Microbial Enhanced Oil Recovery: From Lab to Field

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Oil continues to be a significant energy source worldwide with a steadily increasing oil consumption around the last decades. However, the decreased likelihood of exploring new fields and low primary and secondary recovery make the development of enhanced oil recovery methods important. Microbial enhanced oil recovery (MEOR) is known as a cheap and easy-to-apply method where microorganisms are stimulated within the oil reservoir, which can lead to a series of various oil-mobilizing effects.

In the last years we developed a MEOR concept for mature Wintershall fields consisting of microbiological, petrophysical, reservoir modelling and risk management work. In a first step, original reservoir water from one of the selected fields was sampled at different well locations under sterile and anoxic conditions for over a year. The high-saline (~180 g/L) water contains a complex bacterial and archaeal community with seasonal- and operational-induced fluctuations. Screening for EOR effects (including CO_2 production, cell proliferation, wettability changes, etc.) in those different water samples showed a good and reproducible activity of the fermentative, bacterial order Halanaerobiales. In dynamic sandpack experiments a significant impact of the rock mineralogy, especially the carbonate content, on both microbial activity and oil production was observed. To validate the developed stimulation concept a small-scale field trial was conducted with injection of 300 m^3 nutrient solution + D_2O tracer into the studied field with subsequent re-production after 5 weeks. Although a reservoir drift led to dilution of the injected water, analysis showed successful stimulation of the target community and formation of the required metabolites. Our observations suggest a good transferability of obtained lab data to the field and open up the way forward to a multi-well test to prove microbial enhanced oil recovery.