THE MECHANISM OF DOUBLE-BASE PROPELLANT COMBUSTION AT LOW PRESSURES

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Abstract: The combustion mechanism of double-base propellant in a nitrogen environment at pressures below 1 atm is investigated. It is shown that combustion of samples occurs in the oscillating-cellular mode if the radiative heater igniting the sample turns off immediately after ignition. In this case, the regularities of combustion, such as the dependences of the size of the cells on the mean burning rate and the critical diameter of combustion on pressure, are similar to those at pressures up to 5 MPa. If the radiative heater does not turn off after sample ignition, then combustion at low pressures looks like a quasi-stationary one-dimensional mode (with a flat burning surface). At the same time, the cellular combustion mode with fluctuations of the local burning rates is also observed. The dependences of the characteristic size of the cells on the burning rate and the critical diameter of combustion on pressure are obtained and the temperature of the burning surface corresponding to the measured burning rates is estimated.

Keywords: gunpowder; double-base propellant; non-one-dimensional combustion front; hot-spots pulsating mechanism

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Figure Captions

Figure 1 Views of burning surfaces of combustion samples at different pressures: (*a*) pressure 0.1 MPa, cylindrical sample with a diameter of 19.5 mm; (*b*) pressure 0.05 MPa, sample of rectangular cross section 18.1 × 17.3 mm; and (*c*) pressure 0.03 MPa, cylindrical sample with a diameter of 19.5 mm

Figure 2 Combustion surfaces of the samples burning with a working radiative heater at different pressures: (*a*) 0.1 MPa; (*b*) 0.05; and (*c*) 0.03 MPa. The sample sizes are shown in Table 3

Figure 3 Dependences of the burnt web H and the burning rate U along the vertical generatrix of the sample at pressures of 0.1 (*1*), 0.05 (*2*), and 0.03 MPa (*3*) with the step of 0.32 s

Table Captions

Table 1 The parameters of cells on the burning surface at pressures of 0.1–0.03 MPa

Table 2 The critical diameter at a pressure of 0.05 MPa

Table 3 The mean burning rate and its values at pressures of 0.1–0.03 MPa at working radiative heater

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