Effect of Components Composition on the Mechanism and Characteristics of Composite Fuel Ignition and Combustion within the Framework of the New Strategy for Industrial and Municipal Waste Utilization

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Nowadays, one of the world's major environmental problems is pollution by industrial waste and municipal solid waste (MSW). Only in Russian Federation more than $94 \cdot 10^9$ tons of waste are stored at landfills. Their relatively high energy potential, as well as the need to reduce landfill loading and improve the environmental situation characterizes the prospects for waste utilization by burning as part of composite liquid fuels (a mixture of fine coal, water, and used industrial oils). In the present study, the strategy was proposed for the joint utilization of combustible industrial waste and MSW (wood, rubber, plastic, cardboard), which involves the conversion of typical coal-fired thermal power plants (TPPs) to composite fuel. The implementation of such strategy for waste management in practice, on the one hand, will reduce the negative impact of waste on the environment; on the other hand, will reduce the consumption of high-quality coal fuel for the production of heat and electricity. During the 25 years, the economic effect of new waste management strategy will be at least 65% of the operating cost of coal-fired TPP. This is explained by the determining value (85–95%) of the fuel component (purchase of energy resources) in a typical structure of operating costs and the cost of energy resources, which differs 2.5–3.5 times for coal and composite fuel from waste (in terms of energy released during combustion).

Experimental studies of the combustion process of composite fuel have been carried out to substantiate the prospects for practical application of the developed strategy. When varying the component composition of the fuel, the conditions were established (the content of used oil is more than 20%) at which the fuel sample disperses, which intensifies its burnout. Single 2 mm droplets of composite fuel are reliably ignited and burn out in a motionless air at temperatures 600–1000 °C. The minimum values of the gas-phase ignition delay time are 1 s, the maximum are 9 s. The maximum temperature in the combustion process reaches 1300 °C. The burning temperatures of fuel compositions without adding used oil are 200–300 °C lower.

The addition of used oils to the composition of fuels, on the one hand, has a positive effect on reducing the concentration of dioxins and furans in the flue gases when burning out typical MSW in the fuel composition due to higher combustion temperatures; on the other hand, it negatively affects the increase in anthropogenic emissions. But this deterioration of environmental characteristics does not lead to exceeding the maximum permissible regulatory emissions of pollutants from TPPs for burning solid fuels.

The study of the mechanism and characteristics of dispersion of composite fuel droplets was carried out at the expense of the program for improving the competitiveness of Tomsk Polytechnic University, grant No. VIU-ISHFVP-74/2019.

The development of strategy for industrial and municipal waste utilization was funded by Russian Foundation for Basic Research and the Government of the Tomsk region of the Russian Federation, grant No. 18-43-700001.