Foam stability and bubble growth under high pressure/high temperature conditions: effect of gas type and surfactant

A. Pérez-Gramatges[1]

J. M. F. Façanha,[1] B. G. Alvarenga,[1] L. F. Lopes[1]

[1] Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil

E-mail: aurora@puc-rio.br

ABSTRACT

There is an increased interest in using foams to reduce mobility of gas injected into oil reservoirs, as well as for carbon capture and storage [1]. Despite the formation of stable foam at high pressure/high temperature conditions is key for these processes, most studies only measure the foam parameters at ambient pressure, assuming same behaviour in reservoir conditions [2]. In this work we investigated the foam formation and stability using two types of gas (N_2 and CO_2), at pressures between 1 and 100 bar and at 80°C. Liquid foams were prepared using synthetic seawater as aqueous phase, and two types of surfactant (anionic and zwitterionic) as foaming agents. The results showed that high pressure increased the foamability for both gases, since interfacial tension tended to decrease. However, N_2-foams were up to 70 times more stable than CO_2-foams, being the bubble coalescence the main destabilization mechanism for the former. For CO_2-foams, drainage and Otswald ripening had greater impact, and once the CO_2 became supercritical (100 bar), the coarsening rate increased at least 8 times due to higher gas diffusion, also depending on surfactant type. Moreover, CO_2-foams presented higher bubble size polydispersity than N_2-foams at all pressures, promoting the coarsening mechanism and directly affecting foam stability (Figure 1).

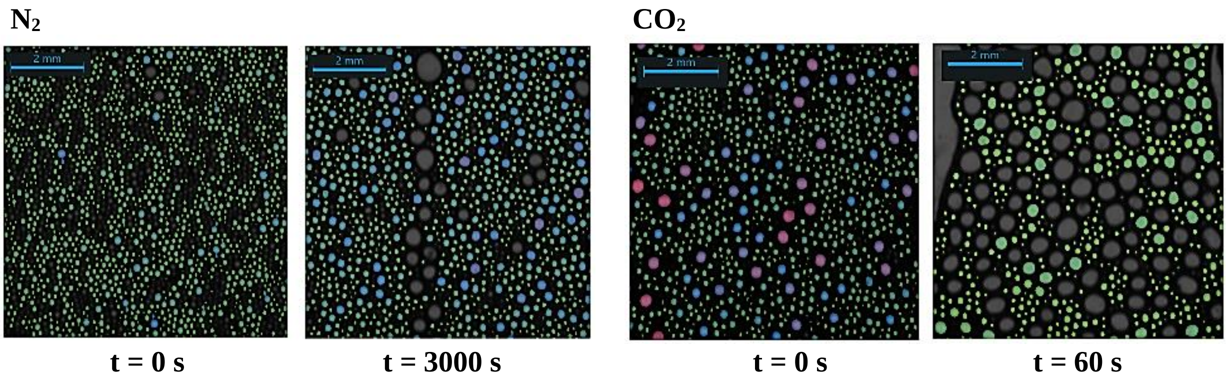

Figure 1: Effect of gas composition on foam stability and bubble size distribution at 100 bar and 80°C.

[1] S. H. Talebian, R. Masoudi, I.M. Tan, P.L.J. Zitha. J. Pet. Sci. Eng. 120:202–215, 2014.

[2] C. S. Boeije, M. Bennetzen, W. Rossen. SPE Reserv. Eval. Eng. 20: 795–808, 2017.