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FUEL ADDITIVES FOR EFFICIENCY IMPROVING OF SOLID FUEL INCINERATION

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Fuel additives based on light ethers increase the efficiency of combustion of liquid fuels. In this paper, the effect of such fuel additives on the combustion efficiency of solid fuels on the example of combustion of Ekibastuz coal was studied. Experiments were carried out as following. On warming and getting required temperature (900oC) of the combustor wall plasma torch was turned off. Thereafter pulverized coal and air were fed to the combustor with consumption 10 and 70 kg/h correspondingly. The gaseous products exit the gas and slag separation chamber and flow into the cooling chambers. Then gaseous products are exhausted to ventilation. Duration of the experiments was 1 hour. That is quite enough for all meters fulfilment and testing of the material and heat balance of the coal combustion. The dust of Ekibastuzski bituminous coal was used in the experiments. The sieve analysis of it revealed that mean size of the coal dust particles was 75 μm. It corresponds to the sieve residue R90=25% characterising milling finesse.

As a result of the coal combustion carbon conversion degree Xc and mass-averaged temperatures Tav were revealed. After starting-up and adjustment work two test experiments on the coal combustion in air and in oxygen-enriched air were carried out. A complex of numerical and experimental studies of high-ash coal incineration in a specially designed combustion chamber with coal consumption of up to 10 kg/h, air flow up to 62 kg/h, and oxygen flow up to 20 kg/h allowed estimating the effectiveness of the fuel additives Omstar -DX1 and Open Flame [1]. During the tests 28 adjustment experiments and 26 serial comparative tests coal burning without the use of additives and by using additives of different weight ratio additive: carbon (0 - 5 ml/kg of coal) were conducted. As a result of commissioning tests consumption of coal and oxidant flow (air + oxygen) required for complete coal burning-out in the compact experimental combustion chamber were identified. The adjustment tests have shown that the fuel additives increase the flame temperature at the exit of the combustor and reduces the concentration of unburnt carbon in the ash and slag of combustion products by 1-2%. Research results show that increasing the concentration of the additive Omstar -DX1 to 1.5 ml/kg of coal increases the temperature of the wall of combustion chamber, and therefore the flame, but has little effect at change in the measured concentrations of the gaseous products of combustion (SO2, NO, CO, CO2). At concentration of the additive 2 ml/kg of coal a slight decrease of SO2, CO, CO2, and a noticed decrease in the concentration of NO were recorded. The additive is beginning to have a significant impact on the efficiency of burning low-grade coal from 2.5 ml/kg of coal. The greatest influence of the additive on the effectiveness of coal combustion was recorded at a concentration of the additive Omstar -DX1 5 ml/kg of coal. For control tests concentration of both additives (Omstar -DX1 and Open Flame) was chosen 2.5 ml/kg of coal. In the framework of the tests of burning low-grade coal, both additives showed a similar efficacy. The degree of carbon conversion (Xc), which characterizes the completeness of burnout coal, is quite high when using both additives. Xc varies in the range of 95.1 - 96.9%. Tendency to increase the degree of coal conversion with increasing concentration of additives is revealed. From the experiments it follows that the use of Omstar -DX1 and Open flame fuel additives results in a significant increase in the efficiency of burning low-grade coal while reducing NOx and SO2 emissions. So, there is an increase in the completeness of coal combustion, which is manifested in an increase in the concentration of CO2 by 25%, and a decrease in the concentration of CO by 89%. In the process of coal combustion, the concentration of nitrogen oxides decreases by 47% and sulfur oxides by 5%. Taking into account the positive results of the tests of efficiency of the fuel additives in combustion of low-grade high-ash coal, we consider it expedient to test their effect on burning high-grade coal in test-bench conditions, and then go to the industrial testing fuel additives in thermal power plants.

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References

1. Morton Z. Fainman. Fuel Additive. USA Patent #4920691, May 1, 1990.