THE EFFECT OF CONTRIBUTION OF DIFFERENT FRACTIONS OF NITRAMINE-CLASS HE ON PLASTIC EXPLOSIVE COMPOSITION DETONABILITY

A. Yu. Tarasov, E. B. Smirnov, A. V. Sarafannikov, A. I. Akhmetzyanov, A. V. Karypova, T. V. Tikhonova, L. N. Shinkareva, I. A. Makarchev, K. A. Gaisina, R. N. Valiev, A. V. Molteninov

FSUE «RFNC – VNIITF named after Academ. E. I. Zababakhin», Snezhinsk, Russia

It is known from literature that explosive composition (hereinafter EC) detonability is most affected by such factors as the nature of an explosive filler, size of particles, particle structure imperfection, density and inhomogeneity of parts made of the EC, and presence and acoustic rigidity of the shell [1]. This work is a continuation of investigation into the effect of high-explosive (hereinafter HE) particle size distribution on EC detonability. Previously, the results of investigation into the effect of bimodal size distribution of nitramine-class HE fractions on detonability of plastic EC were published. [2]. In this work the contribution of nitramine-class HE fractions to the total EC detonability was studied. The work is aimed at finding effective techniques that can affect EC detonability, since in practice it is not always easy to obtain a batch of HE with the required particle size distribution.

To obtain fractions of a certain size, the initial HE batch was screen sized using the sieves with 0.315; 0.25; 0.2; 0.16; 0.1; 0.04 mm openings. The resulting HE fractions were mixed with polyisobutylene to improve the reprocessing performance.

By analogy with [2], EC detonability was determined by the wedge and air-gap methods. Break-upo the detonation process was registered by the witness plate. The obtained results are shown in Fig. 1.

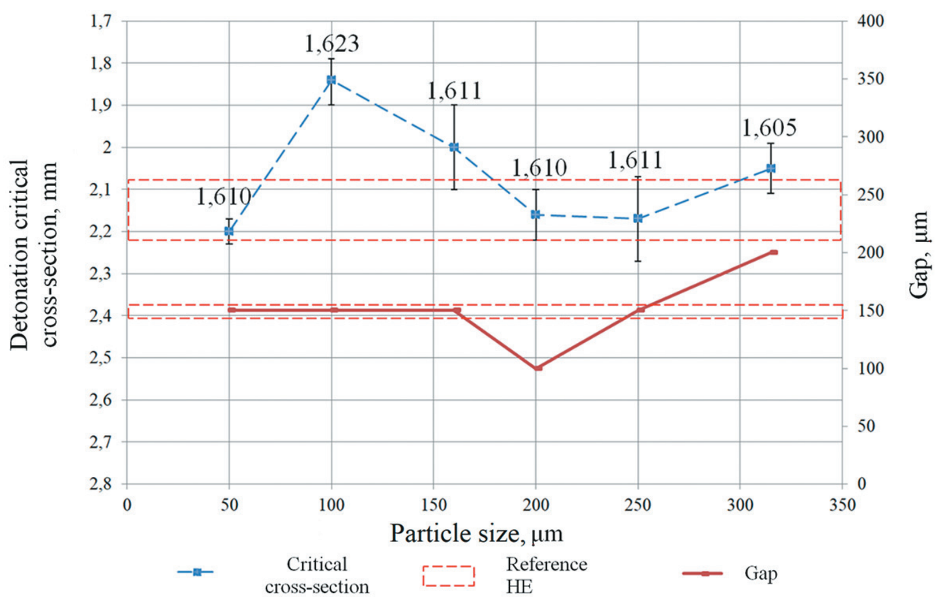

Fig. 1. Overlaying graphs illustrating changes in detonability determined by the wedge and air-gap methods

The two methods of assessing detonability show a good agreement (Fig. 1). Detonability of most of experimental points is representative for the selected HE batch (indicated by a dotted line). The exception is a fraction determined by the residue on the sieve with 0.1-mm openings. To confirm the identified exception, an additional experiment was conducted with a similar setup. The results of the initial and additional experiments completely coincided indicating that the EC with HE fractions larger than 0.1 mm and less than 0.16 mm had higher detonability.

The obtained experimental data can be explained if one considers the relationship between detonability and particle packing density, shown earlier in [2]. So, the packing density for particles of any similar size is 0.74 for an ordered particle packing and 0.64 for chaotic particle packing [3, 4], i. e. packing density is a constant value for particles of the same size. Only the size of "voids" between particles will change. For the EC, "voids" are assumed to be fully or partially filled with a binder. Five of six experimental points had the critical detonation cross-section similar to the EC of the initial HE batch. All six experimental points had approximately the same detonation breakup air gap, equal to that for EC of the initial HE batch.

Since detonability depends on several factors, the reasons for higher detonability of the EC with HE particle size greater than 0.1 mm, but less than 0.16 mm require a separate study.

References

1. Explosion physics [Text] : in two volumes / Edited by L. P. Orlenko. – 3d Revised edition. – Vol. 2. – M. : FIZMATLIT, 2004. – 656 p. (in Russian).
2. **Tarasov, A. Yu.** The effect of bimodal RDX fraction distribution on plastic explosive composition detonability [Text] / A. Yu. Tarasov, E. B. Smirnov, A. V. Sarafannikov et al. // Proceedings of the 17th International Conference "Zababakhin Scientific Talks". – Snezhinsk : RFNC – VNIITF, 2025. Approved for publishing (in Russian).
3. **Belov, V. V.** Computer-implemented solution for scientific, technical, and educational problems [Text] : training tools / V. V. Belov, I. V. Obraztsov, V. K. Ivanov, E. N. Konoplev. – Tver : TvSTU, 2015. – 102 p. (in Russian).
4. **Korolev, L. V.** Close packing of polydisperse particles in composite construction materials [Text] / L. V. Korolev, A. P. Lupanov, Yu. M. Pridatko. – Yaroslavl : Yaroslavl State Technical University (in Russian).