Expanding new materials and strategies to develop biotechnological processes in mature oil fields

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Abstract

Biotechnological processes and products have played a significant role in mature oil fields around the world. These processes can be used in enhancing crude oil recovery from the depleted oil reservoirs to solve stagnant petroleum production, after a various recovery processes methods. Microbial enhanced oil recovery (MEOR) involve stimulating native reservoir microbes or injecting specially selected consortia of bacteria into the reservoir to produce specific metabolic products and mechanisms that lead to improved oil recovery. This also involves flooding with oil recovery agents produced ex situ by industrial or pilot scale fermentation. Improvement in MEOR by energizing the reservoir microbiota or the ex situ production of mobilizing oil agents has been enunciated. Oil souring which results from the metabolic activity of sulfate reducing bacteria (SRB) that use sulfate (present in formation water and/or injected seawater) as an electron acceptor to produce hydrogen sulfide (H_2S) is another problem which biotechnological process and products have been addressed. The toxicity and corrosivity of H_2S in oil and natural gas necessitates costly scrubbing equipment and frequently causes downtime for equipment maintenance. The iron sulfide that typically accompanies SRB activity frequently clogs formation pores, resulting in lower product yields. Bacterial related corrosion and associated loss of productivity, costs the oil and gas industry in excess of $2.0 Billion annually. Currently, control of sulfide generation in industrial situations is achieved using broad-spectrum biocides which are generally hazardous to personnel, and inconsistent with environmental trends and regulations. Biotechnological products and processes using the concept of the biocompetitive exclusion (BCE) have been applied in various oil fields to stimulate many sulfate analogs-reducing bacteria that will out compete with SRB for organic nutrients and the flow of electrons resulting in high redox potential which inhibit or kill SRB. Oil and water separation, removal of S, N and heavy metals in oil as well as production water reinjection are new areas where new materials and novel strategies biotechnological processes are needed. This presentation presents new biotechnological strategies to improve oil production and reduction of problems associated with exploitation, oil water separation, use of new biopolymers for selective plugging of oil-depleted zones, biofilm formation and souring control in oil industries. A complete evaluation and assessment of these processes and product from a biotechnological standpoint based on economics, applicability and performance will be attempting to address almost all the issues concerning the microbial processes, its past and recent trends and its future prospect and directions.

Keywords: Microbial enhanced oil recovery; Mechanisms; Biosurfactants; Biopolymers; Selective plugging; SRB; Souring control; biorefineries.