

The influence of CO₂ injection on the carbonate chemistry and scaling in multiple-effect distillers

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ABSTRACT

The injection of carbon dioxide (CO₂) into natural waters and aqueous solutions is used in several industrial applications. If pure water is saturated with 1600 ppm CO₂, its pH would reach a value of 4.0. In this work, the influence of CO₂ injection on the carbonate chemistry and scaling in multiple-effect distillers is studied. The approach is applied to a reference 5-stage multiple-effect distiller as a case with a distillate production of 380 t/h at a top brine temperature of 64°C. The pH of the feed seawater can be reduced of a factor of 2.15 when 150 ppm CO₂ is injected. CO₃²⁻ is considered limiting to scale formation because Ca²⁺ in seawater is much higher and is not limiting to CaCO₃ precipitation except under at unusual circumstances. Increasing the concentration of CO₂ in the feed water would lead to a decrease in the saturation ratios. The Langelier Saturation Index (LSI) values of calcite changed from 1.3 when zero amount is injected to reach a value of –0.81 when 150-ppm are injected. The calcite-based Ryznar Stability Index (RSI) values in the volume elements of the first stage in the reference distiller vary from ~7.1 (i.e. little scale) to ~4.8 (i.e. heavy scale).

Keywords: CO₂ injection; Carbonate system; Scale formation; Corrosion; Multiple-effect distillers

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