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Thermodynamic characteristics of powder and its performance criteria

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Abstract

The purpose of the study was to find an objective criterion of a performance of powders and powder formulations for evaluating a perspective of their using in modern small arm systems. The questions were raised about a concept of the performance of powders and powder formulations as well as a possibility of a performance evaluation regardless of a specific gun systems. It is shown that a criterion of the performance for explosives based on the physical meaning, introduced by A.F. Belyaev, is analogous to a work of the adiabatic expansion of combustion products in a gun bore or a muzzle energy of a projectile when firing. The energetic characteristics of powders and powder formulations and the work of the adiabatic expansion of combustion products of powders and powder formulations in the form, proposed by I.P. Grave, were regarded as the criterion of the performance of powders and powder formulations. It is shown that a value of a powder force can serve as the objective criterion of the performance of powders and powder formulations in the early and in the middle of the twentieth century. At present, the use of only a powder potential, which is a total energy of the combustion products of powders, or only a powder force, which is numerically equal to a maximum possible work of the combustion products of a powder at their isobaric expansion, as a criterion of a performance is not rational, although both the potential and the force of the powder are the important characteristics of the performance of powders and powder formulations. The energy equation in the form, proposed by I.M. Grave, is proposed to use as the criterion of the performance of powders and powder formulations in the specific gun system with an active throwing scheme. It is shown that the powder performance can be a constant when increasing in a force and decreasing in a potential of a powder at the specific limits and vice versa. If with an increase in one of the characteristic a decrease of another one will be too high, the powder performance will

also decrease. The greatest increase in a powder performance can be achieved while increasing the force and potential of the powder.

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References

- [1] B.A. Dobryakov. Internal ballistics. L. *Office of naval educational establishments of Navy*. **1952**. P.254. (Russian)
- [2] A.Ya. Apin, A.F. Belyaev, G.S. Sosnova. Experimental determination of explosion heat. *Physics of Explosion Coll*. **1953**. Vol.2. P.3-26. (Russian)
- [3] A.F. Belyaev. About full explosion performance. *Physics of Explosion Coll*. **1953**. Vol. 2. P.27-42. (Russian)
- [4] M.E. Serebryakov. Internal ballistics of barrel systems and powder rockets. *Moscow: SPHDI*. **1962**. P.703. (Russian)
- [5] U. Galvitts. Gunpowders and charges. *Moscow: SPHDI*. **1950**. P.195. (Russian)
- [6] I.P. Grave. Internal ballistics. L. *The Dzerzhinsky Artillery Academy of WPRA*. **1933**. P.160. (Russian)
- [7] Alexey A. Andreev, Nikolay M. Lyapin, Yury M. Mikhailov. Thermodynamic characteristics of powder and its performance criteria. *Butlerov Communications*. **2021**. Vol.67. No.9. P.1-6. DOI: 10.37952/ROI-jbc-01/21-67-9-1 (Russian)