CORRELATION BETWEEN CRITICAL PARAMETERS OF DETONATION DETERMINING DETONATION WAVE PROPAGATION LIMITS*

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Abstract: Detonability is one of the most important characteristics of high explosives. One of the main parameters for its estimation is to determine the limiting possibilities of propagation of the detonation wave. Depending on the method used, the detonation wave propagation limits can be determined under various conditions (acoustic stiffness of the surrounding material and geometry of the explosive charge, which determines the presence or the absence of "overdrive" of the detonation wave, a velocity gradient, "dark" zones, etc.) that affect the numerical value of the result. As a result of comparative analysis of experimental data, for several plastic high explosives (based on RDX, nanostructured RDX, TEN, and BTF), relationships were determined that provide the ability to recalculate the values of the characteristics of detonability obtained by only one of the experimental methods for conditions implemented in other methods. It was shown that such calculated estimates give numerical values of these characteristics with accuracy up to the error of the experiment. The results provide a broad experimental basis for comparing estimates of the detonability of explosives obtained by different methods, taking into account the characteristics of each method. As a result of the comparative analysis of experimental data for several plastic explosives (based on RDX, nanostructured RDX, PETN, and BTF), the relationships were determined providing the possibility of recalculating the values of detonability characteristics obtained with the only one of the experimental methods for conditions implemented in other methods. It was shown that such calculated estimations provide the numerical values of these characteristics with accuracy up to the error of the experiment. The results of this work provide a broad experimental basis for comparing estimates of the detonability of explosives obtained by different methods, taking into account the features of each method.

Keywords: explosives; detonability; detonability limit; critical diameter of detonation

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Figure Captions

Figure 1 Explosive charges for determination of critical detonation parameters in straight segment (*a*)–(*c*) and in segment with turns (*d*)

Figure 2 Plot of dependence of explosive charge width (a, C_{wedge}, and $a_{(\mathrm{in\ turns})}$) on its thickness (b, H_{cr}, and $b_{(\mathrm{in\ turns})}$) when determining critical detonation parameters by Eqs. (1)–(3): *1* — $d^{\mathrm{equ}}_{\mathrm{cr(in\ turns)}}$; *2* — $d^{\mathrm{equ}}_{\mathrm{cr(in\ turns)}}/2$; *3* — d_{cr}; *4* — $\Delta_{\mathrm{cr}} = d_{\mathrm{cr}}/2$; *5* — $d^{\mathrm{equ}}_{\mathrm{cr(wedge)}}$; and *6* — $d^{\mathrm{equ}}_{\mathrm{cr(wedge)}}/2$

Figure 3 Plot of "equivalent critical diameter in turns" vs. "equivalent critical diameter on wedge" for plastic high explosives with different explosive fillers: *1* — based on TEN; *2* — based on BTF; *3* — based on RDX; *4* — based on nanostructured RDX; and *5* — based on TEN – nanostructured RDX mixture

Figure 4 The ratio between the critical detonation parameters obtained via different methods provided that the value of the critical detonation diameter is taken as a unit

Table Captions

Table 1 Mean and standard deviations for proportionality factor K for ratios $d^{\mathrm{equ}}_{\mathrm{cr(wedge)}})/b_{\mathrm{cr}}$, $d_{\mathrm{cr}}/b_{\mathrm{cr}}$, $d^{\mathrm{equ}}_{\mathrm{cr(turn)}}/d_{\mathrm{cr}}$, and $d^{\mathrm{equ}}_{\mathrm{cr(turn)}}/d^{\mathrm{equ}}_{\mathrm{cr(wedge)}}$

Table 2 Example of using the proportionality factors from Table 1 to compare the detonability of explosives

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