Phase Equilibria and Speed of Sound Measurements of Carbon Dioxide and Nitrogen Mixtures

Daniel Lozano-Martín, Rodrigo Susial and Angel Gómez-Hernández
TERMOCAL Research Group, University of Valladolid, Valladolid, Spain

Teresa E. Fernández-Vicente and Andrés Rojo
CEM- Centro Español de Metrología, Tres Cantos- Madrid, Spain

José J. Segovia [C, S]
TERMOCAL Research Group, University of Valladolid, Valladolid, Spain
jose.segovia@eii.uva.es

Reducing carbon dioxide emissions through carbon capture and storage (CCS) is one technological solution, however, there are still several technical challenges to the design and operation of CCS. CO_2 captured in power plants and industry is compressed and piped, and then injected into the underground storage site. Reliable knowledge of the thermophysical properties of the substances involved in the processes is crucial to ensure efficient and safe plant design and effective operation of the processes within the CCS chain. As process conditions cover a wide range of pressures, temperatures and complex mixtures of multicomponent fluids, it is not cost-effective to carry out experiments for every combination of parameters. Therefore, measuring thermophysical data of relatively simpler binary and ternary systems, for the usual pressure and temperature range, and using them to verify and improve predictive thermodynamic models, is a way to simplify and address the problem. Fundamental properties such as phase equilibrium or speed of sound data of CO2 containing systems can be predicted with multiparametric equations such as the GERG 2008 equation of state [1], however, the accuracy of these models depends strongly on the reliability of the experimental data on which they are based.

This work presents phase envelope and speed of sound data for the (0.5 CO_2 + 0.5 N_2) and (0.8 CO_2 + 0.2 N_2) binary mixtures. Phase equilibria was measured using a cylindrical resonator working in the microwave band whereas an acoustic resonator was used for speed of sound measurements. The experimental results were compared GERG-2008 equation of state. In addition, speed of sound values were used to derive perfect-gas heat capacities, acoustic virial coefficients and second density virial coefficients.

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