RiLOCK™ Resin Sealant

Liner Plug and Squeeze

Background

The well was drilled in 1958 and used to store chemicals in a cavern 2,587 ft below surface. The 13 3/8-in. production casing had incurred ovality from 1,364 to 1,386 ft and posed a possible weak point. To strengthen the wellbore, a 10 ¾-in. liner was run inside the 13 3/8-in. casing and cemented. Subsequent pressure tests using nitrogen revealed a leak in the 13 3/8 x 10 ¾-in. annulus. This forced the well, the largest storage well at the facility, to be taken offline until the leak was properly repaired. A smaller liner run inside the 10 ¾-in. liner to bypass the leak was considered a last resort option as it would severely reduce the flow rate of the well.

RiLOCK Resin Sealant Job

To keep from running a smaller liner, RiLOCK™ resin sealant was pumped to repair the leak between the 10 ¾-in. liner and the 13 3/8-in. casing. Due to the low BHT and the unique well conditions, the heat from the resin reaction needed to be kept to a minimum. The resin used was designed with an extremely long set time for it to be squeezed into place over time and to reduce the temperature of the exothermic reaction. It did not use any weighting agents as it was not necessary since the wellbore fluid was fresh water. The resin reaction temperature stayed below 150˚F and it remained pumpable through 36 hours.

The compressive strength was 3,600 psi after 7 days and 6,100 psi after 23 days. A CIBP with cement on top was placed in the 10 ¾-in. liner with TOC at 2,341 ft. The liner was cut just above the TOC. 4 bbl of RiLOCK™ resin was displaced into the well through the 2 7/8-in. workstring.

The resin was mixed and pumped successfully without any issues. After the resin was displaced to the TOC, a retrievable packer was set above the resin and then 3,000 psi of squeeze pressure was applied through the 2 7/8-in. workstring. A squeeze pressure of 3,000 psi was maintained on the resin for 72 hours to push it behind the liner through the liner cut to seal the leak. After 11 days, the top of the resin was tagged 4 ft below what was expected, which indicated some of the resin was injected behind the liner. Then the resin, cement, and bridge plug were drilled out. Pressure tests with nitrogen confirmed the leak had been repaired and the well was put back to use.

WELL INFORMATION
Prev. Casing: 13 3/8 in., 72 lb, N-80
Prev. Casing Depth: 2,417 ft
Liner: 10 ¾ in. 45.5 lb, P-110
10 ¾-in. Drillable BP: 2,351 ft
TOC on CIBP: 2,341 ft
Casing Cut: 2,339 ft
Top of Resin: 2,305 ft
Workstring: 2 7/8 in. , 8.7 lb, N-80
Retrievable Squeeze Packer: 2,225 ft
EOT: 2,285 ft
Well Fluid: 8.34 ppg Fresh Water
BHT: 100°F

RiLOCK™ Resin Sealant

Packer Leak Remediation

Background

A client was encountering problems with a leaking production packer on their well. They were experiencing communication between the tubing/casing annulus and had made several unsuccessful attempts to resolve this issue. The leaking packer was preventing the well from being put on production. There was a ¼-in. hole in the tubing at 7,506 ft (18 ft above the packer). Although not originally planned for, this hole was being used for gas-lift purposes. The annulus would not hold a full column of seawater, leaving about a 1,000-ft void in the annulus.

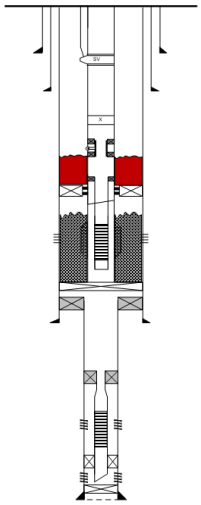
RiLOCK Resin Sealant Job

A total of 20 gal (approximately 15 ft of fill) of 16½-lb/gal RiLOCK Resin was pumped into the annulus and allowed to freefall to the top of the production packer, essentially locking the tubing in place and sealing the annulus so gas-lift production could resume. There were three issues that had to be dealt with on this job. First, there was a freefall from the tie-in point of the annulus to the seawater line in the well at about 1,000 ft. The second was approximately 6,500 ft of water in which the RiLOCK Resin would have to fall through to land on top of the packer. The third obstacle was the ¼-in. hole 18 ft above the packer in the tubing. It was absolutely critical that the RiLOCK Resin not cover the ¼-in. hole and fall into the tubing. This is the reason that only 20 gal of resin was used.

The job began with the pumping of 3 bbl of seawater into the annulus to wet the outside of the tubing and the inside of the casing over the 1,000 ft of void area. The 20 gal of RiLOCK Resin was then mixed and pumped into the annulus, immediately followed by 5 bbl of seawater. Five hours were given to allow the RiLOCK Resin to fall to the top of the packer, followed by 24 hours of waiting to allow the resin sealant to harden.

After 24 hours, a positive pressure test of 500 psi (3,480 psi experienced at the top of the RiLOCK Resin plug) was performed and passed, revealing that the RiLOCK Resin had set against the top of the packer and sealed the annulus.

Prior to the application, more than 1,100 psi of pressure at the packer seal would create leakoff. The ¼-in. hole was also deemed to be free and clear in this test.



WELL INFORMATION
Production Tubing Size: 2 7/8 in., 6½ lb/ft
Production Casing Size: 7 5/8 in., 33 lb/ft
Production Packer: 7,524 ft
Well Fluid: Seawater
Well Fluid Weight: 8.45 lb/gal
Estimated Bottomhole Temperature: 165°F
Max Angle: 37° @ 4,924 ft

RiLOCK™ Resin Sealant

Plug and Squeeze Thru Perforations

Background

During P&A operations of an offshore well, an operator had made repeated attempts to squeeze the 13 3/8 x 20-in. casing annulus with cement; however, the cement plug and squeeze operations were not successful at sealing off pressure buildup

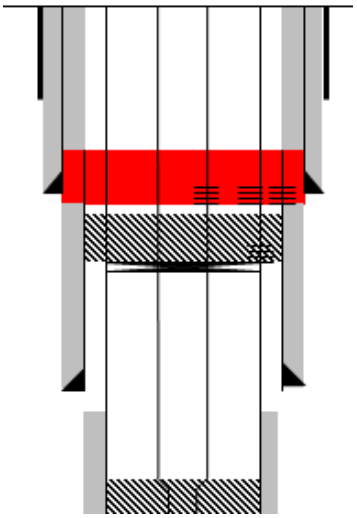
The well configuration was challenging due to multiple strings being perforated to reach the 13 3/8 x 20-in. casing annulus, which was cemented to surface. The operator selected to squeeze the annulus using RiLOCK™ resin sealant due to its solids- free formulation that allows deep penetration into the microannulus as well as its ability to create impermeable plugs within casing.

RiLOCK Resin Sealant Job

Perforations were first shot through the tubing, 9 5/8-in. casing, and 13 3/8-in. casing, allowing access to the 13 3/8 X 20-in. annulus. Circulation was then established in each annulus. Then, 8 bbl of RiLOCK™ resin sealant was systematically pumped by opening and closing the respective backside of the annulus in which RiLOCK™ was being placed. Ultimately, 6 bbl were placed in the 9 5/8 x 13 3/8-in. annulus, 1 ¾ bbl were placed in the 3 ½ x 9 5/8-in. annulus, and ¼ bbl of RiLOCK™ was left in the tubing. At that time, 1,000 psi squeeze pressure was applied and monitored for leakoff.

After 4 hours, the well was shut in and the RiLOCK™ resin sealant was allowed to cure for 44 hours. After a total of 48 hours, the RiLOCK™ resin sealant had hardened and effectively sealed the 13 3/8 x 20-in. annulus, allowing the operator to continue with P&A operations.

No bubbling was observed in the annulus and a positive pressure test was achieved, indicating a successful job.



WELL INFORMATION
Casing: 20 in., 94 lb, K-55
Casing: 13 3/8 in., 68 lb, N-80
Casing: 9 5/8 in., 53.5 lb, P-110
Tubing Size: 3 1/2 in. OD, 10.2
Top of Cement Plug: 1,850 ft. MD
Perforations: 1,845 ft MD
Max Deviation: 43" @ 13,644 ft MD
Well Fluid: 8.6 ppg Seawater
BHT: 100°F

RiLOCK™ Resin Sealant

Resin Annular Plug Placed with Coiled Tubing

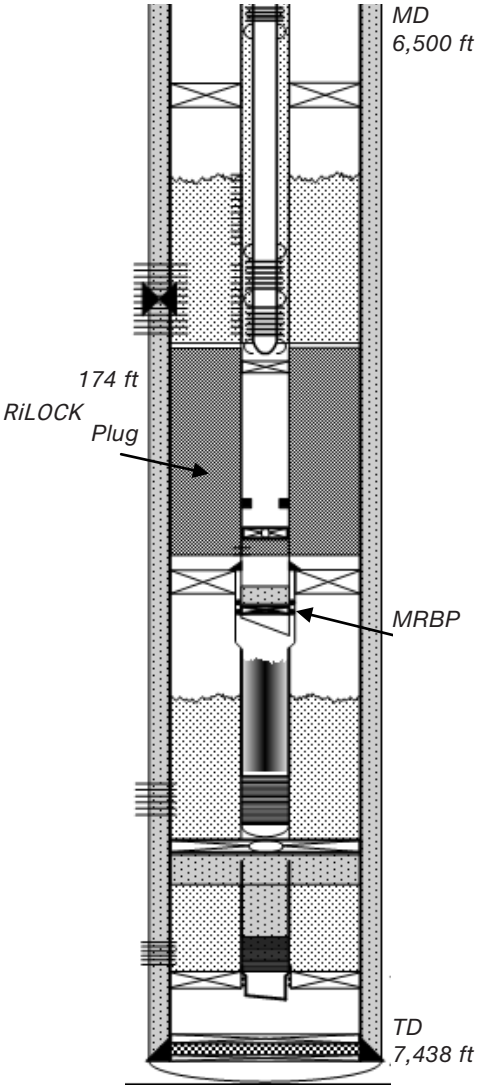
Background

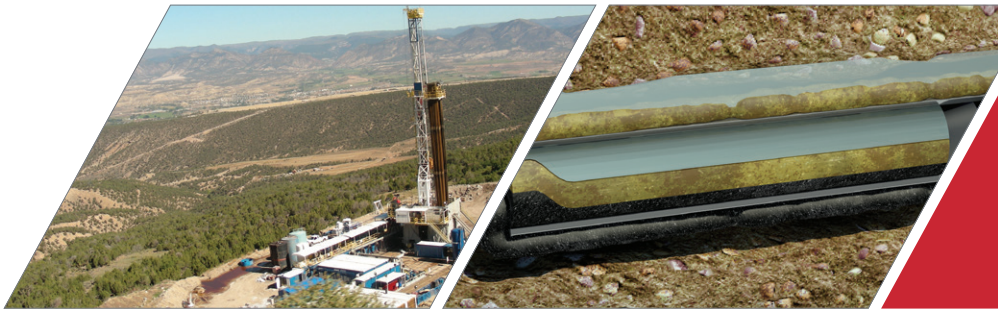
A major operator in the Gulf of Mexico requested assistance with a re-complete of one of their wells. The operator needed to create a base for the thru-tubing gravel pack operation while simultaneously creating a seal from damaged casing. The location of the new production zone and existing VTA packer limited the plug length to 175 ft. RiLOCK™ resin sealant was pumped due to its exceptional mechanical, chemical, and rheological properties as well as its ability to create a good seal in casing with minimal volume.

RiLOCK Resin Sealant Job

The operator temporarily abandoned the bottom production zone by placing a bridge plug in the tubing at 6,870 ft MD and dump bailing 8 ft of cement on top. They then punched tubing at 6,829 ft MD and set a retainer at 6,824 ft MD. At that point, 1¼-in. coiled tubing was run in hole and stung into the retainer. Five bbl of RiLOCK resin sealant was pumped at a rate of ¼ to ½ bpm through the coiled tubing, placing 174 ft of resin in the 7 x 2⁷/₈-in. casing annulus. The coiled tubing was then unstung from the retainer, circulated, and pulled out of hole. At that time, the well was locked in with 500 psi of pressure and monitored for leakoff.

WELL INFORMATION
Casing Size: 7 in., 29 lb, N-80
Production Tubing: 2⁷/₈ in., 6.5 lb, N-80
Baker “PHL” Packer: 6,611 ft MD/5,917 ft TVD
Bad Casing: 6,632 – 6,654 ft MD
Circulation Perfs (5 ft): 6,615 ft MD
Proposed Prod Perfs: 6,630 – 6,650 ft MD/5,933 – 5,951 ft TVD
Coiled Tubing: 1 ¼ in. OD
CT Retainer: 6,824 ft MD
“X” Nipple (2.313 in. ID): 6,791 ft MD
Injection Perfs (2 ft): 6,829 ft MD
VTA Packer: 6,842 ft MD/6,117 ft TVD
Well Fluid: 8.6 ppg KCl
BHT: 150°F





RiLOCK™ Resin Sealant

Section Mill Plug and Squeeze

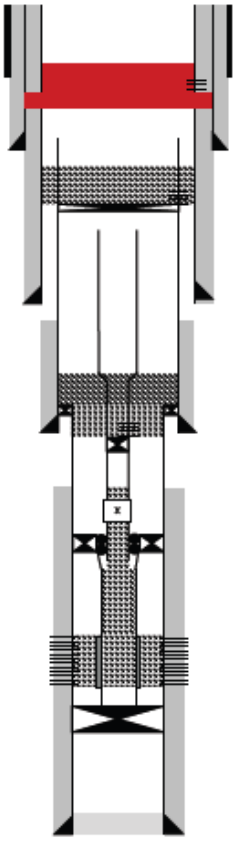
Background

During P&A operations of an offshore well, an operator had made repeated attempts to seal the 10 ¾ x 16-in. casing annulus; however, the use of conventional cement was not possible due to the inability to establish injection. After multiple attempts, the operator selected to remediate using RiLOCK™ resin sealant due to its solids-free formulation that allows deep penetration into the microannulus and microfractures.

RiLOCK Resin Sealant Job

A 5-ft window was milled below the existing perforations through the 10 ¾-in. and out to the 16-in. casing to expose the microannuli and fractures in the cement column. Then, a cast-iron bridge plug was placed 2 ft below the milled window and 5 bbl of 9 ppg unweighted RiLOCK resin sealant was pumped into place using drillpipe at a rate of 1 bpm. Once the RiLOCK was placed, the drillpipe was pulled up 4 joints, circulated clean, and pulled out of hole. At that time, 1,000 psi squeeze pressure was applied and monitored for leakoff. After 6 hours, the well was shut in and the RiLOCK resin sealant was allowed to cure for 42 hours. After a total of 48 hours, the RiLOCK resin sealant had hardened and effectively sealed the microannuli and microfractures, allowing the operator to continue with P&A operations. No bubbling was observed in the annulus and a positive pressure test was achieved, indicating a successful job.

WELL INFORMATION
Intermediate Casing Size #1: 16 in., 84 lb, K-55
Intermediate Casing Size #2: 10¾ in., 40.5 lb, K-55
Drill Pipe: 3½ in., 13.3 lb
Bridge Plug: 649 ft MD
Section Mill: 647–642 ft MD
Injection Perfs (10 ft): 640–630 ft MD
Max Deviation: 28.23°@ 7,164 ft MD
Well Fluid: 8.6 ppg Seawater
BHT: 70°F



Simplified Schematic Showing a RiLOCK plug and squeeze