

TECHNOLOGIES BIOGAS IN FERTILIZERS MANUFACTURE

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The basic biotechnologies of reception of biogas and organic fertilizers from waste products are generalized and synthesized. The basic technical and economic parameters of biogas installations are given.

Key words: biogas, a biogas reactor, organic fertilizers.

The introduction. One of possible ways of reception of energy from a biomass is her in biogas installations. As initial raw material all kinds of organic waste products can be used practically. First of all it is waste products of an agriculture of an animal and vegetable. It can be also waste products of the industry (sugar, dairy, breweries), and as stations of clearing of municipal sewage. Other opportunity is use of natural processes, having a place on ranges and dumps of firm household waste products (ТВО).

Problem. The technology methane allows to receive besides an energy source as biogas high-quality fertilizers and vitamin fodder additives and in essence is without waste. Therefore in the advanced industrial countries necessity of a construction of biogas installations (BI) is defined by three factors: reception of an energy source, agricultural fertilizers and the decision of environmental problems. Densities of these factors differs for the different countries and depends on the prices for energy carriers and fertilizers, and also the ecological legislation of the country and a degree of support of renewed energy sources.

The analysis of last researches and publications. It is executed synthesis most technologies and receptions of biogas and fertilizers from organic waste products [1,2,3], patent search of inventions, the equipment and reactors [4] is carried out. On the basis the analysis the following are formulated.

The purposes of researches: to generalize and synthesize the basic directions of technological process of reception of biogas and organic fertilizers from waste products of manufacture, to give the recommendation for creation designs biogas reactors and the equipment.

Results of researches. Biogas installation works by a principle anaerobnogo sbragivaniyu (without access of oxygen). Liquid biowaste products, act on self-floatable system navozoydaleniu in reception capacity or are pumped over by faecal pumps on the pipeline. In reception capacity there is an initial preparation of raw material, biowaste products are lead up to the certain humidity of a consistence by перемешивания, also there is an initial fermentation of excrement. Further there is a loading in reactors (a bioreactor, the fermenter), is added that quantity which was unloaded before loading. The bioreactor is completely the tight tank, processed by an antiacid covering, and with, also bioreactors teploezoleryesu, for

each biogas installation the layer of warming pays off individually it depends on climatic conditions of region where will be biogas installation is under construction. Sbragevanye cattle-breeding drains, waste products of massacre, or bards occurs in bioreactors essentially executed on a principle of tight capacity. Bioreactors can be executed as from monolithic ferro-concrete, and steel capacities. Works by a principle of a continuous cycle т.е the prepared substratum in bioreactors daily acts, and as is unloaded from a reactor advanced (raw material) on an output biofertilizer. Management of work of all biogas station is made on commands from central program the module in a program -time mode and on gauges of limiting values. In biogas installations the modular principle that enables installation to function in a complex involving all reactors is applied, and in a case of necessity mutually to replace or exclude separate reactors that enables to adjust technological process, in a case of an emergency to make repair not stopping completely all technological module. Applying a modular principle at capacities it is easily possible to include number bioreactors in a modular complex. In a reactor for effective work of bacteria the certain temperature is supported. Depending on the chosen technological process their three: Psehofelnyu - the temperature mode is supported working temperature 20-25C; Mezofelnyu - the temperature mode is supported working temperature 25-40C; Termofelnyu - the temperature mode is supported working temperature from above 40C. Hashing inside a reactor is made in several ways. Mixers, in some cases apply pneumatic mixers. Service life of a reactor more than 25-30 years. The ambassador sbragevanyu on an outputit turns out two products - biogas and nitric fertilizers. Mixers, in some cases apply pneumatic mixers. Service life of a reactor more than 25-30 years. [3,4,5], the ambassador sbragevanyu on an outputit turns out two products - biogas and nitric fertilizers. Assignment of biogas occurs on the pipeline which is equipped with devices of automatic tap of a condensate and safety devices which protect gazgolder from excess of allowable pressure. Devices work on gauges of limiting values. The system is automated, also can work in manual mode. From gazgolder there is a continuous submission of biogas on installation or system of clearing of gas. Cogeneraciu represents process of joint development manufacture electric and thermal energy in a uniform thermodynamic cycle, using one kind of fuel. Cogeneraciu simultaneously meets the requirements by many kinds of energy and it can be used almost by any manufacture, processing or in sphere of municipal services. Using natural gas or biogas, from cogeneraciu the equipment it is a lot of purchases - financial benefit, ekology the least parameter of emission CO₂, high ability, delivery of fuel on pipes etc. Made energy it is possible to use as for heating, and cooling. During work of power station the most part of hot temperature is deduced in an atmosphere through circulation or through smoke gases. The most part of this temperature it is possible to return and rationally to use. Thus, it is possible to increase efficiency of power station by 30-50 %, and efficiency cogeneraciu up to 80-90 %. At cogeneraciu the equipment is greater advantages: - use of energy of the most effective fuel; - reduction of quantityof emissions; - essential reduction of charges by manufacture that raises competitiveness of the enterprise; - an opportunity to offer consumers, including to

inhabitants, the cheapest energy; - The least losses of energy in децентралізованній to system; - birth of a competition in sphere of manufacture of energy; - rather short time of recovery of outlay of the equipment. Received in process cogeneraciū energy can be used: - heatings of water for heating and for reception hot for using; - in manufacture pair; - in manufacture of a cold; - in technological processes, using warmly departing gases. The received energy can be used: - for maintenance of process of own manufacture; - to sell to the licensed enterprises engaged in distribution or transfer of the electric power. Cogeneraciū carry out, applying: - engines of internal combustion; - Steam and gas turbines; - elements of fuel; - microturbines. Tregeneracey - the combined manufacture of the electric power, and colds. The cold can be made: - in refrigerating machines of compressor type, for a drive use the electromotor; - in refrigerating machines type. Tregeneracey it is favourable that effectively enough enables to use not only in the winter - for heating, but also in the summer - an air conditioning in hotels, shopping centers, hospitals etc. Tregeneracey apply as in various industrial branches, where cold water (temperature from 8 up to 14 C), for example, at factories of processing of milk and is necessary. Extraction of such water is enough labour-intensive process in the summer. Use tregeneracey enables the equipment on generating to work during all year, accelerating a recoupment of investments. Advantages tregeneracey: - high efficiency; - reliability; - the low cost price of the made energy; - ekology; - Independent power supply [4,5]. Process of allocation of carbonic acid of biogas occurs in desorber, CO₂ - (carbon) - colorless gas with slightly sourish smell, is not toxic. Is the basic source of carbon for plants. In a liquid condition it is stored in cylinders under a high pressure 65-70 Atm., in firm - represents so-called dry ice. Are used in hothouses, vegetable storehouses, the food-processing industry (as preservative, or for aerated water and lemonades), freezing installations, fire extinguishers. It is possible to use carbonic acid for hlorella (vitamin concentrate) and as the biological vitamin additive in a diet of animals. But as one of variants it is possible to put the compressor to fill cylinders and to sell as a product to hothouse facilities economy, and the enterprises of the food-processing industry. The advanced substratum after installation moves in a separator. The system of mechanical division works in a program-time mode and divides shares the rests of fermentation after a bioreactor on firm and liquid biofertilizers. Transportation of firm fraction of biofertilizer is made by a loader, and transportation of liquid fraction - with the help of the pump and the pipeline in a lagoon for storage. Manure (KRS or pork) is not fertilizer. The basic part of manure constantly collects near farms in plenties. That manure became fertilizer should pass the long period of time (6-7 month). And the longer they lay, the lose nutrients more. Therefore there is a need requirement for their effective processing. The biogas technology accelerated allows to receive with the help anaerobnogo sbragevaneu the natural biofertilizer containing biologically active substances and microcells. The basic advantages of biofertilizers after biogas installation in comparison with usual manure and mineral fertilizers: - The maximal preservation and accumulation of nitrogen; - absence of seeds of weeds;

Absence of pathogenic microflora; absence of the period of storage; - Stability washing away from ground of nutritious elements; - ecological influence on ground. Biogas installation is active system of clearing, any other systems of clearing consume energy, instead of make. Products of any system of clearing still need to be sold, and the product of biogas installation is necessary for the enterprise. As process occurs without access of air (bioreactors are completely tight) smells at processing are not distributed. Biogas installation allows to clean remove a great bulk of polluting organic substances, therefore after installation waste products have no disgusting specific smell. After usual systems of clearing waste products and remain waste products. After biogas installation are high-quality fertilizers. For the new builded enterprises the economy will be enormous. You see it is not necessary to stretch a gas main, a transmission line to establish reserve diesel generators and to build tanks for waste products. Due to accelerated sbragevanyu the volume of lagoons can be reduced twice. The economy of capital expenses will make 30-40 % from cost of biogas installation.

For processing a plenty of waste products of the vegetative and animal origin formed in facilities economy and personal farmsteads of the population it is necessary to use biogas installations, process of processing in which occurs from 7 about 20 days. During processing in biogas passes up to 40-50 % of organic substances on weight. *Перебродившая* the weight turns to the non-polluting fertilizer deprived of pathogenic microflora, eggs *гельминтов*, seeds of weeds, nitrites and the nitrates, specific faecal smells. These fertilizers contain nitrogen as salts of ammonium, mineral phosphorus, kaley and others necessary for a plant biogenic micro-and macrocells, biologically active substances, vitamins, amino acids, *гуминоподобные* connections, ground. The average output of biogas from 1 m.kub makes capacities of a bioreactor 2,0 kub.m. One kub.m biogas is equivalent on to ability 0,6 kub.m. Natural gas, to 0,7 litres of black oil, 0,4 litres of kerosene, 3,5 kg of fire wood also makes 5,5 - 6,5 tys.ккал/ kub.m. Biogas installations is a simultaneous decision not only problems of agrochemistry and power, but also improvement of general ecological conditions and social conditions of inhabitants of village. The raw potential for biotechnologies includes vegetative potential, agricultural and household waste products. The given calculation definition of raw potential on manure of large horned livestock, pigs and *пометы* birds, as having a primary share in the general raw potential and more convenient to processing on a place. Per day from each head KRS it is formed 4 kg of dry waste products or 40 kg of waste products at humidity of 90 %. From each head of a pig - 1 kg of dry substance or 10 kg of waste products at humidity of 90 %. From everyone 100 heads of birds it is formed 14 kg of dry substance or 25 kg at humidity of 56-60 %. In calculations of capacity and quantityБУ the principle of the minimal initial expenses for their construction with use of auxiliaries is put (the receiver of initial raw material, a grinder, the pump, a sediment bowl, *gazgolder*, the compressor) for several reactors that will allow to increase capacity BU gradual introduction in build new reactors and to be limited to the maximal capacity of a reactor 50 kub.m.

Table 1. A parity of capacities of biogas installations between volumes of reactors and presence of cattle in facilities economy

Volume of a reactor, kub.m.	Quantity(amount) of animals and birds		
	KRS, heads	Pigs, heads	Hens, 100 heads
5	10	40	16
10	25	100	34
25	60	250	90
50	125	500	170
100	250	1000	340
200	550	2200	700

The output of biogas for day from 1 kub.m. makes capacities of a reactor 2,0 kub.m. Quantity of commodity biogas - 65-75 % from his full output as other part is spent for heating of a biomass. We accept quantity of commodity biogas of 70 % from a full output. Ability 1 kub.m. biogas is equivalent 0,71 black oil or diesel fuel. The output of dry weight of fertilizers makes 0,08 from loading manure at initial humidity of 90 %. Densities of damp manure is equal 0,8 t/ kub.m. Daily updating of initial weight of 10 %. We accept cost of received fertilizer on dry weight equal usual on the consumer market mixes - 0,7 grn for 1 kg or 700 grn for ton. The positive part of the project makes for each volume of installation of item. 8 (sm. table 2). The pure effect can be received at the account of annual charges, depreciation charges and working costs.

Table 2. Parameters effecting biogas installation

№	The name of parameters	Volume of installation, kub.m.					
		5	10	25	50	100	200
1	Volume of received Φ «y.n/gas, kub.m. day	7,0	14,0	35,0	70	140	280,0
2	The same, tus. kub.m. per one year	2,555	5,110	12,775	25,550	51,10	102,2
3	Quantity(amount) replaced ДТ, tus.l	1,79	3,58	8,94	17,9	35,77	71,5
4	The same in tus.grn	17,18	34,37	83,14	171,84	343,4	686,4
5	Volume of dry weight of fertilizers per day, t	0,036	0,072	0,18	0,36	0,72	1,44
6	The same total per one year, t	13,14	26,28	65,7	131,4	262,8	525,6
7	The same in tus.grn	9,38	18,39	45,99	91,98	183,96	367,92
8	Total sum of incomes, tus.grn	27,18	52,76	129,13	263,82	527,36	1054,32

These parameters characterize perfection of design development and a mode of operation of installations, they can be unequal even inside volumetric lines. Therefore their component it is accepted on the average 20 % from capital expenses. Economic calculation is made on the integrated parameters: at the

minimal productivity of installation, at cost of manufacturing of an individual pre-production model, without taking into account perfection of the "know-how". Actually economic efficiency will be higher under the following factors: - шлам the ambassador сбраживання it is possible to use not only as fertilizers, but also for reception of vitamin concentrate (BVC) as the additive in forages. At use shlam for reception BVC the economy of forages makes 25 %. In opinion of scientists, the effect from use shlam in cormoproevozdstve in 2 times is higher, than as fertilizer. - at replacement of technology of stacking storage and manure losses of nitrogen in shlam are reduced on 20 %. Efficiency of this phenomenon in calculation is not taken into account - efficiency of influence on ground of bacterial sterilization and loss the weeds which are included in initial weight is not taken into account in calculations. - At methane the smell of manure and other initial raw material is eliminated. An estimation of the given effect in money terms to make difficultly, however it is necessary for taking into account. - at replacement of fuel with biogas harmful emissions in an atmosphere are eliminated and general ecological conditions is improved. While there is no exact economic estimation of this factor, but the quantitative estimation can be calculated. Replacement of liquid fuel with biogas (svinocomplexes on 3000 heads) will allow to prevent harmful emissions in an atmosphere: the not burned down fuel - 60 S/year; оксидов sulfur - 524,04 kg / year; carbon - 1236,72 kg / year; and nitrogen - 243,84 kg / year. It will improve ecological conditions of cattle-breeding facilities economy and integrated poultry farms. Even the integrated calculation by one kind of raw material and on two component of effect shows, that application of biogas installations expediently, economically and ecologically effectively [4,5]. Biogas installation on waste products svinocomplexes. Biogas installations on manure of animals are the most simple and have received a wide circulation all over the world. The equipment modular and if the enterprise plans increase of a livestock in the future it is possible to increase and capacity of installation. At use of biogas installation of the enterprise can reduce volumes of use or construction of lagoons in 2 times. Connections of organic chemistry in manure коллоидные, they interfere with evaporation of a moisture from a substratum. In biogas installation the quantity of organic chemistry decreases, and the weight is separated. In liquid fraction of organic chemistry practically is not present, and water from it easily evaporates. One sow with a loop at 20-24 pigs (weight up to 30 kg) gives per day approximately 14,5 kg of manure. The pig on откорме in weight from 30 up to 110 kg gives on the average 4,5 kg. For calculations of a daily output of manure matochnica it is used constant matochnica a livestock. It is economically expedient to establish biogas installation on svinocomplexes with an annual output of pigs not less 10 thousand pigs (500 sows). From ton of pork manure dry substance it is possible to receive 65 m³ of biogas. On cattle-breeding complexes it is the most favourable to transform biogas to the electric power and it is warm. Even if consumption of a complex are insignificant, the enterprise has additional technological lines which consume the electric power. But as it is possible to use gas and directly for burning, or to fill with biometane own motor transport. Biofertilizer - the organic waste products advanced in biogas installations turn to a

biomass which contains a significant amount of nutrients and can be used as biofertilizer. Forming at сбраживанни materials improve physical properties of ground, and mineral substances serve as an energy source and a feed for activity of soil microorganisms that promotes increase of mastering of nutrients by plants. The given biofertilizer contains a number of organic substances which bring the contribution to increase of permeability and hygroscopicity of ground, at the same time preventing erosion and improving the general soil conditions. Organic substances also are base for development of microorganisms which translate nutrients in the form which can be easily acquired by plants. Biofertilizers accelerate process of germination of a seed, raise their interest. Promotes faster plants, removing a stressful situation at change. Such organic fertilizers are effective at ground [4,5]. Biofertilizer also is good microbiological fertilizer. His entering helps ground to be restored after long-term use. The basic advantages of biofertilizers consists in preservation in easily acquired form practically all nitrogen and other nutrients contained in initial raw material. Significant advantage of biofertilizers before manure, in natural conditions, is that at сбраживанни manure, in natural conditions, that at sbragivaniy manure in biogas installations the significant part perishes is, pathogenic microorganisms and seeds of the weeds contained in manure. All equipment is supervised by automatic system, expenses of human work minimal. After 2-week training on installation the person without special skills as all systems and sites of biogas station are equipped with the equipment can work even, carry out operations on commands of system of automatics.

Table 3. Efficiency of installation for processing 20 tons / days

№	Characteristics	Dimensions	Values
1	Output of fertilizers	Tons / day	18
2	Output of biogas	m ³ / day	820
3	Output of carbonic acid	m ³ / day	120
4	Output of methane	m ³ / day	530
5	Output el.energy	Kw / hour	32
6	Output of thermal energy	Kw / hour	40
7	The charge of biogas on heating of reactors	m ³ / day	170
8	Current consumption	Kw / hour	14
9	The attendants	The operator CS/change	1
10	Volume of bioreactors	m ³	240

Conclusions. The raw potential for biotechnologies includes vegetative potential, agricultural and household waste products. Biogas installations on manure of animals are the most simple and have received a wide circulation all over the world. Biogas installations is a simultaneous decision not only problems of agrochemistry and power, but also improvement of general ecological conditions and social conditions of inhabitants of village. During processing in biogas passes up to 40-50 % of organic substances on weight. The biogas technology accelerated allows to receive with the help anaerobnogo sbragevaneu the natural biofertilizer

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ТЕХНОЛОГИИ ПРОИЗВОДСТВА БИОГАЗА В ЕНЭРГЕТИКЕ АПК

С.М. Уминский, Павлишин П.Н.

Ключевые слова: биогаз, биогазовый реактор, органические удобрения.

Резюме

Обобщены и синтезированы основные биотехнологии получения биогаза и органических удобрений из отходов агропроизводства. Приведены основные технико-экономические показатели биогазовых установок.

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Summary

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