Research on Growth Behavior of Calcium Carbonate Scale by Electrochemical Quartz Crystal Microbalance

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An electrochemical quartz crystal microbalance (EQCM) was used to evaluate the scaling behavior of CaCO₃ using an electrochemical method in which cathodic potential was applied to the working electrode. Accelerated scaling experiments were performed by varying the temperature and applied potential in a 3.5% NaCl solution containing 200 mg/L Ca²⁺ and 610 mg/L HCO₃⁻. Scale inhibition efficiencies were also compared in the absence and presence of four scale inhibitors, including amino trimethylene phosphonic acid (ATMP), sodium hexametaphosphate (SHMP), 1-hydroxyethylidene-1, 1-diphosphonic acid (HEDP) and copolymer of phosphono and carboxylic acid (POCA). For further investigation of the scale inhibitors' inhibition properties, the growth kinetics of CaCO₃ scale were investigated by injecting scale inhibitors during the scaling formation process. Additionally, to understand the mechanism of scaling inhibition, X-ray diffraction (XRD) and scanning electron microscopy (SEM) were undertaken to analyze and compare the morphologies, particle sizes, and crystal growth of CaCO₃ scale at different conditions.

Keywords: scale inhibitor; calcium carbonate; morphology; crystal growth

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