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METHODS OF OPTIMAL POWER PARAMETERS DETERMINATION FOR THERMAL FURNACE WHICH WORKS ON BIOGAS MIXTURE, FOR CONDITIONS OF PRESENCE IN ITS CHAMBER OF SPATIAL ELECTRIC PAUL

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The nalysis of scientific researches showed possibilities usage of biogas technologies in the industry. Proposed the method of determination and a apparatus of control by optimal power parameters furnace apparatust, working on biogas composition, in the presence of an electric field in its chamber.

Keywords: biogas composition, heating furnace, heat flow, the spatial electric field, intensification of heat exchange, energy efficiency

In Ukraine of question of the use of alternative and refurbishable energy sources, especially in industry, at times acquires все greater actuality. Introduction of biogas technologies can become the decision of this problem, in the first turn, at the terms of metallurgical industry [1] for energy-supply of thermal and heater furnaces.

Together with it the problem of efficiency of heater apparatus and application of low-caloric mixtures in quality a fuel in the noted industries of industry, in particular, remains no less actual. It is known that fuel properties of biogas mixture are compared to natural gas [2], therefore to the furnace apparatuses which work on him, inherent similar defects, namely uneven distribution of the temperature field. Partly a question is decided by treason of construction and aerodynamic descriptions of apparatus, which are insufficient [3].

It is set [4], that influence of electric field on the temperature distribution process in heater chambers, where as a power medium is used natural gas, is irrefutable and shows up already after in relation to subzero intensity. Thus, in furnaces on biogas mixture it follows to look the similar phenomena from likeness them main component composition. However, in existent researches of question of optimization for power parameters in the chamber of furnace, such however a gas expense and intensity of electric field, by means of which control the process of heating in a furnace, was not examined and need additional analysis and creation of corresponding methods of their determination and control chart. Thus, introduction of method of increase of effectiveness of heater apparatuses which work on biogas mixture, on the basis of application of electric field as a control influence on thermal streams together with the offered schematic solution can give the considerable economy of charges of enterprises on biogas mixture and to reduce its part in the structure of unit cost.

Thus, for the increase of effectiveness of chamber heater furnace it follows to work out the universal methods of determination of optimal power parameters in its chamber at presence of spatial electric field and to create corresponding control system. The last must be actual for any gas mixture and for biogas in particular.

For creation of the noted methods on the first stage it is necessary to execute experimental researches on the concrete object of industrial enterprise for the sake of establishment of intercommunication between the parameters of the heater aggregates, such as a gas expense, voltage of electric field in its chamber and overall descriptions. For achievement of maximal exactness of prognostication at the minimum quantity of the executed operations and also maintenance of statistical authenticity of results of experiment must be carried out its planning on well-known methods [5].

For development of matrix of experiment of type 2^5 a few parameters which can influence on distribution of temperature into aggregatus were select, namely: expense of biogas mixture (Q), m^3/hours; voltage between a metallic blank and gas burner (U), V; sizes of metallic blank (x, y, z) m.

On results the executed planning of experiment in accordance with made for the sake of it matrices get a necessary mathematical model in a kind:

$$T = f\ U,Q,x,y,z\ = b_0 + b_1 \cdot U + b_2 \cdot Q + b_3 \cdot x + b_4 \cdot y + b_5 \cdot z + b_6 \cdot U \cdot Q + b_7 \cdot U \cdot x\ + b_8 \cdot U \cdot y\ +$$
$$+ b_9 \cdot U \cdot z\ + b_{10} \cdot Q \cdot x\ + b_{11} \cdot Q \cdot y\ + b_{12} \cdot Q \cdot z\ + b_{13} \cdot x \cdot y\ + b_{14} \cdot x \cdot z\ + b_{15} \cdot y \cdot z\ + b_{16} \cdot U \cdot Q \cdot x\ +$$
$$+ b_{17} \cdot U \cdot Q \cdot y\ + b_{18} \cdot U \cdot Q \cdot z\ + b_{19} \cdot U \cdot x \cdot y\ + b_{20} \cdot U \cdot x \cdot z\ + b_{21} \cdot U \cdot y \cdot z\ + b_{22} \cdot Q \cdot x \cdot y\ +$$
$$+ b_{23} \cdot Q \cdot x \cdot z\ + b_{24} \cdot Q \cdot y \cdot z\ + b_{25} \cdot x \cdot y \cdot z\ + b_{26} \cdot U \cdot Q \cdot x \cdot y\ + b_{27} \cdot U \cdot Q \cdot x \cdot z\ + b_{28} \cdot U \cdot Q \cdot y \cdot z\ +$$
$$+ b_{29} \cdot U \cdot x \cdot x \cdot z\ + b_{30} \cdot Q \cdot x \cdot y \cdot z\ + b_{31} \cdot U \cdot Q \cdot x \cdot y \cdot z\ \ , \qquad (1)$$

where T - a temperature in the set area of furnace, °C; b_i are model coefficients, __.

On the second stage carried out bringing of necessary weekend data in offered control system by optimal power parameters, of the furnace heater aggregatus, which includes for itself such basic blocks as chart heating of furnace, which set preliminary, block of comparison of current temperature with the set technology temperature, block of determination of optimal values of gas expense and size of voltage between a burner device and blank.

Functioning of the offered chart of control takes place as follows: determine model coefficients; set the technological regime of heating for furnace with a certain step at times $\Delta\tau$; give gas mixture with a technically minimum possible expense ; in the block of comparison a current temperature on a sensor is compared to the value, set by technology on this interval of time. If the value of temperature does not answer a necessary size, voltage is automatically increased on a step ΔU to achievement of maximum $U_{\max}$ and, thus, finds all possible combinations of size of voltage and gas expense for achievement of necessary temperature. If after this increase is insufficient, then the system gives a signal on the increase of gas quantity on the step of presentation ΔQ. From the array of data on an economic criterion elect their advantageous combination of parameters most economic, at what expense on power resources will be minimum value.

The economy of plant on power resources for work of heater furnace is determined by a difference between total charges at every step $\Delta\tau$ temperature to the chart heating for a cycle without control system $\sum B$ and with its $\sum B_{ii\grave{o}}$.

$$E = \sum B - \sum B_{ii\grave{o}} \quad . \qquad (2)$$

Thus, offered a mathematical vehicle will allow to determine the optimal values of initial power parameters of the furnace aggregatus, and thus more exactly to

forecast the quantity of any gas mixture, including biogas which it is possible to save within the limits of financial viability at the conditions of any industrial plant.

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