



**Social responsibility when developing automated fuel supply system for
a boiler furnace**

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Abstract

This paper is devoted to the automated fuel supply system of the hot water boiler «HP-18», working on organic water-coal fuels (OCWF), from the point of view of social and environmental responsibility. The risks to personnel and the environment have been studied during the operation of this boiler at different times of the year and in different modes. The threat to the environment is assessed and recommendations are made to reduce these threats. Summarizing the results the author gives several directions for reducing emissions of toxic substances into the atmosphere and for increasing the energy and environmental efficiency of heat power engineering.

Keywords: Automated fuel supply system, organic water-coal fuel burning, social responsibility, environmental safety;

1. Introduction

Scientific and technological progress acceleration with increasing production capacity, industry and transport systems development lead to a constant increase in energy requirements, and consequently, to the growth of prices for using energy. In this situation, it is worth paying attention to low-grade fuels and products of coal enrichment and refining [2, 5]. One of them is the usage of organic coal-water fuel compositions (OCWF) for their combustion in low-power boiler units or hot-water boilers.

Several papers have developed and described an automated fuel supply system for the «HP-18» hot water boiler [2, 4]. The use of this system in practice is very urgent, since the cost of heat production will decrease with the OCWF use. Users of this system can be private entrepreneurs, as well as the state ones. When changing a standard district boiler house to an automatic control system operating on OCWF, the number of necessary personnel is decreased and the cost of thermal energy is also decreased [3]. To ensure the operability of the system, an operator is required who will monitor the flow of the OCWF to the boiler furnace and maintain the system. When performing these works, the operator may be affected by the following harmful factors:

- 1) high temperature of the air in the working area;
- 2) high humidity;
- 3) high air pollution;
- 4) insufficient illumination at the workplace;
- 5) physical overload;
- 6) exposure of open fire.

2. Work safety

Boiler stations do not work in full in a summer period. All workload falls on a winter period. In spring and autumn, the load is equal. When the boiler burns coal, a large amount of dust is carried along with the flue gases. These indicators will be significantly reduced while using OCWF. Emissions of harmful substances will also be decreased with the correct regulation of fuel and air consumption. All these factors strongly affect the environment, but when moving to an organ-carbon composition, many areas used for storing coal waste will be freed. The social component, when moving to such a system, will be a reduction in price for heating and hot water.

2.1. Analysis of harmful and dangerous factors

The boiler unit using OCWF is dangerous, as well as the boilers that burn usual types of fuels, such as coal, fuel oil and gas. A dangerous factor when using a boiler is the amount of emissions, both to the atmosphere and to the room where the unit is installed. To reduce the amount of emission concentration, the following operations are carried out: installation of cleaning equipment for flue gases, sealing of the technological openings of the boiler unit, additions that can reduce the concentration of emissions of constituent fuels.

As high temperature is required to burn fuels, ventilation is necessary in the room where the boiler is installed in order to ensure normal working conditions for the personnel. Also, ventilation will solve the problem of high humidity. To protect from high temperatures, when carrying out preventive work, specialized clothing is needed.

Noise worsens working conditions, affecting the human body. The process of supplying the air-fuel mixture is noisy, as it is necessary to create high pressure.

2.2. Harmful and dangerous factors that may arise during the installation of the boiler unit that uses OCWF

When installing the boiler unit, it is necessary to follow the manufacturer's instructions, as the unit is a hazardous production facility. The installation of fuel and air nozzles must be carried out in accordance with the requirements, as the supply pressure of the fuel-air mixture is large, and improper installation can lead to explosion of units and devices. Moreover, when electrical equipment is installed, electrical safety is important.

2.3. Measures to protect the personnel of the enterprise from the effects of hazardous and harmful factors

To prevent a burn, when working near the boiler unit, specialized clothing is required, and the safety equipment for the boiler room is implemented.

To prevent the possibility of electric shock, a number of activities are taken and the following requirements are maintained:

- while installing the unit, only serviceable instruments certified by the instrumentation and control service are used;
- to protect against electric shock that can be between the instrument case and the instrument if there is a fault in the line voltage to the housing, the instrument and instrument housings must be grounded;
- when the line voltage is turned on, the operations on the rear panel are prohibited;
- all troubleshooting work is performed by qualified personnel;

- constant monitoring of the electrical wiring is needed.

To reduce the impact of noise on the human body, the following activities are carried out:

- the noise in the units (electric machines, mechanisms and other devices) is weakened;
- the accuracy of parts assembling during a repair is checked;
- work with overloads and breakages of one phase of electric motors is stopped, as it usually leads to noise.

To reduce gas and humidity in the room exhaust system is installed. The room is equipped with a supply and exhaust ventilation with a lower and upper suction, which ensures an even flow of fresh air and removal of the polluted air. Supply-and-exhaust ventilation in all rooms works continuously, excepting a summer period, which is connected with the stop of the boiler house.

3. Environmental safety

Pollution (the environment, the natural environment, the biosphere) is the introduction of contaminants into the environment (the natural environment, the biosphere) or the appearance of new, usually non-typical physical, chemical or biological agents (contaminants) in it, or the excess of their natural average annual level of contaminants in various environments, which lead to negative effects.

3.1. The possible impact on the environment

Emissions of pollutants from thermal power plants caused by combustion processes of organic fuel are one of the main sources of air pollution [1]. The amount of harmful emissions is related to the quality and quantity of fuel burned, the completeness of its use, and the overall efficiency of the heat supply source.

The greatest danger to the biosphere and to human health is the numerous heat sources of low power that do not have flue gas cleaning facilities, located, as a rule, within small settlements

3.2. The environmental impact of the industrial process

Anthropogenic emissions of greenhouse gases and pollutants are one of the main factors causing a change in the chemical composition of the atmosphere and its heat balance. As shown in the studies [4], the processes of extraction, processing and burning of organic fuel are the source of 80% of total air emissions, including 90% of carbon dioxide, and the change in its content is considered to be the main cause of the current temperature increase.

The negative impact of harmful components on public health, flora and fauna produced by facilities is not limited by the territory adjacent to the sources of emissions, but extends to hundreds and thousands of kilometers. Therefore, at present, the problem of environment pollution has a global character, and the costs of its protection have become commensurate with the environmental damage.

3.3. Environmental protection measures

To reduce the amount of emissions, it is necessary to control the flow of air into the furnace of the boiler. After all, if there is a shortage of oxidizer, a big underburn occurs, which leads to an increase in the amount of ash-like waste from the burning process of the fuel composition. And with an excess of air, nitrogen oxides are formed.

Temperature control in the boiler furnace is one of the important aspects in the fuel combustion system, as the greatest influence on the formation of nitric oxide is exerted by temperature. With its growth from 1500 to 2200 K, the yield of nitrogen oxide increases by approximately 10 times, while a fivefold increase in the oxygen concentration increases the emission of nitrous oxide only by 2 times.

The trapping of sulfur compounds in the emissions of thermal plants and various industries is one of the most complex and time-consuming processes due to the following reasons: 1) the amount of exhaust gases is very high; 2) the absorption of sulfur compounds is accompanied by the deposition of calcium and magnesium salts on the walls of the pipes, i.e. it causes the clogging of equipment. The desulfurization of coal and fuel oil is not sufficiently developed and is used rarely. Therefore, in world practice, as a rule, flue gases are purified from sulfur, for which various processes are used. They can be divided into three main groups: processes with the use of liquid absorbers – absorption (wet) and processes based on the interaction of gas with a solid – adsorption and catalytic (dry). Mostly, limestone or lime is used as an absorber in these processes.

4. Conclusion

Thus, several directions are being implemented to reduce emissions of toxic substances into the atmosphere and to increase the energy and environmental efficiency of heat power engineering. One of them is the implementation of environmental measures; the usage of energy saving measures; implementation of environmental monitoring; the development of scientific research and practical application of the latest scientific achievements and scientific and technical developments

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