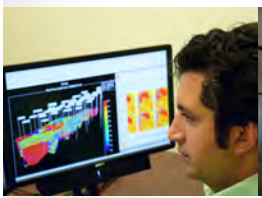
UNLOCK
YOUR RESERVOIR
FIELD-PROVEN EOR SOLUTIONS

tiorco.com

TIORCO
A Nalco Champion Company








CONTENTS


ZERO ACCIDENTS | ZERO INCIDENTS | ZERO ENVIRONMENTAL RELEASES
GOAL ZERO

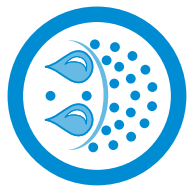
SAFETY FOR EVERYONE EVERYWHERE

At TIORCO, our programs ensure that safety is no accident. Protecting the environment, and the health and safety of our employees, customers and the communities in which we live and work are our highest priorities.

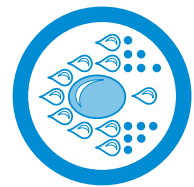
Our solutions are designed to help you produce additional oil in a more efficient, safe and responsible manner than ever before.

INCREASING PRODUCTION STARTS WITH THE RIGHT SOLUTIONS

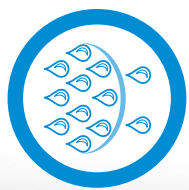
Unlock your reservoir. TIORCO works with you to increase incremental oil recovery and improve your return on investment in a safe and responsible manner. We optimize our field-proven solutions to meet your specific reservoir conditions.



MOBILITY & SWEEP IMPROVEMENT



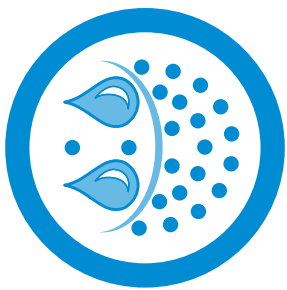
CONFORMANCE IMPROVEMENT



WATER SHUTOFF

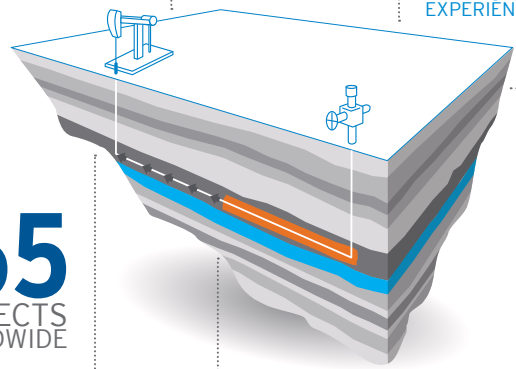
RESIDUAL OIL RECOVERY

MOBILITY & SWEEP EFFICIENCY



3–10%
INCREMENTAL OOIP

MORE THAN
35
YEARS OF EXPERIENCE



165
PROJECTS WORLDWIDE

$2–10
COST/INCREMENTAL BARREL OF OIL

CUSTOMIZED CHEMISTRIES

OUR PROVEN MOBILITY & SWEEP FIELD EXPERIENCE

MOBILITY & SWEEP EFFICIENCY

CASE HISTORY

SITUATION

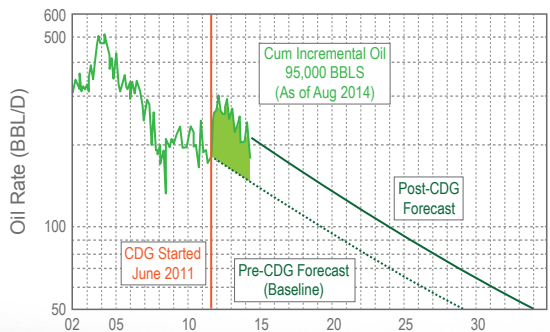
Dina Field is located in the Upper Magdalena Valley Basin, Colombia and is operated by ECOPETROL S.A. Water injection began in 1985 and despite an initial positive response, water cut steadily increased from 30% to 96%. High water cut was attributed to permeability contrast and unfavorable mobility.

PROGRAM

After detailed laboratory, reservoir engineering and simulation studies, a Colloidal Dispersion Gel (CDG) pilot started in June 2011 and represented the first chemical EOR project implemented by ECOPETROL. The pilot project was to continue for one year with the option to extend to additional injectors in the field. The pilot test used a CDG concentration of 400 ppm polymer with crosslinker, 75% less polymer than that required for a straight polymer flood at 1,500 ppm.

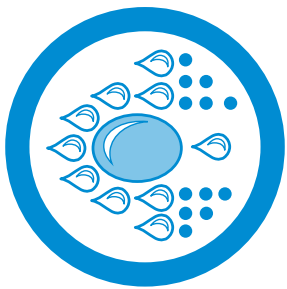
RESULTS

The pilot was expanded to three additional injectors in April 2013, and as of August 2014, incremental oil recovery was 95,000 barrels with up to 8% reduction in water cut. As of January 2015, a total of 3.17 million barrels of CDG have been injected. The full pilot is estimated to generate an incremental recovery factor of 5% or 340,000 barrels of oil over 15 years. As of January 2015 a total of 3.17 million barrels of CDG have been injected with no polymer detected in the offset producers.



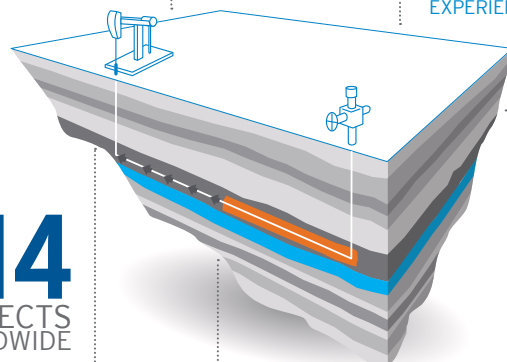
SPE 139200, SPE 165273

CONFORMANCE IMPROVEMENT



1–5%
INCREMENTAL PATTERN OOIP

MORE THAN
25
YEARS OF EXPERIENCE



814
PROJECTS WORLDWIDE

RAPID PAYBACK

<$3.00
COST/INCREMENTAL BARREL OF OIL

OUR PROVEN CONFORMANCE FIELD EXPERIENCE

CONFORMANCE IMPROVEMENT

CASE HISTORY

SITUATION

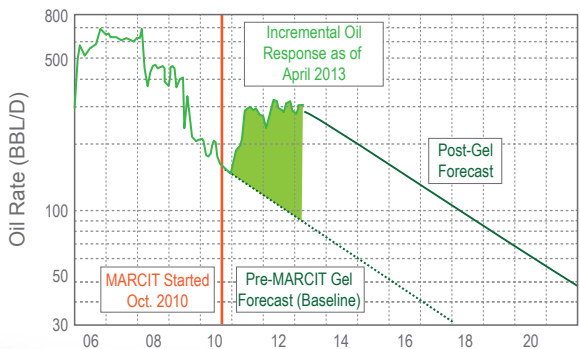
Tello Field is located in the Upper Magdalena Valley Basin, Colombia and operated by ECOPETROL S.A. It began oil production in 1972 with a maximum primary rate of 11,200 bbl/d in 1980. Water breakthrough occurred in 2000 and watercut increased rapidly to 92% due to high permeability contrast and unfavorable mobility ratios. This led to premature water breakthrough in offset producers making the secondary recovery process less efficient. The early water breakthrough has limited the potential for secondary recovery and reduced the economic lifetime of the field.

PROGRAM

Reservoir engineering analysis, supported with injection profile data, showed severe water channeling. A MARCIT gel treatment to modify the water injection profile was recommended. In October 2010 a 45-day treatment program began with six stages of increasing polymer gel concentration from 2,000 to 7,000 ppm.

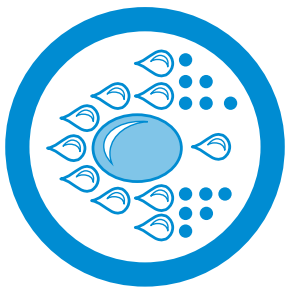
RESULTS

As of March 2014, 340,000 barrels of incremental oil have been produced with the best offset producer yielding 173,000 barrels cumulative incremental oil production. The treated pattern area is still producing and based on these results, MARCIT gel treatments to modify water injection profiles have been extended to six additional patterns in the Tello Field.



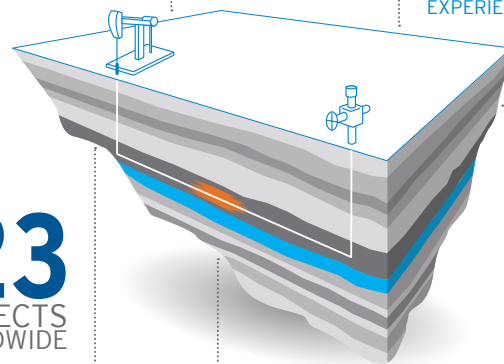
SPE 169478

IN-DEPTH CONFORMANCE IMPROVEMENT



1–5%
INCREMENTAL PATTERN OOIP

MORE THAN
15
YEARS OF EXPERIENCE



123
PROJECTS WORLDWIDE

EASE OF **OFFSHORE** IMPLEMENTATION

$5–15
COST/INCREMENTAL BARREL OF OIL

OUR PROVEN IN-DEPTH CONFORMANCE FIELD EXPERIENCE

IN-DEPTH CONFORMANCE IMPROVEMENT

CASE HISTORY

SITUATION

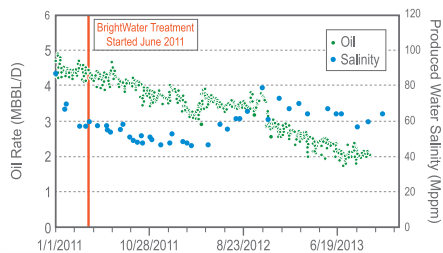
Ebano Field is a high permeability slope-channel turbidite reservoir located offshore Equatorial Guinea, West Africa. Oil production started in May 2009 and water injection began in July 2009. Water breakthrough was observed approximately one year after water injection began, much earlier than the original prediction, suggesting presence of thief zone(s) due to high permeability contrast (0.3 – 25D).

PROGRAM

In September 2010 engineering analyses and detailed simulation and laboratory studies were performed to evaluate the technical feasibility of BrightWater® technology and a well treatment was implemented in April 2011. A total of 48,000 barrels of BrightWater were injected at an injection rate of 6,000 bbl/d, using a concentration of 15,000 ppm (4 cp as injected). This treatment has been one of the largest offshore implementations using BrightWater technology.

RESULTS

Pilot performance indicators confirmed that the BrightWater technology did not change the injection profile and was successfully activated deep into the formation. Time-lapse Fall-off Tests confirmed displacement and activation away from the wellbore region and indicated a permeability reduction due to the treatment. Further evidence of deep reservoir conformance was provided by a 3-4x increase in interwell tracer transit times under the same operating conditions. The post-treatment increase in oil rate (customer confidential) and changes in the salinity of produced water confirm diversion of flow and sweep efficiency improvements generated by the treatment.

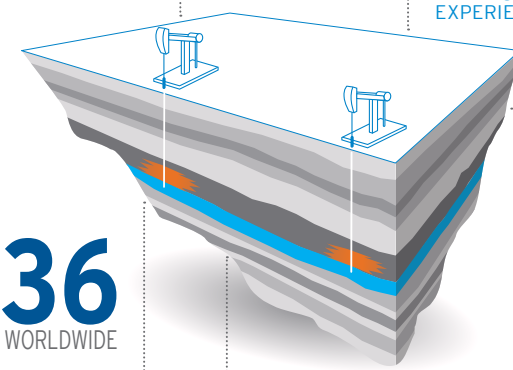


SPE 169132

WATER SHUTOFF

REDUCED OPEX

MORE THAN
25
YEARS OF
EXPERIENCE



1036
PROJECTS WORLDWIDE

$5–10
COST/INCREMENTAL
BARREL OF OIL

IMMEDIATE RESULTS

OUR PROVEN WATER SHUTOFF FIELD EXPERIENCE

WATER SHUTOFF

CASE HISTORY

SITUATION

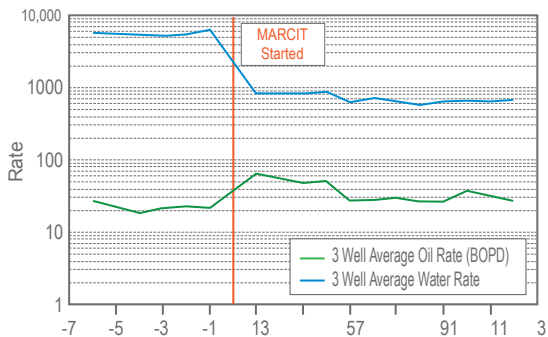
A field located on the western edge of the Big Horn Basin in Wyoming produces from two thick, highly fractured carbonates. The field produces under a strong bottom water drive where water channels through the fractures, resulting in water-cuts in excess of 99% and high fluid levels. Further, the field's fluid processing facilities were constrained, which limited additional drilling campaigns.

PROGRAM

A laboratory study evaluated the use of polymer gels that penetrate and reduce the permeability of the fractures, allowing for improved drawdown and production at improved water-cuts. The study found MARCIT gel technology compatible with the produced water and reservoir temperature. Three producers were chosen for the campaign and the treatment designs were based off the maximum productivity of the well. An average of 8,000 barrels of gel was injected into each well and no surface pressure was observed during the treatments.

RESULTS

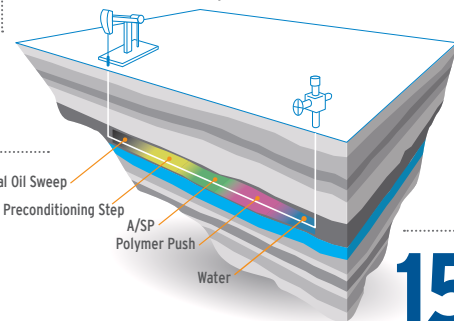
Following a two-week shut-in period to allow for gel maturation, each well was brought back on production. The campaign started in 2010 and showed a 67% average increase in oil production and an 81% decrease in water production. The all-in treatment costs paid off in less than four months assuming a $50 per barrel oil price. Further, the reduction in water production allowed the operator to pursue their drilling program without facilities expansion.



RESIDUAL OIL RECOVERY

+15
PROJECTS WORLDWIDE

$10–20
COST/INCREMENTAL BARREL OF OIL



MORE THAN **7** YEARS OF EXPERIENCE

150
LABORATORY & RESERVOIR ENGINEERING STUDIES

10-20%
INCREMENTAL PATTERN OOIP

OUR PROVEN RESIDUAL OIL RECOVERY FIELD EXPERIENCE

RESIDUAL OIL RECOVERY

CASE HISTORY

SITUATION

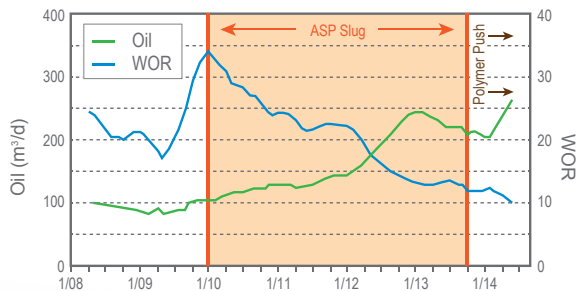
A field located in southwest Saskatchewan, Canada produces from clean sandstone with an average permeability of 385 mD and porosity of 20%. The field has an OOIP of 76 MMbbl and has been waterflooded for 53 years with an estimated ultimate recovery of 35%. The waterflood demonstrated good sweep efficiency but an unfavorable mobility ratio resulted in high residual oil saturation and significant remaining reserves.

PROGRAM

Various strategies to improve oil recovery were evaluated and an Alkali-Surfactant-Polymer (ASP) approach was found to have the most potential to improve mobility and reduce residual oil saturation. ASP injection began in December 2009 and 40% pore volume (PV) was injected over the following three years and ten months. The ASP slug is being followed by an estimated 40% PV polymer push to maintain a favorable mobility ratio.

RESULTS

Oil production steadily increased from 98 m^3/day prior to ASP injection and reached a peak incremental oil production rate of approximately 245 m^3/day three years after the start of the flood. Incremental oil production has continued to increase during the polymer push and the water-cut has dropped from 97% to 90%. The project is economically successful and a second ASP flood has been initiated. The technology has been established as a viable option to improve oil recovery and add recoverable reserves in this region.

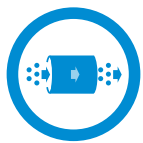


INTEGRATING EOR CHEMISTRY AND YOUR RESERVOIR

FLUIDS ANALYSIS

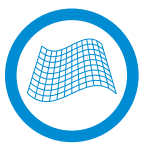
POLYMER & GEL TECHNOLOGIES

PHASE BEHAVIOR STUDIES



CORE FLOOD STUDIES

RESERVOIR EVALUATION



NUMERICAL SIMULATION

Reduce your risk. Collaborate with our integrated team of chemists, engineers and scientists to successfully implement your EOR program. From product development and testing to reservoir evaluation, field deployment design and quality control, we work with you throughout the project lifecycle to maximize oil production. We offer full solutions or can supplement your in-house resources.

EOR LABORATORY

FLUIDS ANALYSIS

EOR LABORATORY

POLYMER & GEL TECHNOLOGIES

EOR LABORATORY

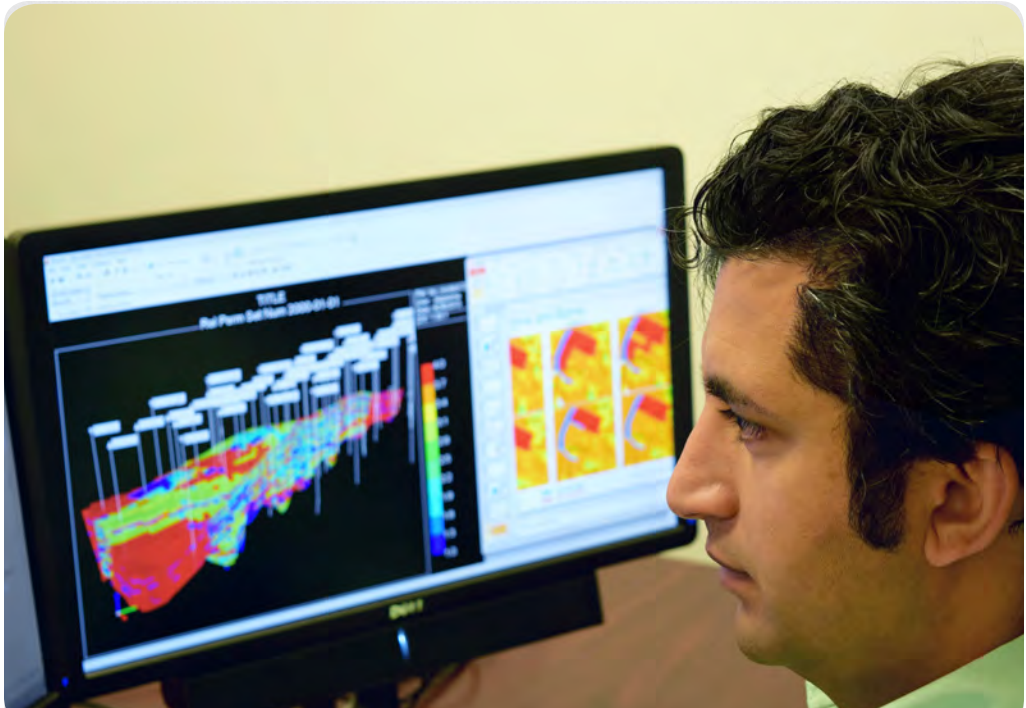
PHASE BEHAVIOR STUDIES

EOR LABORATORY

CORE FLOOD STUDIES

RESERVOIR ENGINEERING

RESERVOIR EVALUATION



RESERVOIR ENGINEERING

NUMERICAL SIMULATION

CUSTOM ENGINEERED EQUIPMENT AND FACILITIES AND FIELD SUPPORT

MOBILE PUMPING UNITS

ONSITE PERSONNEL

CUSTOM FACILITIES & EQUIPMENT

Successfully implement your EOR project with minimal disruption to current operations. We provide project management, skilled field technicians and specialized equipment, with a primary focus on safety, to ensure your project success. Our services are seamlessly integrated with Nalco FabTech should you require custom designed injection equipment and facilities.

ONSHORE / OFFSHORE

FIELD IMPLEMENTATION

MOBILE EOR PUMPING UNITS

FIELD IMPLEMENTATION

TRAINED & EXPERIENCED PERSONNEL

EQUIPMENT & FACILITIES

CHEMICAL INJECTION SYSTEMS

EQUIPMENT & FACILITIES

WATER INJECTION SYSTEMS

FLASH DRIVE CONTENTS:

- Unlock Your Reservoir Brochure
- TIORCO Provisco™ Dry Polymers Product Bulletin
- BrightWater Nanotechnology Brochure
- Nalco FabTech Custom Equipment and Facilities Brochure

UNLOCK YOUR RESERVOIR

UNLOCK
YOUR RESERVOIR
FIELD-PROVEN EOR SOLUTIONS

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