

Dew-Point Measurements for Water in Compressed Carbon Dioxide

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In proposed processes for carbon capture and sequestration, the captured carbon dioxide will contain some water vapor. When the CO₂ is transported in pipelines, it is important to avoid water condensation that can lead to corrosion; optimal design of these systems therefore requires accurate knowledge of the dew point of water in compressed CO₂. We have constructed a facility to determine the equilibrium water content at saturation (dew point) in a compressed gas as a function of temperature and pressure. A saturator humidifies the flowing gas by equilibrating it with liquid water at a precisely controlled pressure and temperature. Afterwards, a gravimetric hygrometer measures the water mole fraction of the humid gas. To accomplish this, the hygrometer first separates the water from the gas using desiccants in water collection tubes. Afterwards, it determines the number of moles of collected water (determined from mass measurements of the water collection tubes) and the number of moles of the remaining dry gas. We report dew-point data on six isotherms between 10 °C and 80 °C at pressures from 0.5 MPa to 5 MPa. Analysis of the isotherms indicates that our data are consistent with theoretical estimates by Wheatley and Harvey of the interaction second virial coefficient between H₂O and CO₂, but our experimentally-determined second virial coefficients have smaller uncertainty. We also experimentally determine estimates for the third virial coefficient corresponding to the interaction between one H₂O molecule and two CO₂ molecules; no data for this coefficient have previously been reported in this temperature range.