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Opinion Article

An Overview of Oil Recovery by Various Microorganisms

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DESCRIPTION

Currently, the majority of economies rely on products made from crude oil, and insufficient oil supplies could imperil a country's development and increase costs of life. Oil demand and price have increased on the global market as a result of developing nations' rising oil consumption. According to the Organization for Economic Co-operation and Development (OECD) and non-OECD countries' predictions of global energy consumption between 2006 and 2030, oil consumption will rise by 15.5% and 73%, respectively, using the available energy resources. Exploration of alternative energy sources and the use of Enhanced Oil Recovery (EOR) techniques in underperforming and exhausted oil wells are two potential alternatives to the steadily rising demand for oil.

The oil industry today uses a variety of EOR techniques to remove trapped oil. The properties of the crude oil in the oil reservoir determine the EOR technique to be utilized. The broad categories of thermal, chemical and gas injection include EOR processes.

Recovering oil from reservoirs

Fossil fuels, which are currently non-renewable, are used to meet the majority of the world's energy needs. Maximizing the oil recovery from existing or abandoned fields is crucial due to the declining rate of new oil field discovery.

Natural pressure allows the oil to flow from the place of formation to the surface, and primary recovery is the first oil that is produced under this pressure. Across 20% of the original oil in place Original Oil in Place (OOIP) in reservoirs around the world is produced using this technique, which is also the least expensive. In cases where the reservoir's natural pressure drops, secondary recovery is employed. Injection of gas or water is a typical method for raising the pressure. These techniques recover an additional of OOIP at a cost higher than the primary recovery. Microbial Enhanced Oil Recovery (MEOR) is sustainable and kind to the environment to the methods that are now in use or being developed.

Oil recovery

The main goal of this technique was to inject or promote the production of CO_2 and/or methane by local bacteria in order to repressurize the reservoir, reduce oil viscosity in the case of limestone or carbonaceous sandstone and leach away calcite and siderite to release adsorbed oil. Injecting the anaerobic bacterium Clostridium acetobutylicum into a reservoir of limestone grains in a 1D model with a 45-hour shut-in period resulted in a 12% increase in MEOR efficacy overall compared to controls. This rise was explained by a drop in the viscosity of Raman crude oil, from 1096 to 84386 (CP) Cerebral Palsy, and a rise in the pH. Additionally, the authors noted that doubling the shut-in period did not boost oil recovery over that of 45 hours, but rather, intriguingly, caused an increase in oil viscosity of 31% and a reduction in pH. It is hypothesized that *C.acetobutylicum* began to create organic acids, which partially dissolved the lime-stone and released the heavier portions of the crude oil, even though the authors at the time had no explanation for this phenomena. Ten years later, the same authors demonstrated that the dissolved CO_2 produced by *C. acetobutylicum* was mostly responsible for the reduction in the viscosity of Garzan crude oil from 80 CP to 50 CP. But caution should be exercised when methane output is increased for oil recovery. In addition to being ignitable, methane is a powerful greenhouse gas that can leak from deep reservoirs into the environment and have an impact on the climate. An alternative method of producing nitrogen is through denitrifying bacteria.

According to literature on CO_2 flooding, under real-world circumstances, CO_2 does cause the breakdown of sandstone's constituent parts. However, it is unclear if bacteria can generate enough CO_2 in an environment that is naturally anaerobic to have effects that are comparable. It might also be necessary to have a minimal immiscible pressure to detect EOR. Additionally, field experience has indicated that as HCO_3- concentration rose in the aqueous phase, the pH fell and $CaCO_3$ scaling issues appeared at the manufacturing well, which has lower pressure and acidity than the surrounding area. Additionally, the

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reservoir's relative low pressure areas will allow compressed CO_2 to expand, cooling the area around it.

Depending on the temperature and pressure, this could lead to the paraffin/asphalting fraction precipitating, which would be bad for oil recovery. The intricacy of employing CO_2 for EOR is another subject of concern. In a CO_2 flood, up to 5 phases may coexist, complicating understanding, modeling, and forecasting of expected oil recovery:

- Water phase
- Phase of liquid hydrocarbons
- CO phase liquid
- Vaporized CO phase
- Asphaltene (precipitate) phase that is solid

It should be noted that because CO_2 density is increasing, shallow, water-flood cooled reservoirs demand more CO_2, but the sweep is improved because the density disparities between CO_2, oil, and water are decreasing. This could significantly affect microbial gas flooding. For instance, it is possible that the native microbial population's metabolic rate and gas production including CO_2 will drop as a result of poor growing conditions, whereas more CO_2 must be produced in order to increase oil recovery. In the context of oil recovery by microbial gas production, two whole-cell MEOR strategies may be pursued: Stimulating native or added biomass to use the heavy hydrocarbon fraction in the reservoir as a carbon source in order to produce gas (and bio surfactants) with the added benefits of reducing crude oil viscosity and the tendency of paraffin/asphaltene deposition, or supplying selective and inexpensive nutrients to native or added biomass as carbon so that it can produce gas.