TECHNOLOGIES FOR OBTAINING ORGANOMENERAL FERTILIZERS AND ASSOCIATED BIOGAS WITH THE SECONDARY USE OF LIVESTOCK WASTE

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Existing problems of environmental pollution with animal husbandry waste, as well as modern technologies, and scientific justification of the most effective technological solutions are analyzed. The existing technologies and installations for the use of animal husbandry waste, methods of obtaining biogas and organo-mineral fertilizers from them, a substantiated technological scheme for obtaining organo-mineral fertilizers and accompanying biogas are considered.

Key words: *biogas, technology, livestock waste, installation, fertilizers.*

Problem. The problem of waste disposal of animal husbandry complexes is particularly urgent and not resolved. Currently, a large amount of manure and visible masses accumulates around many livestock and poultry enterprises, which, if the problem of their disposal is properly solved, can give additional income and at the same time turn farms into practically waste-free productions. Therefore, the urgent task today is the search for effective technological solutions for the processing of livestock waste and obtaining useful energy and products. Among the technologies used, the most common and proven way of processing animal husbandry waste is the production of biogas by the method of anaerobic fermentation [1-3].

Analysis of research and publications. Disposal of waste from production and consumption, preparation, processing generated at animal husbandry enterprises, processing of huge volumes of manure and sewage effluents, which are potential sources of anthropogenic impact on the environment. At the end of the 20th century, the increase in large numbers of livestock in livestock farms in connection with the transfer of animal husbandry to an industrial basis had a global character and was noted in many countries of the world. The main organic residues in agriculture include animal excrement and plant materials. Vegetable waste includes: straw, beet and potato tops and other plant waste. All organic materials can be used as plant fertilizers in the future, thereby replacing mineral fertilizers, which are very costly [2]. The basis of the technology is the microbiological destruction of the organic part of the litter in anaerobic conditions with subsequent biosynthesis of methane. For example: from the experience in Italy, a bio-plant sells the produced electricity to the grid at 22 cents/kWh, and buys it for its own needs from the grid at 14 cents/kWh. A system of benefits has also been developed in connection with the simultaneous solution of environmental problems. In such conditions, biogas technology is quite profitable. Taking into account the factors of natural and climatic conditions and the current legislative framework, we came to the conclusion that this technology is very capital- and material-intensive. With a fermentation time of 30-40 days, large capital investments and energy costs are required. Due to the incomplete decontamination characteristic of the mesophilic regime, additional holding of the sludge must be provided to complete the process.

Research results. Production of biogas and biofertilizers from organic waste is based on the property of waste to release biogas during decomposition in anaerobic, i.e. oxygen-free, conditions. This process is called methane fermentation and occurs in three stages as a result of the decomposition of organic substances by two main groups of microorganisms - acid and methane. In nature, the biological formation of methane is an important process that occurs in a moist, oxygen-free environment, where organic material decomposes under the action of methane-forming bacteria, for

example, in the digestive tract of ruminants or compost pits. The amount and composition of gas in the process of complete decomposition of organic matter depends on the C:H:O:N ratio in the source material. Of the most important compounds that make up organic matter, fats cause the largest output of gas with a high CH4 content, proteins slightly less, but also with a high CH4 content, and carbohydrates - relatively little gas with the lowest CH4 content. The average composition of the gas that can be obtained from animal excrement at the optimal fermentation temperature of 34 °C corresponds to the ratio CH4/CO2 = 2. Depending on the proportion of organic mass capable of fermentation, only 40–50% of the total organic mass placed in it is decomposed in the reactor [3]. In the process of biodegradation, the organic substrate undergoes physical and chemical transformations with the formation of a stable gumified final product. Composting is a dynamic microbial process that occurs due to the activity of a community of microorganisms of various groups.

The analysis showed that production facilities are usually divided into four main types:

without adding heat and without stirring the fermenting biomass;

without adding heat, but with mixing of the fermenting biomass;

with heat input and biomass mixing;

with heat supply, with biomass mixing and with means of control and management of the fermentation process.

The analysis showed that the development of technologies for obtaining biogas goes in different directions, among which the most promising are: improvement of sourdough;

application of special process activators; regulation of the temperature regime; creation of original designs of bioreactor (Fermenter), gas storage (gasholder); increasing the stability and reliability of the functioning of the biogas plant in general. Based on a comparative analysis of technologies, equipment and ways of process intensification, we have developed a technological complex consisting of four modules.

Module I – Anaerobic fermentation module with biogas production is represented by the following technological scheme: waste accumulator – hydrolysis unit – bioreactor (fermenter) – biogas purification system – gas accumulator.

Module II – Module for obtaining organo-mineral fertilizers. The second module of the complex is the technology of obtaining organo-mineral fertilizers.

Module IV – Biodeodorization module. Application of EM technologies Application of EM technology for deodorization and improvement of the microclimate of livestock complexes is the most promising. To solve this problem, it is possible to apply specially developed effective microbiological preparations that allow to reduce the level of unpleasant odors in livestock premises. Production of biological EM-fertilizers based on liquid fraction Under certain conditions, it can be profitable to process manure/litter with the help of EM-preparation (effective microorganisms) organo-bacterial EM-fertilizers, which also belong to the class of biofertilizers. EM technology is suitable for processing liquid and solid manures/excrements. In our case, it is proposed to use EM preparations for processing the liquid fraction remaining after separating the solid fraction from the manure for its gasification or liquid manure after disinfection in the resonator oscillation generator. Treatment with an EM preparation does not require capital expenditures. It is advisable to apply the EM preparation to manure/litter after preliminary disinfection. This will significantly shorten the time and simplify the fermentation process.

The modular construction of the technological complex makes it possible to design biogas plants and fermenters depending on the initial data (composition of raw materials, obtained products and optimizing conditions) with the aim of the most effective and comprehensive application of it for the processing of agricultural waste with the maximum effects of obtaining biogas and fertilizers. The use of an automated control system is assumed. The capacity of the installation is calculated based on the amount of waste to be disposed of. All communications are covered with hydro and thermal insulation and are mounted on the surface, thereby facilitating their maintenance and control.

Conclusions: The analysis of the use of animal husbandry waste showed that waste - raw manure without processing is removed and stored in the fields, thereby negatively affecting the environment, causing soil poisoning, polluting the air, groundwater and being a source of infectious diseases.

Analysis of the composition of animal husbandry waste: raw pig and cattle manure, bird droppings showed that these types of waste are a valuable source of organic and mineral substances and, with appropriate processing, it is possible to obtain valuable products - fertilizers and additional energy - biogas.

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HOMOGENITY OF COMBINED FEEDS

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It is known that the main process of manufacturing high-quality compound feed, which corresponds to the compound feed recipe, is the operation of dosing the components and making a homogeneous mixture. The issue of assessing the performance of the mixer for mixing components and the formation of a uniform distribution of feed components in the final product is an urgent task for producers and consumers of compound feed.
Key words: *quality, mixture, compound feed, assessment, homogeneity.*

Problem. Feed formulation is a method of selecting and mixing different feed ingredients in appropriate quantities to obtain a balanced diet that meets the specific nutritional needs of the animal. At the same time, the age, weight, production goals and other physiological needs of the animal are taken into account. The primary goal of feed production is to provide economical, palatable and nutritious feed to promote optimal animal growth and health. The goal of feed development is the production of economical, palatable and suitable feed. This means that the feed must be nutritious, tasty and contain all the elements in sufficient quantities. If these goals are met, the livestock will regularly consume the feed necessary for optimal growth and development. When producing a complete feed, it is important to ensure that each component is thoroughly mixed in accordance with the formulation of the feed.

Analysis of research and publications. For research, loose compound feed for fattening pigs was chosen. According to the recipe of the ration, the constituent elements were weighed on scales, and then mixed in a laboratory double-roller blade mixer[1,3]. The time required for the formation of compound feed with the predicted homogeneity coefficient was determined using the tare dependence of the homogeneity coefficient on the mixing time of the components units, and with a different mixing angle. The change in the homogeneity coefficient was tested by determining the concentration of salt in the selected samples and by analyzing the change in the coefficient of variation. Unlike loose products, pressed products have a smaller active surface area, and this ensures more stable quality indicators during transportation and storage, they are less prone to the development of microorganisms that spoil the compound feed. Feed quality indicators depend on many factors, but the most important and important is the homogeneity of the prepared mixture [2]. Feed composition is of great importance in livestock nutrition. Firstly, it leads to increased productivity of livestock. A