Making starting harder: how do additives retard scalant formation?

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The scale formation of calcium sulphate in the industry (e.g. desalination plants) is leading to costly production reductions. Thus, it is highly desirable to avoid/retard the precipitation of these solids in such environments. Large quantities of scale inhibitors are used for scale control in these settings but they persist for many years after their disposal. Increasing environmental awareness has pushed scale-inhibitor chemistry to move toward "green" antiscalants that readily biodegrade and have low mobility for minimizing their environmental impact. In the light of this new trend we set out to evaluate the retarding capacity of two "green" antiscalants as a function of salinity and temperature during calcium sulphate precipitation. To obtain a mechanistic understanding of the role, and effectiveness, of these additives on the precipitation dynamics we determined the changes in the effective surface free energy (SFE) as a function of salinity and temperature during calcium sulphate precipitation. We found that salinity did not influence the SFE of the precipitating phase, but in combination with additives a marked dependency is observed on the ionic strength. Hence, the effectiveness of additives is highly depended on solution properties and, based on these measurements (SFE_{eff}) an appropiate application "window" can be established for specific additives.