EXPERIMENTAL AND THEORETICAL STUDY OF COMBUSTION OF GRANULAR CHARGE IN A NOZZLE MANOMETRIC BOMB

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Tests of gunpowder combustion in a constant-volume manometric bomb are characterized by low loading density (up to 0.2 g/cm^3) [1, 2]. The use of a nozzle bomb (NB) at the initial stage of gunpowder combustion research makes it possible to implement a loading density of up to 1 g/cm^3, implement a maximum pressure of up to 600 MPa, and obtain the law of gunpowder combustion during pressure rise and fall. These parameters correspond to the real conditions of barrel launching systems [3].

The aim of this work is to compare the experimentally measured dependence of the pressure change over time in the SB during combustion of a charge of pyroxylin powder with calculations using the thermodynamic model of powder combustion in the SB, and using the conjugate model of non-stationary powder combustion.

After ignition of the powder charge, the pressure in the SB chamber increases to the pressure of the plug opening and then decreases with continued combustion of the charge. The pressure of the plug opening was set equal to 40, 80 and 120 MPa. After opening the plug, the pressure in the combustion chamber drops. The dependence of the pressure on time was recorded until the complete combustion of the charge charge. A comparison was made of the experimentally measured dependence of pressure on time in the SB with calculations based on the thermodynamic model of combustion of a powder sample in the SB using the empirical law of the dependence of the combustion rate on pressure and on the conjugate model of non-stationary combustion of powder, which takes into account chemical reactions in the condensed and gas phases, and boundary conditions of the fourth kind (conjugation conditions) are set on the combustion surface [1, 2]. Satisfactory agreement was obtained between the calculation results and the experimental measurements. It was revealed that the non-stationary combustion rate of pyroxylin powder, due to the high rate of pressure increase above the combustion surface, exceeds the quasi-stationary rate [4]. This difference depends on the rate of pressure increase and on its absolute value. The difference between the quasi-stationary and non-stationary combustion rates decreases with increasing pressure starting from 80 MPa. At the stage of pressure drop, the non-stationary combustion rate of powder is significantly lower than the combustion rate determined by the empirical power law of the combustion rate of powder.

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