CH_4, C_2H_6, and C_3H_8 collisional broadening coefficients of H_2O at 2.7 µm for natural gas online quality monitoring

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Natural gas consists of methane (CH_4), other heavier hydrocarbons, e.g. ethane (C_2H_6) and propane (C_3H_8), and impurity molecules such as water (H_2O). Water vapour accumulated in natural gas transmission lines diminishes its burning quality. In addition, the presence of water vapour in natural gas transmission lines can cause severe problems such as pipeline corrosion and cracking. Therefore, reliable measurements of the water content in natural gas are important. In the last years laser-based hygrometers such as those of tunable diode laser absorption spectroscopy (TDLAS) have been developed for the measurement of the water content in natural gas, but the data evaluation concepts used there, require tedious pressure, temperature and matrix dependent calibration of the instrument. Such calibrations could be avoided under certain conditions using the direct TDLAS approach. But, in order to directly retrieve the absolute water amount fraction without prior calibration of the hygrometer, requires absolute values for the self and foreign collisional broadening coefficients of the target line to model the natural gas spectra. Typically, collisional broadening coefficients are taken from spectroscopic data bases such as HITRAN and GEISA or literature. However, these data bases provide no foreign gas broadening coefficients for most matrix gases in natural gas. Therefore, new collisional broadening coefficients for such perturbers (like CH_4, C_2H_6, and C_3H_8) have to be measured. Collisional broadening coefficient measurements performed using the spectroscopic technique of tunable diode laser absorption spectroscopy (TDLAS) were already reported in some of our previous publications [1, 2].

Here we present CH_4, C_2H_6, C_3H_8 collisional broadening coefficient measurements for a H_2O line at 2.7 µm well suited for H_2O vapour studies in natural gas. The measurements were performed using direct scanning TDLAS. Data quality objective issues such as the traceability of the collisional broadening coefficient results to the SI system of units and the calculation of the uncertainty of the results following the guidelines of the Guide to the expression of Uncertainty in Measurement (GUM) are addressed and discussed.

References

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