
Using helium in liquid rocket engines

© S.A. Orlin

Bauman Moscow State Technical University, Moscow, 105005, Russia

We study a possibility of using helium in propulsion plants with liquid rocket engines (LREs). We list those properties of helium that might be relevant to developing aerospace industry assemblies. We consider examples of using helium as a working body in contemporary LREs for ensuring the functioning of LRE propulsion plant systems (such as pressurisation of propellant tanks before launch or the automation component actuator); we also estimate the role helium plays in the work process taking place in the combustion chamber. We prove that using helium is advantageous as compared to other inert gases (for example, nitrogen). We show that, for a range of propellants, adding helium to the liquid rocket engine combustion chamber may increase specific impulse. We supply results of promising developments in the sphere of designing LREs with an autonomous cooling loop and state the advantages of this design option. We emphasise that the suggested method of upgrading existing LREs that employs the helium application techniques described in the article does not entail significant alterations to the engine design, which means it is economical.

Keywords: *liquid rocket engines, helium, specific impulse, upper stage, promising design options*

REFERENCES

- [1] Dobrovolskiy M.V. *Zhidkostnye raketnye dvigateli* [Liquid rocket engines]. Moscow, BMSTU Publ., 2016.
- [2] Fastovskiy V.G., Rovynskiy A.S., Petrovskiy Yu.V. *Inertnye gazy* [Inert gases]. Moscow, Atomizdat Publ., 1972.
- [3] Finkelshteyn D.N. *Inertnye gazy na Zemle i v kosmose* [Inert gases on the Earth and in space]. Moscow, Nauka Publ., 1979. (Seriya nauka i tekhnicheskii progress) [Science and technological progress series].
- [4] Yakutseni V.P. *Traditsionnye i perspektivnye oblasti primeneniya geliya* [Conventional and promising fields of helium application]. St. Petersburg, All-Russia Petroleum Research Exploration Institute Publ., 2009.
- [5] Orlin S.A. Povyshenie ekonomichnosti kislородno-uglevodorodnykh ZhRD razlichnogo naznacheniya putem vnedreniya promezhutochnogo okhladitelya [Increasing efficiency of oxygen/hydrocarbon LRE for various purposes by means of introducing intermediate coolant]. *Trudy MGTU im. N.E. Baumana no. 608 "Teoriya i praktika sovremennogo raketnogo dvigatelestroeniya", sb. statey* [Proc. of Bauman Moscow State Technical University, no. 608 "Theory and practice of contemporary rocket engine development"]. Moscow, BMSTU Publ., 2013.

Orlin S.A. (b. 1937) graduated from Bauman Moscow Higher Technical School in 1960, Department of Aircraft Engines. Cand. Sci. (Eng.), Assoc. Professor, Department of Rocket Engines, Bauman Moscow State Technical University.
