COMBUSTION CHARACTERISTICS OF MODEL COMPOSITE PROPELLANTS WITH ALUMINUM DIBORIDE[1]

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The work continues comparative investigations [1] of highly loaded model propellant formulations with ca. 40 % of different boron containing fuels. This work is focused on aluminum diboride and mechano-activation effects.

A research objects – three model propellants based on ammonium perchlorate, energetic binder and combined fuel. First fuel, MA1, – "raw" material – is mechanically-activated (MA) mixture of aluminum and boron powders taken in the same mass ratio as in aluminum diboride. Second fuel, MA2, is aluminum diboride made of this "raw" material via method close to one described in [2]. Third fuel, MA3, is MA2 subjected again to mechanical activation. Thus, we compared three fuels of AlB_2-type obtained with different MA-actions.

The data on the burning rate at pressures of 1.2 MPa and 2.5 MPa and on the condensed combustion products (CCP) parameters are reported in present work. For the particles extinguished near the burning surface the oxidation of fuel *on* and *above* the surface is actually investigated [3, 4]. Sampled particles are so called *primary* CCP [5]. The particles mass size distributions in the range from 0.5 microns to millimeters are delivered; the CCP particles morphologies (obtained via optical microscopy, SEM, EDS) are described. The millimeter-sized products are the skeleton-layer or *carcass* remaining in a glass after propellant specimen burned out. The data on the combustion completeness of fuel was obtained via cerimetric method [6].

The approaches to compare fuels in mass parameters of the combustion products and in efficiency of energy release are developed.

For the analysis of data on combustion completeness the complex parameter E is proposed named "efficiency of the energy release". This parameter integrates the incompleteness of fuel combustion, the mass fractions of Al and B in the combined fuel, the reducing number and the specific heat of combined fuel, as well as the mass of carcass residue in a glass.

In general, the efficiency of the energy release E essentially depends on the burning rate value and on the agglomeration process features as well as on the propellant formulation and the combined fuel parameters.

The propellant with fuel MA3 was most energy release efficient among three formulation under study.

REFERENCES

[1] *Glotov O. G., Zarko V. E., Surodin G. S., Kiskin A. B.* // Energetic Materials – Reactivity and Modeling. 48th International Annual Conference of the Fraunhofer Institute for Chemical Technology (ICT), Karlsruhe, Germany. – 2017. – P. 14-1–14-14.

[2] *Korchagin M. A., Zarko V. E., Bulina N. V.* // Eurasian Chemico-Technological Journal. – 2017. – V. 19. – № 3. P. 223-229.

[3] *Glotov O. G., Zyryanov V. Ya.* // Combustion, Explosion and Shock Waves. – 1995. – V. 31. – № 1. P. 72–78.

[4] *Korotkikh A. G., Arkhipov V. A., Zarko V. E., Kiskin A. B.* // Combustion and Flame. – 2017. – V. 178. – P. 195–204.

[5] *Liu J., Liang D., Xiao J., Chen B., et al* // Combustion, Explosion and Shock Waves. – 2017. – V. 53. – № 1. P. 55–64.

[6] *Fedotova T. D., Glotov O. G., Zarko V. E.* // Propellants, Explosives, Pyrotechnics. – 2007. – V. 32. – №2. P. 160–164.

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