Salinity Effect on CO_2 Solubility in Live Formation Water Under Reservoir Conditions

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Abstract:

Dissolution of CO2 in saline waters is considered one of three main CO2 trapping mechanisms, along with structural/stratigraphic trapping and mineralization. CO2 can dissolve in fresh/saline water under typical reservoir pressure and temperatures. Its solubility is dependent on pressure, temperature, and salinity.

The typical assumption in open literatures regarding CO2 solubility studies—that saline water or fresh water is considered as a liquid without any pre-dissolved gases under pressures and temperatures—is not true because any formation water contains appreciable dissolved gases for all pressure and temperature conditions. An example of gas-water ratio (GWR) can be ~1 scf/stb for a saline aquifer and ~5 to 6 scf/stb for formation water in an oil reservoir. Therefore, it is essential to quantify the effect of brine salinity on CO2 solubility in live saline waters. Just as live oil is reservoir oil containing solution gas, “live” brine is defined as saline water with dissolved gases in it.

Two sets of experiments were conducted under typical reservoir conditions. The first set of experiments evaluated the CO2 solubility in live formation water. The second set of experiments evaluated how variation in the live brine salinity affected CO2 solubility. These experiments involved a synthesis of the brine with three different salinities (low, medium, and high), recombination of live formation water, CO2 addition in a high-pressure and high-temperature pressure-volume-temperature (PVT) visual cell, and determination of bubblepoint pressure within the PVT cell.

The results showed that CO2 solubility in live formation water is significantly less than that in “dead” water under reservoir conditions. The CO2 solubility vs. pressure curve has a much steeper slope, which indicates that CO2 can no longer be dissolved in the live brine once it reaches a certain solubility. In addition, the brine salinity affects CO2 solubility in live formation water by further reducing CO2 solubility with increasing live brine salinity.

Understanding CO2 dissolution in live saline water is essential for future carbon capture and sequestration (CCS) evaluation and execution.

Bio:

Jie Wang joined Intertek Westport Technology Center in March 2021 as a senior reservoir engineer. She had a BSc degree in Petroleum engineering and an MSc degree in Chemical Engineering. She is currently a PhD candidate in petroleum engineering with University of Houston. Jie has worked in oil & gas industry for more than 25 years focusing on reservoir engineering, including reservoir fluid characterization (PVT test and EOS modeling), special core analysis (SCAL test and numerical analysis), reservoir simulation, as well as enhanced oil recovery (EOR) for both laboratory EOR test evaluation and subsequent reservoir simulation studies. She has authored and co-authored 10 technical papers in the area of chemical and reservoir engineering. Wang's comprehensive reservoir engineering experience in reservoir fluid and core characterization made her very strong in solving complex reservoir engineering problems. she provides technical advice on carrying out various reservoir fluid and core characterization experiments tailored to specific reservoir engineering goals, she also plays a consulting role for reservoir engineering projects.