November 2012

# New Technology magazine

• the first word on oilpatch innovation

# A CUT ABOVE


In the quest for oil and gas, those companies whose innovation stands above the rest are recognized as the industry's **Technology Stars**

**Microbe Stampede?**

*An old EOR concept is being revived as interest grows and projects proliferate*

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# microbe Stampede?

## An old EOR concept is being revived as interest grows and projects proliferate

By Godfrey Budd

**IT'S BEEN A** long road to commercial application, but some experts believe that the perennial weak sister of enhanced oil recovery (EOR), the cultivation of production-boosting micro-organisms in the reservoir, is starting to show some strength.

Microbial activity in oil reservoirs is common and a general understanding of the role of some microbial processes in oil reservoirs has been around for decades. For instance, types of micro-organisms degrade oil to produce $CO_2$ and methane in the presence of water. Over geological time, such a process has resulted in Canada's oilsands. Some microbial byproducts can lower oil viscosity. Microbial activity can also produce a biomass that plugs up unwanted flow paths in a reservoir. These processes can be used to boost oil production and are known as microbial enhanced oil recovery (MEOR). While microbial-related corrosion prevention is a proven technology, harnessing microbial activity for MEOR has historically been a rather hit-and-miss affair over much of the last quarter century.

Recent laboratory work has accessed the latest measurement and analytic technologies and tools to improve the accuracy of its findings and still came up with some promising results. Growing numbers of field trials, pilots and, indeed, commercial projects are starting to show relatively consistent incremental production with MEOR, especially when compared to the spotty record of the past. A recent flurry of Society of Petroleum Engineers (SPE) papers, besides attesting to these successes, signals a general upswing of interest in MEOR. Oil and gas majors and some large intermediates have been hiring microbiologists recently, says Gerrit Voordouw, a professor and Natural Sciences and Engineering Research Council of Canada industrial research chair in petroleum microbiology at the University of Calgary.

The research indicates that reservoirs should be screened for MEOR, and a range of factors weighed first before deciding to go ahead with it. Still, MEOR could potentially have broad application across the global petroleum sector, resulting in billions of barrels of incremental production. According to an SPE paper (145054) by authors at two oil companies, Denver-based Venoco, Inc. and Calgary-based Husky Energy Inc., and Titan Oil Recovery, Inc. of California, a service company, "MEOR can be applied to a wide range of oil gravities. MEOR has been successfully applied to reservoirs with oil gravity as high as 41 degrees [API] and as low as 16 degrees API."

For oil companies, one part of the allure of successful MEOR—when it actually happens—is that it entails either negligible or no capital investment. It can usually rely almost entirely on existing infrastructure.

### NEW LIFE FOR OLD FIELDS

The chief executive officer of Titan Oil Recovery, a service specialist that provides its proprietary MEOR process to onshore and offshore operators in the United States, Canada and overseas, sees little potential in biosurfactants for MEOR. "The microbial surfactant approach is uneconomic and a non-starter in our view," says Brian Marcotte, who is the co-author of several SPE papers on MEOR.

Titan's process targets fields under waterflood with a reservoir temperature less than 190 degrees Fahrenheit, an API gravity above 16 degrees and water salinity up to 100,000 parts per million. Water cut is typically between 50 and 98 per cent, Marcotte says.

After an analysis of indigenous organisms in a reservoir, a specific mix of nutrients is released into the reservoir in a series of periodic batches via the water injection system. The targeted microbes are stimulated to become interactive with the crude oil in the reservoir by locating at the water/oil interface, which reduces interfacial tension.

By treating the water injection in existing waterfloods, two production mechanisms are affected. "By activating specific species of bacteria, changes in the flow characteristics of the oil are affected and induce the reservoir system to release additional oil to the active flow channels. Stimulated microbes act at the interface of reservoir oil and water, altering the flow potential in the producing formation. In the higher-permeability portions of the reservoir, newly released oil, water and bacteria may interact to form a transient [temporary] micro-emulsion that may alter the sweep efficiency of the injected water as it moves through the reservoir," states an SPE paper (145054), *What Has Been Learned From A Hundred MEOR Applications*, co-authored by Marcotte.

"The effect is to cause a physical change in the character of the oil. We're trying to make micro-oil droplets that will flow through the rock more freely. We're changing the apparent viscosity, not the absolute viscosity," Marcotte says.

The nutrients used are biodegradable and no glucose nutrients are used, as they can stimulate growth of too many types of bacteria. Titan is currently treating over 250 wells in 25 fields in the United States and Canada. Incremental oil recovery varies widely over the short term with the Titan process, with production sometimes more than doubling. Over the long term, however, "This process can recover up to an additional 10 per cent of the original oil in place," according to the SPE paper.