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Using the PC – SAFT model to estimate the speed of sound in synthetic and natural oil and gas mixtures

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Highlights

- Thermodynamic properties
- Sound speed
- PC – SAFT
- Natural gas

1. Introduction

The speed of sound is an important thermophysical quantity, which is used for practical purposes to assess the density of formation fluids in wells in a wide range of external conditions. Along with temperature and pressure, the speed of sound is one of the parameters easily determined in the experiment that can be used to find the molecular weight and density of the gas mixture, as well as to estimate the magnitude of natural gas consumption at gas distribution stations.

Among modern equations of state that are tested by different researchers to improve the quantitative description of the speed of sound in pure and mixed fluids of different nature, the equations of the SAFT (Statistical Associating Fluid Theory) family are distinguished [1]. One of such state equations, the state equation based on the statistical theory of an associated fluid with a perturbed chain (Perturbed Chain – SAFT), was proposed by Gross and Sadowski [2].

In this paper, we applied the version of the PC – SAFT model to estimate and predict the speed of sound for a number of multicomponent systems containing oil and gas fluids. The model calculations performed give good results, sufficient for practical assessments and control of the sound speed (and densities) in the fluid mixtures under consideration.

2. Results and discussion

In this paper, we used the CP – PC – SAFT state equation (Critical Point-based Perturbed Chain – Statistical Association Fluid Theory) and tested the performance of the proposed Polishuk and co-authors method [3] in estimating the sound speed for multicomponent systems containing components of natural gas with different methane content (74–97 mol%). For the calculations, synthetic gas mixtures and natural gas mixtures from different fields were selected, with known experimental sound speeds in a wide range of pressures for a range of temperatures. The average absolute error of the obtained sound speed values in all considered systems does not exceed 2.0%, which indicates high accuracy characterizing the properties of the studied gas mixtures.

According to literature data, the results of predicting the speed of sound and density for a synthetic gas mixture using the CP – PC – SAFT model are somewhat inferior in accuracy given by the GERG-2008 multiparameter correlation equation of state (0.1%), which is recommended and widely used in engineering calculations for oil and gas industry.

3. Conclusions

The results of sound speed and density determination in systems formed by oil and gas components indicate the promise of further use of the PC – SAFT model for evaluating the thermodynamic and thermophysical properties of natural gas for applied purposes.

References [Calibri 10]

[1] W.G. Chapman, K.E. Gubbins, G. Jackson, M. Radosz, Ind. Eng. Chem. Res. 29 (1990) 1709–1721.
[2] J. Gross, G. Sadowski, Ind. Eng. Chem. Res. 40 (2001) 1244–1260.
[3] I. Polishuk, Ind. Eng. Chem. Res. 53 (2014) 14127–14141.