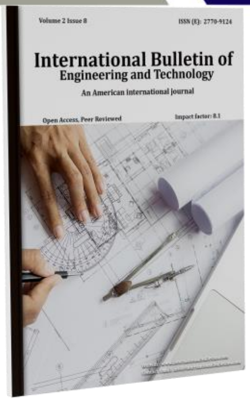

FROM LOCAL ORGANIC WASTE TO BIOGAS: ENERGY EFFICIENCY, SAFETY ASPECTS RELATING TO BIOGAS PLANTS

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Abstract. The article presents the technical requirements for the biogas plant for the processing of local organic waste, and the requirements for ensuring the reliability, energy efficiency, resource-saving, economic and practical efficiency of the plant. Recommendations for choosing the design of the biogas plant are given.

Keywords. local organic waste, processing, biogas plant, technical requirements, plant reliability, energy efficiency, resource-saving, economic and practical efficiency.

Introduction. Today, the problem of waste is becoming one of the most urgent environmental, social and energy issues on a global scale. Analyzes show that in recent years, domestic and industrial emissions have been increasing year by year. Especially in the 21st century, the increase in the volume of household waste began to have a very negative impact on environmental stability [1-5].

Consistent efforts are being made in our country to protect the environment, ensure public health, rational use of natural resources, and improvement of sanitary and ecological conditions [6-7].

Materials and methods. The main and auxiliary equipment of the biogas plant, and pipelines should be covered with thermal insulation. Depending on the type of biogas plant, the required capacity of the reactor for the preparation of raw materials should be greater than the daily loading of raw materials, and the capacity of the receiving reactor should be at least 25%.

Loading the biogas plant 1 or 2 times a day is possible only for raw materials with a high impact (for example, animal excrement) or a low amount of fermenter [4-9].

For devices with large capacities, an automated control system with hourly intervals is recommended to achieve high efficiency.

Depending on the raw material supplied and the height difference between the individual tanks of the Biogas plant, centrifugal, rotary pumps, compressors, and screw conveyors as well as manual loading are usually used for loading.

It is recommended to place the bioreactor of the biogas plant underground or on the surface, as well as in an upright (vertical) or lying (horizontal) position. For the harsh continental climate of Uzbekistan, it is recommended to place the bioreactor underground, which allows reducing the area occupied by the installation and protects the bioreactor from sudden changes in temperature. The size of the bioreactor is measured in cubic meters, depending on the daily productivity, the quality, and the type of raw materials, as well as the temperature of the fermentation process. It is recommended to place the loading and discharge pipes at opposite ends of the bioreactor at its bottom. To ensure the tightness of the bioreactor, the lower ends of the pipes should be located below the level of the raw material [9].

Since the separated biogas is a light gas, the biogas sampling section should be located at the top of the bioreactor. Thermal insulation of the bioreactor and heat accumulator are integral components of the device.

It is advisable to use mineral wool, mineral wool fabrics, artificial foam materials, expanded polystyrene plates, organic insulating materials, and glass fiber as heat insulation. Medium and large-scale biogas plants produce enough biogas for private needs, and partially (alternative) fuels remain in profit, and local fertilizer is obtained from the processed mass [10-15].

A thermometer should be installed to monitor the temperature inside the biogas plant. Pipes, pumps, and fittings are needed to transport heat and control the flow of materials for heating fresh and raw materials.

In addition to pipes, the piping system should use fittings such as couplings, dampers, check valves, cleaning holes, and pressure gauges. The pressure gauge in the pipeline is designed to monitor the operation of the device and the capacity of the system.

Discussion and result. For the continuous operation of the biogas plant, an automation unit is required that controls all parameters and maintains the set temperature and reaction rate.

The gas system is designed to dewater produced biogas, control biogas pressure, and prevent emergency biogas release systems, and consists of a gas distribution pipeline with shut-off valves, a condensate collector, a dehumidification filter, a valve, a valve, a compressor, a receiver, a pressure reducer, a pressure gauge, and other tools. This system must be gas-tight, durable, reliable, safe, and economical and provide the right amount of biogas for each unit. The piping requirements of the biogas system must comply with common standards for all biogas piping. A 2.4 mm diameter pipe is recommended for removing gas from the reactor and to the gas burner, and a 1.2 mm diameter steel pipe is required for all other piping in the system. The required diameter of the pipe depends on the biogas flow rate of the gas devices and the distance between the gas holder and the devices using biogas [5].

All elements of pipeline fittings must meet the requirements of the standards. Therefore, it is recommended to use pipes, taps, valves, valves, gas meters, and parts of one size for the whole system.

A biogas plant requires water and heat energy to operate. The gas produced by the biogas plant must be delivered to the consumer through a low-pressure gas pipeline, which limits its length. Produced alternative fuels must be poured into a sufficiently large container, the size of which depends on the rate of fuel use. Since the biogas plant produces a combustible alternative fuel, it must be protected from unauthorized access.

Biogas treatment systems and requirements for their use.

Before using biogas in heating devices, since they contain harmful and ballast compounds, it is necessary to prepare biogas in advance:

- separation of moisture and solid particles;
- removal of hydrogen sulfide;
- removal of halogen compounds;
- removal of carbon dioxide.

To remove sulfur from biogas, it is recommended to take the following measures:

- chemical-physical method.
- biological method.
- combined method.

In order to convert the energy contained in biogas into a source of thermal, mechanical, and electrical energy and use it as efficiently as possible, it is necessary to conduct research and develop the optimal operating mode of the device [12].

When developing systems for the production and use of biogas, it is necessary to choose optimal options for filling plants from various options, taking into account many local and external conditions. The simplest way is to burn biogas in a gas boiler.

Heating with biogas. For heating with biogas, it is recommended to use heating boilers with low-power gas burners from 10 to 30 kW, as well as special gas burners for high power with a certificate of conformity.

Selection of the design of the biogas plant.

Currently, many projects of biogas plants suitable for operation in different local climatic and socio-cultural conditions have been developed. Before choosing the design and construction parameters of the biogas plant, it is necessary to take into account the local climatic conditions and the base of raw materials for the biogas plant, as well as the physical-thermal, physical-mechanical and physico-chemical properties of the raw materials.

In regions with a relatively cold climate of our country, it is necessary to take into account the thermal insulation of the bioreactor and biomass heating sources, while in the southern regions, it is necessary to take into account the potential of solar energy for heating raw materials, which in turn leads to energy and resource savings.

The amount and type of raw material processed affect the size and type of bioreactor, and the construction and design of the raw material loading and unloading systems. The choice of the design of the biogas plant also depends on the availability of construction materials.

Criteria for choosing a biogas plant design:

Location: Determines whether the bioreactor is mostly underground or above ground, and vertical or horizontal in above-ground construction.

The availability of raw materials determines not only the size and shape of the container for mixing raw materials but also the size of the bioreactor, heating, and mixing devices. If the solids content is below 5%, it can be mixed with biogas. When the solid content of the raw material is more than 10%, it is difficult to use a mechanical mixing system.

Selection of a bioreactor design.

The main criterion for choosing a bioreactor structure is practical application and convenience in terms of maintenance and operation. Regardless of the choice of the bioreactor design, the bioreactor must meet the following requirements.

- Water/Gas must not leak.
- Thermal insulation-necessary for the efficient operation of the biogas plant in the local climate.
- The stability of the bioreactor structure is necessary to withstand all loads (gas pressure, weight and pressure of raw materials, weight of coatings, corrosion resistance) and ensures the long-term operation of the biogas plant.
- From the point of view of fluid dynamics, the ovoid shape of the bioreactor is optimal, but its construction is expensive. The second best form is to prepare the bioreactor in a cylindrical shape.
- The bioreactor can be divided into several sections with the help of internal parts to prevent the formation of a crust on the surface of the raw material and to ensure the complete fermentation of the raw material.

Conclusion. Economic efficiency or practical importance of the work - the developed biogas plant is designed to process any organic waste and pays for itself in about one year of operation.

- as a result of reducing the volume of organic waste in storage areas, it reduces the risk of respiratory and eye diseases by cleaning the air, reduces the generation of greenhouse gases, and preserves ecological stability;

- the epidemiological situation improves as a result of the death of part of the microorganisms contained in the waste in the bioreactor;

- with the help of local organic fertilizers, the productivity of obtaining agricultural products is improved, and the cost of products is reduced;

- the combustion heat of 1 m3 of biogas is 20÷25 MDJ/m^3 depending on the content of methane, which is equivalent to the amount of heat when burning 0.6÷0.8 liters of gasoline, 1.3÷1.7 kg of firewood, and is equivalent to 5÷7 kW allows you to get electricity.

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