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RATING METHODIC OF BIOGAS INSTALLATIONS WORKING IN RAREFACTION CONDITIONS

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Abstract

This article describes about methods of rating and diagnostic safety of pilot and industrial biogas installations and diagnosing the reliability of biogas plant equipment to define different malfunctions and disturbances in its work. There were given sequences of the correct evaluation of the biogas plant equipment' reliability, as well as the diagnosis of failures in its operation, depending on the knowledge of the microbiological sequence of the anaerobic process and the experience of the plant management operators. There were given conclusions in comparison of the total costs for warning, detection and elimination of failures and malfunctions when using direct and diagnostic methods for monitoring the technical state of an energy installation based on renewable energy.

Key words**:** *methodic of rating, biogas installation, malfunction and disturbance, diagnostic and definition of malfunction*

INTRODUCTION

In the second phase of the Action Strategy of the Republic of Uzbekistan for 2017-2021 years, with a view to further strengthening macroeconomic stability and maintaining high rates of economic growth required a gradual transition to a new economic model by introducing in the production of "smart" technologies and the creation of cutting-edge ideas, know-how through the introduction of innovative models of development. It should be noted the importance of introduction of innovative criteria for evaluating the effectiveness of technologies and equipment. This article aims to develop methodology for assessing the reliability of biogas plants operated in rarefied conditions.

MATERIALS AND METHODS

At present**,** there are different methods of evaluation of pilot or industrial units biogas production, the totality of their principles, methods and process, as well as means of their realization. Many authors noted that a range of factors influence to the biogas production process, such as the potential of the feedstock, the design of the biogas plant, the physical and mechanical properties of the feed organic waste, the frequency of loading, internal and external mechanisms for maintaining temperature and humidity, and so on. [1,10,11,15] But besides this, it is necessary to note the importance of the human factor in the correct operation of the process of producing biogas and organic fertilizers.

Fig.1. Biogas plant: 1 container for pre-treatment of biomass to be loaded; 2-tank for heating and loading; 3-bioreactor; 4-filtration of biogas; 5 - gasholder; 6-heating boiler
Source: Photo of biogas plant at 120 m3 installed in Turakurgan district of Namangan region

Setting the correct assessment of the reliability of a biogas plant equipment, as well as diagnosis of failures in its work

depends on knowledge of anaerobic microbiological control of the process and experience of the operator. Fundamentals certification and analysis equipment - is the presence of a unique functional link that allows to use them only for the technically simple components and mechanisms. In evaluating the reliability of complexes biogas plants, such as automated control system (ACS) fermentation processes, human factor [1,8,9,13,19] is the most vulnerable point, dependent on several features such as skills, experience and psychophysical condition etc. The biogas plant operator, at the beginning of his profession and social activities, the number of which is constantly decreasing, is approaching error methods and means of evaluation. The lack of continuity from one operator to several cases of the appearance in the work of the most erroneous stages, which greatly affect the operation of the installation itself.

In research, it was decided on analysis of existing factors of failure of work, that is not the effectiveness of the study and the possible reasons for failure.

RESULTS AND DISCUSSIONS

For the correct course of the process of biogas generation and uranium requires constant analysis and diagnostics of the equipment, which must be held by the operator of the biogas plant.

The basis of the probabilistic reliability evaluation method biogas installation laid method of analysis and identification of fuzzy properties as unity and quality, the appearance of symptoms and signs is intermittent, probabilistic. This is due to the fact that symptoms and signs with such qualities as unambiguous evaluation (diagnosis) of complex objects, such as a biogas plant, may not be, which ultimately complicates troubleshooting. However, a combination of such signs or symptoms carries information about the state of the objects being evaluated (diagnosed). Assess the combination of symptomatic symptoms and symptoms accompanying problems with evaluation matrices [2,7.8,10,14,16,17].

The appearance of malfunctions and their combinations in automatic PBX systems has limitations in accordance with cause-effect relations. Connections for biogas plants operating under vacuum conditions are shown in Fig.2 and Table 1.

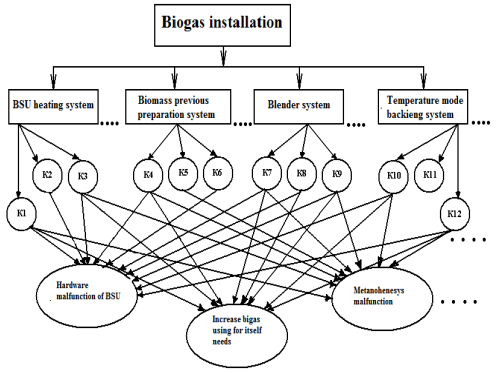

Fig.2. Scheme of cause-effect relations of failures in the work of BSU
Source: created by authors

The elements K1, K2, K3 .... Kn in Fig. 1. The faults (or structural parameters) of the relevant systems and mechanisms of the biogas plant are shown. Each fault alone or in combination, as a cause, leads to the consequence - an increase in the consumption of commodity biogas for heating the bioreactor, a decrease in the output of biogas and organic fertilizer (effluent), etc.

And, as a rule, all malfunctions can cause more than one consequence - their graphs intersect. The appearance of faults and their combinations is of a probabilistic nature [1,3,4,5,6, 9,12,14,18].

From Table 1, it can be seen that such factors as the use of old raw materials, the violation of the anaerobic process, the small grinding of the organic mass and the presence of antibiotics and other minced substances in it, the malfunction of equipment and other factors affect the increase in the percentage of the yield of CO2. One of the most important indicators of BSU performance, namely the quantity of biogas output and the quality of organic fertilizer is affected by the correct or poor performance of the biogas plant operator,

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Table 1.Diagnostic fault matrix of biogas plant

Possible causes	Symptoms							
	Increased%, CO2	Increases pH	Deterioration of biofertilizers	Reducing the amount of emitted biogas	Output of gases with an unpleasant odor	Absence of any gases exit	Increasing the amount of CH4	Increasing Of the duration of the process
Old initial organic waste	+	+	+					+
Daily dose of bioreactor loading			+	+	+		+	+
Violation of the anaerobic process	+	+	+			+		+
Disturbances in the heat supply and insulation system				+	+	+		+
Infringement of tightness				+	+	+		+
Weak milling of the organic mass	+	+	+		+			+
Antibiotics and other disinfectants	+	+	+			+		
Violation of the automated control system		+	+			+	+	+
Incorrect work of the BSU operator	+	+	+	+	+	+	+	+
Hardware malfunction	+	+	+	+	+	+	+	+

Source: created by authors

CONCLUSIONS

The proposed method for assessing malfunctions and malfunctions allows to determine the correct direction of the search for symptomatic combinations (diagnosis and analysis of the anaerobic process) and to establish a detailed diagnosis.

The main criterias for choosing this method is the comparison of the total costs for the prevention, detection and elimination of failures and failures in the use of direct and diagnostic methods for monitoring the technical state of a power plant based on renewable energy sources, as well as the duration of the procedure for obtaining biogas and high-quality organic fertilizers.

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