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C3Or2B-05: Commissioning of the cryogenic phase equilibria test stand CryoPHAEQTS

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Medium-sized cryogenic applications such as local hydrogen liquefaction or HTS power applications require temperatures below 77 K at some kW cooling power. These conditions are efficiently reached by cryogenic mixed refrigerant cycles (CMRC). The CMRC development relies on physical property data of cryogenic fluid mixtures that is not available for most binary and multi-component systems.

The cryogenic phase equilibria test stand CryoPHAEQTS provides precise physical property data of cryogenic fluid mixtures at temperatures between 15 K and 300 K and at pressures up to 15 MPa. It also allows flammable mixtures (e.g. containing hydrogen) or oxidizing mixtures (e.g. containing oxygen). Vapor-liquid equilibria (VLE), vapor-liquid-liquid equilibria (VLLE) and the liquidus line of solid-liquid equilibria (SLE) are obtained by direct sampling from the equilibrium cell and analysis by gas chromatography. The equilibrium cell offers optical access by 4 windows to identify the coexisting phases. The cell temperature is set by a pulse-tube cryocooler and a counter-heater. As a unique feature, the specific heat capacity of the vapor phase in equilibrium is measured by the combination of a novel thermal and a Coriolis type flow meter. Having measured both caloric and thermal properties of the mixtures, we can develop new equations of state that cover all thermodynamic state variables.

In this talk, we report on the progress in the construction and commissioning of CryoPHAEQTS. Validation of the measurement accuracy is presented by comparison of pure substances measurements against literature data.

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