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Opinion Article

Role of Microbial Enhanced Oil Recovery

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DESCRIPTION

It is widely established from numerous core scale tests that increased oil production may result from microbial activity inside a core. Due to the low concentration of bacteria inside the porous media, we contend that the only microbial mechanism that can realistically contribute to oil production is one of the biofilm types. A biofilm may develop on the rock surface and at the oil-water contact as a result of microbial activity. We demonstrate how bacteria can alter the rock's wetting properties by modeling them as immiscible drops. Two strains of oil field microorganisms have been the subjects of experiments. The studies are designed to investigate how microorganisms can adhere to surfaces and interfaces, changing the wetting characteristics of rock, oil, and brine. The first kind of experiment involves microbial capillary tubes, wherein capillary tubes' interfacial or wetting qualities may be altered by bacteria cultured inside of them. The height of the oil-water interface can alter when there is a change in interfacial tension or a wetting feature. The second kind of experiment uses sessile drops, in which the contact angle of an oil drop is tracked over time while it is exposed to microbial activity.

MECHANISM OF OIL RECOVERY

The increased oil production that has been observed in various core scale tests as a result of microbial activity serves as the driving force behind Microbial Enhanced Oil Recovery (MEOR). The enhanced oil output has ranged from extraordinarily high in some cases to relatively low in others. The experimental data strongly suggests that something inside the core is increasing oil output. Because one never truly knows what kind of process is in charge of the increased oil production when oil is spilled, it is difficult to interpret core-scale experiments. One does not know exactly what the bacteria accomplished, even if the excess oil created was caused by them or a product they made. The core functions as a mystery box. One must have a thorough understanding of what the microorganisms are doing in order to conduct a field trial or pilot. Examples include the frequent use of water-soaked cores in investigations at the scale of the core. One must consider that the reservoir is likely not water wet but mixed wet, if the mechanism for increased oil production is a change in wettability toward more oil wet behavior. The porous rock's surface may develop biofilms, which may alter its surface characteristics and/or reduce its permeability. Increased oil production from water-wet cores cannot be explained by a reduction in permeability. The biofilm's characteristics will be distinct from those of rocks. Thus, the wetting characteristics may alter as a result of the change in surface properties within the porous rock. When the receding contact angle is sufficiently lowered, confined oil clusters that have localized wettability changes caused by bacteria may become mobile. Additionally, bacteria adhered to the oil-water interface won't simply separate. The oil cluster would then be carried by microbes to a new area, where they might trigger the mobilization of further oil.

CONCLUSION

Although successful laboratory testing has led to claims that chemical approaches (chemical floods) have tremendous potential, field trials have not shown positive results. Additionally, these techniques are not yet profitable. In these procedures, chemicals like polymers, surfactants, and alkaline solutions are added to the water that is displacing oil in order to alter the physicochemical characteristics of the water and the contacted oil and improve the displacement process. Remaining oil can be displaced and collected during surfactant flooding by lowering the interfacial tension between the oil and the displacing water as well as the oil and rock interfaces. Additionally, in caustic flooding, a reaction between the oil's organic acids and alkaline chemicals produces in-situ natural surfactants that the oil-water interfacial tension.

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