Electronic Supporting Data for

Laboratory investigation of co-precipitation of CaCO3/BaCO3 mineral scale solids at oilfield operating conditions: Impact of brine chemistry

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S1. Schematic of the reactor setup

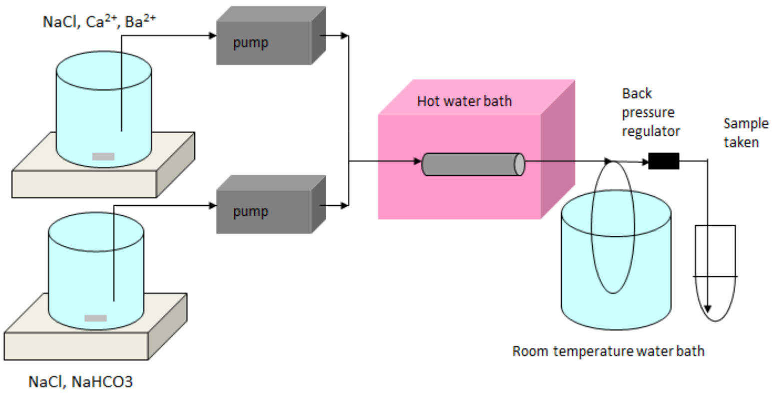


Figure S1. Schematic of the reactor setup.

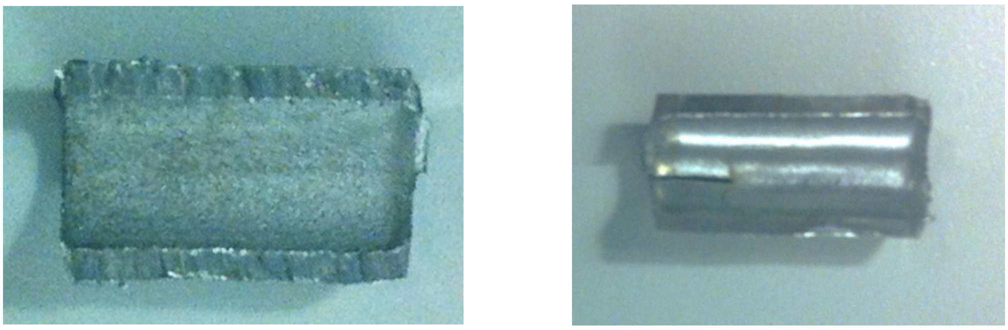
S2. Steel tube reactors after $CaCO_3$ coating treatment

Figure S2. Tube reactors after $CaCO_3$ coating treatment. The upper reactor is made of mild steel and the bottom one is made of stainless steel.

S3. Tube reactor pre-treatment

The reactor tubing materials are cut by wet saw (Buehler IsoMet Low Speed Saw). A 2000-grid sandpaper is wrapped onto a drill bit tightly. The drill bit is inserted into the tubing. The rotation of the drill bit drives the sandpaper to polish the inner surface of the steel pipe. After polishing, the steel tubing is washed with phosphate-free soap to clean the sandpaper debris. Subsequently, the tubing is emerged into 100 mL acetone in a glass cylinder and ultra-sonicated for 15 minutes to get rid of the grease and oil that is attached onto the surface of the tubing. As for the mild steel tubing, after ultra-sonicating, anti-rust oleum is painted onto the outer surface of the tubing to alleviate the corrosion. In the study of surface roughness impact, a stainless steel material purchased from *Swagelok* (Houston, TX) has a much reduced surface roughness with a mirror-like surface. This material was not treated with sandpaper polishing or subsequent oleum painting.

S4. Stainless steel tube reactor materials with different roughness



(a) (b)

Figure S3. Stainless steel tube reactor materials. (a) High surface roughness (*Grainger*, Houston, TX); (b) Low surface roughness (*Swagelok*, Houston, TX).

S5. Saturation index calculation

Mineral scale threat can be quantitatively evaluated by calculating the saturation index (SI) with respect to a mineral. Essentially, SI is the driving force for scale formation and subsequent deposition. At a certain temperature and pressure condition, SI can be calculated by equation S1:

$$SI_{T,P} = \log_{10}\left(\frac{IAP}{K_{sp}}\right) \quad \text{(S1)}$$

where $SI_{T,P}$ denotes the saturation index at a given temperature and pressure. IAP is ion activity product. K_{sp} represents the conditional solubility product. If the calculated SI is higher than zero, the solution at the given condition is supersaturated with the mineral.

S6. Impact of surface roughness on $CaCO_3$ surface coating

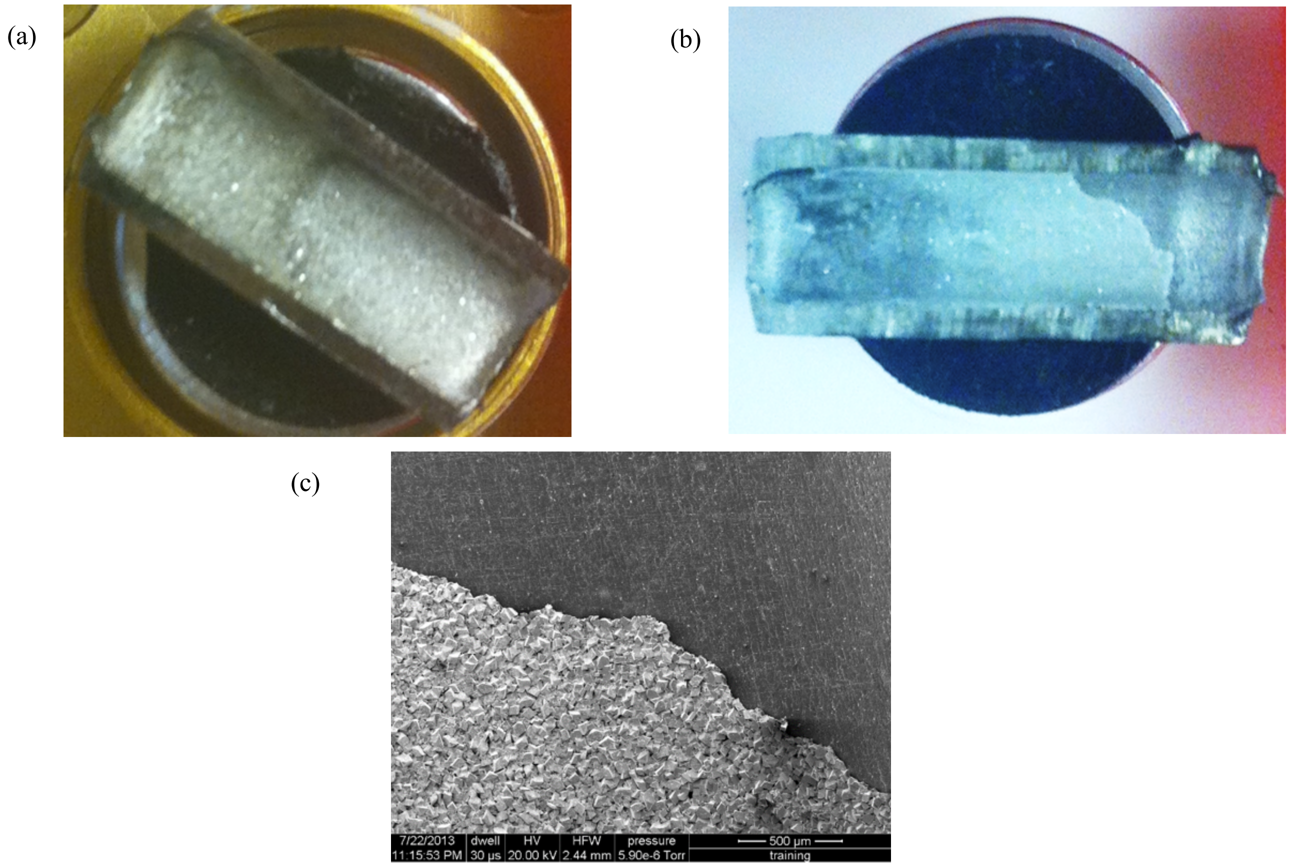


Figure S4. $CaCO_3$ surface coating using stainless materials of different surface roughness. (a) High surface roughness material; (b) Low surface roughness material. A fraction of the attached $CaCO_3$ was peeled off; (c) SEM image of the edge of $CaCO_3$ on the surface of low roughness material.

S7. Mass transfer coefficient calculation

$$ln\frac{Ca_{in}-Ca_{eq}}{Ca_{eff}-Ca_{eq}}=\frac{A}{Q}k_m$$

where k_m (cm s^{-1}) denotes the overall heterogeneous deposition rate constant; Ca_{in} (mg L^{-1}) and Ca_{eff} (mg L^{-1}) are the aqueous Ca concentrations entering and leaving the reactor, respectively; Ca_{eq} (mg L^{-1}) represents the calculated equilibrium Ca concentration at the testing condition of interest; A (cm^2) denotes the internal surface area of the tube reactor and Q (cm^3 s^{-1}) is the feed solution flow rate.