EXPERIMENTAL MODELING OF HYDRODYNAMIC INSTABILITIES DEVELOPING ALONG COMPRESSIBLE MEDIA INTERFACES USING SHOCK TUBES

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Operation of some devices, related to the achievement of high energy density under extreme compression (for example, laser thermonuclear fusion target), depends on hydrodynamic instabilities developing along interfaces between the materials of different densities. The development of hydrodynamic instabilities leads to destruction of interfaces, interpenetration of contacting materials and their mixing, that prevents achieving ultra-high compressions and impairs the facility effectiveness.

Of vital importance is the effect of Rayleigh–Taylor, Richtmyer–Meshkov, and Kelvin–Helmholtz instabilities developing along the interfaces between two media at their accelerated motion, pulsed acceleration, and shear flow, correspondingly.

Computational-theoretical modeling of such instabilities and turbulence using the hydrocodes requires special approaches for solving hydrodynamics equations and extensive computational resources. Verification and validation of physical-mathematical models implemented in a code imply a comparison with accurate asymptotic and approximate analytical solutions with calculation results, which accuracy is beyond doubt, as well as with experimental data [1].

The paper presents the results of experimental modeling of hydrodynamic instabilities developing along the interface between the gases of different densities (Fig. 1) using shock tubes in the RFNC – VNIITF experimental division.

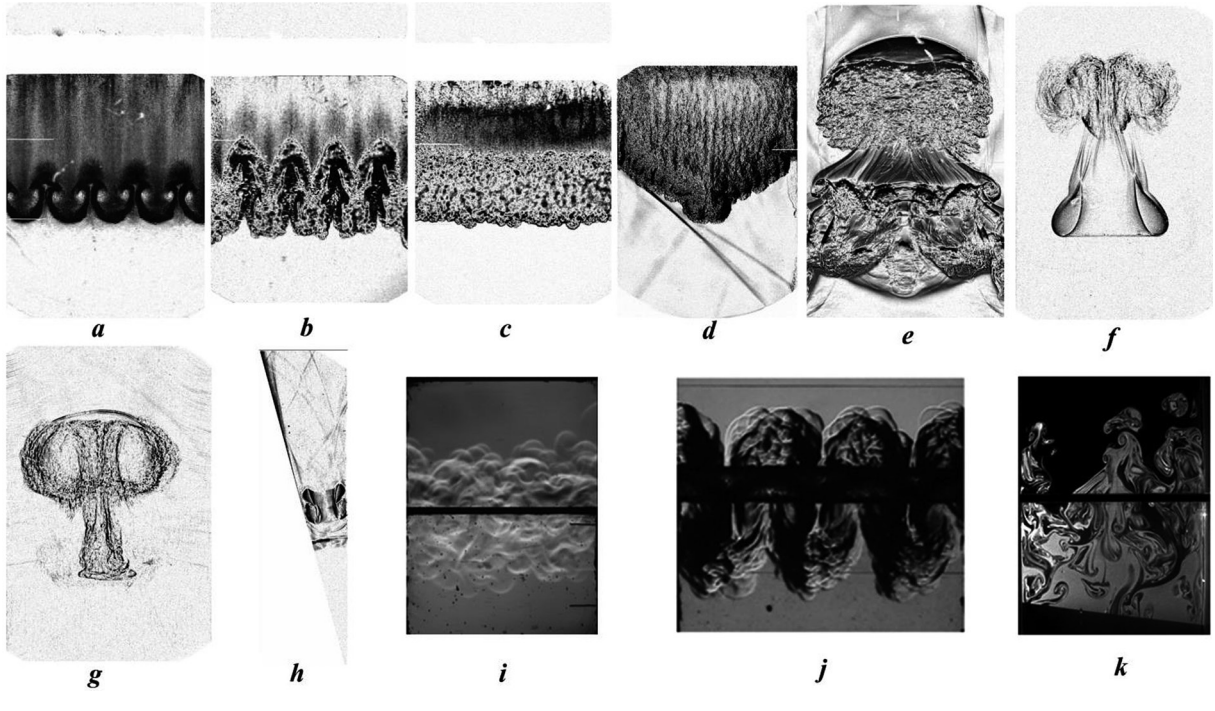

Fig. 1. Selected results of experimental modeling of hydrodynamic instabilities. Interaction of stationary shock wave with single-mode interface (*a*). Single-mode interface (*b*), plane interface (*c*), and sloping interface (*d*) accelerated by rarefaction waves. Hemispherical interface (*e*) and spherical interfaces upon interaction with plane shock waves in the range of the Mach numbers from 1.4 to 6.7 (*f*), (*g*). Spherical interface impacted by cylindrical converging shock wave (*h*). Rayleigh–Taylor instability in the Earth's field of gravity: shadow patterns of flow with small-scale perturbations (*i*) and single-mode high-amplitude perturbations (*j*), internal flow structure (*k*), obtained by "laser sheet"

References

1. **Yanilkin, Yu. V.** Tests for hydrocodes modeling shock-wave flows in multicomponent media [Text] : educational book ; in 2 vol. / Yu. V. Yanilkin, Yu. A. Bondarenko, E. A. Goncharov et al. – Sarov : FSUE «RFNC – VNIIEF», 2017.