

El Paso Corporation completed first natural gas well using all four CleanSuite™ technologies

Halliburton advances environmental performance and completion effectiveness in hydraulic fracturing and water treatment in shale fields

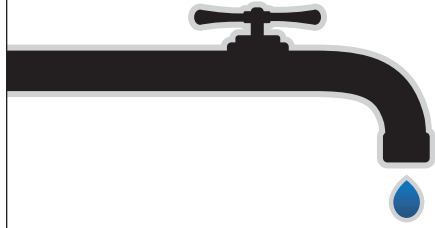


OVERVIEW

Technological advances in the last two decades have made hydraulic fracturing in shale more common throughout the industry. During this period, companies like Halliburton increased efforts to control water consumption and provide fluid systems with a higher margin of safety for people, animals and the environment. Since entering the Haynesville Shale, El Paso Corporation actively explored ways to implement these new environmentally focused technologies.

El Paso teamed up with Halliburton to stimulate one of its wells in the area and elected to use Halliburton's entire line of CleanSuite™ production enhancement technologies for both fracturing and water treatment. The result is the first natural gas well completion using all four systems, setting a new standard and taking the next step in the advancement of hydraulic fracturing.

CHALLENGE	SOLUTION
<p>Water consumption and bacteria growth</p> <p>Shale stimulation in this area requires millions of gallons of water per well. Drought conditions and regulations made it harder to find sources for fresh water. Chemical biocides are required to control bacteria in the water that can destroy the fracturing fluid and cause equipment damage.</p>	<p>Systems decrease need for fresh water and biocides</p> <p>Halliburton's CleanWave® water treatment system enables recycling of flowback and produced water at the well site, decreasing the need for fresh water. The CleanStream® service uses ultraviolet (UV) light to control bacteria growth and reduces the volume of biocides needed for treatment.</p>
<p>Search for fluid system with higher margin of safety</p> <p>El Paso was searching for an alternative fluid system that provided an extra margin of safety during stimulation of a gas well in the Haynesville Shale. Operators also wanted to improve performance and efficiency, and ensure the fluids could handle a variety of viscosities.</p>	<p>New food industry-sourced frac fluid system used</p> <p>Halliburton used its CleanStim® formulation – a hydraulic fracturing fluid system made entirely with ingredients from the food industry – to provide an extra margin of environmental safety. It also yields excellent performance in terms of pumpability, proppant transport and conductivity.</p>
<p>Reduce chemicals transported to well site</p> <p>Developing fracturing fluids at the well site includes the use of liquid gel concentrates that must be transported in a hydrocarbon carrier fluid in order to control hydration. This results in the water-based fluids containing small amounts of hydrocarbons.</p>	<p>Frac fluids mixed with dry polymer</p> <p>Halliburton used its Advanced Dry Polymer (ADP®) blender to deliver the gelling agent in the CleanStim formulation. Halliburton brings it to the well site as a dry powder and mixes it using its patented blending technology, reducing the amount of chemicals transported and used at the well site.</p>



Halliburton's CleanStream® service treated nearly 4.8 million gallons of water for this well. UV light was used to control bacteria growth, eliminating the need for more than 2,400 gallons of biocides for this well.

4.8 MILLION GALLONS OF WATER TREATED

HAL37018

1.05
MILLION GALLONS



Halliburton's CleanWave® water treatment system recycled 1.05 million gallons of flowback and produced water at the wellsite, reducing the need for fresh water by nearly 25%.



Halliburton's CleanStim® formulation is made with ingredients sourced from the food industry, providing an extra margin of safety for people, animals and the environment.

EXTRA MARGIN OF SAFETY

HAL37017

HAL37021



ALL CLEANSUITE TECHNOLOGIES USED IN ONE WELL COMPLETION

The first natural gas producing well to be completed using the entire CleanSuite system for hydraulic fracturing and water treatment.

- CleanStim® Fracturing Fluid System
- CleanWave® Produced Water Treatment System
- CleanStream® UV Light Bacteria Control
- ADP® Advanced Dry Polymer Blender

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HAL37016

El Paso sought new production enhancement technologies

Since El Paso Corporation entered into the North Louisiana Haynesville Shale in 2008, the company has completed over 76 wells. On average, each of these well treatments required 4.8 million gallons of water. The company wanted to reduce its dependence on fresh water and needed alternative sources because of both government restrictions and drought conditions at the time. The company also wanted to minimize the use of chemical biocides and find an alternative fluid system that could maximize production and provide an extra margin of safety.

El Paso teamed with Halliburton to use CleanSuite technologies

El Paso realized there was an opportunity to use all of Halliburton's proprietary CleanSuite™ technologies on one well. The two companies began with a series of pilot programs over a two-year period at different sites. The CleanStim® hydraulic fracturing fluid system was originally introduced in a sandstone reservoir in order to quantify regained conductivity and proppant transport. El Paso also piloted Halliburton's CleanStream® service in this area, testing it to ascertain its ability to help control bacteria growth. The CleanWave® water treatment system was used to recycle water and lower costs at smaller, vertical wells before moving to horizontal wells.

These pilot programs led to the use of all CleanSuite technologies on a single horizontal well in the Haynesville Shale. The target well consisted of 14 stages at a total depth of more than 17,000 feet and bottomhole temperatures greater than 340°F. Operators estimated 4.8 million gallons of fluid and 5.9 million pounds of proppant would be used for this well.

Water recycling decreased demand for fresh water and saved money

One of the biggest challenges in any shale operation is finding sources for the millions of gallons of water necessary for stimulation. Not only were state and local regulations a challenge for El Paso, drought conditions during testing made finding reliable sources of fresh water more difficult. Halliburton used its CleanWave water treatment system to recycle flowback and produced water at the well site to decrease the need for fresh water. The system is an efficient and mobile way to treat and reuse the water that's required as a routine part of the fracturing process. It treats by electrocoagulation, a process that separates contaminants and leaves clear water suitable for producing frac fluids. This process reduces transportation, procurement, and disposal costs. The amount of flowback and produced water recycled for this one well was more than one million gallons.

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Ultraviolet light technology controlled bacteria growth in fluids

To minimize corrosion, reduce production of sour fluids in the well and prevent degradation of fracturing fluids, controlling bacteria growth is critical. Chemical biocides are often used, but are toxic and must be handled carefully.

To solve these challenges, Halliburton used its CleanStream® service. It uses UV light to control bacteria growth. Operators incorporated the CleanStream system into the existing frac equipment without significant modification, and treated more than 4.8 million gallons of fluid. The service eliminated the need for more than 2,400 gallons of chemical biocides and improved the environmental profile of the fluids being used.



HAL37020

Fluids sourced from food industry provided extra margin of safety

El Paso and Halliburton also used the CleanStim® fluid system on this well. The system provides an extra margin of safety to people, animals and the environment and, in most wells, actually improves performance. The CleanStim formulation is comprised of ingredients sourced from the food industry, including some present in many fruits and vegetables. The system provides excellent performance in terms of pumpability, proppant transport and conductivity within the propped fractures.



HAL32947

Advanced Dry Polymer Blender eliminated need for carrier fluids

To reduce the amount of chemicals transported and used at the well site, Halliburton used its Advanced Dry Polymer (ADP®) blender. Rather than using an industry-accepted liquid slurry to deliver the gelling agent in the CleanStim formulation, Halliburton uses a dry powder and mixes it with water using its patented blending technology. The use of the ADP blender has eliminated over four million gallons of hydrocarbon based carrier fluids from fracturing treatments since it was introduced. The dry blending process can be used with any of Halliburton's fracturing fluids.

First natural gas completion using entire CleanSuite system

El Paso and Halliburton successfully implemented the entire CleanSuite system in one well program, making it the first natural gas completion using all four "green" technologies. El Paso was thrilled with the results, calling it a "win" for both companies. These pioneering technologies will help pave the way for future shale plays, significantly reducing the need for fresh water, minimizing a well's environmental footprint, and improving efficiency, production and safety.

"Teaming with Halliburton on the use of this 'green' suite of technologies was a 'win' for us and demonstrates that industry is proactively developing important advancements for hydraulic fracturing."

John Jensen,

*Senior Vice President of Operations,
El Paso Exploration and Production*