



Applying microbial treatment in the field.

Culture Club

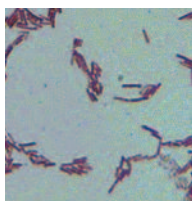
Microbial EOR Technology Gaining An Industry Foothold

It may not be a new concept, but the use of microbial technology to improve oil recovery in mature fields appears to slowly be gaining renewed interest in the collective consciousness of the petroleum industry.

Numerous factors, including the economic viability of the process as well as its environmentally-friendly attributes, have aligned to create fertile ground for what could become the large-scale use of biotechnology in enhanced oil recovery programs.

GloriOil Limited, a Houston, Texas-based entity created in 2005 to commercialize technology initially developed and field tested by The Energy and Resources Institute (TERI) in India, is on the leading edge of the movement. Its patented Enhanced Oil Recovery by Microbial Consortia (EORMC) process is providing encouraging results in field applications in the Texas Panhandle and South Texas.

"I would say it's starting to gain a foothold in the industry's mindset in terms



FERTILE GROUND

Above: In-house laboratory bio-reactor where microbes are grown. Left: Microbial lifeforms.

of EOR," says Stuart Page, GloriOil chief executive officer. "If you look around at the [scientific] publications at the moment you [can see it's] getting more and more traction. People are talking about microbial enhanced oil recovery. I think, in general, EOR is becoming a much more interesting area of focus for everybody and microbial recovery, because of its history, because it's had such success in the past

and because it's a real innovative technology that is concentrated in very few places right now, I think that's why it's getting lots of interest."

EORMC, which GloriOil has branded the BioFilter process, creates a downhole bioreactor in the formation that decreases water cut while also boosting both oil quantity and quality, explains Page. BioFilter is a patented consortium of microbes created from existing microbes found within an existing formation. GloriOil says these microbes produce bio-surfactants, biopolymers, solvents, gases and acids that mobilize residual oil. The company claims that use of BioFilter decreases water cut while increasing production of a treated well by up to 200%.

While the microbes and nutrients used by GloriOil are unique to the process, they are applied in a similar manner to previous microbial treatments. Known commonly as the "huff-puff" method of oil extraction, it involves injecting a microbe-nutrient mixture into the reservoir.

Over the course of one to two weeks, these microbes incubate in the reservoir, producing minute amounts of carbon dioxide and methane within the

pores. That essentially causes oil swelling that, coupled with reduction in interfacial tension and oil viscosity reduction due to the other byproducts produced by the microbes, alters the reservoir conditions, thereby enabling remaining oil in place to flow while reducing water cut.

The technology was developed and tested since the early 1990s by TERI, GloriOil's technology provider and co-founder (GTI Group is the other co-founder). TERI researchers wanted to create more robust microbial biotechnology than was previously available that could be used in hotter and higher pressure reservoirs.

The first field application of EORMC took place in India for national oil company Oil and Natural Gas Corporation Ltd.'s (ONGC's) Gujarat fields. TERI reported that by applying this technology to 25 oil wells, 63,325 barrels of incremental oil was extracted, translating into revenues of more than \$3.16 million (US) based upon a price of \$50 per bbl.

"[TERI] did lab work and analysis and theoretical science and then they progressed to the field that ONGC had given them to work on. [To make] a long story short, they treated 25 wells — 19 wells were very effective, six wells didn't work," Page says. "Of the 19 wells that worked they had 200% incremental oil recovery for a period of about six to eight months. So they were very compelling results."

In the end, TERI researchers had cultured a set of microbes that can survive temperatures as high as 90 C and pressures up to 4,500 psi. This was a marked improvement over previous oil recovery microbes that could bear temperatures only up to 65 C. In addition, GloriOil says microbes used in the EORMC process also work in reservoirs with salinity levels up to 14%.

Based on the success of the India field trials, GloriOil brought TERI's technology to Texas, where the company is now effectively applying biotechnology in mature fields to improve recovery and reduce operating costs.

Paraffin treatment

Page says a derivative technology has also been used with encouraging results to create an internal biofilm coating on downhole tubulars to prevent paraffin buildup.

"We've done a number of treatments in the U.S. so far. We've treated a bunch of wells in the Texas Panhandle for paraffin deposits back in June, and they are still flowing freely so the treatment is very long-lasting."

Called WellMAID, the paraffin treatment uses a patented consortium of customized microbes developed from indigenous microbes within a given geographic area that has suffered from paraffin precipitation.

"WellMAID microbes begin interacting with paraffin in a well the same day they are installed," Page says. "They form a biofilm coating inside the well and surface tubulars and continuously inhibit paraffin deposition as it occurs, keeping the well

operating smoothly, and [they] have demonstrated effectiveness in excess of 18 months in some cases before re-treatment is needed."

Bill Vahrenkamp, owner of Arlington, Texas-based BCI Energy Company, has used GloriOil technology on company wells in the Panhandle, a once prolific play that has been dying a slow but sure death for the past three or four decades.

"The Panhandle field is an old field — 70 to 75 years old — and many of the wells still produce but only one to two barrels [per day] of oil or less," he says. "The bottom line is we decided we wanted to use the [GloriOil] technology and we used it on nine wells that had paraffin problems. Of those nine wells, seven are still producing."

Although he admits production wasn't enhanced on a barrel count basis, Vahrenkamp says the paraffin treatment worked as advertised and that any production from the wells has been a bonus as they would not have been operational otherwise.



GROWING PRODUCTION

Left: Coring is conducted to collect naturally-occurring paraffin degrading microbes in North Texas. Right: The result of extreme paraffin buildup at a well in the Panhandle field.

new financing. The funding was co-led by Kleiner Perkins Caufield & Byers (KPCB) and GTI Group, which co-founded and seeded the company.

"We believe GloriOil's technology will deliver much-needed improvements in recovery efficiency to many of the world's 30,000 producing oil and gas fields," KPCB partner Joseph Lacob comments. "The company has assembled a world-class team combining biotechnology and oilfield expertise, and we are excited to be participating in the development and growth of this organization."

Page says the financing is indicative of the promise the technology holds. "Our management team, advisers, early adopter operators and investors have really come together to help us deliver game-changing well- and field-level enhanced recovery programs. We have exceptionally high buy-in to our value proposition of increasing oil production while lowering the producer's lifting costs," he says. "Our unmatched technology, top talent, formidable war



"I did get the results I wanted from a wellbore standpoint in that the wells we put these micro-bugs on had paraffin problems. [GloriOil] took samples of our oil and paraffin and I guess you could say they created designer bugs, put it in the wells, which were some of our worst wells, and it kept our wells clean," he explains.

"What impacted us is the fact the wells have remained producing. We put the treatment on in June and the wells are still producing and we haven't done anything else to them since. The bugs are doing their job."

As for the use of EORMC in Texas to date, Page says GloriOil has treated a number of wells on a single well stimulation basis. "It's early days to tell you how it's performing because you have to watch the wells for some period of time but we're encouraged by the results that we see so far," he says. "We think things are going well."

An example of the interest being demonstrated by GloriOil's efforts occurred in July of this year, when the company announced it had closed \$10 million in

chest and scalable business model give us the right ingredients to capture this significant market opportunity."

That opportunity could soon include Canada, Page adds. "We recently had a call from an operator from around the Calgary area who wants us to do some work with him. He's in a very high salinity environment, 25% salinity, so one of the factors for us is finding a microbe that exists and survives and does the things we need it to do in that kind of salinity," Page says.

"What we will be doing is actually taking a sample and analyzing the microbial population and if we can find a viable microbe, absolutely we will be trying it out up there," he says. "I think Canada is a great area for candidate wells for this kind of treatment." ■ Paul Wells

CONTACTS FOR MORE INFORMATION

Stuart Page, GloriOil, Tel: (713) 237-8880

Charley Siess, Sales and Marketing director, GloriOil,

Tel: (713) 237-8880, E-mail: csiess@glorioil.com