SIMULATION OF HETEROGENEOUS DETONATION INTERACTION WITH POROUS INSERT*

S. A. Lavruk[1] and D. A. Tropin[2]

Abstract: A physical and mathematical model in one- (1D) and two-dimensional (2D) formulation that describes the process of interaction of a heterogeneous detonation wave (DW) with a semi-infinite porous medium is proposed. The following detonation regimes are revealed: propagation of the attenuated cellular DW at velocities less than the Chapman–Jouguet velocity at concentrations of cylinders less than critical and detonation failure with the destruction of the cellular structure at concentrations of cylinders equal or greater than critical. A map of the propagation regimes of heterogeneous detonation of the stoichiometric mixture of aluminum particles with a diameter of 1, 2, and 3.5 μm in oxygen in a cylindrical porous zone with a diameter of 100 μm was constructed. The critical conditions for the propagation of heterogeneous detonation in the stoichiometric mixture of 1, 2, and 3.5 μm are obtained. It is shown that with an increase in the size of burning particles from 1 to 3.5 μm, the critical volume concentration decreases. Comparison of the results of 1D and 2D calculations shows that they are similar to each other.

Keywords: physical and mathematical modeling; heterogeneous detonation; porous insert; detonation failure

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[1]S. A. Khristianovich Institute of Theoretical and Applied Mechanics, Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk 630090, Russian Federation; lavruk@itam.nsc.ru

[2]S. A. Khristianovich Institute of Theoretical and Applied Mechanics, Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk 630090, Russian Federation; d.a.tropin@itam.nsc.ru

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Contributors

Lavruk Sergey A. (b. 1991) — Candidate of Science in physics and mathematics, junior research scientist, S. A. Khristianovich Institute of Theoretical and Applied Mechanics, Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk 630090, Russian Federation; lavruk@itam.nsc.ru

Tropin Dmitry A. (b. 1986) — Candidate of Science in physics and mathematics, senior research scientist, S. A. Khristianovich Institute of Theoretical and Applied Mechanics, Siberian Branch of the Russian Academy of Sciences, 4/1 Institutskaya Str., Novosibirsk 630090, Russian Federation; d.a.tropin@itam.nsc.ru