

Improve
waterflood sweep efficiency
with Halliburton's
k-Trol® service.



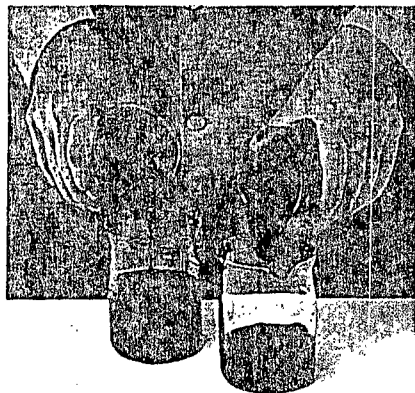
No other service offers so many advantages at such a low cost.

The k-Trol service from Halliburton starts cutting costs when you first use it. The material is batch injected, so there is no need for expensive metering and continuous injection equipment.

The service is designed to minimize, or even eliminate, the major problem in waterflood operations—streamlining. In most floods, injected water tends to follow the path of least resistance through the formation to production wells.

Once that streamline is established, waterflood efficiency is greatly reduced.

The k-Trol service, which can be used to enhance an entire waterflood



Lab demonstration shows why k-Trol material is so effective in helping improve waterflood projects. Beaker on left contains the material as it appears on the surface. It is a monomer with a viscosity very similar to water, so it pumps easily, and follows streamlines created by injection water.

Beaker on right shows k-Trol material after polymerization, which occurs within the formation. Final viscosity is variable, and 30,000 to 50,000 ppm in place concentrations are easily obtainable. The thick polymer diverts injection water to other areas of the formation, to help improve sweep efficiency.

operation, or to help remedy a specific problem in a single well, is designed to minimize streamlining.

The material is injected as a low viscosity monomer—1 to 2 centipoises—so it tends to seek the portions of the formation subject to streamlining, eliminating the need for special downhole tools. Because it goes in as a monomer, there are none of the shear problems experienced when injecting polymerized materials. Injection horsepower requirements are greatly reduced.

What happens in the formation makes the big difference.

The k-Trol material, after it enters the formation, chemically reacts to form a high viscosity polymer. The material can be designed to react slowly to achieve deep penetration prior to polymerization. Final viscosity is variable—up to 1-million cps has been achieved in our labs. You can also vary polymer concentrations to fit your requirements. While conventional polymers are limited, 30,000 to 50,000 ppm concentrations are easily obtainable with the k-Trol material.

Once the polymer forms, injection water is immediately diverted to less

permeable sections of the zone, greatly improving sweep efficiency. During the life of the flood, low viscosity injection water eventually can finger through the k-Trol material. Because the polymer is miscible in water, the water takes on some of the high viscosity characteristics of the polymer material. In effect, a polymer flood is created.

All indications show the k-Trol material to be extremely long lasting... it should remain effective for several years. Unlike permanent type plugging materials, k-Trol material allows access to the formation for possible future recovery techniques.

The k-Trol service offers one other significant advantage. It is the only polymer flood technique that has been used successfully in limestone formations, as well as in sandstone.

Exclusive computer design technique makes k-Trol service even more effective.

As part of the k-Trol service, Halliburton can now design a k-Trol service treatment for your waterflood. The programs are based on data obtained from field results with k-Trol materials, so you get a realistic design.

You can use Halliburton's computer programming to examine the effects of different k-Trol treatments, then select the best treatment for your requirements.

XYZ OIL COMPANY
WILCOX

EDWARDS #3
ST. LANDRY
PERCENT POROSITY = 25.00
PERMEABILITY IN MD = 300.00
OIL ZONE THICKNESS = 5.00
WELL SPACING IN ACRES = 40.00
OVERDISPLACEMENT PLANNED = 1.00
WELLBORE DIAMETER, INCHES = 5.50
MONOMER CONCENTRATION PERCENT = 4
EXPECTED VISCOSITY, CPS = 40000.0
EXPECTED YEARS = 20
CALCULATED INJECTION PRESSURE = 751.11 PSI
IF CALCULATED INJECTION PRESSURE DIFFERS BY 30% FROM ACTUAL BOTTOM HOLE INJECTION PRESSURE, CALCULATE EFFECTIVE PERMEABILITY WITH PROGRAM FPERM*, DATAFILE KFILE
PERMEABILITY IN DARCIES — UNTREATED: 0.3000 TREATED: 0.061390
OVERDISPLACEMENT PLANNED = 1.0 BARRELS
A KTROL TREATMENT OF 250.00 BARRELS WILL BE DISTRIBUTED TO A RADIUS OF 81.3 FEET IN 1028 DAYS OF NORMAL INJECTION

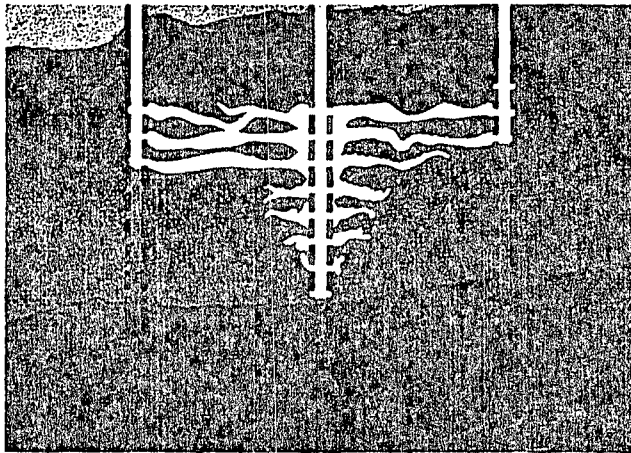
A KTROL TREATMENT OF 350.00 BARRELS WILL BE DISTRIBUTED TO A RADIUS OF 94.8 FEET IN 1442 DAYS OF NORMAL INJECTION

A KTROL TREATMENT OF 500.00 BARRELS WILL BE DISTRIBUTED TO A RADIUS OF 113.0 FEET IN 2064 DAYS OF NORMAL INJECTION

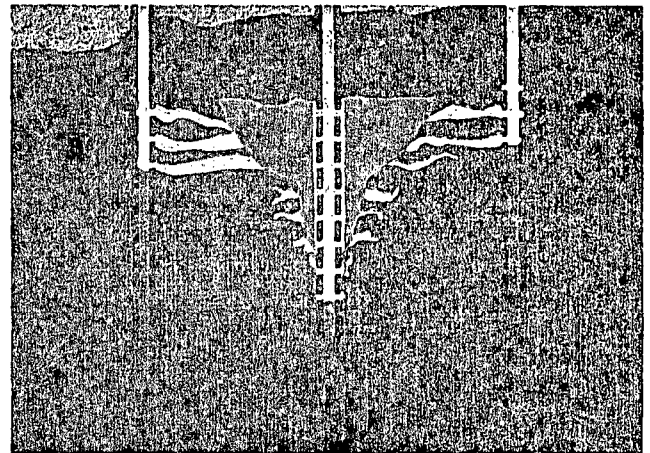
A KTROL TREATMENT OF 1000.00 BARRELS WILL BE DISTRIBUTED TO A RADIUS OF 158.4 FEET IN 4139 DAYS OF NORMAL INJECTION

Here's how k-Trol works in the formation to help improve oil recovery ratios in waterflood projects.

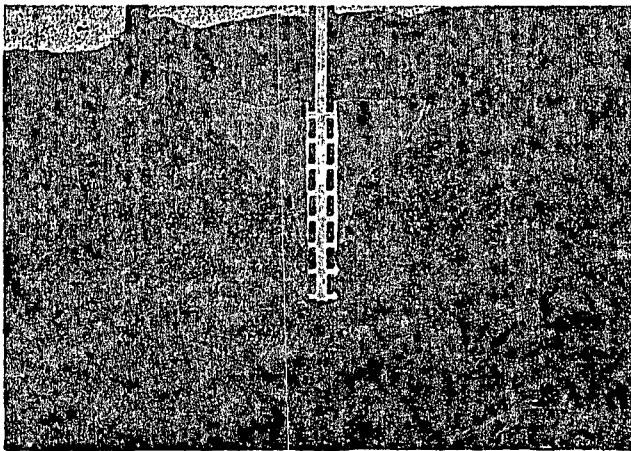
- 1 Injection water follows path of least resistance through formation to producer, establishing streamlines. Once streamlines are established, flood sweep efficiency is greatly reduced.



- 2 The k-Trol material is injected as a monomer with a viscosity similar to that of water, so it easily enters the streamlines.

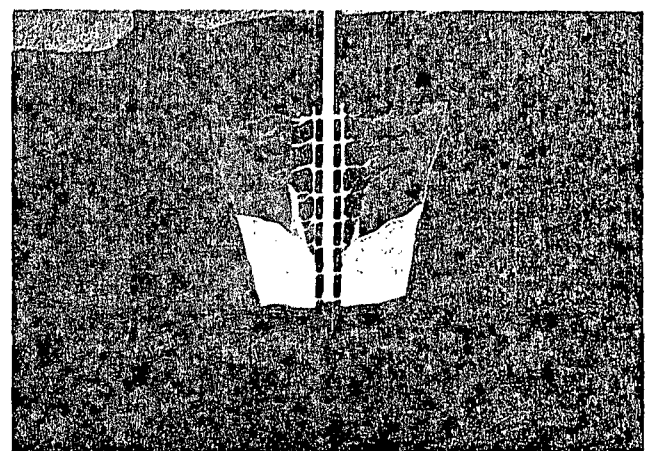


- 3 At a predetermined time, which can be adjusted to meet field conditions, the k-Trol material forms an extremely viscous polymer, impeding the movement of flood water.



- 4 Injection water is diverted to other areas of the formation, helping improve a real and volumetric sweep efficiency.

Eventually, injection water begins to finger through the k-Trol polymer. That water takes on many characteristics of the material, in effect, creating a polymer flood mechanism.



Waterflood project responds to k-Trol service.

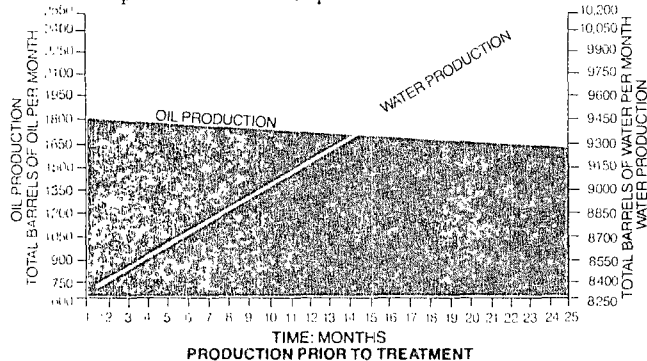
In this Ector County, Texas waterflood, production was lower than expected from the 26 wells surrounding six injection wells. Operator and Halliburton worked together to develop

a k-Trol service treatment for the field. After a thorough analysis of reservoir conditions, k-Trol service treatments were designed for the injection wells. Each well was treated with a volume of k-Trol polymer totaling between 25 and 35% of its daily injection volume.

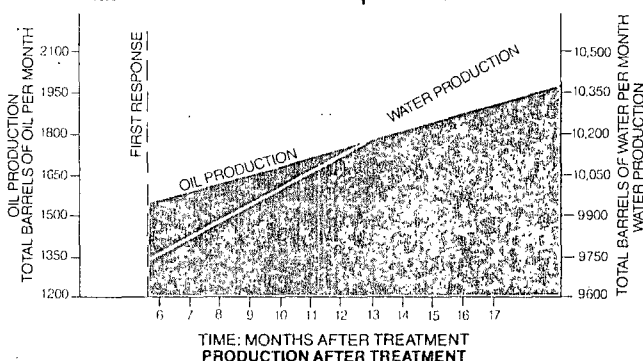
Initial response to the treatments

came within six months. Ten of the production wells showed an increase in oil production. After 17 months, oil production was still improving. The other 16 wells had a significant decline in water production. The curves show details.

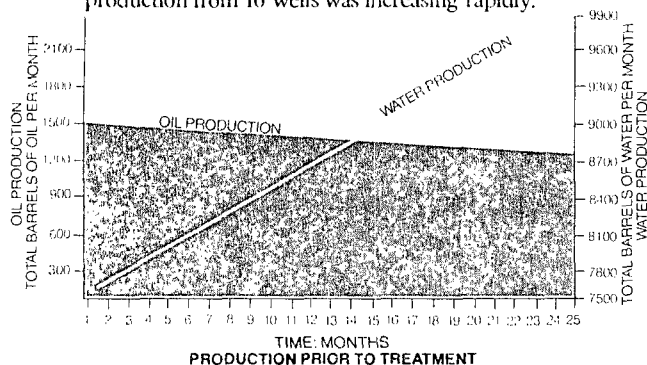
Prior to k-Trol service treatment, 10 wells were showing a decline in oil production and a rapid increase in water production.



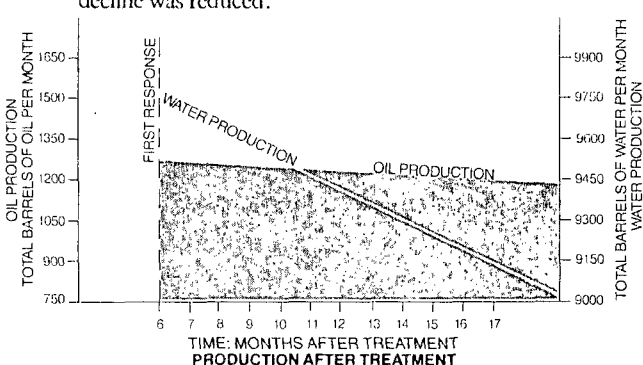
After k-Trol service treatment, the same 10 wells had a substantial increase in oil production with a minor increase in water production.



Prior to k-Trol service treatment, water production from 16 wells was increasing rapidly.



After k-Trol service treatment, water production began to decline. Oil production also continued to decline, but the rate of decline was reduced.



PRODUCTION FIGURES ARE AN AVERAGE OF THE PRODUCING WELLS REPORTED TO BE IN PRODUCTION FOR EACH MONTH.

**The k-Trol service –
another reason why Halliburton
is your best way to make
the most of every well.**



Duncan, Oklahoma 73536



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