

# BrightWater<sup>®</sup>

## A New Technology for Waterflood Sweep Improvement



The Science of Enhanced Oil Recovery

### BRIGHTWATER

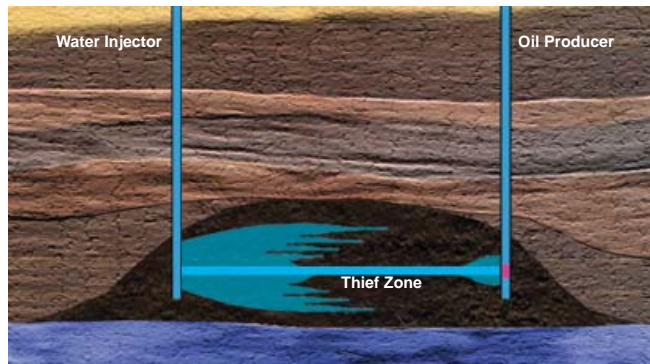
Every day, your company is challenged to produce as much of its oil reserves as possible. Unfortunately, even after secondary recovery attempts like waterfloods, most reservoirs still produce only 40 to 60 percent of the original oil in place.

Now, TIORCO offers an alternative that promises to maximize your production: BrightWater chemical and application technology. Co-developed by Nalco, BP and Chevron, BrightWater is a sub-micron particulate chemistry that is injected downhole with flood water during a secondary recovery process.

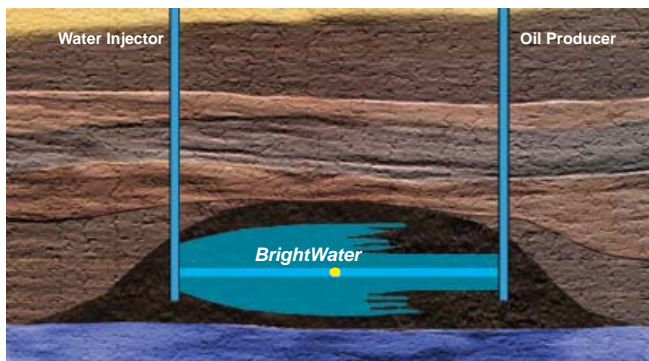
BrightWater has been designed to activate at a pre-determined "in-depth" location within the reservoir. Upon activation, the BrightWater particles begin to expand to many times their original volume, blocking pore throats and directing injection water into untapped, oil-rich zones. This deep reservoir profile modification causes additional oil to be swept toward the producing wells.

Over time, production begins to improve. With a simple treatment, you stand to recover up to an additional 10 percent of the original oil in place. This literally translates to millions of dollars in value being added to your asset.

Various grades of BrightWater chemistry have been designed to target injection water thief zones at a range of reservoir temperatures and salinities. The latest generation of BrightWater currently tested for some North Sea fields will expand and set at less than 50°C. At this temperature, the technology promises to not only improve sweep efficiency, but also to minimize the volume of chemical plug required.



If barriers to vertical flow are absent, water channels through the thief zone and will bypass the patch, plug or gel block.



BrightWater is injected into, and expands in the vertically isolated thief zone. If barriers to vertical flow are absent and deep reservoir profile modification is in place, water is diverted to the unswept formation.

### BENEFITS OF BRIGHTWATER

- Restricts flow of water into high permeability thief zones
- Reduces unwanted costly water production
- Improves sweep efficiency
- Improves reservoir oil recovery by up to 10 percent
- Can be deployed with conventional chemical injection equipment and existing water injection systems
- Water miscible solution
- Poses no risk to your reservoir or the environment
- No shutdowns required

### CASE HISTORIES

- **Asia Pacific**

This field marked the first deployment for BrightWater in 2001. This proof-of-concept study showed TIORCO and the customer that BrightWater could be successfully manufactured and deployed, and a positive oil response was soon observed.

The field produced an additional 300,000 barrels of oil after the BrightWater treatment, with a corresponding decrease in oil cut decline.

- **North Sea**

Currently in development, this field study for a North Sea operator will use the new cold-activating BrightWater technology, set to activate at less than 50°C.

The operator and TIORCO are jointly completing reservoir modeling work and tracer studies to understand and predict the incremental oil recovery. The expected oil recovery is large, and a sizable target exists due to fault-induced channeling.

The field trial will require 100 tonnes of BrightWater to be injected as a solution with a seawater flood over a period of 4-5 days. It is expected to take approximately three months to form the block deep in the reservoir, and incremental oil recovery should commence after an additional three months.

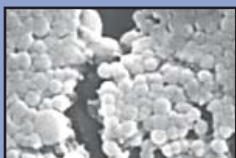
- **North America**

In this mature field, production wells were showing relatively high water cuts of above 70% even with low to medium total pore volume injection.

Following a miscible injection test to determine the connectivity pattern between wells, three injection wells positioned in a triangular pattern relative to one another were chosen. The BrightWater treatment was deployed in late 2004, and by mid 2005 the producer began to see incremental oil production.

Over the course of 2005 to 2007, the offset production well had produced 410,000 barrels of incremental oil, which translated to a revenue increase of over \$20 million. The operator expects the BrightWater treatments to continue to pay dividends into the foreseeable future.....over the next 15 years, they expect to produce an additional 2 million barrels of incremental oil.

With application of the BrightWater technology, sub-micron particles placed deep in the reservoir swell and effectively shut off injection water thief zones. The 'blocks' force subsequent injected water into unswept zones, pushing previously bypassed oil in place toward producers and increasing daily production.



BrightWater at sub-micron size before injection



BrightWater expanded and aggregated after application into the reservoir

