MATHEMATICAL MODEL OF PHYSICAL AND CHEMICAL PROCESSES IN COMBUSTION OF BALLISTIC SOLID FUELS (FIRST REPORT)

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Abstract: Physical and chemical processes during combustion of homogeneous (double-base) solid propellants (HSP) have been investigated and chemical reactions corresponding to endo- and exothermic processes of formation of gaseous and liquid substances in liquid-viscous reaction layer have been listed. To calculate the values of species concentrations, all necessary differential equations with initial and boundary conditions have been formulated and analyzed. The proposed approach allows one to calculate the value of the burning rate of HSP in both stationary and nonstationary conditions. The statement of the problem for HSP combustion is new due to accounting the liquid-viscous reaction layer and liquid-viscous layer in the equations of heat and mass transfer on the moving interphase surface, as well as the differences in concentrations of all substances on this surface. The system of diffusion equations in liquid-viscous reaction layer and in liquid-viscous layer, the mathematical model of Zel'dovich gasification phenomena for determining the burning rate of HSP, and the implicit method for numerical solution of the system of nonlinear parabolic equations are also new.

Keywords: homogeneous solid propellant; combustion; mathematical modeling; chemical reactions; gasification

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