Pitzer ion interaction parameters for $BaSO_4$-NaCl-H_2O system at reservoir conditions

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Oil production can be enhanced by injecting seawater into the reservoir. However, if the formation water is rich in Ba^{2+}, it combines with SO_4^{2-} in the seawater to form poorly soluble barite. Abundant data from oil reservoir records show that barite is often the main problem in scaling. Geochemical speciation codes can be used for estimating the saturation state in solutions and hence, to predict the potential for scaling. However, formation waters in particular have high ionic strength, which makes it necessary to use an ion activity correction method, such as that developed by Pitzer. Several compilations of Pitzer parameters exist for the Na^+-Cl^--Ba^{2+}-SO_4^{2-} system but they give significantly different results.

We determined the temperature dependent Pitzer parameters for NaCl, Na_2SO_4 and $BaCl_2$ by fitting osmotic coefficient data for 25<T<300 °C and molal concentration from 0 to 10, using equations consistent with the PHREEQC speciation code. Compared with the existing PHREEQC Pitzer database, the new parameters yield activity coefficients and solubilities that agree significantly better with experimental data for Na_2SO_4 and $BaCl_2$ at T>25 °C (Fig. 1). In saline systems, where 25<T<300 °C, the new parameters improve barite solubility preditions (R^2 = 0.95) compared with those from PHREEQC (R^2 = 0.69), reflecting improvements at higher temperatures in particular. This will significantly improve predictions of barite scaling.

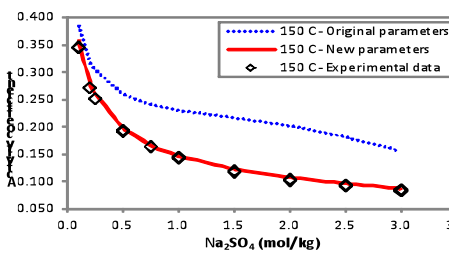

Figure 1. Experimental activity coefficients for Na_2SO_4 compared with data predicted using the original PHREEQC Pitzer parameters and the new parameters at T=150 °C.