NOVEL ROCKET PROPELLANT BASED ON SORBITOL AND POTASSIUM PERCHLORATE

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Abstract: The properties of a novel rocket propellant based on sorbitol and potassium perchlorate have been studied. The stability and high burning rate required for the faced combustion regime of the propellant in the combustion chamber are achieved by adding a catalyst, the search of which was conducted among simple and complex cyanides, cyanates, and thiocyanates. The efficiency of the catalyst was determined by the magnitude of the linear burning rate under normal conditions. To give the propellant plastic properties, sorbitol was partially replaced with polyoxybenzenes. For the most successful compositions, the dependences of the thrust characteristics on the catalyst content in the propellant and on the initial temperature have been studied. The experiments on propellant burning in a manometric bomb have also been performed.

Keywords: composite solid propellant; potassium perchlorate; sorbitole; burning rate; thrust; initial temperature

DOI: 10.30826/CE19120315

Acknowledgments

This work was partly supported by the subsidy given to the N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences to implement the state assignment on the topic No. 0082-2016-0011 "Fundamental studies of conversion processes of energetic materials and development of scientific grounds of controlling these processes" (State Registration No. AAAA-A17-117040610346-5) and topic 0082-2018-004 (State Registration No. AAAA-A18-11803159008808). The authors thank A. V. Suvorov for the production of the electronic thrust-measuring test rig and Yu. A. Lobanovskii for consulting on the issues dealing with the gasdynamics of jet engines.

References

1. Launius, R. D. 2003. *To reach the high frontier: A history of U.S. launch vehicles*. Lexington, KY: University Press of Kentucky. 233 p.
2. Ponomarenko, V. K. 1995. *Raketnye topliva* [Rocket propellants]. St. Petersburg: VIKKA im. A. F. Mozhayskogo. 372 p.
3. Dixon, S., B. Tunick, and E. Brown. 2004. Composite propellant compositions. U.S. Patent 20040094250 A1.
4. Rebeko, A. G. 2014. Novye raketnye topliva na osnove perkhloratov metallov [New rocket propellants based on metal perchlorates]. Patent RF No. 2594218.
5. Afanasiev, I. B., and A. V. Suvorov. 2008. V kosmos na sachare: "Karamel'noe toplivo" [Into the space using sugar: "Caramel propellant"]. *Populyarnaya mekhanika* [Popular Mechanics] 4:80.
6. Sutton, G. P., and O. Biblarz. 2010. *Rocket propulsion elements*. Hoboken, NJ: John Wiley and Sons. 595–599.
7. Sedov, L. I. 1970. *Mekhanika sploshnoy sredy* [Mechanics of continuum]. Moscow: Nauka. Vol. 2. 48 p.
8. Feodosiev, V. I. 1979. *Osnovy tekhniki raketnogo poleta* [Fundamentals of rocket flight engeneering]. Moscow: Nauka. 21 p.
9. Belyaev, A. F., V. K. Bobolev, A. I. Korotkov, A. A. Sulimov, and S. V. Chuiko. 1973. *Perekhod goreniya kondensirovannykh sistem vo vzryv* [Transition of burning in condensed systems into explosion]. Moscow: Nauka. 293 p.

Received Auguat 12, 2019

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