Generation of shock wave in a tube by detonation of spherical high explosive

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The aim of the present study is experimental investigation and numerical simulation of blast generator based on detonation of spherical high explosive placed axially symmetric inside a tube. In the experiments, thick-walled metal pipes with a radius of R = 15 and 19 mm were used in which PETN spherical charges of 0.8 and 2.5 g (density 1600 kg / m^3) were exploded. The motion of the shock front in air or xenon was recorded by the shadow technique through longitudinal windows in the tube. Details of a complicated flow pattern cannot be revealed on the basis of the experimental dependence of the velocity of the shock front on time (distance). To overcome this difficulty 3D numerical simulation were performed using GAS DYNAMICS TOOL package (Zibarov, 2000) with implemented procedure for detonation of high explosive. For the sake of validation of numerical method the shock-front arrival time t_A at a distance of 200 mm from the charge was chosen as a reference parameter. The calculated values of t_A was found to be (1.6 – 1.8) times shorter than that experimentally determined. It should be noted that in the present experimental arrangement the scaled distance Z from the center of the charge to the tube wall is varied from Z = 0.11 to Z = 0.2, where $Z = R/M^{1/3}$ and M is the charge weight (in units of mass). Such a short distance can set limits on the accuracy of calculations of incident and reflected shock parameters. Meanwhile, the intensity of the reflected shock has a great impact on the velocity of shock propagated along the tube. It was found that the calculated results significantly overpredict the experimental data on amplitude of reflected shock given by commonly accepted air-blast code ConWep. Similar feature was observed recently at calculations by AUTODYN code (Shin et al., 2015). In the present work we discuss how to bring calculated CFD results and experiment into better agreement.

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References.

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