Abstract

This doctoral thesis describes the water hammer phenomenon, which occurs in installations and networks, e.g. during the sudden closure of a valve located on a pipeline. The work is devoted to the water hammer in a pipe consisting of sections made of various materials. As part of the dissertation, laboratory tests were carried out at the Hydraulic Laboratory of the Faculty of Civil and Environmental Engineering at the Gdansk University of Technology. Calculations were also carried out with the use of the programming developed at the Department of Hydrotechnics write in Fortran 77 Language.

As part of the work, a review of current state of knowledge in the field of the water hammer phenomenon in elastic and viscoelastic pipes was performed. The description presents a mathematical way of describing this phenomenon in a pipe made of one material and sections made of different materials. The course of the water hammer phenomenon is relatively well recognized in the pipe made of one material, however, often the installation or network can be made of different materials. In this case, the speed of the pressure wave changes on individual sections of the pipeline. In elastic pipes such as steel, the wave speed is a large value and takes values up to 1400 m/s, while in viscoelastic pipes such as polyethylene it is smaller and takes values to 350 m/s. This has a significant affect on the course of the pressure oscillation, changing both the extreme values and the damping rate. The way in which the propagation of the pressure wave depends mutual on the proportion of the length of individual sections of pipelines made from different materials and their relative position and the tank and the valve. For the purposes of the study laboratory tests were carried out, the testing-bench and its modifications were described. The research methodology and measurement results were also presented. The following section describes the modified finite element method that was used to perform the calculations. The final part of the work presents a comparison of the results of measurements and calculations as well as conclusions drawn on the basis of the analysis of the presented results.

The thesis presented by the author that the change of the pipe material fundamentally changes the damping and smoothing process of the pressure wave during the water hammer in relation to the material homogeneous pipes has been confirmed in the work.