Measurements of pH for CO2 Acidified Brine Systems under Reservoir Conditions

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Carbon storage by injecting CO_2 into reservoirs or aquifers is a potentially critical transitional technology, offering a near-term solution to mitigate global climate change. Acquiring a comprehensive knowledge of the pH of CO_2 in brines under reservoir conditions is essential for the detailed understandings of the physical and chemical interactions between reservoir fluids and minerals during gas injections that are required to ensure a safe and effective long-term storage of CO_2. To our knowledge, very limited quantitative pH measurements for CO_2-acidified brines have been reported in the literature over the wide ranges of temperatures, pressures and ionic strengths relevant to carbon storage. Moreover, limited studies have described the methodology for pH sensor calibration in a high salinity environment. In this work, pH measurements were conducted in a high-pressure apparatus constructed from titanium. The maximum operating temperature and pressure for the experimental setup were 473 K and 20 MPa, respectively, under high salinity conditions. Measurements below 363 K were achieved by using a commercial CO_2-resistant glass pH electrode. Measurements above 363 K were performed using a commercial ZrO_2-based pH probe. A commercial high-temperature high-pressure Ag/AgCl reference probe was used for both low and high temperature measurements. Tris and HCl solutions were employed for calibration purposes and the effect of additional salts on the pH of both solutions was calculated from the Pitzer model. Measured results were validated by comparing with published experimental data. The calibration procedure introduced in this work allowed for accurate measurements of pH under high salinity conditions (up to 6 M NaCl). The experiment work was completed with a correlation between the pH and the CO_2 solubility of the CO_2-acidifeid brine system at various temperatures and pressures.

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