PHYSICAL AND MATHEMATICAL MODELING OF THE PROPAGATION OF HETEROGENEOUS DETONATION THROUGH A LAYER OF GAS SUSPENSION OF ALUMINUM PARTICLES

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In the framework of mechanics of multiphase media, the problem of heterogeneous detonation propagation along a channel partially filled with a pre-mixed gas suspension of aluminum particles in air is considered. Earlier, when studying the interaction of a porous insert with a heterogeneous detonation wave in a gas suspension of aluminum particles in oxygen, it was found that detonation breakdown occurs when the height of the free zone along which the detonation propagates is half the detonation cell [1]. In this work, it is planned to test the critical conditions of propagation during layered propagation of heterogeneous detonation in other dispersed inert media.

The physical and mathematical model is based on the hybrid detonation model [2] and verified in [3]. The height of the layer occupied by the gas suspension of reacting particles, the density and size of the reacting particles, and the inert phase located outside the region of the gas suspension of reacting particles were varied. At the first stage, air was located above the layer of the gas suspension of reacting particles. The flow patterns and detonation propagation were studied. The calculations were performed for particles with a diameter of $d_2 = 1$ μm, $\rho_2 = 0.45$ kg/m^3. The channel width was 30 cm. The problem was solved in two stages. At the first stage, a regular cellular structure was established in the channel over a length of about 3 meters. After that, the resulting leading front is used for calculations where only part of the channel is occupied by the reacting mixture.

During the calculations, numerical schlieren images of detonation propagation over a layer of reacting particles 15 cm (Fig. 1, *a*) and 5 cm (Fig. 1, *b*) high were obtained. It is evident that for both cases, Richtmyer-Meshkov instability is formed at the phase boundary, with the formation of mushroom-like structures. It is also evident for both cases that the detonation propagating over the layer of reacting particles is ahead of the front propagating over the free region. On the leading front layer with a height of 15 cm (Fig. 1, *a*), the development of transverse waves is observed ($y = 0.1$ m, $x = 5.07$ m). At a layer height of 5 cm (Fig. 1, *b*), such structures are not observed.

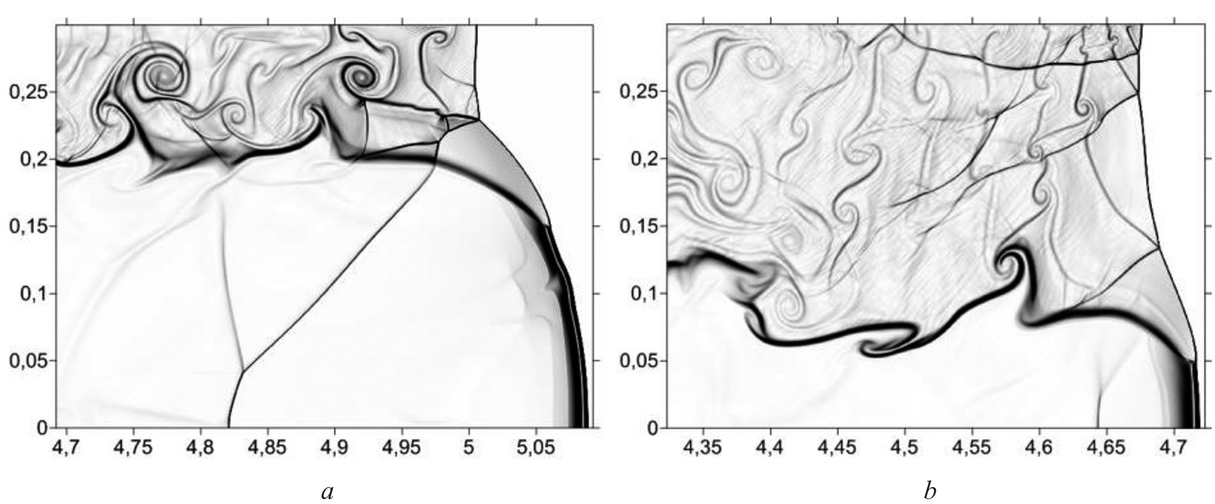

Fig. 1. Propagation of detonation over a layer of reacting particles. Layer height 15 cm (*a*) and 5 cm (*b*)

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