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# MANUFACTURE BIOGAS ORGANIC FERTILIZERS FOR POWER APC

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*The country's energy security is heavily dependent on the degree of diversification of energy used to meet its energy needs. Ukraine has a great potential for biomass, which is available for energy use. The main components of the potential are agricultural waste and energy crops. Attracting this potential to energy production can satisfy about 13% of Ukraine's demand for primary energy. One of the possible ways of obtaining energy from biomass is its anaerobic digestion in biogas plants. Almost all types of organic waste can be used as the raw material for fermentation. First of all, it is an agricultural animal (manure) and vegetable waste. It can also be industrial waste (sugar, alcohol, milk, breweries), as well as municipal wastewater treatment plants. Another possibility is the use of natural processes of anaerobic digestion, takes place at landfills and landfills of solid household waste (SHW). Biogas plants on deer animals are the simplest and widely distributed throughout the world. Biogas installations is a simultaneous solution not only to the problems of agrochemistry and energy, but also to improve the overall ecological situation and social conditions of the villagers. For the processing of a large amount of plant and animal waste produced in farms and private homes of the population, it is necessary to use biogas plants, the process of processing of which takes place from 7 to 20 days. In the process of processing into biogas goes to 40 -50% of organic matter (by mass). Biogas technology allows accelerated production of anaerobic digestion of natural biofuels containing biologically active substances and trace elements.*

**Key words:** bioenergy, biomass, biogas, methane fermentation, biogas plant, reactor, landfill, biofuel.

**Introduction.** At present, the Energy Strategy of Ukraine for the period up to 2030 and the future perspective, along with other measures, will also be envisaged, and will provide significant modernization of power equipment for power plants and boiler houses, which requires large capital investments. In the near future, it should be oriented not only on new technologies, but all the existing ones in the heat power sector should be used to realize low-cost, fast-paying projects that can already give a noticeable energy saving effect and reduce greenhouse gas emissions. To such projects, after their feasibility study, biomass burning may also be included. The technological costs of using renewable energy resources are constantly being improved and the cost of the installed kilowatts is reduced. Energy security of a country depends strongly on the degree of diversification of energy carriers used to meet its energy needs [1,2].

**Problem.** Ukraine has a great potential for biomass, which is available for energy use. The main components of the potential are agricultural waste and energy crops. Attracting this potential to energy production can satisfy about 13% of Ukraine's demand for primary energy. The development of the bioenergy sector in Ukraine

should be consistent and well-grounded, taking into account possible impacts on the national economy and on the environment. A prerequisite for sustainable and economically sound use of biomass for energy needs is as accurate as possible its potential assessment. Only such an approach can avoid the possible negative impact on the economy and on the environment. The main components of the potential are agricultural waste and energy crops. Widespread attraction of non-traditional and renewable sources into the energy balance of the agrarian sector is a promising direction ensuring the reduction of the energy deficit and environmental protection. In non-traditional energy, processing of biomass (organic agricultural and household waste) with methane fermentation takes a special place to obtain biogas containing about 70% of methane and disinfected organic fertilizers. Extremely important in agriculture, where various amounts of fuel are consumed for various technological needs and the continuous need for high quality fertilizers, is the utilization of biomass.

**The purpose of research.** The transition to sustainable development is possible by providing a radical restructuring of the entire technology of management, which should be aimed at saving all types of resources, the use of renewable energy sources and reducing the negative impact of energy on the society and the biosphere.

**Research results.** Geographic, ecological conditions and the specifics of Ukraine's economy determine for her the use of biomass, organic household and industrial waste as one of the most promising areas of development in the use of non-traditional renewable energy sources. For the development of this area in Ukraine there is a wide range of bioenergy resources, regional conditions, the possibility of using various technologies and solving various economic tasks. The main source of biomass in Ukraine is agricultural waste and, first of all, straw of cereal crops. Another significant source of biomass in Ukraine is the pestle stock of livestock.

Table 1. **Potential of possible biogas plants in Ukraine**

| Livestock sector | Approximate capacity of the Ukrainian market, installation of methane tin 1000 м3 | Installed capacity, MW, thermal power | Hours of hours / year | Replacement of fossil fuels, million e / year | Capital expenditures, USD n.million. |
|---|---|---|---|---|---|
| Cattle | 2400 | 594 297 | 8360 | 0,56 | 480 |
| Pigs | 315 | 50 25 | 8360 | 0,0434 | 63 |
| Bird | 150 | 4483622 | 8360 | 0,0385 | 30 |
| Total | 2865 | 688344 | | 0,6419 | 573 |

Moreover, for cattle (cattle) and pigs, statistical data on livestock was used, and the amount of poultry was determined based on existing egg production data, based on the estimate that one chicken carries 250 eggs a year. Further on the special rules was calculated the output of manure for each group of animals, the amount of dry matter in manure (cattle - 20-22%, pigs - 9-12%, poultry - 25%) and the amount of organic matter in the dry residue (cattle and pigs - 80 - 85%, poultry - 75-77%). According to the indicators of the biogas output from 1 kg of organic matter introduced into the reactor, the biogas output for these three groups of animals is

determined. Such installations also perform the role of treatment plants, which reduce the chemical and bacterial contamination of soil, water, air. The technology of methane fermentation allows to receive in addition to biogas high quality fertilizers and protein-vitamin feed additives and are essentially non-waste. Therefore, in developed industrial countries, the need to build biogas plants is often determined by the decision of environmental problems. In Ukraine, a number of organizations possessing design and technical documentation for the construction of biogas plants of various sizes have experience in the development of biogas plants. However, for different, mainly economic reasons, these installations have not been implemented. The development of the market is restrained by two factors - the inaccessibility of the loan, and most importantly - the lack of private ownership of land and land banks. There are practically no major commercial biogas plants in Ukraine today. One of the first large biogas plants is now built at the pig farm of Agro-Oven in the village of Olenivka, Magdalinivsky district, Dnipropetrovsk region, within the framework of a technical assistance demonstration project provided by the Government of the Kingdom of the Netherlands. The reactors maintain a temperature of 32-34 ° C to meet the mesophilic bacterial process.

Table 2. **Maximum allowable processing costs for substrates**

| Limit costs when fermenting 60 days in Euro / tonne of raw mass | |
|---|---|
| Livestock (8% dry matter) | 0 |
| Bird droppings (50% dry matter) | 40 |
| Potato Bard (6% dry matter) | 0 |
| Fresh slopes of the lawn (18% of dry matter) | 14,10 |
| Herbal silage (35% dry matter) | 38,70 |
| Scarecrow (35% dry matter) | 42,70 |
| Corn silage ripe (35% dry matter) | 38,20 |
| Green rye silos (25% dry matter) | 24,50 |
| Winter wheat varieties (40% dry matter) | 37,50 |
| A mixture of plant wastes (CCM) (3.5% fiber, 65% dry matter) | 94 |
| Wheat Cereal (87% dry matter) | 140 |
| Rape seeds (88% dry matter) | 198,80 |

Haywater drains are fed into methane tanks through a common mixing tank. The average dry matter content in the wastewater is 11.6%. To prevent the separation of effluents from fractions in the methane, the manure is intermittently mixed. The retention time is about 25 days. The generated biogas is collected by a gas gauge located above the methane tin. The gas cylinder consists of two layers of film. A small amount of hydrogen sulfide, present in biogas, is removed using a microbiological aerophilic purification system. In the process of transportation to the gas engine in the biogas also water condensate is removed. The heat produced by the engine is used for heating methane tanks (10% in summer, and up to 50% in winter) and heating the farm in winter. The composition of the biogas plant

includes equipment for dehydration, through which the fused mass is divided into liquid and solid fractions. The liquid fraction can be pumped through pipelines to the nearest fields as fertilizers. A solid fraction, which is also a high quality fertilizer, can be transported over long distances or sold to other farms. The use of the plant leads to a significant reduction in greenhouse gas emissions into the atmosphere. The effect is achieved by reducing methane emissions in comparison with the traditional technology of storage of pumice manure in open maps (413 tons / year of methane or 6520 tons / year of CO2 equivalent), as well as by replacing fossil fuels with biogas for energy production (976 t / year CO2-equivalent). ] Different forms of reactor (P) and materials from which it is made are analyzed. Recommendations on choosing the shape, size, design and material are developed. Considered also the location of the reactor: vertical, horizontal, sloping, associated with the method of loading and unloading the reactor. The main factors influencing the productivity of a bioenergy plant (BEE) are analyzed.

1. Reaction activity of microorganisms. 2. Chemical composition and dimensions of biomass particles. 3. Time of fermentation of biomass in the reactor. 4. Concentration of microorganisms in the reactor. 5. Method and effectiveness of mixing the reaction medium. 6. Loading rate of raw material. 7.Temperature and acid (pH) modes. 8. Presence of living and poisonous substances.

Based on the manure potential suitable for anaerobic digestion in Ukraine, the experience of technology development in the world and technical and economic calculations, the concept of construction of large biogas plants in Ukraine (with a methane voltage of 800 mS and above) is proposed. Such installations can be built on farms with a stock of 600 heads, in pig farms with a stock of 6000 heads, in poultry farms with a population of 200 thousand heads. For a good profitability, the dry matter content in the manure should not be between 8-10%. Large biogas installations can provide sufficient profitability, organize mechanization and automation of the process, provide year-round consumption of biogas in the cogeneration plant, establish a system of dehydration of the fermented mass. Construction of 2900 plants with an average volume of methane gas 1000 mZ will allow to replace in Ukraine 1.33 million tons. in rural areas, to obtain independent sources of electricity and heat, sources of high quality organic fertilizers, as well as to make a significant contribution to improving the ecological situation in Ukraine, including addressing the problem of climate change. In addition to agricultural enterprises, enterprises of the food industry (sugar, alcohol, milk, breweries), as well as sewage treatment plants have a significant potential for the implementation of biogas plants. In addition, Ukraine has a great potential for biogas use at solid household waste landfills (MSW). Cities of Ukraine generate about 40 million mZ / year of solid waste (10 million tons / year). More than 90% of solid waste is collected and exported to more than 700 landfills, located around the cities, about 140 landfills are landfills for solid waste, suitable for collection and subsequent use of biogas. Of the 140 landfills, 90 are the largest, with up to 30% of all TGWs located in Ukraine. It is these landfills that are the most cost-effective for collecting and utilizing biogas available for energy production at large solid waste landfills and is about 400 million mZ / year, which corresponds to 0.3 million tons

of standard fuel. / year The potential producer of biogas is alcoholic plants with concentrated wastewater and a sufficient amount of hot water, the heat of which can be used to create the optimum temperature of methane fermentation. UkrNIIspirtbioprod has developed a technology for obtaining biogas at alcohol plants with the use of concentrated sewage as a nutrient medium. The output of biogas for a spirits with a productivity of 6,000 tons of alcohol per day is 24,000 mZ. During operation of the plant 275 days, 6.6 million megawatt biogas per year will be obtained. Methane content in biogas reaches 70-75%, and the remainder falls on carbon dioxide and minor impurities of other gases. With the use of biogas in the boiler plant, about 5000 tons of conventional fuel per year can be saved. Therefore, from the energy point of view, it is profitable for the alcohol factory. Getting biogas is also important for environmental protection. It is known that about 1500 mZ of sewage is produced at the alcoholic beverage factory, which is 20,000 mg / DMZ. At methane fermentation of GPK they decrease by an average of 80%, that is, up to 4 thousand mg / dm. In this case, methane-forming bacteria use mainly easily accessible organic substances. Therefore, even when discharging such semi-treated wastewater into the fields of filtration, they will not cause great harm to the environment.

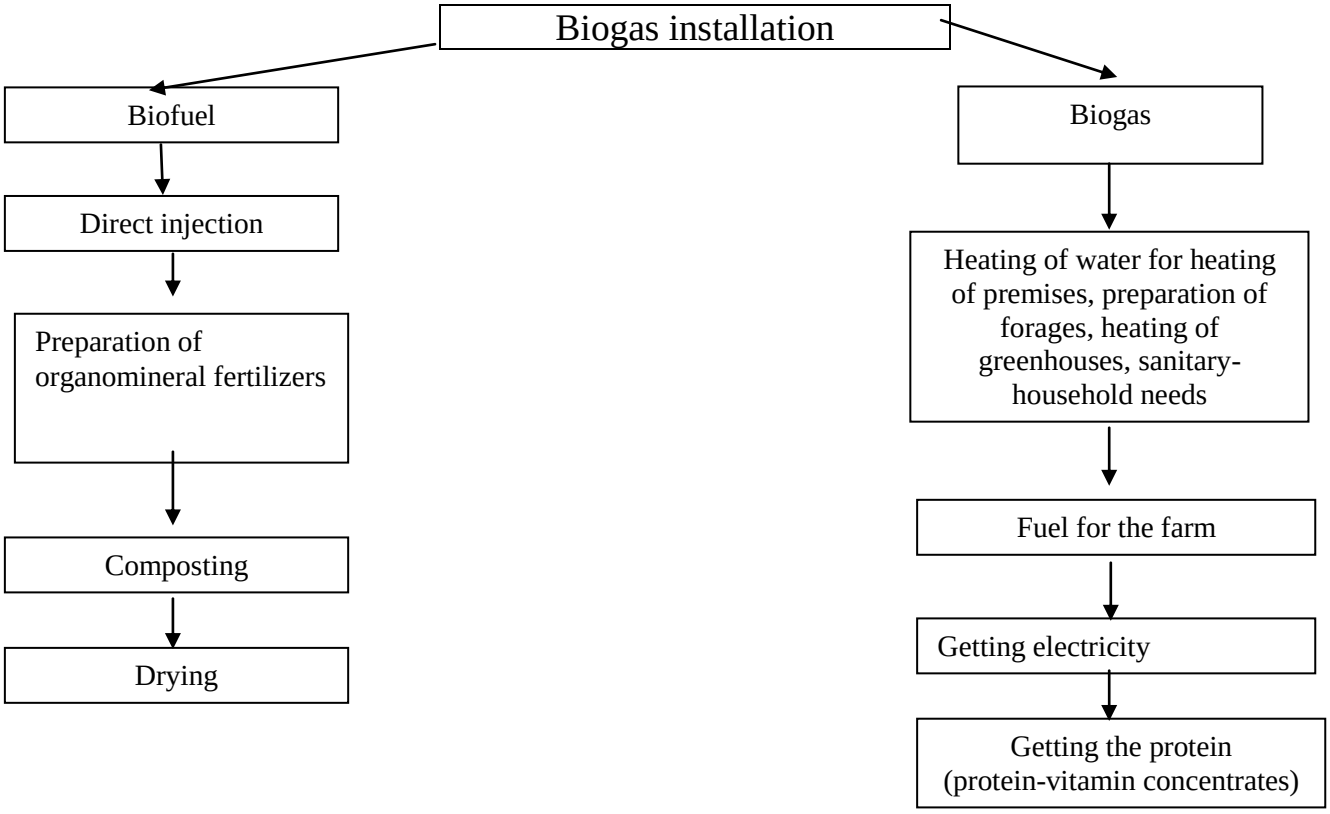


**Fig. 1.** Use of waste products in a biogas installation.

At present, the main technologies of biogas utilization are: combustion of biogas in heat boilers with the production of thermal energy; combustion of biogas in engines - generators with electricity generation. At the same time, carbon dioxide, whose content in biogas reaches 40%, is simply a ballast, which reduces the calorific value of biogas by about 1.5 times. The efficiency of biogas use can be greatly improved by dividing it into the main components: methane and carbon

dioxide. In this case it turns out a high-calorie, including motor fuel in the form of pure methane and a valuable raw product in the form of carbon dioxide. In the NSC KPI, an original biogas separation technology has been developed with simultaneous compression of components to pressures of 10-20 MPa. The basis of technology is laid: the process of cryodistillation of biogas from a condensed (liquid or solid) state and the process of cryocompression separating component without the use of a mechanical compressor.

**Conclusions.** One of the possible ways of obtaining energy from biomass is its anaerobic digestion in biogas plants. Almost all types of organic waste can be used as the raw material for fermentation. First of all, it is an agricultural animal (manure) and vegetable waste. It can also be industrial waste (sugar, alcohol, milk, breweries), as well as municipal wastewater treatment plants. Another possibility is the use of natural processes of anaerobic digestion, takes place at landfills and landfills of solid household waste (SHW). The raw material potential for biotechnology includes plant potential, agricultural and household waste. Biogas plants on deer animals are the simplest and widely distributed throughout the world. Biogas installations is a simultaneous solution not only to the problems of agrochemistry and energy, but also to improve the overall ecological situation and social conditions of the villagers. For the processing of a large amount of plant and animal waste produced in farms and private homes of the population, it is necessary to use biogas plants, the process of processing of which takes place from 7 to 20 days. In the process of processing into biogas goes to 40 -50% of organic matter (by mass). Biogas technology allows accelerated production of anaerobic digestion of natural biofuels containing biologically active substances and trace elements.

## REFERENCES

1.Geletukha G.G., Zhelyzensa T.A., Zhovmir N.M. [etc.](2010). Estimation of the energy potential of biomass in Ukraine. Industrial heat engineering. - T. 32, No. 6. - P. 58-65.

2.Makarchuk O.G., Savchuk V.K.(2011). Bioenergy potential of agricultural production: economic dimension, forecast of the use of the monograph K .: Agrar Media Group. 177 p.

3.Kaletnik G.M.(2010). Biofuels. Food, Energy and Ecological Safety of Ukraine: Monograph-To: "High-TechPres". - 516 p.

4. Burdenyuk I.I.(2014). Economic-mathematical modeling of biofuel production / I. I. Burdenyuk, L. O. Volontier (2014). Materials of the IV International Scientific and Technical Conference "The Land of Ukraine - The Potential of Food, Energy and Environmental Safety of the State". In two volumes, volume 1, Vinnitsa:. - pp. 74-77

5. Injutin S.V., Uminsky S.M., Chuchuy V.P.(2015). Alternative sources of energy. A manual for students in higher education. TES publishing house and printing house., ISBN 978-617-7054-81-7, 2015, p.494c.

6. Inyutin S.V., Uminsky S.M. (2013). Production of biogas and organic fertilizers from agricultural waste. Machinery and technology of agroindustrial complex.
№ 11 (50) - All-Ukrainian scientific and technical journal. Jan.19-24.

# ПРОИЗВОДСТВО БИОГАЗА И ОРГАНИЧЕСКИХ УДОБРЕНИЙ ДЛЯ ЭНЕРГЕТИКИ АПК

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**Ключевые слова:** биоэнергетика, биомасса, биогаз, метановое брожение, биогазовая установка, реактор, полигон, биоудобрение.

Резюме

*Энергетическая безопасность страны существенно зависит от степени диверсификации энергоносителей, используемых для удовлетворения ее энергетических потребностей. Украина имеет большой потенциал биомассы, которая доступна для энергетического использования. Основными составляющими потенциала отходы сельскохозяйственного производства и энергетические культуры. Привлечение этого потенциала в произ ¬ водства энергии может удовлетворить около 13% потребности Украины в первичной энергии. Одним из возможных способов получения энергии из биомассы является ее анаэробное сбраживание в биогазовых установках. В качестве исходного сырья для сбраживания могут быть использованы практически все виды органических отходов. Прежде всего это отходы сельского хозяйства животного (навоз) и растительного происхождения. Это могут быть также отходы промышленности (сахарной, спиртовых, молочных, пивоваренных заводов), а так же станций очистки коммунальных сточных вод. Другой возможностью является использование природных процессов анаэробного сбраживания, имеет место на полигонах и свалках твердых бытовых отходов (ТБО). Биогазовые установки на навозе животных являются самыми простыми и получили широкое распространение во всем мире. Биогазовые установки - это одновременное решение не только проблем агрохимии и энергетики, но и улучшение общей экологической обстановки и социальных условий жителей села. Для переработки большого количества отходов растительного и животного происхождения, образуется в хозяйствах и личных подворьях населения необходимо использовать биогазовые установки, процесс переработки в которых происходит от 7 до 20 дней. В процессе переработки в биогаз переходит к 40 -50% органических веществ (по массе). Биогазовая технология позволяет ускоренно получить с помощью анаэробного сбраживания натуральное биоудобрение, содержащее биологически активные вещества и микроэлементы.*

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**Key words:** bioenergetics, biomass, biogas, metane fermentation, biogas installation, reactor, range, biofertilizer.

Summary

*The country's energy security is heavily dependent on the degree of diversification of energy used to meet its energy needs. Ukraine has a great potential for biomass, which is available for energy use. The main components of the potential are agricultural waste and energy crops. Attracting this potential to*

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