ЭЛЕКТРОМЕХАНИКА

MULTIFUNCTIONAL INTELLIGENT THROTTLES

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ABSTRACT

The article considers the existing approaches to the organization of regulation and control systems for gas infrared heating in industrial premises. As a result of the analysis, it was revealed that the generally accepted approach to the design and implementation of such systems leads to many disadvantages: energy overruns, high wear and tear of equipment due to constant on / off and "cold start", etc. These shortcomings directly affect the monthly costs aimed at creating a thermal regime in the premises.

As a result, it was proposed to pay close attention to regulation and control systems at the design stage of gas infrared heating, namely, to apply new approaches to organizing the automation of gas infrared heating. In addition, the results of an experiment carried out on a real object are presented.

Key words: *Infrared heating, gas infrared emitters, regulation and control systems, energy saving, modeling, automation.*

Interest in energy efficient technologies is growing steadily throughout the world from year to year. In Azerbaijan, the relevance of energy saving and energy efficiency improvement was confirmed by the adoption in 2009 of Federal Law No. 261 “On Energy Saving and Energy Efficiency and on Amendments to Certain Legislative Acts of the Azerbaijan Republic” and is currently emphasized by the Government of the Azerbaijan Republic [1].

Industry is one of the main sources of energy consumption in Azerbaijan. At the same time, the problem of energy saving is acute in all industries without exception. No industry can do without energy carriers [2].

Increasing the intensity of technological processes, saving energy resources and increasing the energy efficiency of heating systems for industrial buildings can be achieved by replacing convective heating with gas infrared heating systems [3].

A set of such systems should be formed as follows [4]: a set of gas infrared emitters, a microprocessor-based control and monitoring system, sensors for perceived temperature and outside air. In addition, fire sensors and CO and CH4 leakage sensors are installed in the room. An analysis of gas infrared heating systems in existing facilities [5, 6, 7] showed that the specified set is used in practice, as a rule, partially: - 80% of the analyzed gas infrared heating systems are not equipped with a microprocessor control and monitoring system, a local control and monitoring console , sensed temperature and outside air sensors; - 10% are equipped with temperature control devices: a heating system on/off controller with an internal air temperature sensor; - 10% are equipped with devices from the given set. In the first case, the process of regulating the operation of gas infrared heating is carried out by the operating organization by manually turning the emitters on and off.

The process of manual control does not allow realizing the full potential of energy savings as a result of the use of gas infrared heating: there is no weather-dependent regulation of thermal power and the possibility of transferring the heating system during off-hours, weekends and holidays to the “on duty” mode. This leads to excessive consumption of energy resources during almost the entire heating period, high wear and tear of equipment due to constant on / off and "cold start".

In the second case, temperature control is carried out by changing the power of the heating system by turning off the entire heating system or part of it at the signal of the indoor air temperature sensor. This type of regulation does not take into account the radiation temperature and heat flux from the emitters. Radiation temperature and heat flux, together with air temperature, relative humidity, air mobility in the room and other indicators of the microclimate, form the perceived temperature. It follows that for gas infrared heating systems it is necessary to use sensed temperature sensors. For example: to establish a temperature of 18°C in a room heated by gas infrared emitters, it is necessary to take an air temperature of 10°C and a radiation temperature corresponding to the radiation intensity q=115 W/m2 (Fig. 1). Many studies in Europe [8, 9] have shown that in the case of a decrease in air temperature by 1 °C from the set value, energy savings will be 7%. Therefore, the installation of one sensor that gives an impulse according to one of the characteristic temperatures leads to a significant overspending of energy resources, and also cannot adequately provide comfortable conditions in a heated room.

This temperature control process is commonly referred to as "single-stage control". However, with all the advantages compared to the two previously considered cases, single-stage regulation also has a negative side: high equipment wear due to constant on / off and "cold start". In addition to the previously mentioned shortcomings, the existing approaches lead to:

• insufficient level of comfortable conditions in the room: when a certain temperature is reached, the control device turns off the radiators, and in this case the person feels only the heat of the air without radiation. This mode of operation of gas infrared heating is less favorable from a hygienic point of view, since the periodic switching off of the radiators somewhat changes the radiation component of human heat losses [10].

• excessive consumption of energy resources during almost the entire heating period, as well as increased costs for equipment maintenance: when designing heating systems, the heat load is calculated. This calculation is based on the minimum outside temperature in addition to the inside temperature.

For example, for Tyumen, the minimum outdoor temperature is minus 35 °C, although the average outdoor temperature of the heating period is only minus 6.9 °C. To ensure the desired temperature, the heating equipment is calculated for the case with the lowest possible outdoor temperature. This means that the heating system is operating with excess power.

The purpose of the experiment is to establish the possibility of regulating the thermal power of the heating system by changing the gas pressure in front of the heater.

As a result, it was found that the regulation of gas pressure on the emitter nozzle leads to a decrease in thermal power from approximately 100% to 65% (Fig. 1). However, in the course of the study, tongues of flame appeared on the emitter body, caused by a decrease in the flow area of the emitter nozzle (Fig. 1).

Conclusion from the experiment: the process of regulating the thermal power of a gas infrared emitter should be carried out by installing an automatic pressure regulator on the automatic unit of the emitter.

Figure 1. Regulation of the thermal power of the GII from 100% to 6

Figure 2 - The appearance of flames on the body of the GII

With stepless modulation, the heating output of the heating system is adapted to the actual heat demand of the building by means of stepless modulation between 65% and 100% of the heat output of the heater.

Graphically, these control processes are presented in fig. 2.

So far, the processes of regulating the thermal power of gas infrared heating: two-stage and smooth modulated regulation in Russia have not been studied. This, apparently, explains their absence in all buildings heated by gas infrared emitters.

Conclusion

The problem of heat and energy saving when heating buildings with a large volume cannot be solved solely through the use of gas infrared emitters without taking into account the automation of the entire heating system.

Therefore, at the design stage of gas infrared heating, it is necessary to pay close attention to regulation and control systems, since full heat load is required only a few days a year, the rest of the time it is advisable to use the equipment not at full capacity, while saving resources and reducing equipment wear.

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