INDUSTRIAL APPLICATION OF INTERMETALLIC RADIATIVE POROUS BURNERS FOR OILLESS KINDLING OF DUST COAL BOILERS

A.V. KULIK[1], I.V. KANYGIN[1], A.Yu. KOPTEV[1], S.N. MOKRIN[1] Yu.B. GONCHARENKO[1,2], K.A. SHTYM[1]

[1]Far Eastern Federal University, Vladivostok, Russian Federation,
[2]JSC Khabarovsk Energy Technological Company, Khabarovsk, Russian Federation

The most of thermal power plants use heating oil for dust coal boiler kindling and for maintaining of stable boiler operation at the regimes of low power. Dust coal / air mixture supplies through the heating oil torch for this [1]. Heating oil lighting is also necessary to provide the stable combustion inside the boiler furnace in case of using coal with various properties and content. It leads to sustainable but inefficient and ecological unfriendly boiler operation. Heating oil price is significantly higher than coal one. Thus, it is expedient to use cheaper fuel for the procedures described above, for example liquid petroleum gas (LPG). The main problem of coal and gas co-combustion is related with high reactivity of gas fuel in comparison of coal. Moreover, gas torch is unable to generate the radiative heat flux enough to ignition of coal dust. One of the ways to overcome these problems is stabilization of dust coal torch in high density radiative heat flux generated by radiative porous burners operating on gas fuel. In this paper the results of development and commercial introduction of oilless coal dust lighting system based on radiative porous burners is presented.

Industrial partner RusHydro company proposed the power plant which is located in the city of Birobidzhan as an object for test introduction. Pilot device was mounted on dust coal boiler BKZ-75FB instead of one of the two heating oil injectors. The main part of apparatus is ignition unit which include two consequent sections. Each section consists of four 12 kW gas combustors (modules) where 280 mm x 160 mm x 17 mm intermetallic Ni-Al porous plate produced by SHS method was used as emitter [2]. Module case was made from steel covered by high temperature thermal insulation from the inside. Gas manifold was mounted on the side opposite to emitter. Air from compressor and LPG were used. The ignition of combustible mixture was performed by spark plug. Modules were installed oppositely in vertical and horizontal planes at the distance of 180 mm. Thus, eight modules of ignition unit formed 180 mm x 180 mm x 650 mm square channel, and free end was connected to the dust pipe. Coal dust / air mixture was directed from feed tract of neighbor boiler.

Ignition unit reached the working temperature of emitters (~1000 ^{o}C) in 5 minutes after start. Then dust / air mixture supplied to the ignition unit, ignited and formed coal dust torch inside the boiler furnace. After 15 minutes pilot dust coal torch reached to stable self-sustaining regime and gas supply stopped. However, air supply to the ignition unit didn’t stop to avoid the slagging.

The average heating oil consumption for cold start of the boiler is 3,6 tons which is equivalent to heat release of 9 tons of coal. Test experiments showed that LPG consumption of developed ignition unit with eight modules during 15 minutes was 15 liters. Thus, considering the actual price of energy resources economic benefit from commercial introduction of developed oilless coal dust lighting system provide the reduce of expenses on boiler kindling up to 2,85 times.

REFERENCES

[1] Burdukov A.P. Chernova G.V. Konovalov V.V. Churashev V.N. Development of technology for oil-free plasma kindling and lightning based on ultra-fine pulverized coal fuel, Izvestiya Tomskogo Polytehnicheskogo Universiteta. Georesources Engineering 2002 {in Russian}

[2] Maznoy, A., Pichugin, N., Kirdyashkin, A. Zambalov, S., Guschin, A. Predicting oxidation-limited lifetime of Ni-Al-Cr porous radiant burners made by combustion synthesis, Journal of Alloys and Compounds., 2023, 934, 167885

This work was financially supported by the Ministry of Science and Higher Education of the Russian Federation (project No. FZNS-2024-0003)