

Speed of Sound Measurements in Binary Mixtures of Hydrogen with Pentane and Hydrogen with *iso*-Butane Using a Clamp-on Ultrasonic Flow Meter

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With the increasing adoption of hydrogen as an energy carrier that should be introduced and transported using even existing natural gas distribution lines, new thermodynamic models capable of accurately describing hydrogen-hydrocarbon mixtures are required. Currently, available models have a range of validity limited to a hydrogen content up to 10 %. To improve existing equations and to develop new, and more accurate models, measurements of the speed of sound were carried out in a mixture of hydrogen and pentane (1 mol%) and in a mixture of hydrogen and *iso*-butane (5 mol%). A clamp-on ultrasonic flow meter was specifically modified to serve as a speed of sound meter and perform the measurements in the hydrogen mixtures. This instrument was calibrated in the temperature range of (250 to 330) K and pressures up to 5 MPa, using nitrogen and helium as reference fluids. Although the adoption of a clamp-on flow meter cannot guarantee the best results in terms of accuracy, it is an instrument more suitable to be adopted as a transfer standard for speed of sound for checking and calibrating ultrasonic flow meters on-site. The results obtained in this way will also be used to provide support for the characterization process of hydrogen-enriched gases in the context of the EURAMET project "Metrology for Gas Network Decarbonization" (Decarb).