

Halliburton helped Permian Basin operator save more than \$500,000 and 8,000,000 gallons of water

First complex crosslinked frac fluid to work with up to 285,000 ppm total dissolved solids (TDS) helped provide effective fracturing and reduce costs



OVERVIEW

Historically, using produced water for fracturing has been cost-prohibitive. The cleanup costs necessary to create an effective crosslinked frac fluid were just too high compared to the cost of fresh water. Now, however, new Halliburton technology allows operators to use produced water with TDS up to 300,000 parts per million (ppm) to formulate an effective, crosslinked fluid.

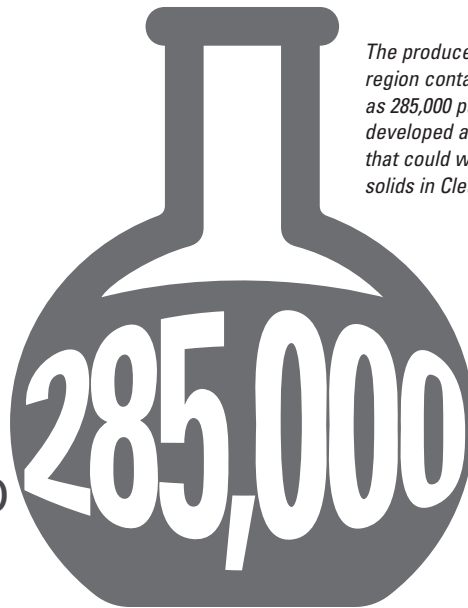
This new technology makes produced water an attractive alternative to fresh water by reducing transportation and disposal expenses.

Halliburton used this technology for an operator in the Permian Basin. Halliburton first treated the produced water with its CleanWave® Water Treatment service, and then customized its frac fluid chemistry to successfully fracture eight wells, saving eight million gallons of fresh water and \$500,000 to \$700,000 in total cost of operations.

CHALLENGE	SOLUTION
<p>Produced water with high total dissolved solids</p> <p>Oil and gas wells in areas within the Permian Basin produce water with TDS concentrations up to 285,000 ppm. At such levels, developing stable crosslinked fluid systems becomes difficult, so operators use fresh water for fracturing. But, due to drought conditions, fresh water had become expensive.</p>	<p>Integrated system produced customized frac fluid</p> <p>Halliburton scientists developed a customized frac fluid to work with this high-TDS produced water. The fluid is designed to crosslink using the operator's produced water. Halliburton treated eight wells with the formulation. It worked as effectively as fluids mixed with fresh water.</p>
<p>High cost of cleaning produced water</p> <p>The dirtier the water, the more treatment costs. Treating produced water can be very expensive – especially when trying to make it as clean as fresh water. Halliburton needed to lower the cost-per-barrel treated, so that the operator could at least break even.</p>	<p>Treatment with CleanWave service and high-TDS fluid</p> <p>Halliburton used its CleanWave Water Treatment service, an electrocoagulation process that removes hydrocarbons, heavy metals and <i>suspended</i> solids. Even though <i>dissolved</i> solids remained, the water was clean enough to work effectively with the new customized fluid system, lowering treatment costs.</p>
<p>Transportation costs</p> <p>Transporting water is a huge cost for any hydraulic fracturing operation. Wells in the Permian Basin require 40,000 to 60,000 barrels of fresh water. Much of that water must be transported to the site with trucks. Transportation expenses, including the potential impact on infrastructure, can be costly.</p>	<p>Water treated on site, saving money</p> <p>Halliburton treated the produced water on site reducing the cost of water transportation. Surface transportation and underground piping moved most of the produced water, which decreased the need for trucking by 1,400 loads, saving money and infrastructure.</p>

**TOTAL
DISSOLVED
SOLIDS**

UPTO



PPM

The produced water in the Permian Basin region contains dissolved solids as high as 285,000 parts per million. Halliburton developed a complex crosslinked frac fluid that could work with this level of dissolved solids in CleanWave® treated produced water.

8 MILLION
GALLONS
OF FRESH WATER
CONSERVED

Eight wells were successfully fractured with the new crosslinked fluid mixed with produced water that had been treated with the CleanWave system. By recycling, the company saved eight million gallons of fresh water and also reduced disposal costs.

**REDUCED
COST**

\$500,000
TO
\$700,000

Halliburton Water Management Solutions helped reduce the volume of fresh water purchased and transported. It also helped lower disposal costs, saving the operator \$500,000 to \$700,000 in total cost of operations.

Halliburton treated the produced water onsite and moved it by surface transportation or underground piping, reducing trucking by 1,400 loads. The operator saved the costs associated with transporting the water and reduced the wear and tear on the area's infrastructure.

1,400 TRUCKLOADS



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Operator sought cost-effective way to reuse produced water

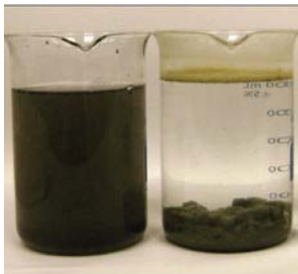
Oil and gas production in the Permian Basin region generates large quantities of produced water with high total dissolved solids (TDS) levels. Most of the high-saline produced water is injected into disposal wells. However, drought conditions in New Mexico caused this company to look for a way to reuse produced water for hydraulic fracturing operations. Typically, wells in the area require 40,000 to 60,000 barrels of fresh water for a hydraulic fracturing job. This operator believed using produced water as the base fluid for fracturing would decrease its dependence on fresh water and could lower the overall cost of the well stimulation treatment.



Halliburton technologies helped produce frac fluid with high TDS

The operator had never used produced water for fracturing and turned to Halliburton, a leader in water treatment, water management and hydraulic fracturing. Halliburton provided a cost-effective, integrated solution that enabled the operator to reuse the high-TDS produced water.

The produced water contained TDS values as high as 285,000 parts per million. Conventional wisdom said that crosslinking frac fluids could *not* work effectively with a TDS level that high. However, after a preliminary analysis of the operator's produced water, a team of Halliburton scientists developed a customized, crosslinked frac fluid that *could*. Chemistry provided part of the solution; technology provided another.



CleanWave® Water Treatment service removed contaminants

Halliburton used its CleanWave Water Treatment service to help remove suspended solids, hydrocarbons, and heavy metals from the water. The CleanWave® system uses an electrocoagulation process that coagulates suspended matter in the water. Suspended solids float to the top where they can be skimmed off, making the water clean enough to reuse for fracturing with Halliburton's customized chemistry. The CleanWave system cleans produced water enough to enable effective crosslinking and fracturing.

Making the water potable would not have been cost-effective. Thanks to the customized chemistry, potable water was not necessary. The combination of customized chemistry and CleanWave technology created a cost-effective solution that helped lower the expense of water acquisition, treatment, transportation, and disposal.

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Reduction in fresh water used and transportation costs

Halliburton helped the operator reduce the amount of fresh water needed plus associated expenses by minimally treating the produced water and using it as the frac fluid base.

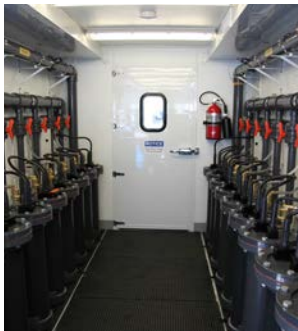
Halliburton used this combination in eight wells, saving eight million gallons of fresh water. By using produced water to create the crosslinked frac fluid, the company also reduced disposal costs. It did not need to reinject those eight million gallons of produced water into a disposal well.

Through innovative water management solutions that enable the reuse of produced water, Halliburton helped reduce the operator's water acquisition, transportation, treatment and disposal costs. Fresh water did not need to be trucked in from other locations. Halliburton treated the produced water onsite and moved it by surface transportation or underground piping, reducing trucking by 1,400 loads. Ultimately, the company saved money and reduced wear and tear on the local infrastructure.



Production from wells proved the worth of integrated system

The eight wells contained a total of 98 fracturing stages. Initial results indicated production similar to offset wells that were fractured with fresh water as the base fluid. Initial oil production of one test well was 591 barrels per day. Initial oil production from an offset well using fresh water as the frac fluid base was approximately 600 barrels per day.



Halliburton helped turn waste stream into revenue stream

The successful test marked the first time in the Permian Basin that produced water with high dissolved solids was used to create a crosslinked frac fluid. The results demonstrated that treated, produced water with high levels of dissolved solids could effectively form the basis for hydraulic fracturing fluids.

Halliburton helped this operator reduce costs by \$500,000 to \$700,000 and save eight million gallons of fresh water. The successful operation also demonstrated Halliburton's leadership in developing innovative industry solutions.

“Halliburton helped provide a total solution that enabled us to leave eight million gallons of fresh water where it belongs.”

*Completion Engineer,
Permian Basin operator*