Burning of diesel fuel under vapor gasification conditions

E.P. Kopyev[1], S.V. Alekseenko[1], I.S. Anufriev[1], S.S. Arsentyev[1,2], O.V. Sharypov[1], E.Y. Shadrin[1], M.S. Vigriyanov[1]

[1] Kutateladze Institute of Thermophysics SB RAS, [2] Novosibirsk State University

A new method of burning liquid fuel using water vapor was proposed in the Kutateladze Institute of Thermophysics SB RAS, in which gasification of carbon-containing particles of incomplete combustion of liquid hydrocarbons occurs [1]. Earlier, it was demonstrated on the example of burner-type evaporative-type devices [2, 3] that the supply of superheated water vapor to the burning zone of liquid hydrocarbons dramatically intensifies combustion. At the same time, stable ignition, high combustion completeness and low content of toxic components in combustion products are ensured. Such a method of combustion is promising for the environmentally safe disposal of low-quality liquid hydrocarbon fuels and combustible waste of production with the generation of thermal energy.

As continuation of previous studies, in this paper, using the example of diesel fuel the combustion of dispersed liquid hydrocarbon fuel in a burner with forced controlled steam supply is experimentally studied. Spraying of liquid fuel is provided as a result of interaction with high-speed jet of superheated water vapor. At using sub-standard liquid fuel this dispersion method has significant technical advantages, associated with preventing the coking of the injector and clogging the fuel supply channels, which improves the performance and reliability of the burner. To substantiate the regularities of the influence of the parameters of water vapor on the main characteristics of the combustion process of liquid hydrocarbons (the composition of the combustion products and the specific heat release power), it is necessary to obtain data in various combustion regimes. The investigations are carried out on a fire test bed equipped with a new burner (10 kW), an electric steam generator (average power consumption 1.5 kW), a plunger metering pump, an automated control system for a steam generator, a fuel supply system, electronic scales for controlling water and fuel consumption, and necessary instrumentation. The measurement of thermal power during the combustion of diesel fuel in the investigated regimes are carried out using a flow calorimeter [2,3]. To control the composition of the gaseous combustion products, the TESTO 350 gas analyzer are used. As a result of the study, regimes are found in which high completeness of combustion of the fuel is ensured, while a low content of harmful CO and NOx emissions in gaseous reaction products is ensured.

The research are carried out with the financial support of the state represented by the Ministry of Education and Science of the Russian Federation, RFMEFI60417X0185

References

1. Russian Federation Patent No.2219435. Method of soot-free burning of fuels. (2003). Alekseenko S.V., Anufriev I.S., Vigriyanov M.S., Kopyev E.P., Sharypov O.V. Characteristics of Diesel Fuel Combustion in a Burner with Injection of a Superheated Steam Jet// Combustion, Explosion, and Shock Waves. – 2016. – Vol. 52. – N. 3. – P. 286–293.

3. Anufriev I., Arsentyev S., Vigriyanov M., Kopyev E., Sharypov O. Burning of substandard liquid hydrocarbons with steam gasification // MATEC Web of Conferences. – 2017. – Vol. 115. – Article No. 03013. – 4 p.