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# Manifestation of the effect of shock wave desensitization upon projectile detonation initiation in explosive thin layers

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*The article describes numerical modeling detonation initiation in shielded thin layers of explosives exposed to high-speed projectiles with regard to their shock-wave desensitization occurring due to their pre-compression by the shock wave generated at the initial stage of projectile penetration in the shielded layer of explosive. In the course of solving the problem by using LS-DYNA it was found that due to lack of accountability of shock wave desensitization effect in Lee-Tarver kinetics, integrated into the program LS-DYNA, it is not possible to reproduce the experimental fact of existence of the maximum screen thickness, above which detonation of the charge PVV-12M, of 6 mm thick is not initiated when exposed to the projectile with the diameter of 17.5 mm, at the speed of 2.21 km/s. To account for the effect of shock wave desensitization in problems of detonation initiation two-dimensional numerical solver of problems of mechanics of compressible solid continuum "Erudit", developed by S.V. Fedorov in the BMSTU, was used. Modernized Lee-Tarver kinetics of explosive decomposition, regarding for the possibility of desensitization of explosives under non-monotonic loading, was integrated into this solver. The developed method of numerical simulation allows the experimental data to be reproduced. As the calculations showed the detonation initiation doesn't occur under the projectile influence on a shielded thin layer of PVV-12M mm with the thickness of 6 mm and a faceplate thickness of 7 mm, but at a thickness of 6 mm detonation initiation occurs, which is consistent with experimental data.*

**Keywords:** *detonation initiation, shock-wave, desensitization, numerical modeling, kinetics of decomposition, explosive thin layer.*

## REFERENCES

- [1] Orlenko L.P., ed. *Fizika vzryva* [Physics of Explosion]. Vol. 2. Moscow, FIZMATLIT Publ., 2002, 656 p.
  - [2] Kobytkin I.F. *Boepripasy i vysokoenergeticheskie kondensirovannyye sistemy — Ammunition and high-energy condensed systems*, 2008, no. 2, pp. 50–56.
  - [3] Kobytkin I.F., Selivanov V.V. *Vozbuzhdenie i rasprostranenie vzryvnykh prevrashcheniy v zaryadakh vzryvchatykh veshchestv* [Initiation and Propagation of Explosive Transformations in an Explosive Charge]. Moscow, BMSTU Publ., 2015, 354 p.
  - [4] Orlenko L.P., ed. *Fizika vzryva* [Physics of Explosion]. Vol. 1. Moscow, FIZMATLIT Publ., 2002, 823 p.
  - [5] Urtiew P.A., Vandersall K.S., Tarver C.M. Shock initiation experiments and modeling of composition B and C-4. *The 13th International Detonation Symposium*. Norfolk (USA), 2006, pp. 632–642.
  - [6] Kobytkin I.F., Vyshinskiy P.N., Dorokhov N.S. *Iniitsirovanie detonatsii v tonkikh sloyakh vzryvchatykh veshchestv, razmeshchennykh mezhdru metallicheskimy platinami pri vozdeystvii kompaktnykh udarnikov* [Initiation of Detonation of Explosives in Thin Layers, Placed between the Metal Plates under the Action of Compact Projectiles]. In: *Trudy mezhdunarodnoy*
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- [7] Veldanov V.A., Markov V.A., Pusev V.I., Ruchko A.M., Sotskiy M.Yu., Fedorov S.V. *Zhurnal tekhnicheskoy fiziki – Journal of Technical Physics*, 2011, vol. 81, no. 7, pp. 94–104.
- [8] DeOliveira G., Kapila A.K., Schwendeman D.W., Bdzil J.B., Henshow W.D., Tarver C.M. Detonation Diffraction, Dead Zones and Ignition Model. *The 13th International Detonation Symposium*. USA, 2006, pp. 534–542.
- [9] Vandersall K., Garsia F., Tarver G., Fried L. Shock Desensitization Experiments and Reactive Flow Modeling on Self-Sustaining LX-17 Detonation Waves. *The 15th International Detonation Symposium*. USA. 2014. pp. 114–122.

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