Effect of underwater explosions on hydrodynamics and the nature of perturbation propagation

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The article presents the results of investigating a number of problems related to underwater explosion, including a detailed analysis of structure and parameters of the wave field generated by explosive charges. We describe the formation mechanisms for a wide range of flows in the case of shallow underwater explosions and their mathematical models. We analysed the specifics of how the shockwaves transform, how they amplify when colliding, and the problems of bubble detonation wave forming. We show that the nature of perturbation propagation depends on physical and chemical properties of the explosive; that for an explosive charge of a certain mass the bubble pulsation shape is largely dependent on the water depth and the proximity of boundary surfaces; and that most of the initial gas bubble energy goes into creating pressure pulses and turbulent motion stemming from rapid radial and vertical displacements of the gas bubble. We derive equations of motion for compressible liquid in various formulations, which makes it possible to integrate over the volume bound by the shockwave front and the surface of the rarefaction wave following the compression wave at a certain distance. The rarefaction and compression waves intersect on the free sea surface, in the vicinity of which rapid expansion conditions are fulfilled. We use the equations of conservation of mass, momentum and energy to derive boundary conditions.

Keywords: *underwater explosion, shockwave, pressure, gas bubble, system of equations, boundary conditions, density, compression, sea surface*

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