Modeling of gasification of complex solid porous polymer in low-temperature gas generator for high-speed flying vehicle

Eugene Salgansky[1], Ksenia Borovik[1,2], Sergey Fetsov[1,2], Nickolay Lutsenko[1,3], Leonid Yanovskiy[1,4]

[1] Institute of Problems of Chemical Physics, Russian Academy of Sciences, Chernogolovka, Russia, 142432

[2] Far Eastern Federal University, Vladivostok, Russia, 690091

[3] Institute of Automation and Control Processes, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia, 690041

[4] Moscow Aviation Institute, Moscow, Russia, 125080

sea@icp.ac.ru

Currently, research is underway to create a high-speed flying vehicle equipped with a solid fuel engine. At high flight speeds, the stagnation temperature of the incoming air flow reaches high values which do not allow air to be used as a coolant in the cooling system. In this case, hydrocarbon fuel placed on board the flying vehicle can be used to cool the engine. To implement such flying vehicle, it is necessary to use low-temperature gas generators of combined charges, consisting of propellant and evaporated solid energy-condensed fuel. This will allow the engine to be cooled by the convective flow of the gasification products of the evaporated fuel. In [1-2], a mathematical model and a numerical method were proposed for calculating the gasification of solid porous fuel, and this process was numerically investigated for the case when the gas pressure at the inlet of porous fuel was fixed, but inlet gas velocity was unknown and non-constant. The present work is devoted to the theoretical study of the regularities and mechanisms of gasification of solid porous fuel when solid porous fuel consists of different materials.

The influence of the characteristics of solid fuel on the operating conditions of the gas generator has been investigated for polymethyl methacrylate (PMMA) and polyethylene (PE). Four variants of the fuel composition are considered: 1) the fuel consists of PMMA, 2) the fuel consists of PE, 3) the fuel consists of PMMA:PE=50:50, 4) the fuel consists of PE:PMMA=50:50. It is shown that the composition of the fuel is a control parameter that determines the operating time of the gas generator.

This work was supported by the Russian Science Foundation (№ 21-79-20008) - Salgansky E.A., Borovik K.G., Fetsov S.S. and Lutsenko N.A. and as part of a state assignment (AAAA-A19-119100800130-0) – Yanovskiy L.S. The research is carried out using the equipment of the shared research facilities of HPC computing resources at Lomonosov Moscow State University.

References

1. E. A. Salgansky, N. A. Lutsenko, V. A. Levin et al., *Aerosp. Sci. Technol.* **2019**, 84, 31.
2. E. A. Salgansky, N. A. Lutsenko, *Aerosp. Sci. Technol.* **2021**, 109, 106420.