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Green-surfactant driven EOR: A Biotechno-Econo Approach for Eco-Friendly Recovery of Petroleum

The 2016 Paris accord and the mandates of some of the G-8 and BRICS countries including India revolved around an unanimous resolve to provide Governmental policy support and administrative boost for encouraging the scientific and industrial communities to develop more advanced, cost-effective and eco-friendly technologies not only for renewable energy resources, but also for enhanced petroleum recovery, mainly using green technologies like Microbial Enhanced Oil Recovery (MEOR). This has become more evident through the recent changes in the US priorities and policies. A 2-year federal budget approved by the US Congress includes an expanded tax credit for enhanced oil recovery, a measure pushed by the Governors of six O&G-producing states including North Dakota and Oklahoma and the top Permian oil producer, Occidental Petroleum. As counterintuitive as it may sound to those who want to drastically shift the paradigm from fossil energy to address and mitigate climate change challenges, most of the G-8 countries have long supported development of technologies that could potentially retard or even stop the growth of industrial carbon emissions, while simultaneously expanding the recovery of oil from existing oil fields.

MEOR scores over other EOR processes on two accounts. Firstly, the microbial cell factories need little input of energy to produce the MEOR agents and secondly, the application of microbial processes does not directly depend on the global crude oil price. In an in situ process, stimulation of the indigenous microflora by injecting suitable nutrients serves to enhance oil mobilization. It is the exponential nature of microbial growth, which leads to the production of useful biochemical agents for MEOR at higher rates from inexpensive and renewable resources. However, there are a few shortcomings of MEOR. One major obstacle that has slowed the implementation of MEOR has been the difficulty in isolating and/or engineering microbial strains, which can survive in the extreme environment of the oil reservoirs. MEOR, to be economically viable, demands the use of microbial strains, which remain viable at such reservoir conditions as temperatures above 90 ºC, pressure over 17.25 MPa, extremes of pH and salinity. Genetic engineering tools and techniques are being used to develop and tailor microorganisms that can not only survive and grow in extreme reservoir environment, but can also subsist on inexpensive nutrients and produce substantial amounts of metabolic products including enzymes as EOR agents. Also, optimization of nutrients and testing the microbes and their bioproducts compatible with reservoir conditions are required. During field tests, design of the microbial system and oil production response has to be well documented and results have to be monitored and followed up. In this context, this study and analysis illustrate the efficacy of a biosurfactant-biopolymer driven MEOR process that was developed with the help of a partially simulated reservoir in the form of a packed sandstone column. The microbial consortium being developed includes thermophilic and microaerophilic Baclilli strains. Improvements of the operational and economic performances of an EOR project in the future would require the application of a synergistic approach among EOR processes, thereby making the new-gen MEOR processes more techno-economically sound with improved market share.