ideal evacuation and high chemical resistance to various products to be stored. Specially developed for gas flows formed in industry and at biogas plants. Each scrubber is manufactured with the use of resins most suitable for each specific product, and all equipment has factory guarantees and a production certificate.

Specifications

Gas volume flow:	**510 m3/hour**
Diameter:	**4,5 m**
Height:	**12 m**
Electric consumption:	**1,5 kW**
Quantity:	**1 pcs**

Reservoir for storage and dosing of reagents(FPDS)

Reservoir for storage of liquid types of reagents. The tank is a ready-to-install system with automation and a control cabinet for managing processes from filling, mixing to dosing with a pump. The tank is made of high-quality plastics, such as PE, PP, PVDF and PVC. It is possible to use in various climatic zones and for contact with the most aggressive environments. Resistance to temperature changes and use at temperatures from -40°C to +100°C. Pressure- and impact-resistant welded and glued joints - created in accordance with DVS recommendations - are as strong as the sheet material itself.

Specifications

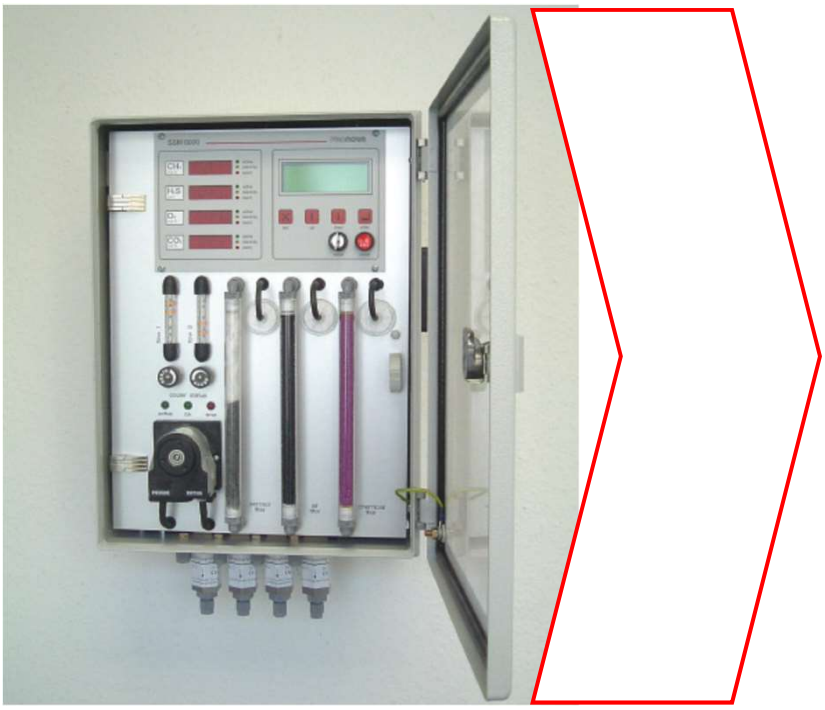
Total volume:	**10 m3**
Quantity:	**1 pcs**

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:	**510 m^3/hour**
Pressure:	**min 10 mbar- max 60 mbar**
Quantity:	**1 pcs**



Gas analyzer (CH4, CO2, H2S) (GA-01)

The gas analyzer is a combined measuring device. It consists of a fixed Control block and a mobile gas measuring device.
The Control block is designed for the automatic measurement and monitoring of the amount* and composition of gases produced in biogas plants.
The device measures the gas compositions at the individual measuring locations sequentially.
The mobile gas measuring device is usually docked to the Control box via the docking station (stationary measurements).
As an option, mobile measurements can be taken at selected measuring locations. The gas measuring device is removed from the Control docking station to carry out the measurement.

Specifications

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

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:	**1200 kW**
Produced heat power:	**1192 kW**
Generator:	**50Hz**
Количество:	**1 шт.**

Emissions
NOx <500 mg / Nm³ (5% O2)

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

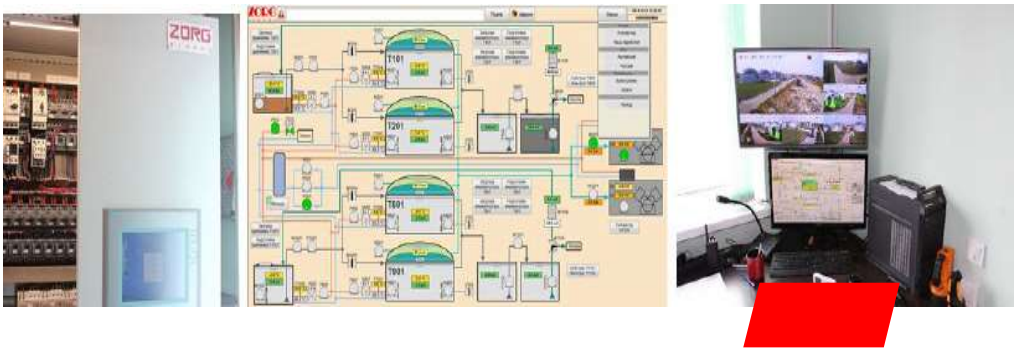
Engine power:	**0,7 kW**
Flow:	**1 m^3/hour**
Pressure:	**4 bar**

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:	10 pcs



Automation and electrical equipment

Process control equipment is used for supervision and regulation operation of the plant and for the limitation of damage. In case of emergency (for example, breakdown of the electrical power supply) the biogas plant is automatically transferred to safe operating conditions by the process instrumentation. Critical electrically driven devices are supplied with emergency power. An automatic system allows the supervision of the plant in real time and to recognize and correct aberrations immediately; to run the plant at its optimum saving resources and costs; and to record for the electronic database operation parameters. The automatic system consists of a control cabinet and sensors for parameter control of technological processes and execution devices.
The control cabinet is designed based on the industrial controller Siemens CPU315-DP2, using periphery distributing system Simatic ET200S, and operator panel OP277 Touch with touch-sensitive controls. Communications is executed by PROFIBUS and MPI with physical interface RS-485. The control program is designed based on the Simatic Step7. The control cabinet is a modular design. The upper part has a power box with central and front-end processor. The periphery distributing system, Simatic ET2005, is installed with input - output units. The lower part with interface relay and clips is installed for connecting execution devices. The entire plant is controlled by a single operator.

Specifications

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

Sensors set

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

Specifications

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

Laboratory

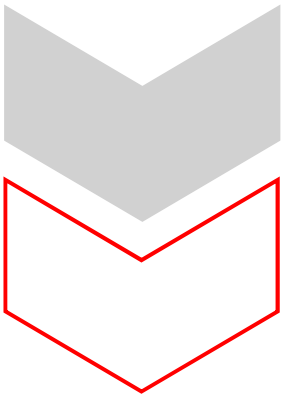
Monitoring and control of parameters of raw materials and fermentation processes is important for the efficient operation of a biogas plant. The laboratory allows you to assess the content of dry matter in the input raw materials, fermented mass, determine the ratio of volatile organic acids to total inorganic carbon (FOS/TAC parameter), determine the degree of substrate fermentation in fermenters, the level of biogas output, and evaluate the efficiency of separator.

-

Equipment

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

Equipment specification list



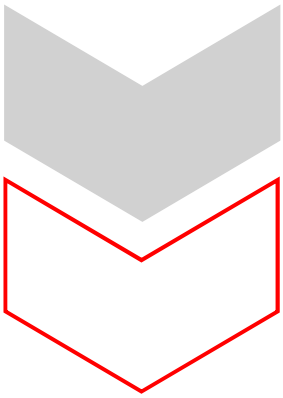
№	Equipment	Characteristic	Quantity
1	**Safety valve**	**set**	**10**
2	**Digester equipment**		
2.1	Hermetic gate	pcs	10
2.2	Spray nozzles	set	10
2.3	Sewage pipeline flanges	set	10
2.4	Heating pipes supporting structures	set	10
3	**Percolate pump**	**N=5,5 kW**	**3**
4	**Biogas flow meter**	**pcs**	**11**
5	**Air supply system**	**set**	**1**
5.1	Compressor	Q=210 l/min P=3,0 atm N=2,2 kW	1
5.2	Air fan	Q=800 l/h P=1500 Pa N=1,1 kW	1
5.3	Solenoid valve	set	1
5.4	Solenoid valve	1-50 m3	1
5.5	Filter-regulator	G1/2"	1
5.6	Manometer	G1/8 16 bar	1
5.7	Manometer	P=0...0.4 bar	1
5.8	Pressure regulator	M112; G1/2"	1
5.9	Back-flow prevention valve	G1/2"	1
6	**Submersible mixer**	**N=3,0 kW**	**1**
6.1	Airtight motor gearbox	set	1
6.2	Mixer control mechanism (high-quality structural galvanized steel)	set	1
6.3	Electric motor mount (high-quality structural galvanized steel)	set	1
6.4	Support (high-quality structural galvanized steel)	set	1

№	Equipment	Characteristic	Quantity
7	**Sewage percolate pump**	**N=7.5kW**	**3**
8	**PVC gas holder H/D =3/4**	**250 m3**	1
8.1	Weather protection film	Ø8,7 m	1
8.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant		1
8.3	Air blower	16A, 0,5kW	
8.4	Excess and minimum pressure valve		1
8.5	Dome level sensor		1
8.6	Mounting system		1
8.7	Accessories		1
8.8	Safety valve		1
9	**Safety valve**	**set**	**10**
10	**Air blower**	**0,5 kW**	**1**
11	**Biogas Cooling System**	**510 m3/h**	**1**
11.1	Chiller		1
11.2	Heat exchanger		1
11.3	Polypropylene glycol tank		1
12	**Biogas compressor**	**Q=510m3/h, H=150mBar, N=4,2kW**	**2**
13	**Desulphurizaton system**		**1**
13.1	Biogas scrubber	510m3/hour	1
13.2	Reagent preparation and dosing station	set	1
13.3	Circulation pump		1
13.4	Numbers of charcoal columns	200 kg	1
14	**Gas analyzer (CH4, CO2, H2S)**	**set**	**1**
15	**Co-generator**	**1200 kW**	**1**
16	**Flare**	**510 m3/h**	**1**
16.1	Compressor	set	1

№	Equipment	Characteristic	Quantity
16.2	Manual locking element	set	1
16.3	Deflagration fuse	set	1
16.4	On-site control cabinet	set	1
16.5	Auto ignition system	set	1
16.6	Auto Main Gas Solenoid Valve	set	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	**Dry cooler 100kW heat pow.**		**10**
20	**Water supply and sewerage system, complete, disassembled**	**set**	**1**
21	**Automation with electrical equipment**	**set**	**1**
21.1	Incoming distribution cabinet with a set of automation DB-1		1
21.2	Incoming distribution cabinet with a set of automation DB-2		1
22	**Sensors, set**		**1**
22.1	Gas pressure sensor		10
22.2	Conductivity sensor		10
22.3	Pressure/level sensor		10
22.4	Ultrasonic sensor		10

№	Equipment	Characteristic	Quantity
22.5	Resistive thermometer (gas temperature)		10
22.6	Thermal converter	TR10-B-M-DZZKTA-2-QRZZM-150-DCK-CE-R-00735-ZZ	10
22.7	Thermowells for thermocouples	TR10-B	10
22.8	Thermal converter heating circuit	TR30-P-Z-Z-A-ZZZ-13R-DBB-ZZZZ-B000025-ZZ	10
22.10	Substrate pressure sensor	SEN-3251 B055 G1 4Bar	2
22.11	Substrate pressure sensor	SEN-3251 B045 G1 2,5Bar	2
22.12	Immersion level sensor	LS-10 0,6 bar 4-20 mA	2
22.13	Coolant pressure sensor	SEN 3276 B065 G1/2 6Bar	10
22.14	Humidity and gas temperature sensor	ESFTF-I	10
23	**Laboratory**	**set**	**1**

ANNEXIES



	Day	Digester 1	Digester 2	Digester 3	Digester 4	Digester 5	Digester 6	Digester 7	Digester 8	Digester 9	Digester 10
	1	Loading									
	2	Loading									
	3	Loading									
1	4	Percolate sprayed	Loading								
2	5	Percolate sprayed	Loading								
3	6	Percolate sprayed	Loading								
4	7	Percolate sprayed	Percolate sprayed	Loading							
5	8	Percolate sprayed	Percolate sprayed	Loading							
6	9	Percolate sprayed	Percolate sprayed	Loading							
7	10	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading						
8	11	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading						
9	12	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading						
10	13	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading					
11	14	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading					
12	15	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading					
13	16	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading				
14	17	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading				
15	18	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading				
16	19	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading			
17	20	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading			
18	21	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading			
19	22	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading		
20	23	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading		
21	24	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading		
22	25	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	
23	26	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	
24	27	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	
	28	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading
	29	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading
	30	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading
	1	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	2	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	3	Loading	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	4	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	5	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	6	Percolate sprayed	Loading	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	7	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	8	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	9	Percolate sprayed	Percolate sprayed	Loading	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	10	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	11	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	12	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	13	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	14	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	15	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed
	16	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed
	17	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed	Percolate sprayed
	18	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Discharge	Percolate sprayed	Percolate sprayed	Percolate sprayed
	19	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed
	20	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed	Percolate sprayed
	21	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Discharge	Percolate sprayed	Percolate sprayed
	22	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed
	23	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying	Percolate sprayed
	24	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Discharge	Percolate sprayed
	25	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying
	26	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Drying
	27	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Percolate sprayed	Loading	Discharge

Basic diagram

Explication of equipment

N/№	Name	Amount
HG-01...HG-10	Hermetic gate gateway type	10
SNS-01...SNS-10	Spray nozzles (set)	10
BFM-01...BFM-10	Biogas flow meter	10
HS-01...HS-10	Heating system	10
SV-01...SV-10	Pressure safety valve	10
AC-01	Air compressor	1
PU-01...03	Percolate pump	3
PU-04...06	Sewage percolate pump	3
AG-01	Submirsible mixer	1
GH-01	Gasholder	1
SC-01	Scrubber	1
CHL-01	Biogas cooling system	1
BC-01, BC-02	Biogas compressor	2
CF-01	Desulfurization system	1
GA-01	Gas analyzer	1
BMF-11	Electromagnetic flow meter	1
BF-01	Biogas flare	1
CHP-01	Cogeneration power plant	1
DC-01...DC-10	Digester cooling system	10

Explication of buildings

N/№	Name	Amount
D-01...D-27	Digester V=1972 m³	10
PT-01	Percolate tank V=399 m³	1
HS-01	Boiler / operator room	1
FPDS	Reagent preparation and dosing station	1

Legend main pipelines

- TA — Technological pipeline of air
- TCP / TCP — Percolate pipeline
- BG1 / BG1 — Biogas
- HS / HS — Technological pipeline of percolate / Heat system pipeline
- WS — Water supply
- FeCl3 — FeCl3
- axid water — axid water

pre-sorted municipal solid waste

Air

ferric chloride

Water

acetic acid

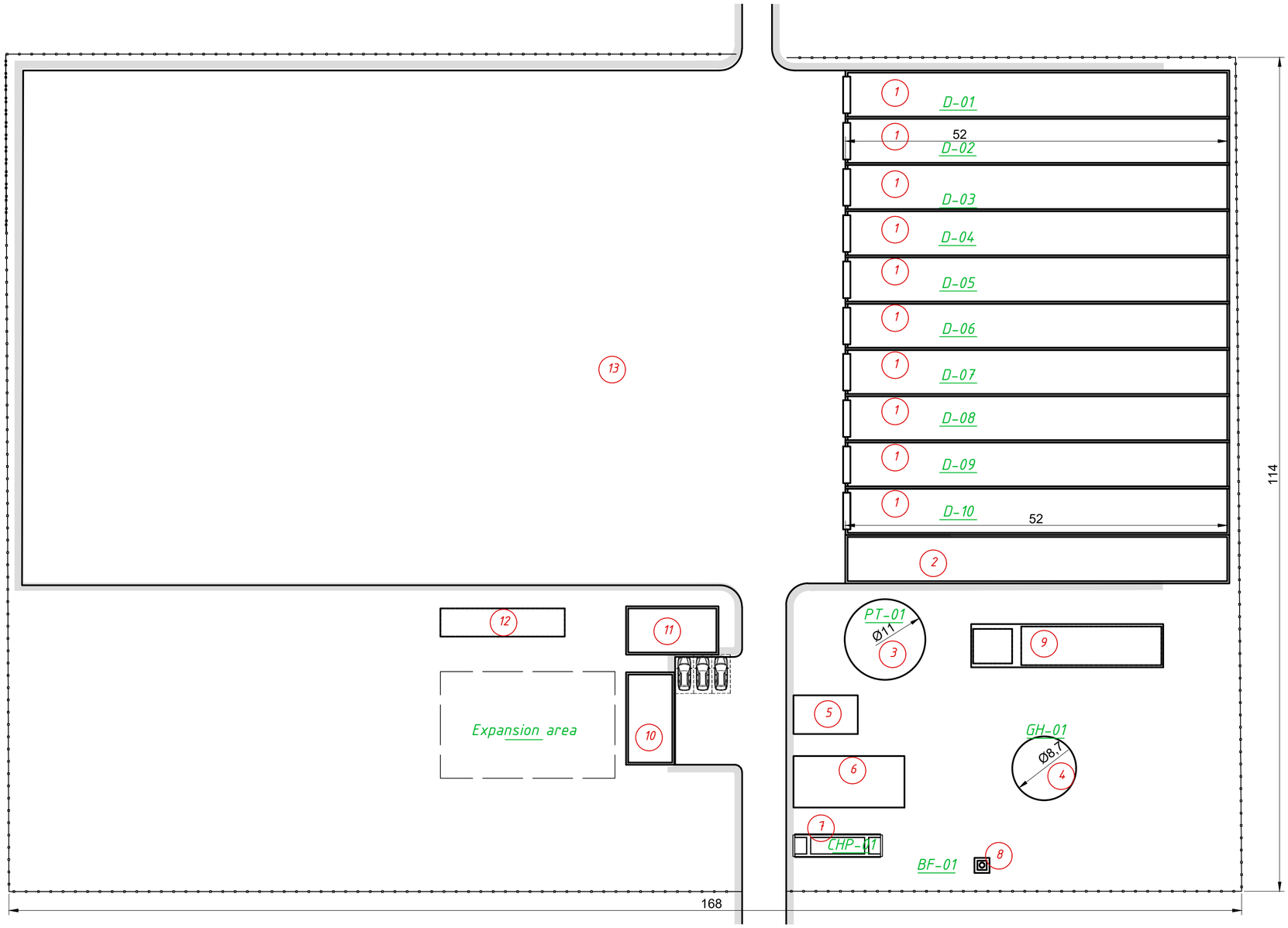
Water

Water to start

Electrical energy

ZORG BIOGAS

Plan



Explication

N/№	Name	Note
1	Digester (D01..10)	
2	Equipment room	
3	Percolate tank (PT-01)	
4	Gasholder (GH-01)	
5	Scrubber	
6	Gas preparation	
7	Cogeneration power plant (CHP-01)	
8	Flare (BF-01)	
9	Water supply pump station & water storage tanks	
10	Warehouse	
11	Administrative building	
12	Rainwater treatment facilities	
13	Composting area	

ZORG BIOGAS

Annex 4

Electrical load

Name equipment	Instal. Pow. (kW)	Q-y (pcs)	Total installed power (kW)	Working hours per day	Consumption kWh per day
Mixer in percolate tank	3,0	1	3,0	12,0	36,0
Biogas compressor	4,2	2	8,4	12,0	100,8
Biogas cooling system	30,0	1	30,0	24,0	720,0
Electric valve	0,1	20	2,8	0,5	1,4
Circulation pump for supplying network water to the digester	1,1	1	1,1	24,0	26,4
Percolate pump	1,5	2	3,0	12,0	36,0
Sewage percolate pump	1,5	2	3,0	12,0	36,0
Air compressor for gasholder lock	1,5	1	1,5	24,0	36,0
Air blower for double membrane	1,0	1	1,0	24,0	24,0
Scrubber	1,5	1	1,5	24,0	36,0
Co-generator 1200 kW	18,0	1	18,0	24,0	432,0
Circulating pump feeding water network at co-generator	5,0	1	5,0	24,0	120,0
Circulating pump feeding network water at technical building	1,5	1	1,5	24,0	36,0
Propylene glycol pump station	0,8	1	0,8	0,5	0,4
Drinage pump	2,1	1	2,1	0,5	1,1
Lighting of the biogas plant territory	1,0	1	1,0	12,0	12,0
Working lighting of switchboard	0,1	1	0,1	0,5	0,1
Digester cooling system	4,0	10	40,0	at t>55°C	
Circulation pump for supplying network water to the digester cooling system	2,0	10	20,0		
Desulphurization system compressor	1,5	1	1,5	24,0	36,0
Biogas analyzer	0,1	1	0,1	24,0	2,4
Total installed power, kW			**145,4**		
Total consumed electric energy, kWh per day					**1692,5**
Total consumed power, kW					**70,5**

ZORG BIOGAS

Prices for quipment and services for 1.2 MW biogas plant (120 tonnes pre-sorted MSW per day)

Pos	Name	Number of units	Unit price, EUR	Discounts*	Discounted unit price, EUR	Discounted price sub-total, EUR	
1	Project documention	1	65 000	0%	65 000	65 000	
2	Supervision	1	30 000	0%	30 000	30 000	
3	Startup and training	1	30 000	0%	30 000	30 000	
4	Living and travel expences	1	30 000	0%	30 000	30 000	
5	Delivery of the equipment (container)	7	8 000	0%	8 000	56 000	
6	Spray nozzles (set)	10	6 000	0%	6 000	60 000	
7	Percolate pump	3	27 000	0%	27 000	81 000	
8	Percolate pump (drainage)	3	27 000	0%	27 000	81 000	
9	Submersible mixer for percolate tank (3,0 kW)	1	9 000	0%	9 000	9 000	
10	Gasoholder external	1	69 000	0%	69 000	69 000	
11	Water supply and canalization system	1	25 000	0%	25 000	25 000	
12	Air supply system, as a unit.	1	10 500	0%	10 500	10 500	
13	Heat supply station	1	54 000	0%	54 000	54 000	
14	Digester dry-cooler	10	17 000	0%	17 000	170 000	
15	Automation and electric cabinet	1	170 000	0%	170 000	170 000	
16	Motorized valves (set)	20	4 000	0%	4 000	80 000	
17	Sensors (set)	11	20 000	0%	20 000	220 000	
18	Biogas chiller (Biogas cooling system) 510 m3/h	1	95 000	0%	95 000	95 000	
19	Biogas blower 510 m3/h	2	9 000	0%	9 000	18 000	
20	Biogas scrubber 510 m3/h	1	250 000	0%	250 000	250 000	
21	Reagent dosing station 10m3	1	45 000	0%	45 000	45 000	
22	Desulphurization column with active coal 200 kg	1	29 000	0%	29 000	29 000	
23	Biogas burner 510 m3/h	1	64 000	0%	64 000	64 000	
24	Gas analyzer	1	25 700	0%	25 700	25 700	
25	Gas conditioning unit 510 m3/hour	1	36 000	0%	36 000	36 000	
26	Biogas flow meter	1	21 000	0%	21 000	21 000	
27	Cogeneration heat power plant MWM Caterpillar 1200 kW with silencer, oil tank, engine coooling in a	1	740 000	0%	740 000	740 000	
29	Digester gate (h= 6m)	10	25 000	0%	25 000	250 000	Client
30	Construction	1	1 000 000	0%	1 000 000	1 000 000	Client
			by Zorg, EUR			2 564 200	
			Client, EUR			1 250 000	
			TOTAL Zorg + Client, EUR			**3814200**	

Implementation terms and payment

Months	10.25	11.25	12.25	01.26	02.26	03.26	04.26	05.26	06.26	07.26	08.26	09.26	10.26	11.26	12.26
Data collection															
Project documentation		50%		50%											
Equipment manufacturing															
Equipment supply								30%		20%	30%	20%			
CHP unit			30%								70%				
CHP unit (supply)															
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

ZORG BIOGAS

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

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

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