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NONLINEAR OSCILLATION OF FREE SURFACE OF A LIQUID INTO HORIZONTALLY LOCATED CYLINDRICAL TANK

Incompletely filled tanks are an integral part of many existing objects of transport machine-building and aerospace engineering. In the motion of these objects active environmental effects lead to fluid oscillation accompanied by various nonlinear effects affecting strongly the dynamics of structures. The results of the experimental research and finite-element simulation of spatial oscillation of the free surface of a fluid inside the horizontal cylindrical tank in harmonic exciting the tank are presented. The research aim is to find regularities of a nonlinear fluid behavior. For the experimental determination of spatial natural oscillation of the free surface of a fluid inside the tank the method of free oscillation is employed. Mathematical modeling is performed using the finite-element method. Natural frequencies and shapes of dominant modes (lateral and longitudinal) of slosh oscillation inside the tank depending on its filling level are determined. The phenomena associated with non-linear properties of the system of the tank structure and a liquid (limitation of slosh amplitudes; wave profile asymmetry and the continuity gaps of the liquid interacted with tank walls; circular oscillatory motions) are studied. It is found that the results obtained by mathematical modeling natural frequencies and modes of oscillation of the free surface of a liquid are in satisfactory agreement with experimental data. It is shown that mathematical modeling spatial oscillation results in the determination of causes for occurring complex modes of oscillation of the free surface of a liquid.

Keywords: *free surface of liquid, cylindrical tank, spatial oscillation, nonlinear effect, natural frequency, experimental investigations, mathematical modeling, finite element method.*

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