Extending the Limits of EOR Surfactant Research

How to find new surfactants for enhanced oil recovery applications in high-temperature reservoirs.

Surfactants are the key to enhanced oil recovery as their effect on the rock surface and oil-water interface allows the mobilization of oil that is otherwise trapped by capillary forces in the rock matrix. They furthermore lead to the proper emulsification between water and crude oil which tremendously increases the efficiency in the oil recovery process.

However, many reservoirs have very harsh conditions that will lead to the chemical degradation of typical surfactants caused by high temperatures and high salinity. With oil recovering companies being required to explore reservoirs that are under exceedingly ambitious conditions it is necessary to find suitable surfactants. To develop and test these new surfactants, researchers need to be able to run their tests under conditions which are present in reservoirs. Amongst the key parameters to study and optimize surfactants is the interfacial tensions (IFT) which can be measured by our newly developed spinning drop tensiometer SVT 25 with special capillaries that can work with superheated water of up to 130 °C.

To illustrate the interesting results that can be achieved with this kind of equipment we want to highlight the latest work from Zulkifli and his team at Petronas Research. Using our

spinning drop tensiometers with special capillaries withstanding the pressure they quantified the effects of aging time on various surfactants above 100 °C and seawater salinities up to 32000 ppm by monitoring the IFT over time. They were able to show that typical surfactants based on sulfate- and sulfonate are not stable under these conditions since the sulfate-based surfactants encounter hydrolysis problems under these temperatures and the sulfonate based surfactants precipitate in the presence of divalent ions. In contrast to this finding, using alkyl ether carboxylates (AECs) pure or blended with alkyl polyglucosides (APGs) led to the finding of a system that can work well under harsh conditions. At 106 °C they found the lowest IFT of 0.01 mN/m when AEC:APG was used in a 50:50 ratio with a total surfactant concentration of 0.1-0.2 weight% in seawater salinity brine. The thermal stability of these formulations was studied for 60 days at 106 °C revealing no significant changes.

The key to successfully measure under harsh conditions is a specially designed capillary that allows for a safe superheating of aqueous solutions up to 130 °C without boiling.

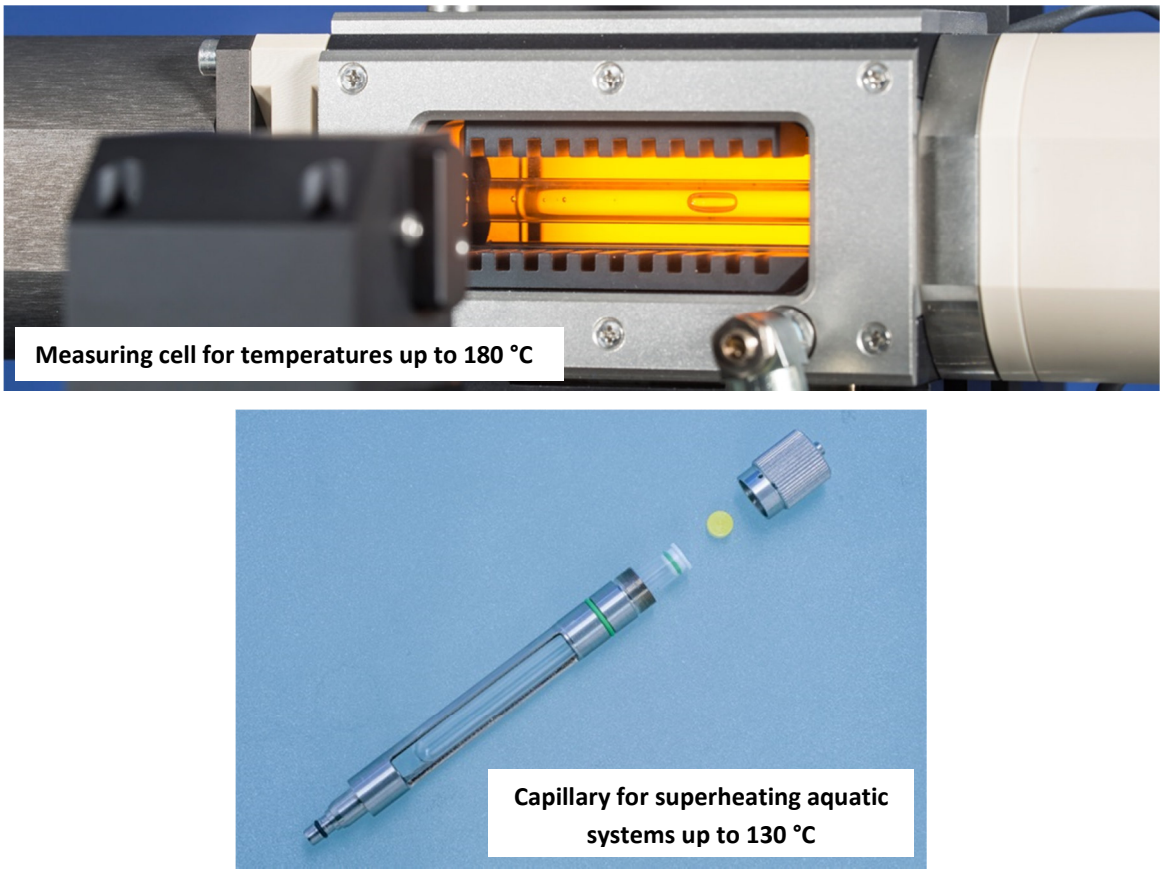

Figure 1: Special capillary for superheated liquids

If you want to know more about the content of the article, you can directly refer to the literature information below:

[1] **Evaluation of new surfactants for enhanced oil recovery applications in high-temperature reservoirs**; N. N. Zulkifli, S. M. Mahmood, S. Akbari, A. Azhan, A. Manap, N. I. Kechut, K. A. Elrais; *Journal of Petroleum Exploration and Production Technology* **2019;** https://doi.org/10.1007/s13202-019-0713-y

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