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An acoustic resonator for determining the void fraction of bubbly mercury flows

Ronald Roy, Christopher Ormonde, Parag Chitnis, Robin Cleveland and R. Glynn Holt
Boston University, Dept. of Aerosp. and Mech. Eng., 110 Cummington St., Boston, MA 02215, USA

An acoustic resonator for measuring free-gas void fraction of a helium-mercury mixture is investigated. We employ a vertical, stainless steel cylindrical waveguide with a 5.08-cm i.d., a 1.27-cm wall thickness, a 40-cm length, and pressure-release boundary conditions at both ends. A bubble injection flow loop produces 2-phase mixtures of varying void fraction that flows upwards through the tube, spills over, and recirculates. The resonator is driven from the top by a 2.54-cm diameter circular piston affixed to an electrodynamic shaker. A hydrophone mounted 1 cm above the tube bottom is used to measure the frequency response of the system. Sound speed is inferred by assuming a linear dependence of axial mode number on mode frequency, and void fraction is calculated assuming a mixture sound speed for a bubble population with maximum sized much smaller than the resonant sizes in the modal frequency range (Wood's limit). The system was validated using non-bubbly water and water-air mixtures of different void fractions. Void fraction measurements for Helium-Mercury mixtures will be presented. [Supported by the ORNL Spallation Neutron Source, which is managed by UT-Battelle, LLC, under contract DE-AC05-00OR22725 for the U.S. Department of Energy.]