DISSOLUTION OF CALCIUM(II) DODECYL SULPHATE PRECIPITATES IN THE PRESENCE OF ALCOHOLS

Csaba Bús[1], Adél Ádám[1], Szilveszter Ziegenheim[1], Pál Sipos[2], Bence Kutus[2]

[1]Department of Organic Chemistry, University of Szeged, H-6720 Szeged, Dóm tér 8, Hungary
[2]Department of Inorganic and Analytical Chemistry, University of Szeged, H-6720 Szeged, Dóm tér 7, Hungary
e-mail: bus.csaba@szte.hu

Abstract

Anionic surfactants are commonly used in chemical Enhanced Oil Recovery (cEOR) technologies, where their primary goal is to reduce the interfacial tension (IFT) between oil and water which is crucial for the overall efficiency. However, the presence of alkaline earth cations, in particular Ca^{2+} and Mg^{2+}, in brine water may cause a decrease in the surfactant concentration because of precipitation [1]. Alcohols, commonly used as co-solvents, have been reported to enhance the solubility of Ca^{2+}-surfactant salts [2]. Yet, despite the importance of this side reaction in cEOR, research focusing on the impact of alcohols on surfactant precipitation is sporadic.

In this study, we characterized the effect of alcohols on surfactant precipitation in aqueous solutions of calcium chloride and sodium dodecyl sulphate (SDS), applying spectrophotometry, tensiometry and dynamic light scattering. In the absence of metal salt, we find alcohols to increase both the size of SDS particles as well as the surface tension at the water-air interface. Upon addition of Ca^{2+} ions to aqueous samples of SDS, we observe the rapid formation of solid $CaSDS_2$. Strikingly, this precipitate can completely dissolve when alcohols are added to the system: isopropyl alcohol (20.0 V/V%), 2-butoxyethanol (10.0 V/V%) and *n*-octanol (10.0 V/V%) enhance the solubility of the precipitates up to 10.0 g/L Ca^{2+} concentration. Conversely, Methanol (MeOH) and ethanol (EtOH) do not alter the solubility significantly.

These results suggest the addition of alcohols to anionic surfactants' solutions to be a simple and effective method to suppress the interactions between the surfactant and Ca^{2+} ions.

[1] Negin, C.; Ali, S.; Xia, Q. Most Common Surfactants in Chemical Enhanced Oil Recovery, *Petroleum*, **2017**, *3*, 197–211.

[2] Miyazaki, N.; Sugai, Y.; Sasaki, K.; Okamoto, Y.; Yanagisawa, S. Screening of the Effective Additive to Inhibit Surfactin from Forming Precipitation with Divalent Cations for Surfactin Enhanced Oil Recovery. *Energies*, **2020**, *13*, No. 2430