The Role of Diffusion for Non-Miscible Gas Injection into a Fractured Reservoir

Yannick YANZE\(^1\), Torsten CLEMENS\(^2\)
\(^1\)OMV E&P, \(^2\)OMV E&P
Trabrennstrasse 6-8, 1020 Vienna, Austria
Yannick.Yanze@omv.com, Torsten.Clemens@omv.com

Abstract

To improve oil recovery from pervasively fractured reservoirs, gas injection can be considered. In such reservoirs, the fractures typically provide the flowpaths but contain a limited amount of the oil whereas the matrix often has orders of magnitude lower permeabilities but contains the oil.

To improve oil recovery from such reservoirs, gas/oil gravity drainage can be applied. In this process, a gravity stable displacement can be achieved.

If gas is injected which is not in equilibrium with the oil, the non-equilibrium gas components diffuse from the fracture system into the matrix and the components of the oil diffuse towards the fracture system. This results in a modification of the properties of the oil affected by diffusion and gravity drainage rates accordingly.

The effects of non-equilibrium gas injection into a pervasively fractured reservoir were studied at the example of an Austrian reservoir. This type of gas injection results in a zone of decreased oil viscosity for gases such as CO\(_2\) and CH\(_4\) at the interface of the gas and the oil in the matrix. This zone of lower oil viscosity increases the gas/oil gravity drainage rates.

The results show that the effect of diffusion can increase cumulative oil production up to 25% compared with a case neglecting the effect of diffusion. The effect of diffusion could be determined for various parameters such as permeability, porosity, fracture spacing and matrix block height. While for some of the parameters, the effect of diffusion scales with the square root of time (e.g. permeability), for others an exponential relationship has been determined (fracture spacing).
The results derived for the example reservoir can be used more generally to screen whether the effect of diffusion should be incorporated into reservoir studies concerning non-equilibrium gas injection and how large the error could be in case that diffusion is neglected.