BIOGAS IS AN ALTERNATIVE ENERGY SOURCE

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ANNOTATION

The biogas plant is currently a characteristic element of modern, waste-free production in many areas of agriculture and the food industry. If the enterprise has waste from agriculture or the food industry, there is a real opportunity with the help of a biogas plant not only to significantly reduce energy costs, but also to increase the efficiency of the enterprise, to get additional profit.

For a number of enterprises, obtaining biogas can partially solve not only the energy problem, but also the environmental and economic one. This problem is especially relevant for agriculture, the food industry, and utilities, where there is a large amount of organic waste. Biogas production equipment makes it possible to obtain combustible gas directly at enterprises, burn it in the boilers of the enterprise to produce industrial steam or use it for other needs.

KEYWORDS

Methane, bacteria, temperature, biogas, psychrophil, mesophil, thermophil, climate, bacteriologic, effluent, liquid, biowaste, biopreparation, energy.

Now, at a time of rising energy prices and disappearing oil and gas reserves, alternative power sources are becoming increasingly widespread. Biogas has become one of the fuels used to generate electricity.

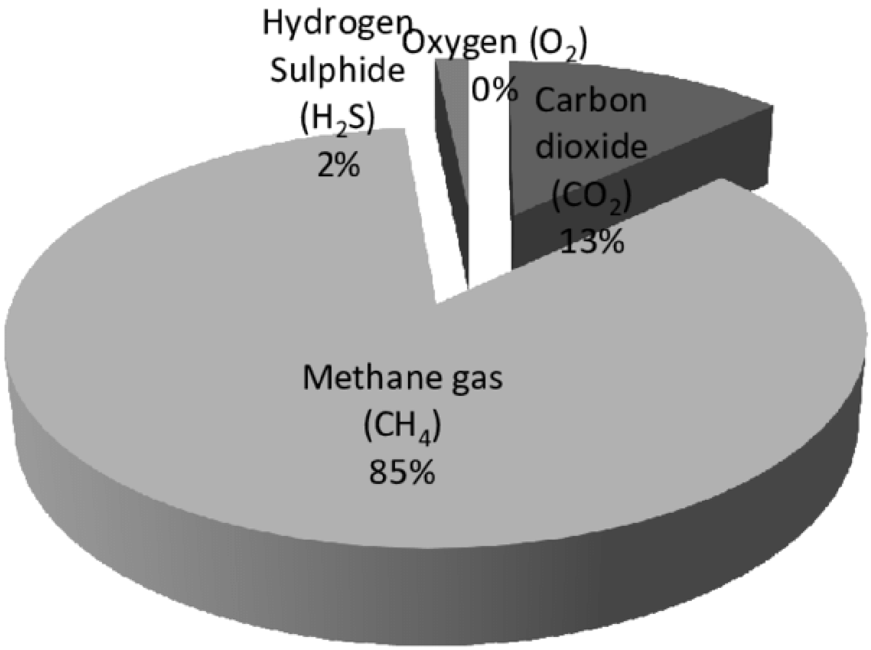
The growth of greenhouse gas emissions, the increase in water consumption, its pollution, the depletion of land and reserves of natural energy resources force us to look for new sources of energy. One of them is biogas technologies.

Biogas energy is a reliable and cost-effective alternative to mainline natural gas and centralized energy supply, as well as a source of cheap, economically clean organic fertilizers comparable in organic value to complex fertilizers. The importance of this factor will increase with the growth of gas tariffs and the associated increase in the cost of mineral fertilizers.

This problem is relevant today and the process of processing organic waste has great practical value, both for the economy and for scientific progress in general.

The composition of biogas.

Biogas is a common name for a combustible gas mixture obtained by decomposition of organic substances as a result of an anaerobic microbiological process (methane fermentation).



Depending on the type of organic raw materials, the composition of biogas may vary, but, in general, it includes methane (CH_4), carbon dioxide (CO_2), a small amount of hydrogen sulfide (H_2S), ammonia (NH_3) and hydrogen (H_2).

Since biogas consists of 2/3 of methane, a combustible gas that forms the basis of natural gas, its energy value (specific heat of combustion) is 60-70% of the energy value of natural gas, or about 7000 kcal per m3. 1 m3 of biogas is also equivalent to 0.7 kg of fuel oil and 1.5 kg of firewood.

Raw materials for biogas production.

Modern technologies make it possible to process any kind of organic raw materials into biogas. These are manure, poultry manure, grain and silage after-alcohol bard, beet pulp, fish and slaughterhouse waste (blood, fat, intestines, etc.), household waste. Dairy waste (salty and sweet whey) and juice production enterprises (fruit, berry, vegetable pulp, grape pomace), technical glycerin from the production of biodiesel from rapeseed are also used. It is possible to produce biogas from potato processing waste (peelings, skins, rotten tubers, etc.), various energy crops (silage corn, rapeseed, sunflower, oats, sugar and fodder beet together with tops, cereals), as well as grass silage, a mixture of clover with other herbs, etc.

The quality of raw materials is characterized by humidity (the lower it is, the better), biogas yield and methane content in it (the higher, the better). On average, a ton of cattle manure produces 50-65 cubic meters of biogas with a methane content of 60%, from various types of energy plants — 150-500 cubic meters with 70% methane.

The maximum amount of biogas - 1300 cubic meters with a methane content of up to 87% — can be obtained from animal fat.

When using biotechnologies for processing waste from livestock and poultry farms, agricultural enterprises, you are always provided with raw materials and it is not difficult to collect it. Biogas plants on manure are the simplest in design. Microorganisms involved in the fermentation process enter the manure already from the intestines of animals, so they do not need to be added to the waste to accelerate the decomposition process (as, for example, in the case of some types of plant raw materials). It is also not necessary to equip the installation with a hydrolysis reactor (as with bird droppings).

Biogas plant installation.

A biogas plant is a complex for processing agricultural, industrial and household waste, cleaning the enterprise from dirt, generating electricity, heat and high—quality fertilizers. After purification of biogas, biomethane is obtained, which is used for lighting, heating and refueling cars.

Biogas plants are a comprehensive solution for the disposal of waste from the food industry, the agro–industrial complex, the production of heat, electricity, and fertilizers. The production of methane in a biogas plant is the realization of a biological process.

Pic. 1. Biogas plant

Since each installation, as well as each client, has individual requirements, a bioenergy station is created using the modular construction method.

This makes it possible to find individual and flexible solutions, from a small stop to computer-controlled systems with a capacity in the megawatt range.

Most livestock farms construct biogas plants to generate electricity and heat. From 1 cubic meter of biogas during combustion in a cogeneration plant (equipment for combined electricity and heat production), it is possible to produce 2 kW/ hour of electricity. The output of the biogas itself depends on the type of raw materials used. For example, 50-65 cubic meters of biogas are formed from a ton of cattle manure, 100-500 cubic meters from various types of energy plants. Usually BP produces much more electricity (about 1.5–2 times) than the company needs, respectively, the surplus can be sold. For example, a large dairy farm for 4 thousand cows, using a biogas plant, produces 12 MW of electricity per day, while it consumes only 6-7 MW. The biogas system itself is very economical: it consumes only 10-15% of the energy produced in winter and 3-7% in summer. And the heat generated by it is enough not only to heat a cowshed, pig farm or poultry house, but also for current household needs: steam, boiled water, drying straw, seeds, firewood, etc. It is advantageous to put greenhouses near biogas plants — excess heat can be used to maintain the desired temperature. In the cost of greenhouse cucumbers, tomatoes, flowers, 90% of the costs are heat and fertilizers. It turns out that near the biogas plant, the greenhouse can work completely free of charge, with the highest possible profitability.

It makes no sense to fertilize the soil with ordinary manure or other waste — they should "ripen" within three to five years. If you produce biogas, fertilizers that are ready for use are obtained at the same time — this is a co-product of any bio-installation. In ordinary waste (for example, manure), minerals are chemically bound to organic matter, and plants cannot "digest" them. In fermented biomass, minerals are separated from organic matter, so they are easily digested. In addition, an environmentally friendly product is obtained, devoid of nitrites, weed seeds, pathogenic microflora, and specific odors. As practice shows, when using liquid or solid biofertilizers, yields increase by 40-50%. Moreover, the consumption is from one to five tons instead of 60 tons of untreated manure for 1 hectare of land.

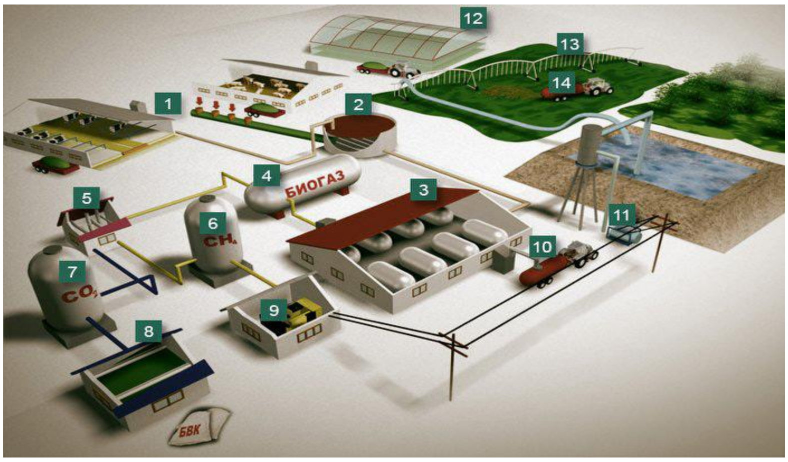
Functional purpose of biogas plants.

1. Production of liquid biofertilizers in daily volumes of approximately different daily loading volume of prepared raw materials.

2. Biogas production (65-75% methane).

The main product of a biogas plant in its value is biofertilizer. It is the main one for conducting "ecological" agriculture. Products grown only with the use of biofertilizers are environmentally friendly and have a market value significantly higher than products grown using various artificial chemical fertilizers and pesticides. The yield of the expressed crops with the use of biofertilizers is 20-100% higher than without them.

The principle of operation of the biogas plant.



Pic. 2. Operation of the biogas plant

1. Livestock buildings equipped with a self-melting manure removal system.

Harvesting and delivery of organic raw materials intended for the production of biogas is carried out directly in livestock buildings equipped with self-melting manure removal systems.

2. The receiving container in which the raw material mass is prepared for processing.

Storage of the mass, bringing the indicators of raw materials in accordance with the established norms is provided in the receiving tank.

3. Biogas plant.

Biogas production is carried out in a biogas plant - a microbiological process during which organic raw materials are decomposed in the absence of oxygen. The central elements of the process are fermentation products and the biogas produced itself.

4. A tank for collecting biogas (gas tank).

The gas produced in the biogas plant is stored in a separate gas tank for a long or short term.

5. Carbon dioxide separation column.

The gas produced in the biogas plant consists of 30-45% carbon dioxide (CO_2) and 55-70% methane (CH_4). With the help of a separation column, biogas is separated into technically pure carbon dioxide and methane.

6. Gas tank with methane.

The methane separated by means of a separating column enters a separate gas tank and is stored in it for a long or short term. With the help of this gas tank, it is also possible to equalize the consumption of methane.

7. Gas tank with carbon dioxide.

Carbon dioxide separated by means of a separation column enters a separate gas tank and is stored in it for a long or short period. From the gas tank, carbon dioxide enters the chlorella algae cultivation site, where it participates in the metabolic processes of its cells.

8. The site where the unicellular green algae chlorella is cultivated in order to obtain a biological vitamin concentrate.

At this site, the cultivation of chlorella algae and the production of biological vitamin concentrate from it is provided, which can be introduced into any animal feeding regimes and used for the manufacture of granular compound feeds.

9. Gas generator.

Methane from a separate gas tank enters the gas-burning system and is used as fuel to generate energy and heat for greenhouses.

10. Removal of the nitrogen fertilizers obtained and their removal to the fields.

The sediment formed in the reactor is removed approximately twice a year and applied to the soil as fertilizers. The volume of sediment depends on the volume of processed biomass, the content of solids in the base raw materials.

11. Electric pump.

Automation controls the on/off of the electric pump.

12. Greenhouse heated by biogas.

One of the most expedient and economically viable ways of using biogas is heating of greenhouse facilities.

13. Self-propelled circular irrigation system.

The multifunctional equipment of the irrigation system ensures the application of fertilizers, germination of crops, irrigation and regulation of the degree of mineralization of the soil.

14. Introduction of exported nitrogen fertilizers into the soil.

Nitrogen fertilizers produced in biogas plants are the basis of "environmentally friendly" agriculture. Crops grown with the use of biological fertilizers have a higher market value.

Thus, biogas production appears to be the most attractive bioenergy sector for investors. Biogas is not only one of the most promising renewable energy sources today, capable of providing heating and lighting for various agricultural facilities, daily operational needs of farms. The biogas plant allows you to create a closed waste-free production and provides a stable income.

Reliability and safety when working with a biogas plant.

The main components of the installation are made of polymers operating at constant temperature and pressure. They are not subject to corrosion, and therefore almost eternal. Components subject to wear, such as the bellows of the holder, mixers, heaters can easily be replaced in case of failure.

The hydraulic and pneumatic system of the biogas plant is designed in such a way that protection against exceeding the permissible pressure is embedded in the reactor circuit itself, and therefore absolute reliability and trouble-free operation is ensured.

Conditions required for the operation of a biogas plant

To place the installation, you need a flat area of 15-30 sq.m. To install the reactor, you need a litter of boards. To prepare the substrate, 100-300 liters of water are needed daily, preferably with a temperature of about 25C. For the automation to function, a power supply with a voltage of 220V and a maximum current of 5A is required. For the operation of electric heating, another current is added for heaters at the rate of 2.7 A per 1 cubic meter of reactor volume. A lagoon (a pit with concreted walls) is needed to collect biofertilizers. You can also use a pit with walls, reinforced boards, branches or in another way, but some of the biofertilizers will seep into the soil. There will be no harm from this, but there will only be less biofertilizers to use.

An example of calculating the parameters of a biogas plant for an order.

Let's say that there are 3 cows, 10 pigs and 30 chickens on the farm. According to generally accepted statistics, a cow per day allocates up to 36 kg per day. Manure with a humidity of 65% and a density of 950kg./ cubic meter. The pig secretes 4kg. Of manure with a humidity of 65% and a density of 600 kg. / cubic meter. The chicken emits 0.16 kg. Litter with a humidity of 75% and a density of 1100kg./ cubic meter. The finished substrate should have a humidity of about 90%. Provided that you collect all the waste, it is 108kg every day. cattle manure, 40 kg of pig manure and 3.2 kg of chicken manure. Calculations show that it will take 354 liters of water per day to prepare the substrate. The resulting substrate will have a density of 940 kg. / cubic meter and a volume of 537 liters.

The fermentation cycle (optimal duration) will be about 15 days. The reactor of the biogas plant must be 80% full. Therefore, the required volume of the reactor will be 10 cubic meters. Since it is unlikely that it will be possible to collect all the waste without losses, an 8 cubic meter reactor will be enough. The volume of the preparation tank should be one third larger than the daily volume of the substrate, so that the substrate can be mixed without danger of splashing, i.e. about 700l.

The total power of electric heaters will be 4.8 kW. In the cold season, it will work up to 6 hours a day. Taking into account the costs of automation and mixing, this will be about 48 kW/h. per day, or 1440 kW / h. per month. These are the worst possible conditions. In fact, such consumption is possible only in winter. In addition, these calculations do not take into account the reactor's own heating as a result of fermentation. In fact, in the cold season, 1.5-2 times less electricity will be used to heat the reactor. In the warmer months, electricity costs will be significantly less.

Such a biogas plant will produce about 10-14 cubic meters of biogas per day. It will also produce about 430 liters of liquid biofertilizers per day. The standard for the use of biofertilizers is 400-2000l./ha for the growing season. This means that this installation will provide fertilizers for a year from 80 to 400 hectares of acreage.

Advantages of biogas plants

1. Availability of raw materials for the operation of the installation.
2. Continuity of the technological cycle.
3. Technological flexibility: the use of biogas makes it possible to obtain several types of resources simultaneously – gas, motor fuel, electricity, heat.
4. Territorial flexibility: when using a compressed gas compression and transportation system, cogeneration plants can be located in any area and do not require the construction of expensive gas pipelines and network infrastructure.

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