WellLock® Resin System

Paul Jones, PhD

Principal Scientist

WellLock® Resin System

- Resilient polymer network resists gas channeling
- High compressive strength
- Continually transmits hydrostatic pressure
- High pressure seal
- Chemically resistant
- Compatible with water
- Complements cement

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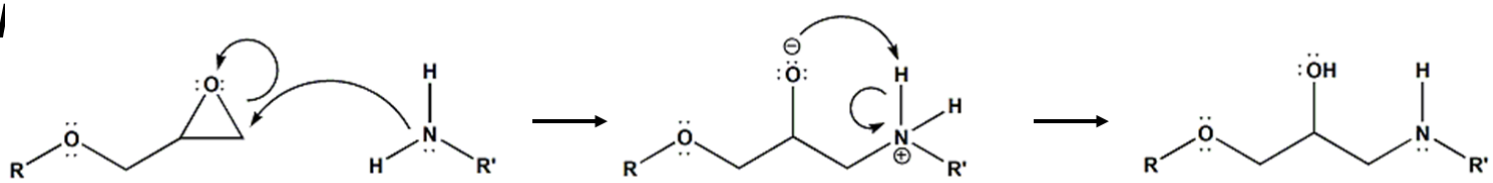
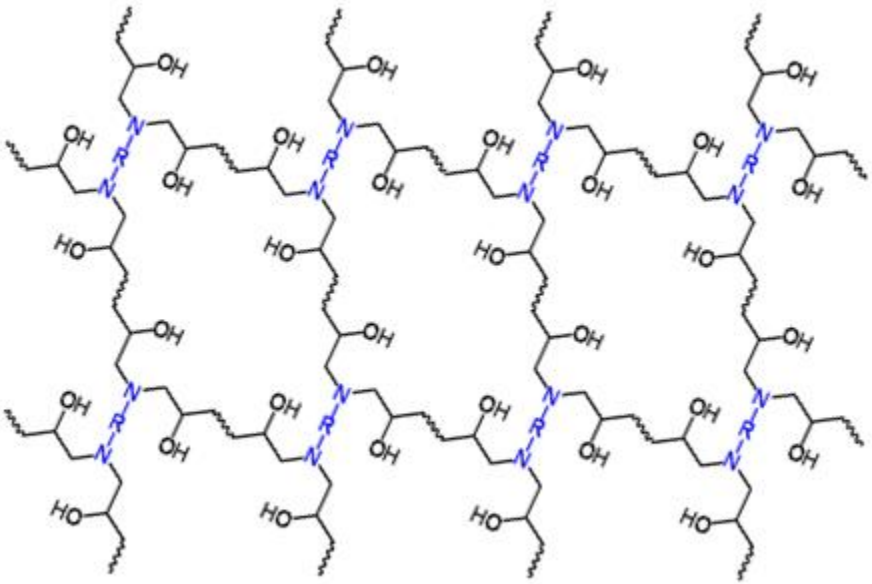
WellLock® Resin System – Chemistry

A cross-linking reaction between a polyfunctional amine hardening agent and difunctional epoxides, resulting in a cu





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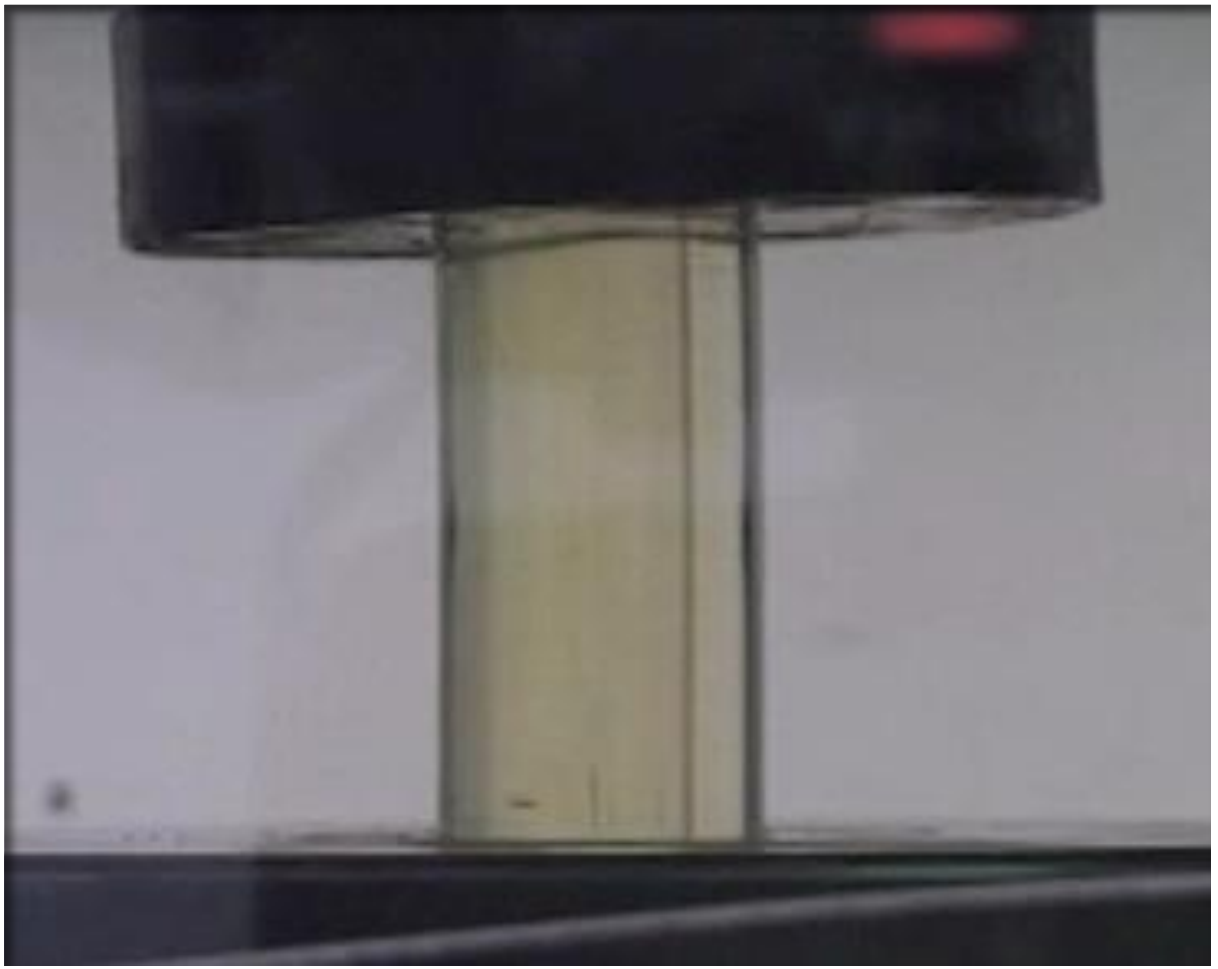
WellLock® Resin System – Elasticity



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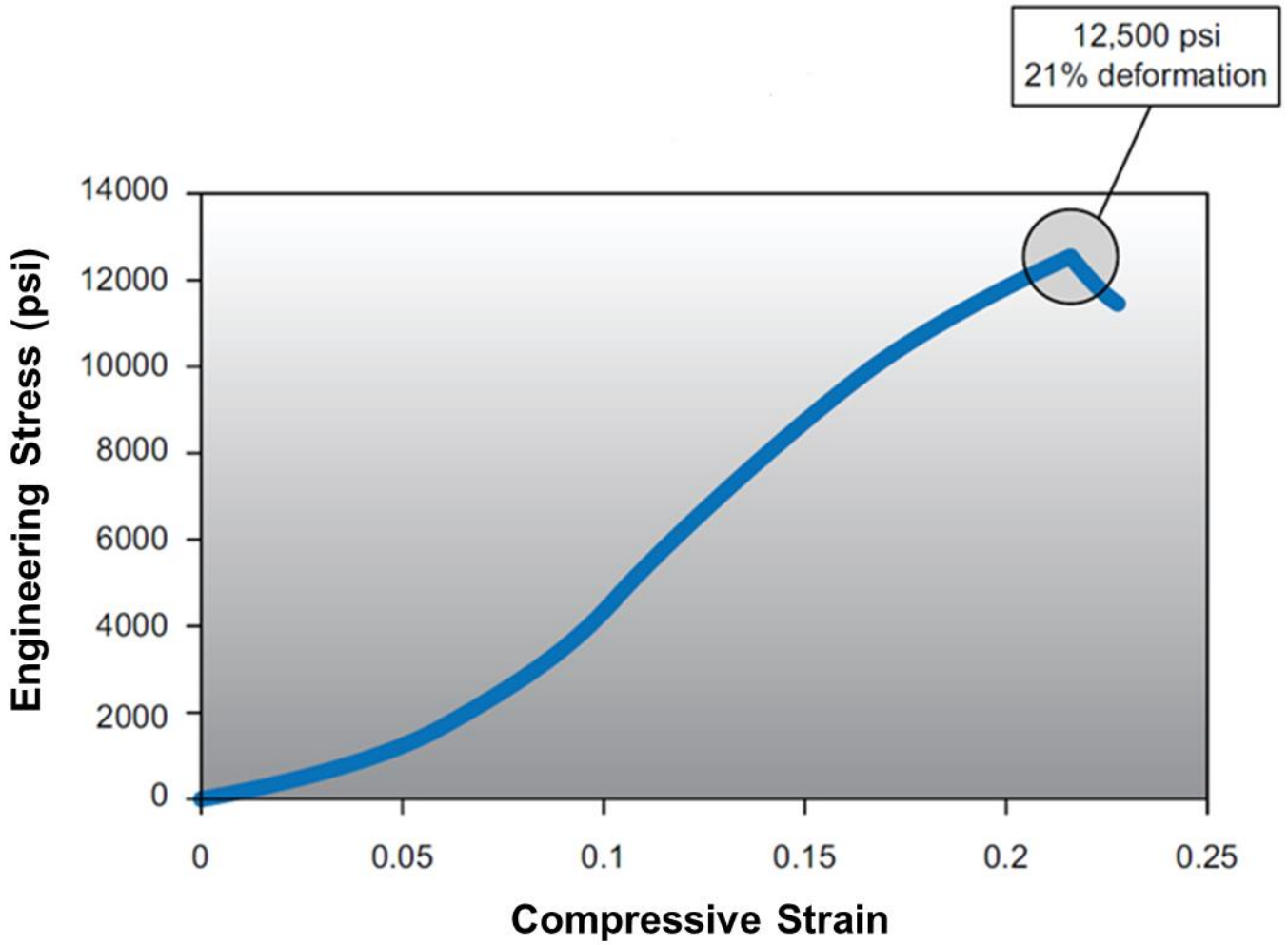
WellLock® Resin System – Compressive Strength



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WellLock® Resin System – High Penetration Fluid

Attributes

- Solids-free
- Newtonian rheology
- Penetrates micron-sized spaces

Opportunities

- Tight casing leaks
- Gravel packs
- Annular gas remediation

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WellLock® Resin System

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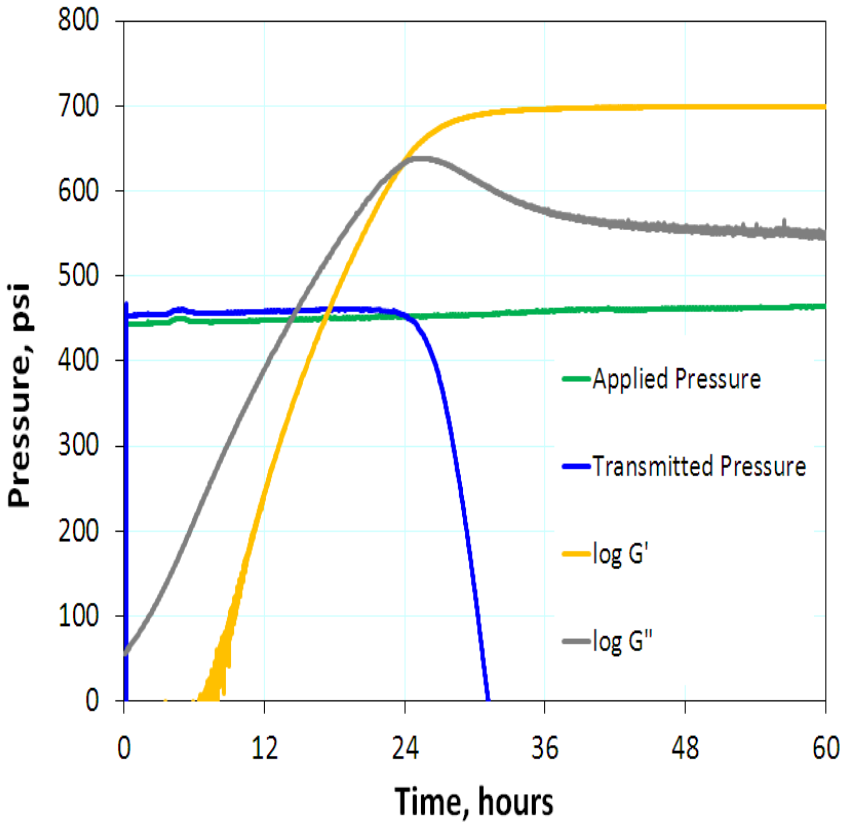
WellLock® Resin System – Pressure Transmission



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Why haven't we been using these materials?

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WellLock® Resin System – Fluid Compatibility

Water

WellLock Resin

Conventional Resin Blended with Water

WellLock Resin Blended with Water

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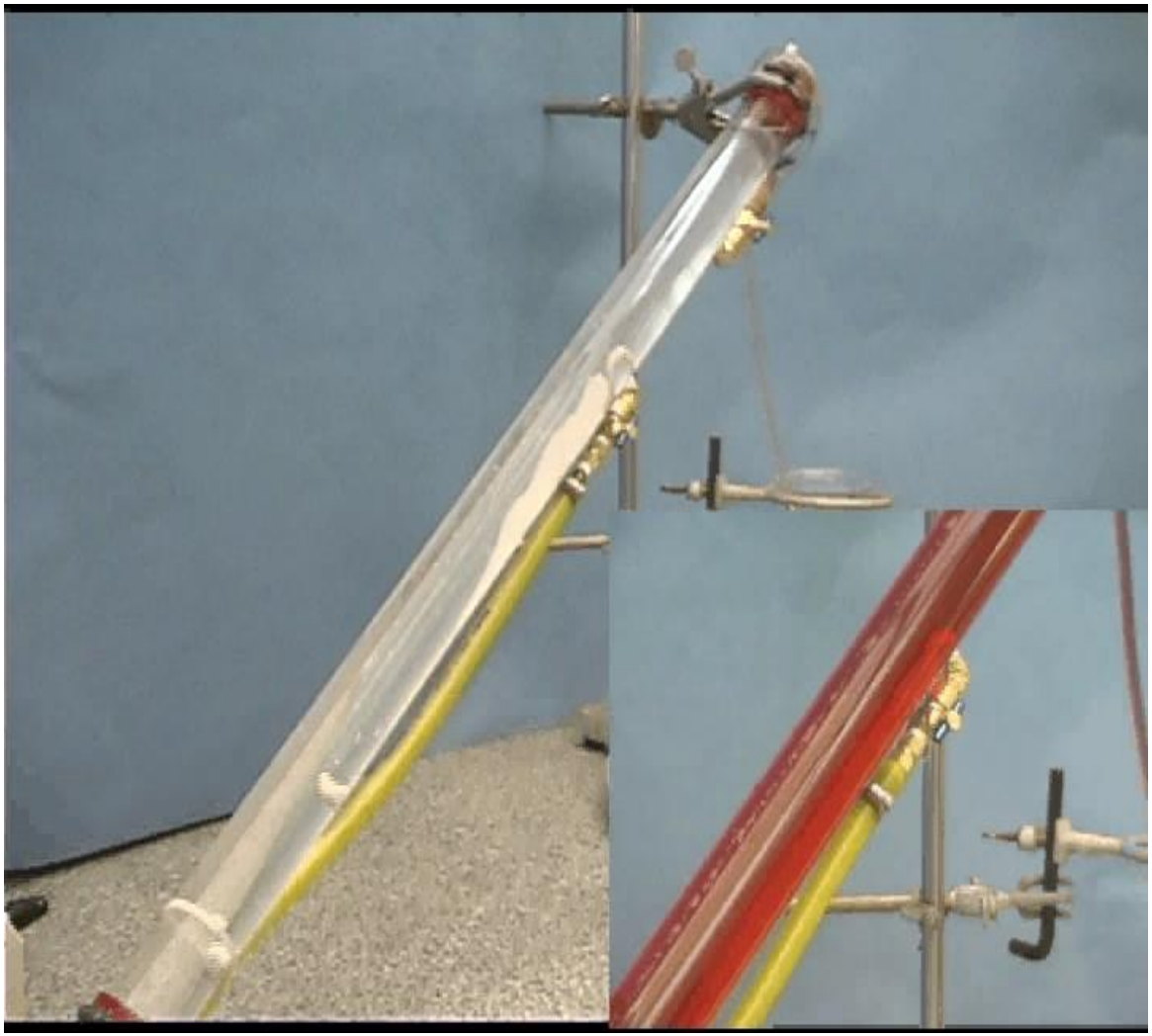
WellLock® Resin System – Fluid Compatibility



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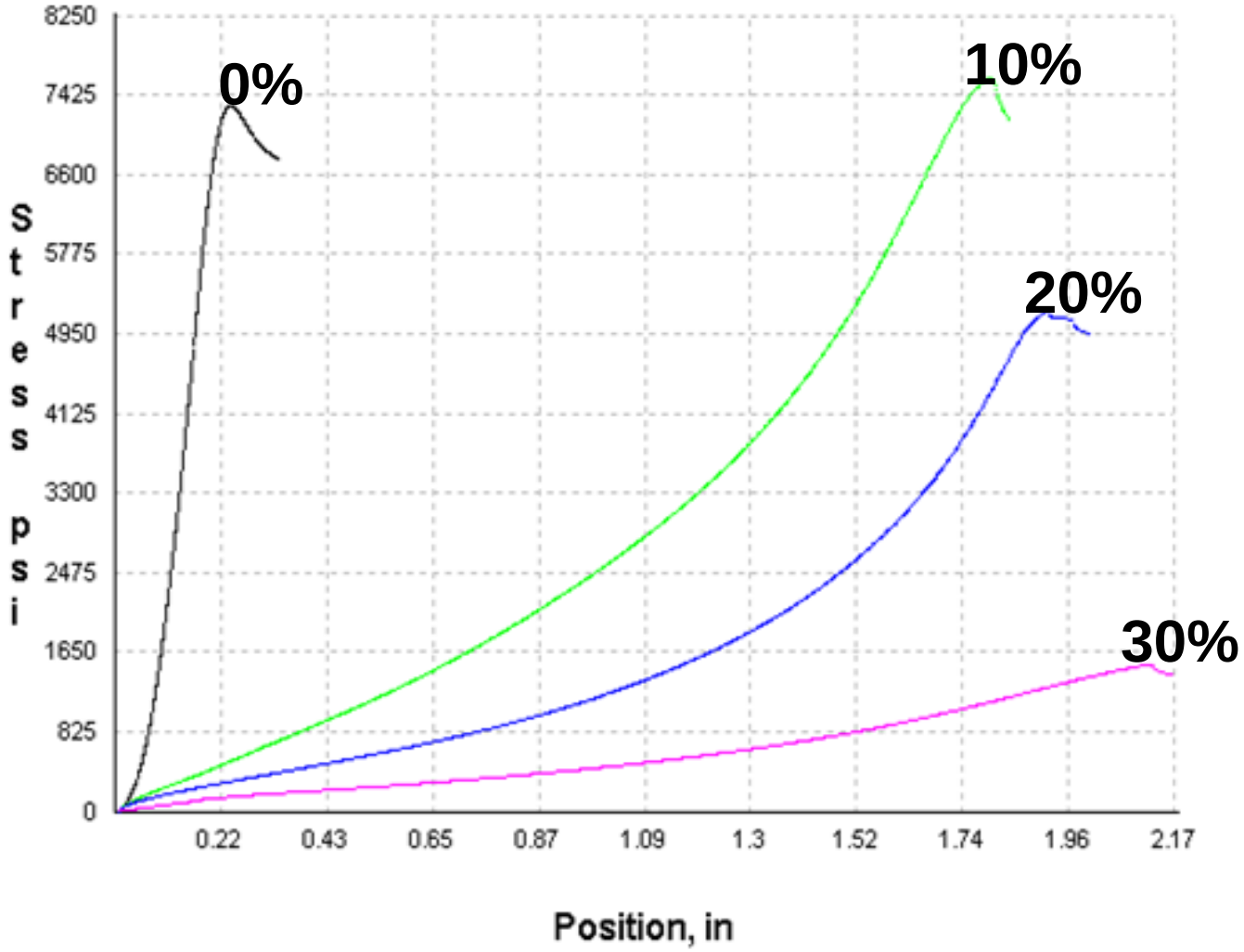
WellLock® Resin System – Fluid Compatibility



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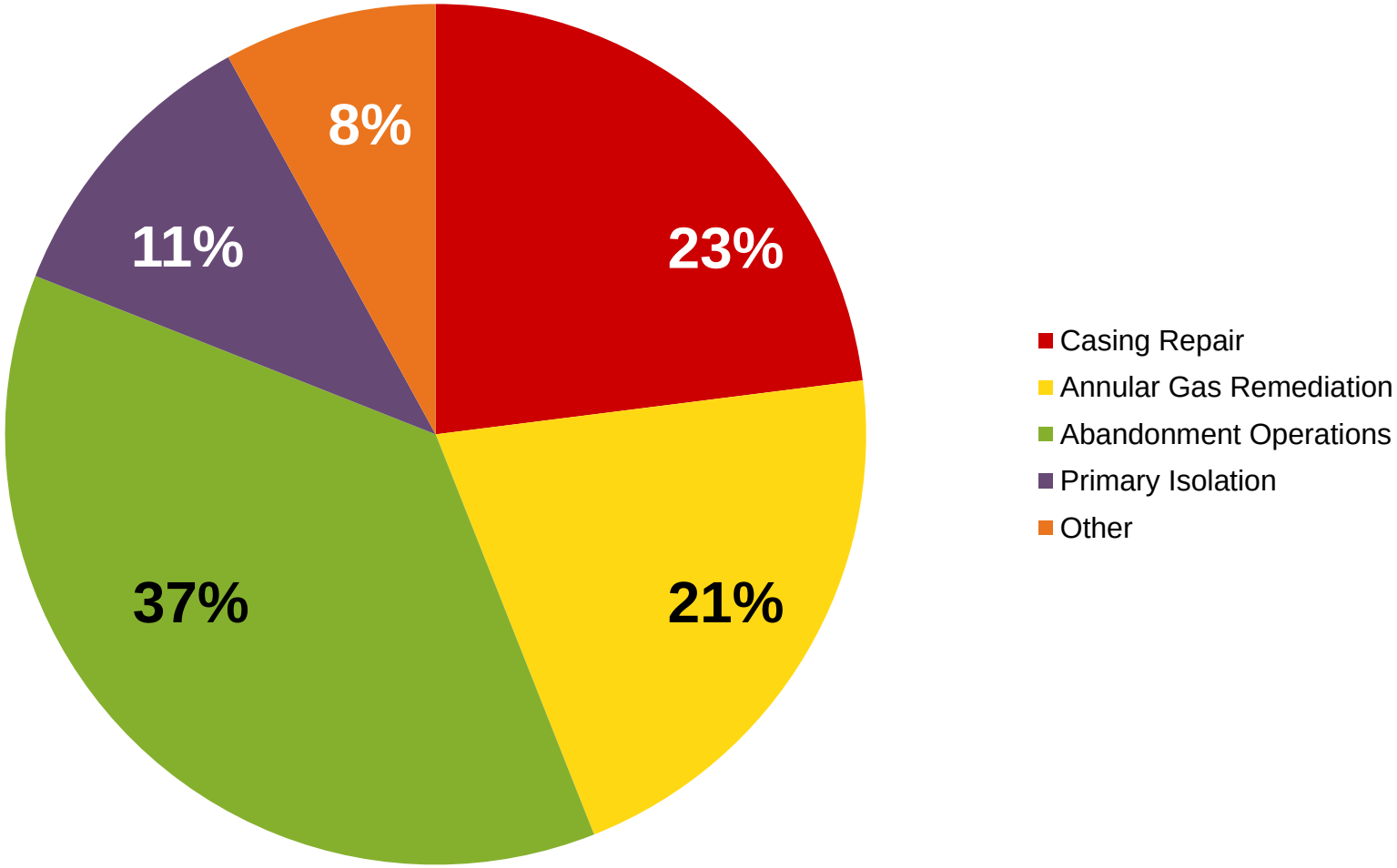
WellLock® Resin System – 100 Case Histories



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Case Study 1 – Offshore Abandonment

CHALLENGE

- Gas bubbles rising to surface
- Multiple conventional abandonment attempts failed
- Rig costs accruing daily

SOLUTION

RESULTS

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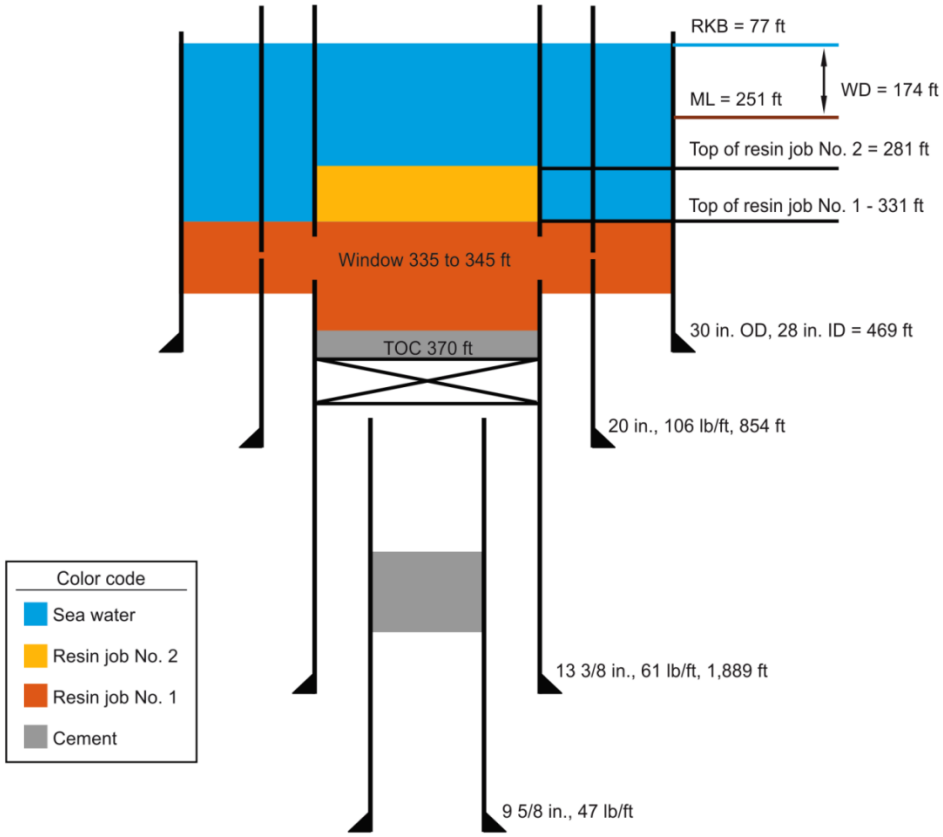
Case Study 1 – Offshore Abandonment



CHALLENGE

- Gas bubbles rising to surface
- Multiple conventional abandonment attempts failed
- Rig costs accruing daily

SOLUTION

- WellLock resin
- 10 bbl squeeze application
- 50 ft resin plug set inside 13-3/8” casing

RESULTS

- Leak successfully sealed
- Plug operation allowed casing to be cut
- Rig moved to next well

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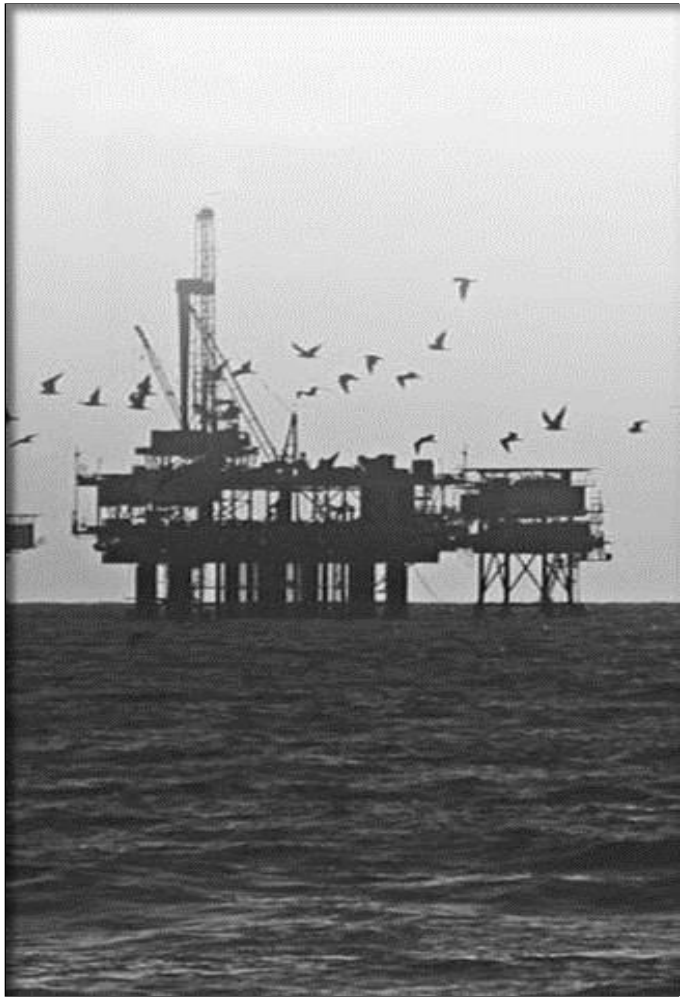
Case Study 2 – Offshore Abandonment



CHALLENGE

- 23 abandoned bubbling wells in Gulf of Mexico require re-entry for repair
- Limited treatment volume (1-3 bbls) available in 26” drive pipe with well cap
- Sealant must prevent any gas channeling and achieve strong bond
- Riserless operations to be conducted

SOLUTION

- LockCem™ - composite cement containing WellLock resin
- Increased bonding to casing
- Reduced permeability of set cement
- Increased resistance to gas channeling

RESULTS

- Successful mixing of small batches and placement through grout string
- Elimination of bubbling in all wells
- Avoided costly milling operations and large amount of rig time

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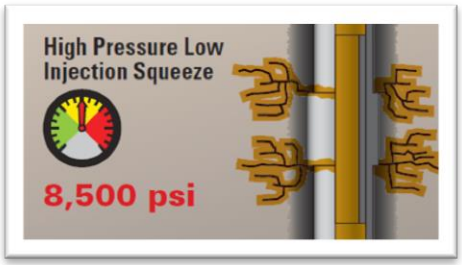
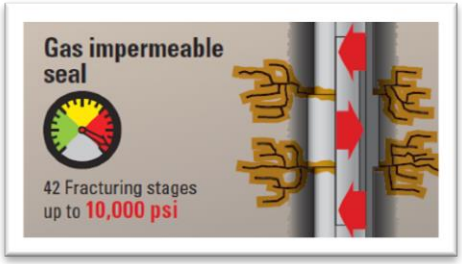
Case Study – Casing Leak Prior to Hydraulic Fracturing





CHALLENGE

- Previous casing patch leaking – 5000 psi pressure test shows 2000 psi leak off in 15 min
- Second casing patch highly restrictive
- Low chance of success with cement squeeze due to low injection

SOLUTION

- Bradenhead squeeze with WellLock resin
- Squeeze job 1 – 2.5 bbl injected at 5500 psi
- Squeeze job 2 – 0.5 bbl injected at 8500 psi (pressure held on well after placement 8500 psi for 6 hours)

RESULTS

- Pressure tested to 9000 psi
- Remediation withstood 42 hydraulic fracturing stages with pressures up to 10,000 psi

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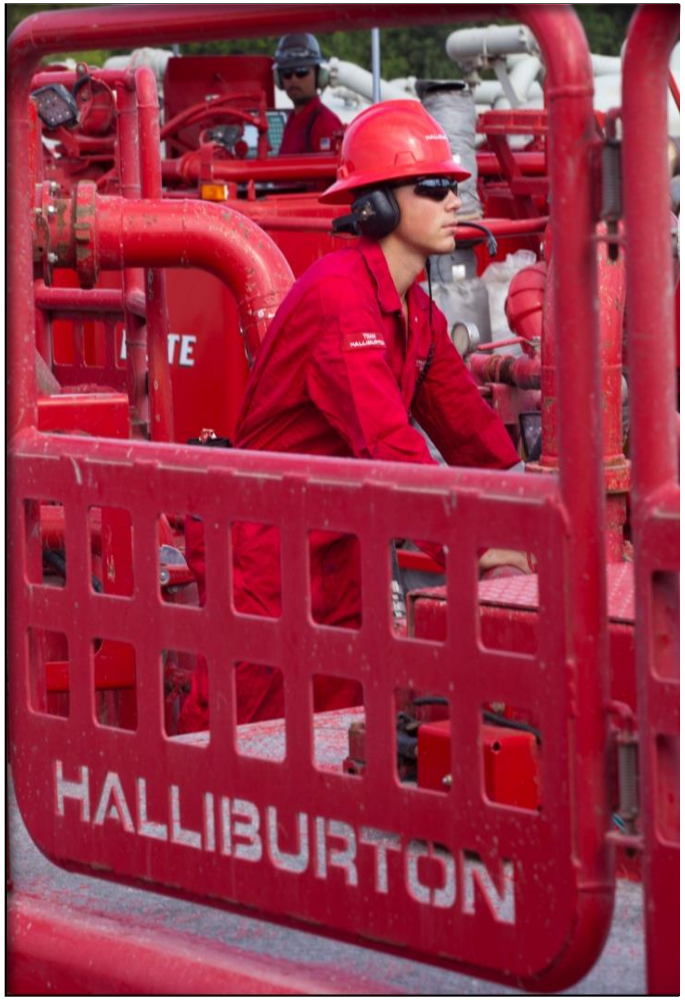
Case Study – Annular Gas Remediation



CHALLENGE

- Sustained casing pressure in the Marcellus Shale on intermediate casing during well construction
- Gas flowing to surface
- Drilling suspended

SOLUTION

- Perforation of interval containing gas source
- Isolation of perforations using bridge plug and retainer
- Squeeze through retainer using solids free WellLock resin
- Fluid train: water → resin → cement

RESULTS

- Annular gas flow dropped throughout operations
- Zero gas flow detected after 60 hours

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Technical Paper Listing

- J.A. Urdaneta, J.M. Arroyave, and P. Jones, Halliburton; J.L. Amaya, A. Coral, and H. Hernandez, Gran Tierra Energy Colombia 2014. **Novel Gas Shutoff Resin System for Well Abandonment Applications in Colombia: A Case History** Paper SPE 169400 presented at the SPE Latin American and Caribbean Petroleum Engineering Conference held in Maracaibo, Venezuela, 21–23 May.

- Jones, P. J., Karcher, J., Ruch, A., Beamer, A., Smit, P., Hines, Halliburton; S., Olson, M., Day, D., Marathon Oil Company 2014. **Rigless Operation to Restore Wellbore Integrity using Synthetic-based Resin Sealants.** Paper SPE 167759 presented at the SPE/EAGE European Unconventional Conference and Exhibition, Vienna, Austria, 25-27 February. http://dx.doi:10.2118/167759-MS

- Jones, P.J., London, B.A., Tennison, L.B., and Karcher, J.D. 2013. **Unconventional Remediation in the Utica Share Using Advanced Resin Technologies.** Paper SPE 165699 presented at the SPE Eastern Regional Meeting, Pittsburgh, Pennsylvania, USA, 20–21 August. http://dx.doi.org/10.2118/165699-MS.

- Jones, P.J., Karcher, J.D., Bolado, D. 2013. **Offshore Plug and Abandonment using Synthetic Resin Technology.** Presented at the RAO/CIS Offshore Conference 2013, St. Petersburg, Russia, 11-13 September.

- Morris, K.A., Deville, J.P., and Jones, P.J. 2012**. Resin-Based Cement Alternatives for Deepwater Well Construction.** Paper SPE 155613 presented at the SPE Deepwater Drilling and Completions Conference, Galveston, Texas, USA, 20–21 June. http://dx.doi.org/10.2118/155613-MS.

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