Detonation combustion of anthracite particles in an air flow

Fedor A. Bykovskii[1], Sergey A. Zhdan[1], Evgenii F. Vedernikov[1], Yuriy A. Zholobov[2]

[1] Lavrentyev Institute of Hydrodynamics SB RAS,

[2]Novosibirsk State University,
630090, Novosibirsk, Russia

Available methods of burning solid fuels ensure rather low efficiency and require large-size furnaces. There is one more method: detonation combustion, which now attracts increased attention of specialists. In this method, the combustor size is determined by the detonation wave size, and the specific flow rates of the fuel increase by a factor of tens and hundreds. Specialists of the Lavrentyev Institute of Hydrodynamics of the Siberian Branch of the Russian Academy of Sciences have been engaged in studying detonation combustion of fuel-air mixtures for a long time. The method of detonation combustion was successfully applied to burn particles activated charcoal particles in plane-radial vortex combustors 204 and 500 mm in diameter and to burn Kuzbass long-flame (cannel) coal particles in combustors 500 mm in diameter. The goal of this work is to ensure and study continuous combustion of a mixture of anthracite particles with air. The experiments were performed with pulverized anthracite of the Listvyanskoe deposit in the Novosibirsk Region with addition of hydrogen.

Continuous spin detonation of a fuel-air mixture with a two-phase mixture (disperse anthracite with addition of hydrogen) was obtained in a flow-type plane-radial vortex chamber 500 mm in diameter for the first time. Hydrogen also served for transportation of the coal particles to the combustor and for promoting a chemical reaction in the detonation wave front. The minimum amount of hydrogen necessary for continuous spin detonation was 4.2% of the coal consumption rate. The measured TDW velocities with respect to the outer (500 mm) diameter of the combustor varied from 1.2 to 2.07 km/s, and their structure was not principally different from those observed previously in the case of detonation combustion of cannel coal and charcoal.

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