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TOOLS AND TECHNIQUES

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HEAVY OIL

Oil Busters

Enzyme fluid improves oil mobility

IT MAY SOUND SLIGHTLY macabre, but a process that involves the death of oil-loving microbes following the mass production of non-living enzymes could potentially boost recovery rates for Western Canadian heavy oil.

"The bottom line is that it is about recovering as much oil as we can," says John Gray, president and founder of Houston-based Jumpstart Energy Services, LLC. "I think on some of those [heavy oil wells] if you could bump a percentage or two overall that is tremendous."

While increased production from existing heavy oil fields in Western Canada represents a significant potential opportunity, the challenge has always been to overcome the issues of the high viscosity, low mobility and the tendency of heavy oil wells to

become clogged with sand.

Jumpstart's enzyme enhanced oil recovery (EEOR) process uses a proprietary enzyme fluid called Greenzyme to potentially address that issue. When the fluid is pumped downhole the enzymes catalyze the breakdown of larger oil droplets/molecules into smaller ones, allowing more oil to pass through the pore throats.

"The enzymes can almost grab and release oil," says Gray. "The enzymes recombine without being consumed and do this again and again and it can do this very rapidly, sometimes hundreds of thousands, if not even millions of times per second."

This reduces interfacial tension and improves relative permeability and mobility. The enzyme will quickly release oil from sand, limestone or other solid formation surfaces.



ACTIVE RELEASE

Sand was added to 15-18 API oil. A 10% enzyme solution was added to one sample (left) and water was added to another sample (right). Settled sand is clean on the enzyme solution (left) and does not stick to the glass, while the sand still bonds significant oil to the bottom of the water sample (right) and oil adheres to the glass.

Possible applications using the enzyme technology include conventional heavy oil production, between cycles in cyclic steam stimulation wells as well as in waterfloods, he says.

Jumpstart is authorized globally for Greenzyme, an enzyme solution of non-living extracted proteins made from the DNA of selectively cultured microbes. Developed by Apollo Separation Technologies, Inc., it is manufac-

tured in the United States.

The fluid, which is water soluble and oil insoluble, is produced in a proprietary batch fermentation process that impregnates the DNA of the microbes in a high protein nutrient soup. The microbes generate more than one type of enzyme.

"You generate a lot of enzymes and what you eventually do is kill the oil-loving microbes and you are left with these non-living



enzymes, along with inert material,” says Gray. The material is then stabilized with some inhibitors at a low level which makes for a more stable product as enzymes sometimes of themselves can be unstable, he says.

Greenzyme is diluted according to the particular treatment method or type of application and then pumped downhole. Because the enzyme solution is stable and does not require the injection of a fermentable carbohydrate nutrient base that may be required in a microbial enhanced oil recovery (EOR) process, it can be used in a waterflood or non-gel hydraulic fracture, according to Gray.

Greenzyme is reported to be ideally suited for sandstone, water-drive formations with less than 30 degree API oil, greater than 20% porosity and greater than 100 millidarcies permeability for single well treatments, but is not limited

to those parameters.

It has already demonstrated its promise in field treatments around the world. Greenzyme has been used mainly in China in EOR and well stimulation, while in the United States it has been used in some dolomite fields in the San Andres formation and sandstone and limestone formations in Texas, including a non-gel hydraulic frac.

In the Shengli heavy oilfield in China, average production for one well rose to about 150 barrels (bbls) per day from about 29 bbls a day before the treatment, while the water cut declined to about six per cent from 15%. At one mature well in Texas, production doubled to eight bbls per day from four bbls a day.

Jumpstart commissioned leading international testing laboratory Intertek to obtain a better understanding of what was taking place. Tests indicated that in addition to catalyzing the breakdown of higher molecular-weight paraffin, the enzymes also possess some biosurfactant properties, helping

to release the oil from within the formation in the form of small droplets that are carried within fluids moving to a producing well, says Gray. “The overall effect appears to improve relative permeability and oil mobility.”

A series of core lab tests conducted by PTS Laboratories, Inc. were designed to determine if additional original oil in place (OOIP) is recovered post-waterflood. They found that the percentage of OOIP increased dramatically with enzyme dosage with a recovery rate of nearly 13% at a seven per cent solution following a 48-hour soak.

“Jumpstart would like to push the envelope a whole lot further; it’s just a question of having the funding to do it,” says Gray. “We are a very small company with limited resources but see big possibilities for EEOR.”

The company is seeking to treat heavy wells in California, then use that base of knowledge to apply to wells in Canada and other areas around the world.

Jumpstart deals directly with

operators and charges a service fee per job or for wells treated (including the enzyme fluid). Inventory costs are normally included while freight and taxes are separate.

“We know there are future opportunities down the road for increased efficiencies, which is why we have filed several process utility patent applications,” says Gray. The company has patent pending status in the U.S. for applications in cyclic steam, water-alternating-gas, waterflood injection, near wellbore treatment of natural gas wells and non-gel hydraulic fracturing.

“We think the enzyme fluid technology which has a lot of benefit for the oilfield today can be scaled up with even more efficiencies that will provide operators additional opportunities to improve returns,” Gray says.

• **Elsie Ross**

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