Heat Capacities and Acoustic Virial Coefficients for a Synthetic Coal Mine Methane Mixture by Speed of Sound Measurements

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Coal mine methane (CMM) and other kind of coal seam gases are by products obtained from coal mining. These gases are a safe issue inside mines because they might be explosive if they are mixed with air in certain proportion. Nowadays, they are more often used as energy source, but in order to improve the performance and achieve higher efficiencies, accurate thermodynamic properties and equations of state are required. Unfortunately there is a lack of these gas mixture properties. Some equations of state as GERG-2008 were developed to predict natural gas like mixtures. However, coal mine methane composition is significant different and, therefore, experimental measurements are necessary to compare reliability of the equation of state and theoretical properties. This study is focused on obtaining accurately some thermodynamic properties such as isobaric and isochoric heat capacities, adiabatic coefficient as perfect gas and acoustic virial coefficients of a synthetic coal mine methane mixture at two different temperatures (250 K and 273.16 K). These properties are calculated using acoustic resonance to measure speed of sound and extrapolating to zero pressure. A spherical resonator was used for the measurements of the speed of sound for the CMM mixture. It is equipped with two capsule-type platinum resistance thermometers which provide a standard uncertainty in temperature measurements of ± 1 mK at 273.16 K. The pressure is measured by means of two resonant quartz-crystal manometers for the pressure ranges (0 to 2) MPa and (1 to 20) MPa with a relative standard uncertainty of ± $1 \cdot 10^{-4}$ Pa/Pa. The total uncertainty of the speed of sound is not worse than 0.02%. The results have been compared with the GERG-2008 equation of state.

Acknowledgments

The authors want to thank to Junta de Castilla y León for the economic support in the VA391A12-1 project.