SIMULATION OF EXPERIMENTS FOR STUDYING THE RELATION BETWEEN DETONATION FRONT VELOCITY AND CURVATURE IN CYLINDRICAL LOW-SENSITIVE HE SAMPLES

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Experiments for studying the detonation velocity of cylindrical samples of different diameters (the diameter effect) are important for the verification of a condensed HE detonation model. It is known that explosives are characterized by a critical diameter d_{cr}, or a minimal diameter at which detonation wave propagation is still possible, and by a limiting diameter d_{lim} above which the detonation velocity stops to increase. When a charge of a finite diameter detonates, the shock front, under the action of side rarefaction waves, gets a convex form in the direction of detonation wave propagation. Its curvature k is also an important characteristic of the process.

TATB-based explosives are interesting for the study of the diameter effect because of a significant difference between the critical and limiting diameters: $d_{lim} \approx 10d_{cr}$, with the detonation velocity D reduced by ≈10% as the diameter decreases. Papers [1, 2] present experimental results on the detonation parameters of cylindrical samples including those with inert and explosive shells. A unique relation between detonation wave velocity and curvature was established.

It is known that the main reason for nonideal detonation of TATB-based explosives under the conditions far from critical is the slow release of energy caused by exothermic ultra-dispersed diamond (UDD) clustering in explosion products (EP) [3, 4]. UDD clustering outside the chemical zone was confirmed in experiments where the dynamics of condensed carbon nanoparticle sizes was studied with synchrotron radiation [5]. In plane wave experiments, the non-ideality manifested itself as the dependence of the effective Jouguet pressure on the distance travelled by the detonation wave [4].

In this paper, the joint TATB detonation model developed in [6] was used for the simulation of experiments on cylindrical samples [1, 2]. The model considers both the slow kinetics (the release of some calorific heat outside the HE-EP zone), and the HE shock sensitivity. The dependences $D(d)$ and $D(k)$ obtained in calculation and in experiment agree well. With no account for slow kinetics it appeared impossible to reproduce the experimental parameters.

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