Eos-Cg: Helmholtz Fundamental Equation of State for Application in Ccs Processes

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The reduction of greenhouse gas emissions is one of the most prominent goals in energy technologies. Storage technologies like compressed air energy storage (CAES) and fossil power generation with capture and storage of CO_2 (CCS) are considered key technologies in this context. Both technologies result in high demands on thermodynamic property models. Complex phase equilibria and properties at high pressures need to be calculated accurately for mixtures of highly non-ideal fluids like carbon dioxide and water. As one of the projects funded by the E.ON International Research Initiative, the project *"Equation of State for Combustion Gases and Combustion Gas Like Mixtures (EOS-CG)"* focuses on a thermodynamic property model, which is sufficiently accurate in the relevant range of mixtures, temperatures and pressures (from humid air to compressed carbon dioxide rich mixtures in the liquid phase). The thermodynamic model presented here uses the approach of Lemmon and Tillner-Roth [1], which was further developed by Kunz and Wagner [2,3], namely a Helmholtz fundamental equation of state based on existing highly accurate pure-fluid Helmholtz-type equations of state with corresponding-states mixing rules and additional binary excess functions. The model parameters were fitted to experimental data available in the literature using a non-linear multi-property fitting method. Mixture models have been developed for mixtures of CO_2, H_2O, N_2, O_2, Ar, and CO. The main challenge was to accurately describe the complex high-pressure phase equilibria, which still pose a challenge for accurate established equations of state, especially when water or CO_2 are involved. The contribution at the *18th Symposium on Thermophysical Properties* will open with a short discussion on the technical background and on the experimental data situation before presenting the results by exemplary comparisons of the new equation of state with other established property models and experimental data.

[1] Lemmon, E.W.; Tillner-Roth, R.; *A Helmholtz energy equation of state for calculating the thermodynamic properties of fluid mixtures*, Fluid Phase Equilibria 165 (1999), 1–21

[2] Kunz, O.; Klimeck, R.; Wagner, W.; Jaeschke, M.: *The GERG-2004 wide-range equation of state for natural gases and other mixtures*, Fortschr.-Ber. VDI, Reihe 6, Nr. 557, VDI Düsseldorf, 2007.

[3] Kunz, O., Wagner, W. *The GERG-2008 Wide-Range Equation of State for Natural Gases and Other Mixtures: An Expansion of GERG-2004*. To be submitted to J. Chem. Eng. Data (Jan./Feb. 2012).