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DEVELOPMENT OF METHOD FOR PARAMETERS OF IMPULSIVE HEATING CALCULATION FOR HEAT FURNACES

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The method of theoretical calculation of temporal parameters of impulsive method of heating is developed. Experimental confirmation of the created method is conducted. Offered method of calculation of parameters of impulse allows to adapt the structural features of any heater aggregate for introduction of impulsive method of heating.

Keywords: impulsive heating, metal, evenness of heating, temperature mode, burner device

Introduction. The modern impulsive heating of heater equipment has indisputable advantages before traditional continuous realization of temperature conditions of thermal aggregates [1,2]. It and evenness of heating on all volume gardens of metal, absence of critical temperature overfalls, considerable increase of конвективної constituent of heat exchange due to the exception of «stagnant» areas from aerodynamics of the swept volume of aggregate, and also automatic organization of optimal draw-through stream of warming gases.

However on the way of general introduction of the impulsive heating next obstacles get up:

– the existent park of burner devices on, that it is set on asms, as a rule, it is not adjusted for work after the maximum modes which are necessary for realization of the noted heating;

– positive experience of introduction and positive results is turned out it is impossible to use in wide scales for lack of methods of theoretical calculation of pulsewidth of presentation of fuel, and also duration of its absence.

Therefore for realization of impulsive method of heating a burner device is worked out [3], what allows to provide the mode of heating in the wide range of temperature and charges of fuel and air at their smooth and step presentation in the swept volume of furnace.

Main part of researches. The calculations of parameters of the impulsive heating carry out by determination of dynamic descriptions of object of researches. Thus main parameters is duration of impulses and pauses between them. For this purpose it is necessary to get the curves of acceleration on the known methods [4], and then to execute a calculation, that it is given below.

It is known, що differential equation of dynamics of heating in a furnace is the inertia link of the second order:

$$\grave{O}_2^2 \frac{d^2 X_{out}}{dt^2} + \grave{O}_1 \frac{dX_{out}}{dt} + \tilde{O}_{out} = k \cdot \tilde{O}_{ext} \ , \qquad (1)$$

where T_1, T_2 – constatant of time, c; X_{out} – a temperature in the controlled point after the width of furnace, °C; T_{ext} – a temperature in the controlled point to the width of furnace, °C k –a coefficient of transferrableness of object; t – duration of process, s.

The transmission function of the noted link looks like:

$$W(p) = \frac{k}{T_2^2 \cdot p^2 + T_1 \cdot p + 1} \ , \tag{2}$$

where p – an operator.

A transmission function (2) which has two levels are material root can be written down as

$$W(p) = \frac{k}{(T_2 \cdot p + 1)^2} \ . \tag{3}$$

For experimental confirmation of the worked out methods in the swept volume of operating furnace of thermal workshop of AOJ «Electrometallurgical plant «Dneprospetsstal′» was set five thermels, on even distance one from other in relation to the width of furnace in one of its areas.

From transmission functions (6) get gain-phase frequency descriptions

$$W(i\omega) = \frac{k}{(Ti \cdot \omega + 1)^2} \ . \tag{4}$$

For the calculation of duration of presentation of gaseous fuel from gain-phase description determine gain-frequency characteristics for all five points as

$$A(\omega)_j = \frac{k_j}{T_j^{\,2} \cdot \omega^2 + 1} \ , \tag{5}$$

where j = 1.5 – a number of experiment point.

On condition of the impulsive heating of metal it is desirable to get the minimum rejection of temperature in every point of her measuring. Therefore execute comparing of right part of correlations (8) to the minimum value of overfall of temperatures of tmin and find frequencies of reversal at times.

$$t_{\min} = \frac{k}{T^2 \cdot \omega^2 + 1} \ ; \tag{9}$$

$$\omega = \frac{1}{T}\left(\frac{k}{t_{\min}} - 1 \right)^{0,5} \ . \tag{10}$$

Coming from the brought higher theoretical positions over, overfall of temperature in relation to the width of furnace it is possible to expect after a formula:

$$\Delta t(\omega) = \frac{k}{T^2 \cdot \omega^2 + 1} \ , \tag{11}$$

where T – time of object, during which arrive at the permanent value of temperature during presentation of single step indignation, s.

It is set experiments, that a maximal value of duration of impulses is characteristic for a middle point, that is why take him for an optimal size [5].

In the executed experience after a 100 % thermal loading of furnace a temperature during presentation of maximal expense of gas at the beginning of

process folded 720 °C, during next three minutes of its value increased to 760 °C; after disconnecting of gas stabilizing of temperature level in a furnace arrived at during six minutes. After determination of descriptions of curve of acceleration and calculations of pulsewidth it was got t_u = 540 s, id est 9.0 minutes, that close enough to the value expected in theory.

Conclusions. Offered methods of calculation of parameters of impulse of presentation of gaseous fuel, that allows to adapt the structural features of any heater asm for introduction of the modern perspective impulsive heating.

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