Speed of Sound Measurements on (Argon + Carbon Dioxide) in the Temperature Range from (275 to 500) K at Pressures up to 8 MPa

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The speed of sound of two (argon + carbon dioxide) mixtures was measured over the temperature range of (275 to 500) K with pressures up to 8 MPa utilizing the spherical resonator system of the National Institute of Standards and Technology. The compositions of the gravimetrically prepared mixtures were (0.50104 and 0.74981) mole fraction carbon dioxide. The measurements were carried out to improve the data basis for binary mixtures relevant for carbon capture and storage (CCS). It is known that the vibrational relaxation of pure carbon dioxide is distinct and leads to high sound absorption at frequencies of the order of 10 kHz. This circumstance significantly impedes the sound speed measurements on carbon dioxide and its mixtures. In contrast to the standard operating procedure for the spherical resonator, non-radial resonances at lower frequencies had to be taken into account. Still, the data show a comparatively high scatter and the usual overall uncertainty of this general type of instrument could not be matched with the present measurements. However, the results are compared to the GERG-2008 reference equation of state for natural gas and to a Helmholtz energy model specifically fitted for humid gases and CCS mixtures. The recent experimental data will be useful for improving the interaction parameters in equations of state describing CO_2-rich mixtures. To extend the work on sound speed measurements on CO_2-rich binary mixtures, a new spherical resonator system has been set up at the Thermodynamics Institute of Ruhr-University Bochum. We also present first results from measurements with this new instrument.