European Research in Natural Gas Properties

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High-accuracy thermodynamic property calculation methods are needed for a wide variety of applications in the gas industry, including gas metering (sonic nozzles and orifice meters), gas storage, and compressor and interstage cooler calculations.

A European gas research working group of GERG (Groupe Européen de Recherches Gazières) has investigated the pVT behavior of natural gases and as a result published the GERG 88 virial equation for pressures up to 12 MPa in 1988 [1]. Following that, the experimental GERG data were used in correlating the AGA 8 - DC 92 equation [2]. To test the compositional range of application for the equations outside the range of pipeline quality natural gas additional measurements on natural gases diluted or enriched with pure gases were performed at Ruhrgas [3]. To extend the range of application, further rich natural gases (high contents of ethane, propane and butane) are being investigated at NEL, National Engineering Laboratory, Glasgow, and Ruhrgas AG, Dorsten. This work is sponsored by oil and gas companies as well as the Gas Research Institute, Chicago. A GERG working group has recently assessed existing fundamental equations of state for their ability to calculate reliably and accurately caloric properties like speed of sound or heat capacities. Even the reference equation of state used today, the AGA 8 - DC 92, fails to fulfil some of the requirements [4].

As a consequence of this assessment of existing equations in the GERG Working Group of 1.3 "Fundamental equation for caloric properties," Klimeck, Span and Wagner proposed the concept of developing a new wide-ranging equation of state for natural gases [5]. The equation will be expressed in terms of Helmholtz energy and cover the whole fluid region describing accurately the gas phase of natural gases and will be valid in phase equilibria and liquid phase calculations. The main advantage of such an equation is that even for applications which are completely in the gas phase the prediction of caloric properties near the phase boundary will be greatly improved.

Details of the European research program will be given and some results discussed.

[1] M. Jaeschke, S. Audibert, P. van Caneghem, A.E. Humphreys, R. Janssen-van Rosmalen, Q. Pellei, J.P.J. Michels, J.A. Schouten, and C.A. ten Seldam, “High Accuracy Compressibility Factor Calculation for Natural Gases and Similar Mixtures by Use of a Truncated Virial Equation,” *GERG Technical Monograph* TM2 (1988), 163 pp. Fortschritt-Berichte VDI, Reihe 6, No 231 (1989)

[2] K.E. Starling and J.L. Savidge, “Compressibility Factors of Natural Gas and Other Related Hydrocarbon Gases,” American Gas Association (A.G.A.) Transmission Measurement Committee Report No. 8, Second Edition (1992).

[3] M. Jaeschke, H.M. Hinze, and A.E. Humphreys, “Supplement to the GERG Databank of High-Accuracy Compression Factor Measurements,” *GERG Technical Monograph* TM7 (1996), 125 pp, Fortschritt-Berichte VDI, Reihe 6, No. 355 (1997).

[4] M. Jaeschke (editor), “Fundamental Equation for Caloric Properties of Natural Gases,” - GERG Round Robin Test on Speed of Sound and Enthalpy Data and Test of Existing Equations; R. Klimeck, R. Span, R. Kleinrahm, and W. Wagner, Collecting of Data and Test of Existing Equations of State GERG Technical Monograph TM9, to be published (1997).

[5] R. Klimeck, R. Span, and W. Wagner, Ruhr-Universität Bochum, Bochum, Germany, proposal to GERG Working Group 1.3 (1996).