SHOCK WAVES IN WATER WITH BUBBLES OF REACTIVE GAS: CALCULATION

K. A. Avdeev[1,2], V. S. Aksenov[1,2,3], A. A. Borisov[1,2], D. G. Sevastopoleva[1,3], R. R. Tukhvatullina[1], S. M. Frolov[1,2,3], and F. S. Frolov[1,2]

[1]Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation

[2]N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation

[3]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), 31 Kashirskoe Sh., Moscow 115409, Russian Federation

Abstract: Based on the system of equations of two-phase compressible viscous reactive flow, the numerical simulation of penetration of the shock wave in water with reactive gas bubbles (stoichiometric mixture of acetylene and oxygen) has been performed. It has been shown that in such bubbly liquid, a stationary supersonic self-sustained reaction front with fast and complete fuel burning in the leading shock wave may exist. This kind of reaction front can be interpreted as "bubbly detonation." The calculated and measured velocities of the bubbly detonation waves have been compared for the range of the initial volumetric gas content from 2% to 6%. Satisfactory qualitative and quantitative agreement between the results is obtained. The structure of bubbly detonation wave has been studied numerically. The volumetric gas content behind the leading front of such a wave is shown to be a factor of 3–4 larger than that for the pressure waves propagating in water with air bubbles under the same initial conditions. A bubbly detonation wave can be formed after penetration of a shock wave to a small ($\sim$ 300 mm) depth in a column of bubbly liquid. The proposed model can be used for searching the conditions to achieve the most efficient momentum transfer from pressure waves to bubbly liquid in the prospective hydrojet pulsed detonation engines.

Keywords: bubbly liquid; reactive gas; shock wave; hydraulic shock tube; reactive two-phase flow; hydrojet engine

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Contributors

Avdeev Konstantin A. (b. 1971) — Candidate of Science in technology, specialist, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; senior research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; kaavdeev@mail.ru

Aksenov Victor S. (b. 1952) — Candidate of Science in physics and mathematics, senior research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; designer, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; associate professor, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), 31 Kashirskoe Sh., Moscow 115409, Russian Federation; v.aksenov@mail.ru

Borisov Anatoliy A. (b. 1932) — Doctor of Science in physics and mathematics, chief research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; scientific consultant, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; borisov@chph.ras.ru

Sevastopoleva Dina G. (b. 1993) — technician, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; student, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), 31 Kashirskoe Sh., Moscow 115409, Russian Federation; dinasevastopoleva@icloud.com

Tukhvatullina Ruzana R. (b. 1988) — research engineer, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; tukhvatullinarr@gmail.com

Frolov Sergey M. (b. 1959) — Doctor of Science in physics and mathematics, head of department, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; scientific head, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; professor, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), 31 Kashirskoe Sh., Moscow 115409, Russian Federation; smfrol@chph.ras.ru

Frolov Fedor S. (b. 1981) — Candidate of Science in physics and mathematics, senior research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; senior specialist, Noncommercial Partnership Center of Pulse Detonation Combustion, 4 Kosygin Str., Moscow 119991, Russian Federation; f.frolov@chph.ru