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C1Or4A-06: Development and validation of a vibrating-wire viscometer for liquid natural gas measurements down to 80 K

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Viscosity data for natural gas mixtures in particular with helium components are insufficient in literature, which creates an obstacle to the development of a corresponding mixture viscosity model or correlation. Precise viscosity measurement of cryogenic fluids including methane, ethane and their mixtures with other rare components requires a viscometer capable of operating at high pressures up to 10 MPa and at temperatures down to 80 K. A cryogenic vibrating-wire viscometer has been designed and developed for such an application. Tungsten wire is used as the sensing element and is clamped at both ends instead of being fixed at one end but leaving the other end freely connecting to a suspended weight. Tungsten rods were chosen as the supporting structure to synergize the expansion of the Tungsten wire, which avoids creating a tension induced by a large variation of temperature. Thereby, it ensures that the resonant frequency of the wire remains nearly unchanged from 300 K to 80 K. By using nitrogen as a calibration fluid, the viscosity measurement is estimated to have an uncertainty of < 2 % in the range from 17 to 150 μPa·s. Some methane mixtures are tested in wide temperature and pressure range and their viscosity data will be reported.

Author: YANG, Yilun (Shanghai Jiao Tong University)

Co-authors: SUN, Jiadong (Shanghai Jiao Tong University); HUANG, Yonghua (Shanghai Jiao Tong University)

Presenter: YANG, Yilun (Shanghai Jiao Tong University)

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