PULSE ANALYSIS IN THE COMBUSTION CHAMBER OF A HEATING BOILER

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The problem of increasing the energy efficiency of thermal boilers is extremely relevant for modern energy, because the increase in the cost of energy resources and the strengthening of requirements for the environmental safety of the operation of power plants necessitate the improvement of fuel combustion processes. One of the promising areas of improvement of thermal equipment is the use of pulsations in the combustion chamber of a thermal boiler. This phenomenon arises as a result of the specific combustion regime of a water-oil emulsion (WME) [1], which in the process of thermal decomposition forms micro-explosions of droplets, contributing to more intensive heat and mass transfer, improving the completeness of combustion and reducing harmful emissions.

The combustion process of BME differs from traditional combustion of fuel oil or gas due to phase transformations of the liquid in the emulsion droplets. When heated, water globules in the middle of the BME droplet turn into steam, creating micro-explosions that break the fuel into small particles. This contributes to a more uniform mixing of the fuel with the oxidizer, improved mixture formation and more complete combustion of the fuel mixture. Pulsations in the combustion chamber caused by microexplosion processes significantly affect the gas-dynamic characteristics of the flow [2]: they contribute to the formation of zones with variable temperature and pressure, improve the circulation of combustion products, and activate heat transfer to the heating surfaces. Particularly effective is the use of combustion chambers with elements of the Helmholtz acoustic resonator, which allows controlling the pulsation frequency. Experimental and practical studies have established that optimal pulsation parameters contribute to an increase in the efficiency of the thermal boiler by 3-5%, and also provide a reduction in fuel consumption by up to 7-10% compared to traditional combustion modes. In addition, due to more complete combustion of fuel, the concentration of harmful impurities in the combustion products - nitrogen oxides (NO_x) and carbon monoxide (CO) - is reduced, which improves the environmental performance of energy equipment. An additional positive effect of using pulsations in the combustion chamber is a reduction in the amount of soot and acid deposits on the walls of the boiler's heat exchange surfaces, which contributes to increasing maintenance intervals and extending the life of the equipment.

Conclusion: The use of pulsations in the combustion chamber of a thermal boiler when burning a water-oil emulsion allows to significantly increase the efficiency of heat and mass transfer processes and the completeness of fuel combustion. Intensification of the combustion process contributes to increasing the boiler efficiency, reducing fuel consumption, reducing the formation of harmful substances in combustion products and improving the environmental performance of energy equipment.

References:

1. Heller Z. I. Fuel oil as fuel. 2005. 280 p.
2. Goryachkin V. Yu., Kornienko V. S. Intensity of corrosion processes in utilization boilers when burning water-fuel emulsions *Bulletin of the Ukrainian State Technical University*. 2013. No. 2. P. 101–110.