ZORG
Clean energy

Commercial offer
Biogas plant

100 t/day food waste

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ZORG™

Resume

Municipal solid waste sorting plant with 300 t/day capacity produces big volumes of organic waste (30-40% from total volume).

Biogas plant installation is planned within the sorting plant territory. Separated organic fraction (remaining inorganic 20%) will be transported to biogas plant for recycling.

Biogas plant construction will make possible recycling of 36500 t/year of organic waste and produce 7 300 000 m^3 of biogas per year.

After gas conditioning system biogas will be pumped to co-generation unit for production of 15 768 000 kWh of electric and 20 000 000 kWh of heat power.

Content

Biogas yield calculation

Initial data for calculation:
Municipal solid waste sorting plant.
Quantity of sorted organic waste - 120 t/day (humidity 70%).
Pure organic waste quantity - 100 t/day (humidity 70%)

Customer:
Project No.: 1201-10

Issued by: **Vitaliy Ivanov**
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Biogas plant operational period:	(52 weeks, 7 days a week, 24 hours day)	**365**	Working days per year
Production period:	(52 weeks, 7 days a week, 24 hours day)	**8 760**	Machine hours per year
		24.0	Working hours per day

Substrate	Quantity per day (t)	Quantity per year (t)	DM (dry matter) (%)	DM (kg/day)	ODM (organic dry matter) (%)	ODM (kg/day)	Biogas yield (m3/kg ODM)	Biogas yield (m³/day)	Biogas yield (m³/year)	Methane content (%)	Biogas caloric value (kW/m³)
Pure food waste	100	36500	30.00	30000	96	28800	0.68	20000	7 300 000	70.00	7.0

Co-generation unit

Electric power kWh	**1800**
Heat power kWh	**2200**

Biogas plant technical performances

Characteristics		Values	Figures
1	Efficiency	t/h	4,16
2	Substrate humidity	%	70
3	Biogas yield	m^3/h	834
4	Produced electric power	kW	1800
5	Produced heat power	kW	2200
6	Biogas plant energy consumption	kW	150
7	Biogas heat power consumption	kW	500
8	Maintenance personal	person	3
9	Area required	Ha	1,8

Scope of supply

Biogas plant consists of constructed facilities and equipment. Construction part of the project (concrete tanks) can be executed by the Customer at net price and under our supervision.

All equipment is of high quality produced in EU, USA or under German license in Ukraine.

Price list

	Price, Euro			
	Project documentation	Supervision, start-up and adjustment, training	Equipment (FCA)	Construction*
Biogas plant	92.000	30.000	1 320.000	1 430.000
Substrate preparation facility		20.000	790.000	420.000
Waste water treatment system		10.000	610.000	170.000
Co-generation unit 1,8 MW		10.000	1 150.000	

* Can be executed by the Customer under Zorg's control and supervision.

Contracts

Project implementation is executed simultaneously under 3 contracts:

- Engineering contract,
- Equipment supply contract (FCA),
- Construction contract (or supervision contract in case Customer executes construction).

Implementation terms

Months	1	2	3	4	5	6	7	8	9	10
Documentation										RESERVE
Equipment supply										
Construction										
Start up										

Payment order

Under project engineering contract:

- 50% down payment,
- 50% of the contract price after one month.

Under equipment supply contract:

- 50% down payment,
- 40% payment from the contract price after 2 months,
- 10% after notification of readiness for shipment.

Construction contract (or supervision contract in case of construction executed by the Customer):

- Against executed works acts.

Working principle

Food waste have certain peculiarities and require two stage technology for its recycling. The peculiarity is that substrate preparation facility is required (disintegration, inorganics separation and pasterusation). Two stage anaerobic digestion technology assumes split of main digestion steps in different digesters with different temperature mode and retention tiime. Organic waste accumulation is designed for 1-2 days of storage capacity and takes place in receving tank.

Substrate feeding system

Biological process of consecutive (phasic) conversion of organic compounds can 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 second stage elementary organic compounds come through hydrolysis oxidation by means of heteroacidogenic bacteria with production of acetate, carbon dioxide and free hydrogen. The other part of organic compounds including acetate forms C1 compounds (elementary organic acids). Produced substances are the feed stock for methanogenic bacteria of third type. This stage flows in two processes of A and B type the character o 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 particular to living environment to be compared to acidogenic bacteria. They require complete anaerobic environment and need longer reproduction period. The sped and scale of anaerobic fermentation depend on bacteria metabolic activity. That is why the biogas plant technological scheme has hydrolysis reactor with at least 4-5 days retention time using mechanic mixing and main digester for methanogenic bacteria with 25 days retention time mechanic and hydraulic mixing system. After sorting facility organic wastes are transported to biogas plant and loaded to mechanical crashing unit, where organic and non organic compounds are crashed. Non organic materials detachment that have density lower then water is performed with the help of hydraulic sedimentation in special tanks. Inorganic parts with density less then 800 kg/m^3 come to upper layer and removed be special device. Neutralization of water solution from bacteria

Hydraulic mixing system

and viruses is made in tube sterilization unit during 1 hour at 70C^o temperature.

Using pipe water solution is transported to closed tank which serves as accumulation vessel for sterilization. From that tank water is fed into the tube sterilization device equipped with heat exchanger at inlet stage. Water heating is made by heat exchanger and kept in tubes for a required period of time. In that way water solution is circulated for in hour in a closed circle consisting of accumulation vessel – pump – sterilization unit. During the heating in tank water solution density decreases to 850 kg/m^3 that makes

Gas holder

Working principle

Substrate separation system

Inorganic particles detachment with higher density more effective. In order to perform this process water flow is changed at an angle 90 degrees hence accumulating small heavy at the tank bottom. These particles are discharged with the help of screw discharger that is installed at the bottom of the tank.

Prepared water solution of organic substances acquires quality of nutrient substrate for bacteria. After sterilization stage substrate pumped to hydrolysis reactor for 8-10 days retention time. In hydrolysis reactor special temperature conditions secured, the humidity is increased and pH level is carefully controlled. From the hydrolysis reactor substrate is supplied in doses to digester, that is very significant factor for bacterial balance preservation. Biogas accumulated in outer bag gas holders made of strong and tensile material. The main condition for digestion is substrate temperature 25-28 C^{o} and complete mixing. That is why tank reactor is equipped with wall heating system and hydraulic mixing system.

Substrate contains simple alcohols and acetate, which are soluble in water. Produced substrate loaded under the pressure to digester where final 30 days stage of waste recycling into biogas and organic fertilizer takes place.

Required conditions for digestion are constant temperature of substrate in the range of 36-38 Co, even and proportional substrate loading within whole digester square. Substrate supply to digester is made 8-12 times per day in a program time mode with the help of pump. Digester is a gas proof and hermetically sealed tank made of reinforced concrete. In order to maintain even temperature its internal side equipped with bottom and walls heating system. Such system passes through compulsory hydraulic testing. In order to prevent heat losses the outer side of digesters walls insulated. Mechanical mixer is inside the digester and ensures complete and careful mixing. Fermented biomass discharge takes place with the same periodic as loading. Biogas plant control is made by central program module in a time-programmed mode in accordance with limit sensors values.

Produced biogas collected to the gasholder. Gasholder is can be used as gas proof cover of the digester and execute the function of gas storage orto be performed as a outer bag gasholder. Gasholder membrane is ultraviolet and ozone resistant and has low throughput of biogas. The gasholder material is resistant to fire and is very tensile. Gas extraction is made by pipeline, which equipped with automatic condensate discharge unit and safety devices which secure gasholder from excess pressure. All devices work on limit sensors data. From the gasholder biogas is continuously fed to the co-generation unit or biogas treatment system. Digested biomass directed to separation unit. Mechanical separation unit works 8-12 times per day in a time-programmed mode and detaches digested biomass to solid and liquid fertilizer.

Automatics

Treated substrate after biogas plant directed to the separation unit. Mechanical separation unit operated in a program mode and detach liquid and solid bio-fertilizer fraction. Bio-fertilizer can be directed to packing and granulation line.Biogas plant work is visualized at central control room monitor. The control room is equipped with central control unit, which allows switch of any biogas plant module into automatic or manual mode with local or remote control.

Main scope of equipment

No	Equipment	Description	Quantity
1	Mixing equipment:		
1.1	Horizontal paddle mixer (motor drive 1 unit included) MG-04.00.000.	N=5,5 kW, n=11r/min	3
1.2	Horizontal paddle mixer (motor drive 1 unit included) MG-05.00.000.	N=5,5 kW, n=11r/min	1
1.3	Hydraulic mixing system	N=7 kW,	3
2	Substrate separation unit:		1
2.1	Frame	profiled iron	1
2.2	Separator (motor drive 1pc., vibrator 1pc.)	Q=40 t/h,N=7.5 kW	1
2.3	Auxiliary metal structures	profiled iron	1
3	Gas conditioning unit:		1
3.1	Gas filter		1
3.2	Gas flow meter	Qmax= 600 m^3/h	2
3.3	Compressor	N= 5,5 kW,	2
3.4	Emergency valve	Pmin= 1 kPa - 20 kPa	2
3.5	Manometer radial execution	0-0,6 bar	4
3.6	Angle thermometer	0.100°C, G1/2, L=63	3
3.7	Boll gas valve	Dy 80	3
3.8	Gas analyzer	CH_4, CO_2, H_2S	1
3.9	Pressure regulator	Pmax = 1 bar	1
3.10	Supporting and auxiliary structures	Stainless steel	
3.11	Piping	Stainless steel	
4	Heat supply station:		1
4.1	Heat exchanger	Q=500 kW,	1
4.2	Surge tank	V=500 L	1
4.3	Electrical boiler	Q=220 kW	2
4.4	Circulation pump	Q=30.5 m^3/h,	1
4.5	Circulation pump	Q=16.1 m^3/h,	1
4.6	Circulation pump	Q=12.5 m^3/h,	1
4.7	Circulation pump	Q=44.5 m^3/h,	2
4.8	Temperature control valve	Dy50,U=24v	1
4.9	Thermometer	T=0..120 C	3
4.10	Adjustable valve	3.5 bar	1
5	Automatics:		1
5.1	Automatics station		1

5.2	Level sensor	P=0…0.6 bar	9
5.3	Foam level sensor		9
5.4	Temperature sensor		9
5.5	Substrate excess pressure relay		2
5.6	Heating circuit temperature sensor		6
5.7	Control valve		1
5.8	Pressure sensor	P=0 0.1 bar, 4-20 mA	1
6	Electric equipment:		1
6.1	Light signal device		1
6.2	Distribution box with counter		1
6.3	Distribution box		1
6.4	Starting box		1
6.5	Lighting panel		1
7	Air supply system:		1
7.1	Compressor	P=7 bar,	1
7.2	Compressor	Q=100 m3/h,	1
7.3	Rotameter	1-10 m^3	3
7.4	Air blower	N=0.75 kW	3
7.5	Manometer	P=0…0.4 bar	3
7.6	Piping end fitting	PVC, stainless steel,	set
8	Gas holder:		2
8.1	Gas holder		2
8.2	Cover dome		2
8.3	Air blower	16 A, 0,5 kW	2
8.4	Emergency valve	DN 150, 25 m^3/h	2
8.5	Excess and minimum pressure valve		2
8.6	Dome level sensor		2
8.7	Mounting system	set	2
8.8	Inspection hole		2
8.9	Accessories		
9	Co-generator:	Capacity =1100 kW Capacity =700 kW	
9.1	V-engine		2
9.2	Generator	400 V	2
9.3	Power distributor		2
9.4	Heat exchanger water-water		2
9.5	Heat exchanger combustion products-water		2
9.6	Gas and fire alarm system		2
9.7	Gas pressure amplifier		2
9.8	Sensor system		2
9.9	Muffler		2
9.10	Gas piping with stop valves		2
9.11	Cooling system		2
9.12	Sound proof container		2

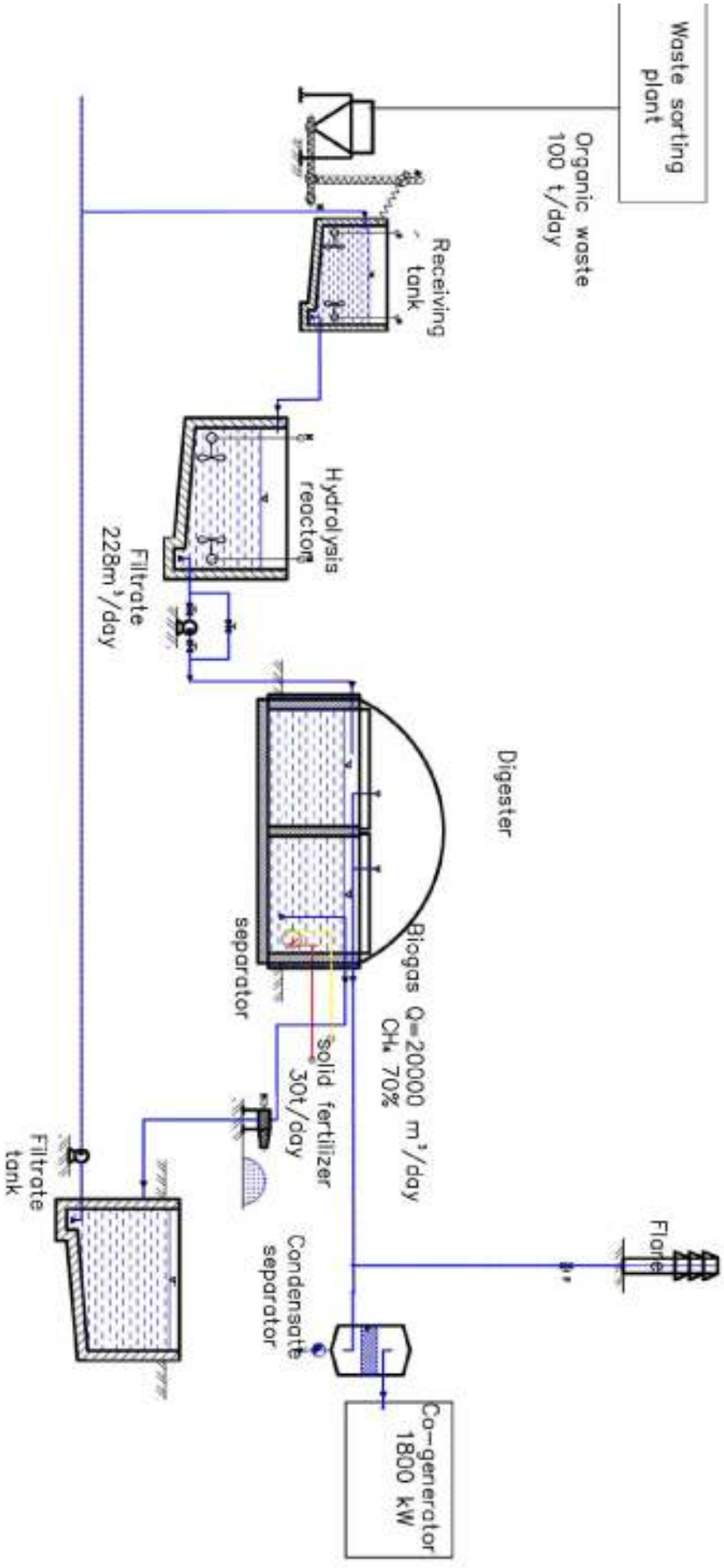
Scope of facilities

No	Item	Type	Qu-ty	Materials
1	Preliminary tank 300 m^3	Reinforced concrete structures	1	Concrete, reinforcing steel ø 8-12, embedded steel parts.
2	Hydrolysis reactor 300 m^3	Reinforced concrete structures	3	Concrete, reinforcing steel ø 8-12, embedded steel parts.
3	Digester 2400 m^3	Reinforced concrete structures	3	Concrete, reinforcing steel ø 12-25, embedded steel parts.
4	Open tank for digested biomass 300 m^3	Reinforced concrete structures	1	Concrete, reinforcing steel ø 8-12, embedded steel parts.
5	Utility and service building	Concrete base, walls from concrete slabs and bricks	1	Concrete slabs, ceramic bricks, concrete bridges, concrete solution.

Scope of documentation

Explanatory note Statistic calculation
Drawings Layout and transport Architectural solutions Concrete structures Wooden structures Metal structures
Drawings Gas supply Air supply Water supply and sewage Ventilation and heat supply
Drawings Production technology
Drawings Power equipment Illumination and protection facilities Plant automatics
Start-up and adjustment instructions Plant schedule Operational instructions

Scheme


Waste sorting plant
Organic waste 100 t/day
Receiving tank
Hydrolysis reactor
Filtrate 228m³/day
Digester
separator
Biogas Q=20000 m³/day CH₄ 70%
Solid fertilizer 30t/day
Filtrate tank
Flare
Condensate separator
Co-generator 1800 kW