

ASSESSMENT OF THE EFFICIENCY OF THE USE OF FIRE DEVICES WHEN CONVERTING A BOILER FOR BIOMASS COMBUSTION

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Abstract

To achieve effective operation of thermal power equipment, it is necessary to carry out energy saving measures, economize on the use of fuel and energy resources, reduce the amount of harmful emissions into the environment, as well as maximize the use of secondary energy resources and waste after biomass processing, etc.

Keywords: biomass, boiler, solid fuel, grate, combustion device.

Introduction

Great technical progress in the combustion of solid fuels (in particular wood chips) was achieved with the use of a grate. It consists of separate elements - cast iron beams or bars, called beam or bar grates, or cast iron plates, called plate grates. At the same time, mechanical furnaces allow almost complete control over the course and intensity of the combustion process [1, 2].

Depending on the design and location of the grate, furnaces are divided into the following: with a horizontal grate; with an inclined grate and a moving fuel layer.

A furnace with an inclined grate has an angle of inclination equal to the angle of natural slope of the fuel being burned. This ensures its slow sliding down the grate as it burns out. The recommended angle of inclination for hard coal is 40-45°; for brown coal - about 40°. In such furnaces, fuel is supplied continuously (with drying in the upper parts of the grate) and enters the zone of intensive combustion on the lower half of the grate. The fuel residues and slag slide down onto a small horizontal slag grate (gratings), where the final afterburning of the fuel occurs. To facilitate the removal of slag, these grates are made movable or tiltable [3]. The main advantage of such furnaces is a continuous supply of fuel without the participation of a stoker, no penetration of cold air into the furnace space when loading fuel, ease of cleaning from slag, almost complete combustion, etc. The disadvantage of its design is a more complex air supply system compared to a simple fixed grate grate. In this case, air is supplied under the grate and above the fuel layer, the lower grates burn out faster and require more frequent replacement [3].

The purpose of the work is to analyze the efficiency of using furnace devices with movable grates using the example of re-equipment of the KVG-7.56 boiler for burning wood chips (biomass).

Research results

The corresponding boiler house is a source of heat supply for the exhibition buildings located on the territory of the National Complex "Expocenter of Ukraine". In the existing separately located boiler house building, three hot water boilers are installed, respectively: type KVG-7.56, capacity $Q = 7.56$ (6.5) MW (Gcal/h) - 1 unit; type KSVT-3.0, capacity $Q = 3.0$ (2.58) MW (Gcal/h) - 2 units. The boiler house's heat engineering equipment is in good condition and suitable for further operation. The total heat capacity of the boiler house is 13.56 (11.66) MW (Gcal/h).

In terms of heat supply reliability, the boiler house belongs to category II. Heat consumers also belong to category II. The boiler house's operating mode is the heating period (cold period of the year). Heat supply from the boiler house is carried out via a two-pipe underground system to the buildings of buildings No. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. External heat networks have been partially restored and are in satisfactory technical condition. The pumping equipment installed in the boiler house fully meets the required conditions, is in satisfactory technical condition and is suitable for further operation. The existing chemical water treatment complex fully meets the needs of the boiler house and is suitable for further operation.

After conducting a technical examination and assessing the feasibility of restoring heating and hot water supply, a decision was made to reconstruct the boiler house with the re-equipment of the existing KVG-7.56 boiler for burning biomass and the backup of two KSVT-3.0 gas boilers.

The re-equipment of the boiler house involves the arrangement of a combustion device of the IP.FB.01 type under the KVG-7.56 boiler for burning wood chips. The furnace is designed on the basis of an inclined movable grate, which will allow for efficient combustion of wood chips and the generation of heat in the required quantity to provide buildings No. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 located on the territory of the Expocentre of Ukraine. The project also includes technical solutions for the arrangement of mechanized fuel supply systems, ash removal and smoke removal. The boiler room reconstruction project provides for the installation and operation of equipment that meets all requirements for labor protection, fire safety, and sanitary standards in force under the legislation of Ukraine. When operating a wood chip boiler, additional equipment for flue gas purification is used, which ensures that the relevant values of the maximum permissible concentration of pollutants in emissions to the atmosphere are not exceeded. The design thermal power of the boiler after reconstruction is reduced to 5.7 MW. The existing main and auxiliary heat engineering equipment of the boiler house remains in operation without replacement. The total estimated capacity of the boiler house after reconstruction will be 11.7 MW, while the connected heat load to the boiler house will be 4.3 MW.

1. The flame has a longer path. This ensures more complete combustion of the fuel, reducing the number of sparks.

2. The flame rising above the wet fuel dries it, improving its combustion process. This makes it possible to burn fuel with a humidity of up to 45%.

Final afterburning occurs in the finishing zone of the grate, where after the last row of the grate, the ash enters the ash channel through a mesh that traps foreign materials that can enter the combustion device along with the fuel (stones, metal elements, etc.). From the ash channel outside the boiler combustion space, ash and unburned residues are automatically removed to a separate ash container. The ash removal conveyor has an independent separate drive powered by the boiler controller.

Conclusions

The advantages of the combustion technology on a movable inclined grate are as follows:

- the possibility of operating the boiler on fuel with low energy value, high humidity and ash content, as well as low ash sintering temperature;
- high stability of the combustion process of complex fuels;
- increased environmental performance of the combustion process, which is especially important for the utilization of complex and heavily polluted fuels.

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