CALCULATION OF THE DELAY TIME OF THERMAL EXPLOSION OF A MIXED ENERGETIC MATERIAL ON POLYBUTADIENE BINDER

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Abstract: The dependence of the thermal explosion delay time τ on the ambient temperature T_S is calculated for samples of the K-2 vulcanized composite energetic material containing HMX, ammonium perchlorate, and aluminum. Butadiene rubber plasticized with transformer oil was used as a binder. The kinetic parameters required for the calculation were determined by thermal analysis methods and corresponded to the temperature zone of the exothermal decomposition reaction of HMX in K-2 at heating rates of 0.3–4.6 K/min. The calculated dependences $\tau(T_S)$ in the range of T_S from 180 to 230 °C are in satisfactory agreement with the experimental data obtained by the present authors and by other researchers for K-2 cylindrical samples with a radius of 2 and 10 mm.

Keywords: thermal explosion; thermal decomposition; energetic material; octogen; activation energy

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Figure Captions

Figure 1 Temperature dependence of the rate of thermal decomposition of the K-2 sample at $b = 1$ K/min, calculated using zero-order equations (*1*), first-order equations (*2*), first-order autocatalysis equation at $\alpha_0 = 10^{-4}$ (*3*), and Prout–Tompkins equation for $n = 0$, $m = 1$, and $j = 0.9999$ (*4*). All maximum values of the curves are normalized to unity. The experimental peak corresponds to 213.8 °C

Figure 2 Temperature dependence of the periods of delay of thermal explosion of K-2 samples: *1* and *2* — calculation according to the thermal conductivity equation for cylindrical specimens with a radius of 2 and 10 mm, respectively; *3* — calculation using Eq. (7) at $j = 0.9999$ and $\alpha = 0.01$; *4* — experimental data [7]; *5* — our experimental data; and *6* — experimental data [8, 9] for high explosives based on HMX

Figure 3 Dependence of the critical radius of cylinders of infinite length on temperature at Bi numbers equal to 10^{-2} (*1*), 10^{-1} (*2*), 10^{0} (*3*), 10^{1} (*4*), and 10^{2} (*5*)

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