THE METHOD FOR DETERMINATION OF SOLID FUEL COMBUSTION CHARACTERISTICS IN HIGH-SPEED AIR FLOW

D. A. Vnuchkov, V. I. Zvegintsev, S. V. Lukashevich, and D. G. Nalivaichenko

S. A. Khristianovich Institute of Theoretical and Applied Mechanics of Siberian Branch of the Russian Academy of Scinces, 4/1 Institutskaya Str., Novosibirsk, 630090, Russian Federation

Abstract: The task of the study is to develop a unified experimental methodology for investigating combustion characteristics of various solid fuels in high-speed gaseous oxidant flows and for presenting the experimental results obtained in the uniform manner. The developed technique is based on using specialized experimental facility for quantitative determination of combustion characteristics of various fuels in a wide range of airflow parameters corresponding to the real flight conditions while using the same geometry of combustion chamber. The experimental results are used for certification of fuel characteristics from the point of view of its applicability in the solid fuel ramjet engine (SFRE). In addition, the obtained experimental data can be used to improve methods for calculating solid fuel combustion process in a combustion chamber of real geometry.

Keywords: SFRE; solid fuel; experimental facility; combustion; combustion characteristics

Acknowledgments

The work was supported by the Russian Foundation for Basic Research (grant No. 15-08-04581 NK/15).

References

1. Arkhipov, V. A., V. E. Zarko, I. K. Zharova, A. S. Zhukov, E. A. Kozlov, D. D. Aksenenko, and A. V. Kurbatov. 2016. Solid propellant combustion in a high-velocity cross-flow of gases (review). *Combust. Explo. Shock Waves* 52(5):497–513.
2. Zvegintsev, V. I. 2014. *Gazodinamicheskie ustanovki kratkovremennogo deystviya. Ch. 1. Ustanovki dlya nauchnykh issledovaniy* [Short-duration gas-dynamic facilities. Part 1. Facilities for scientific research]. Novosibirsk: Parallel. 551 p.
3. Vnuchkov, D. A., V. I. Zvegintsev, D. G. Nalivaichenko, and S. V. Lukashevich. 2016. Issledovaniye kharakteristik goreniya tverdogo topliva v vysokoskorostnom potoke vozdukha [Investigation of of solid fuel combustion in high-speed air flow]. *Tr. XIII Vseross. nauchn.-tekhnich. konf. "Artilleriyskoye vooruzheniye Rossii-2015". Biblioteka zhurnala "Voenmekh. Vestnik BGTU"* [13th All-Russian Scientific and Technical Conference "Artillery Armament of Russia-2015" Proceedings. Library of the magazine "Voenmech. Bulletin of BSTU"] 33:76–82.
4. Vnuchkov, D. A., and V. I. Zvegintsev. 2016. Metodika issledovaniya goreniya tverdogo topliva v vysokoskorostnom potoke gazoobraznogo okislitelya [The method for investigation of solid fuel combustion in high-speed flow of oxidizer]. *Mat-ly V Vseross. konf. "Fundamental'nyye osnovy ballisticheskogo proektirovaniya"* [5th All-Russian Conference "Fundamentals of Ballistic Design" Proceedings]. St. Petersburg: BSTU. 60–63.
5. Aul'chenko, S. M., V. I. Zvegintsev, S. V. Lukashevich, and D. G. Nalivaichenko. 2016. Metodika raschetno-eksperimental'nykh issledovaniy kharakteristik goreniya tverdykh topliv v vysokoskorostnom potoke vozdukha [The method of theoretical and experimental studies of solid fuels combustion characteristics in high-speed air flow]. *Conference (International) on High Energy Materials: Demilitarization, Antiterrorism, and Civil Application Proceedings*. Tomsk: TSU. 49–52.
6. Aul'chenko, S. M., and V. I. Zvegintsev. Ispol'zovanie eksperimental'no poluchennykh kharakteristik goreniya tverdogo topliva dlya rascheta gazotermodinamicheskikh protsessov v kamere sgoraniya [Use of experimentally obtained characteristics of solid fuel combustion for calculation of gas-thermodynamic processes in the combustion chamber]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 10(4):57–62.

Received September 25, 2017

Contributors

Vnuchkov Dmitry A. (b. 1980) — junior research scientist, S. A. Khristianovich Institute of Theoretical and Applied Mechanics of Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk, 630090, Russian Federation; vnuchkov@itam.nsc.ru

Zvegintsev Valery I. (b. 1944) — Doctor of Science in technology, chief research scientist, S. A. Khristianovich Institute of Theoretical and Applied Mechanics of Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk, 630090, Russian Federation; zvegin@itam.nsc.ru

Lukashevich Sergey V. (b. 1981) — junior research scientist, S. A. Khristianovich Institute of Theoretical and Applied Mechanics of Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk, 630090, Russian Federation; lukashevich@itam.nsc.ru

Nalivaichenko Denis G. (b. 1975) — Candidate of Science in technology, research scientist, S. A. Khristianovich Institute of Theoretical and Applied Mechanics of Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk, 630090, Russian Federation; denis@itam.nsc.ru