Numerical simulation of continuous rotating detonation of hydrogen–air mixture in annular flow path

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The combustion of a fuel–air mixture in detonation waves rotating in an annular flow path (AFP) or continuous rotating detonation is one of the possible options for organizing the operation of advanced power plants. In this paper, a numerical simulation of the flow in the AFP during the experiment [1] at the Lavrentyev Institute of Hydrodynamics SB RAS was performed. Continuous rotating detonation in a 306 mm diameter AFP was investigated. The parameters of the mixture components supplied to the AFP were pre-calculated taking into account the physical relationships of their outflow from the receivers. The change in the flow rates and the ratio of components during the experiment led to the appearance of operating modes of the AFP with one, two and three detonation waves. Simulation of the flow in the AFP took into account the mixing of components in the three described modes. It was performed using an algorithm for solving Favre-averaged Navier–Stokes equations for a reacting gas [2]. It is shown that supersonic outflow is not realize in the entire outlet section when combustion products flow into the atmosphere. The satisfactory correspondence of the calculated and experimental data on the number of detonation waves and the frequency of their rotation in the AFP is demonstrated.

[1] Bykovsky F A, Zhdan S A and Vedernikov E F 2006 *Combust., Explos. Shock Waves (Engl. Transl.)* **42** 463–471

[2] Gouskov O, Kopchenov V, Lomkov K, Mnatsakanyan Y, Prokhorov A and Shutov A 2001 *AIAA Pap.* 1821