

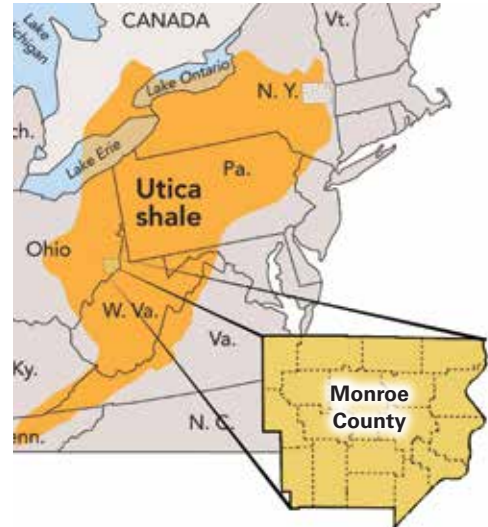
WellLock® Resin provided well integrity to withstand forty-two fracturing stages.

CHALLENGE

Prior to a fracturing operation on a well in the Utica Shale basin in Ohio, an operator conducted a pressure test and found indications of a casing leak. A casing patch was installed, but with a 5,000 psi pressure test the well continued to lose pressure at a rate of 2,000 psi in 15 minutes. The pressure continued to leak off until stabilizing just below 1,750 psi. With the inner diameter already narrowed by the casing patch, the operator wanted to avoid running a second one; a second casing patch would further narrow the inner diameter, increasing completion operations expenses by requiring the use of slim-hole plugs.

A squeeze job using cement would not further narrow the inner diameter, but the results of the injection test indicated a minimum injection rate. In this situation, cement would be prone to providing nothing more than a skin effect or simply bridging off. As a result, remediation with cement was not an option.

Halliburton recommended the WellLock® resin system. Not only is WellLock resin proven to penetrate and seal off even micron-sized leaks, it is field-proven for mill out when left behind in the casing. The operator approved use of WellLock resin, convinced by data that it would not further restrict the inner diameter of the well (enabling use of standard plugs for the completion operation) and that the low yield point of the resin would allow it to flow deep into the crack yet resist the flow dynamics of the leak.



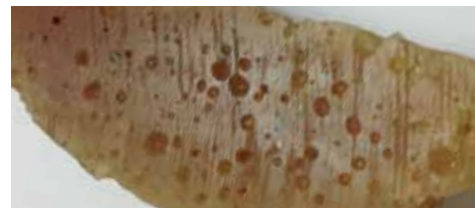
SOLUTION

The first squeeze operation was performed by placing 10 barrels (bbl) of WellLock resin opposite the suspected leak and using the bradenhead method, 2.5 bbls of resin material was squeezed into the leak. Forty-eight hours later, the WellLock resin was milled out and the well was again pressure tested to 7,000 psi. Although the results showed significant improvement and the well only lost 400 psi in 15 minutes, this well was not secure enough to withstand the aggressive completion plan nor meet regulatory requirements.

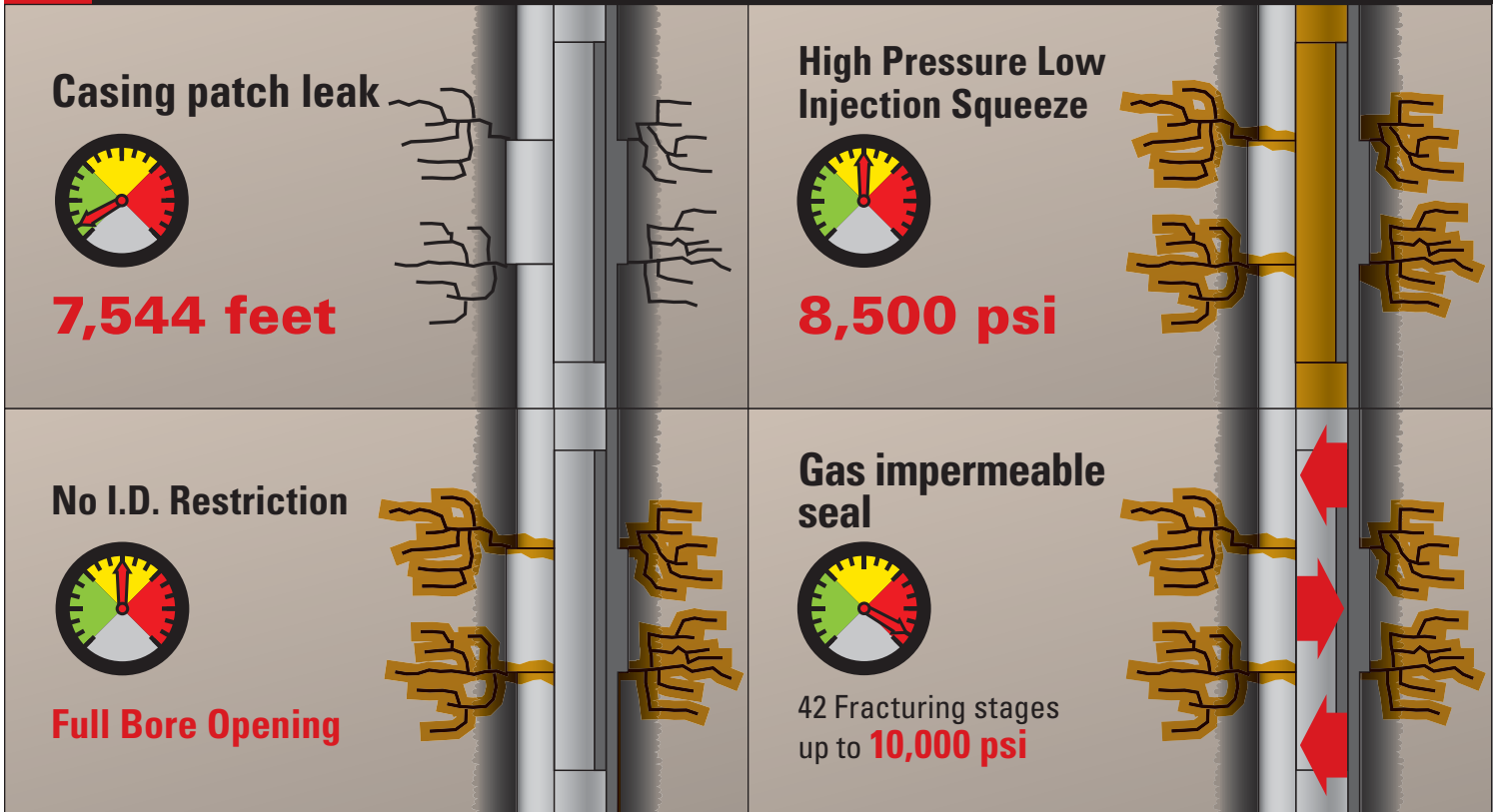
Four days later a second squeeze was initiated using WellLock resin. Using the same bradenhead method, 7 bbl of the resin was placed opposite the problem zone to squeeze 0.5 bbl into the leak, and then the operation involved an additional step: 8,500 psi was held on the well for 6 hours, allowing the resin to cure. After 48 hours, the resin inside the casing was milled out and the well was pressure tested to 9,000 psi. The pressure test was successful and the well proceeded to the completion phase.

RESULT

The customer successfully completed 42 hydraulic fracturing stages. The well retained integrity, sustaining the concussive forces of the perforating operation followed by pumping pressures of up to 10,000 psi for the fracture stimulation treatment.



Encapsulated gas bubbles were evident throughout the cured WellLock resin cutting returns. During the curing process, the resin viscosity builds, trapping gas bubbles rather than allowing channels to form.



CHALLENGE	SOLUTION	RESULTS
<ul style="list-style-type: none"> Casing leak at 7,544 feet Casing patch ineffective Cost-effective solution needed High pressure, low injection rate <ul style="list-style-type: none"> Job 1: 5,000 psi and 0.5 bbl/min 	<ul style="list-style-type: none"> Recommended WellLock® resin Performed squeeze job 1 / 2.5 bbl injected in @ 5,500 psi Performed squeeze job 2 / 0.5 bbl injected in @ 8,500 psi 	<ul style="list-style-type: none"> Leak was shut off WellLock resin provided a gas impermeable seal 42 fracturing stages up to 10,000 psi have been pumped and the well brought on to production

Benefits of WellLock Resin

- Excellent mechanical properties
- High ductility and compressive strengths up to 18,000 psi
- Can withstand 100 times more than the typical pressure differential required within the wellbore
- Can withstand impurities in the wellbore and achieve a set state with high bond strength
- Flexible in placement technique and can handle extreme wellbore conditions and geometries
- Can have very low rheological values without detrimental effects
- Compatible with brines and hydrocarbon fluid

Frac Stages:	42
Volume of Proppant:	4,861,483 lbs
Volume of Water:	268,647 bbls
Ave. Max Pressure:	9,534.8 psi
Ave. Pressure:	8,778.1 psi
Ave. Slurry Rate:	55.1 bpm

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