A New Approach to Sealing Unwanted Casing/liner Perfs, Breaches and Leaks

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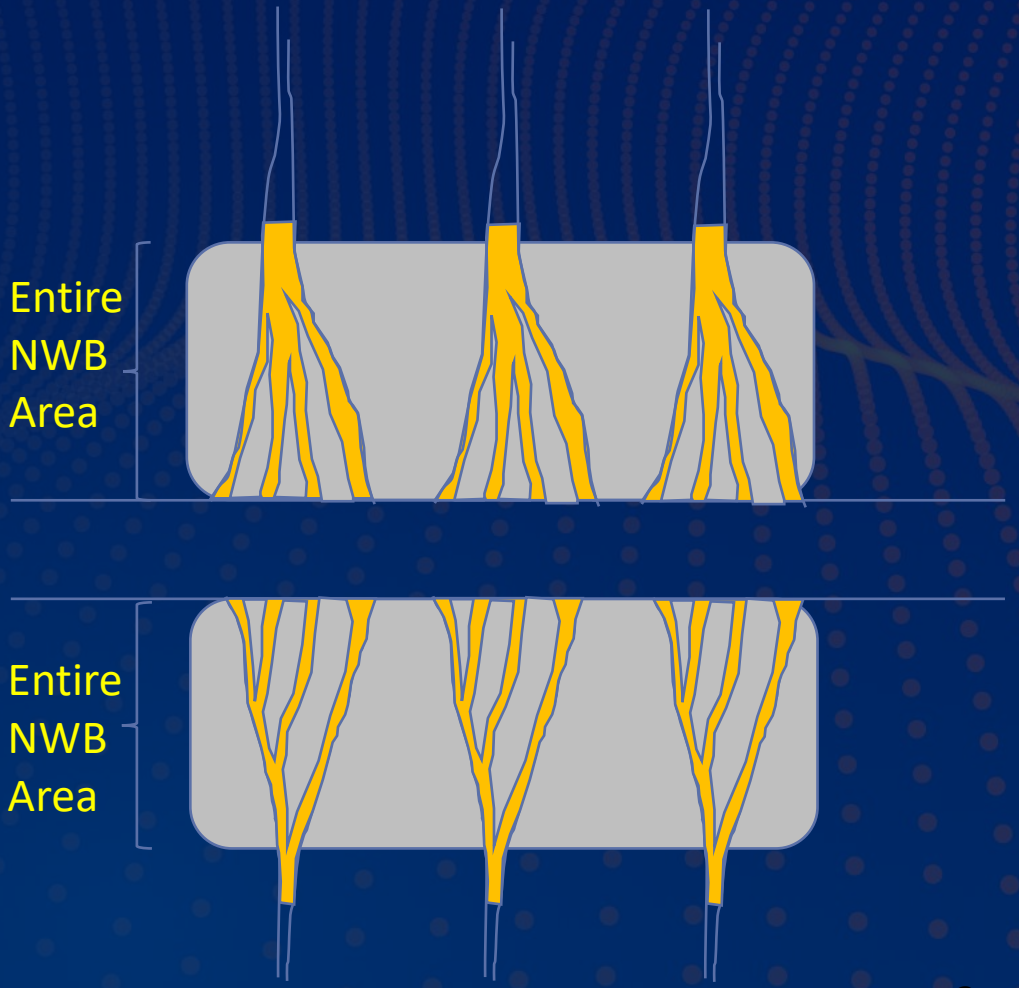
SPE Denver - May Study Group Meeting

Outline

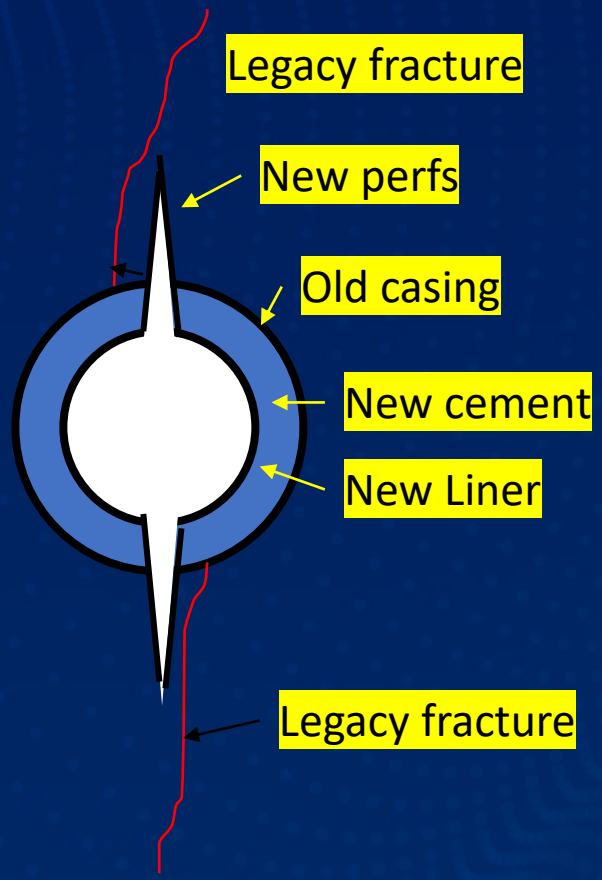
- Introduction to a new sealant material
- Applications
  - Prep for Refracs
  - Fix casing leaks
  - Block old or unwanted perfs
  - Loss circulation control
  - Conformance
- Properties of the Sealant
- Proof of Concept Case Study
- Advantages of the Sealant

What is it? *(Patented)*

- A strong crosslinked gel used to block old fractures and perfs
- Liquid on surface, sets to a solid at downhole temperatures
- Can penetrate into complex fractures near wellbore area.
- Resistant to formation water and acid

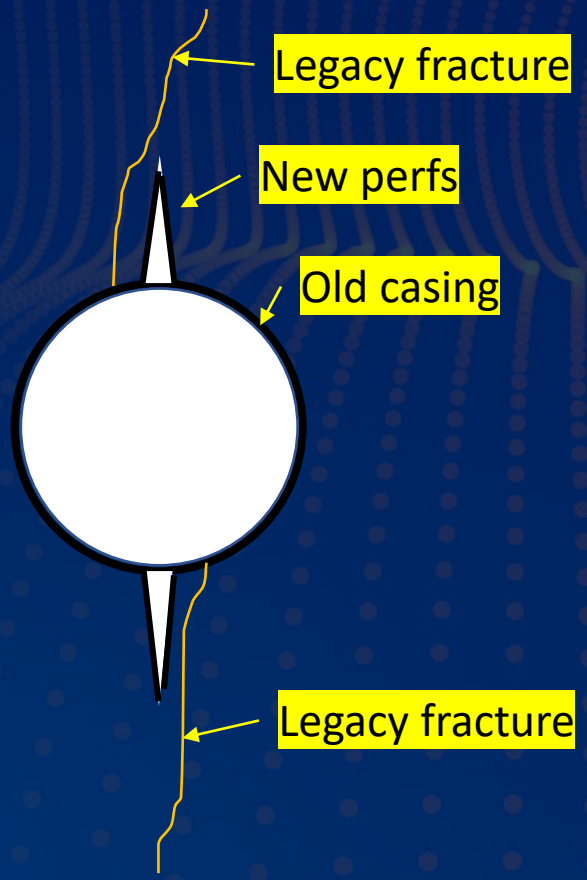


Compared to Liner Method

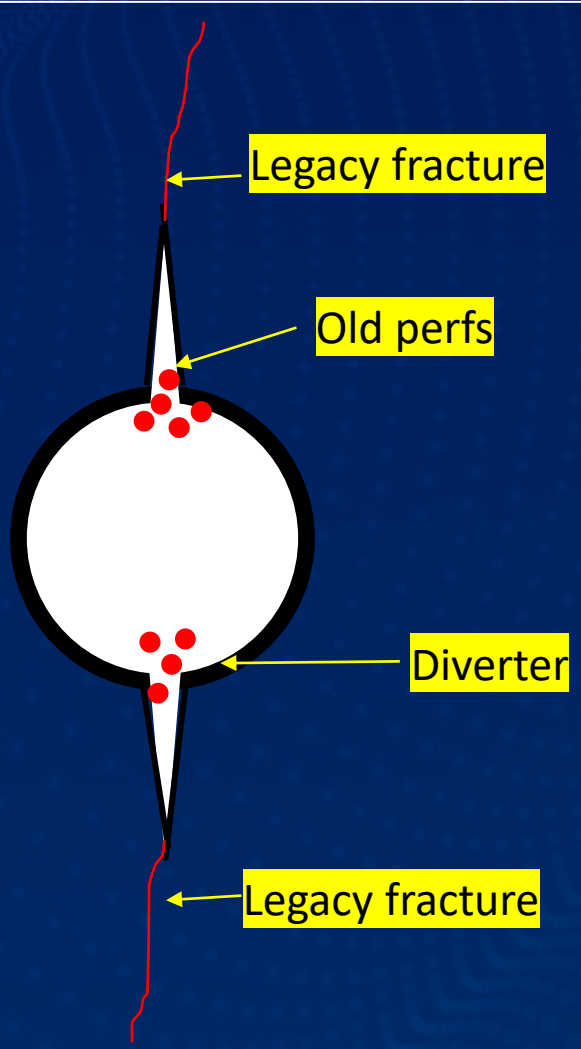


Challenges of liner method:

- New perfs need to penetrate through 2 layers of casing and 2 cement sheathes
- Due to channeling, zone isolation can be difficult when cementing between casing and liner
- Could still frac into legacy fractures by communicating wellbore pathways

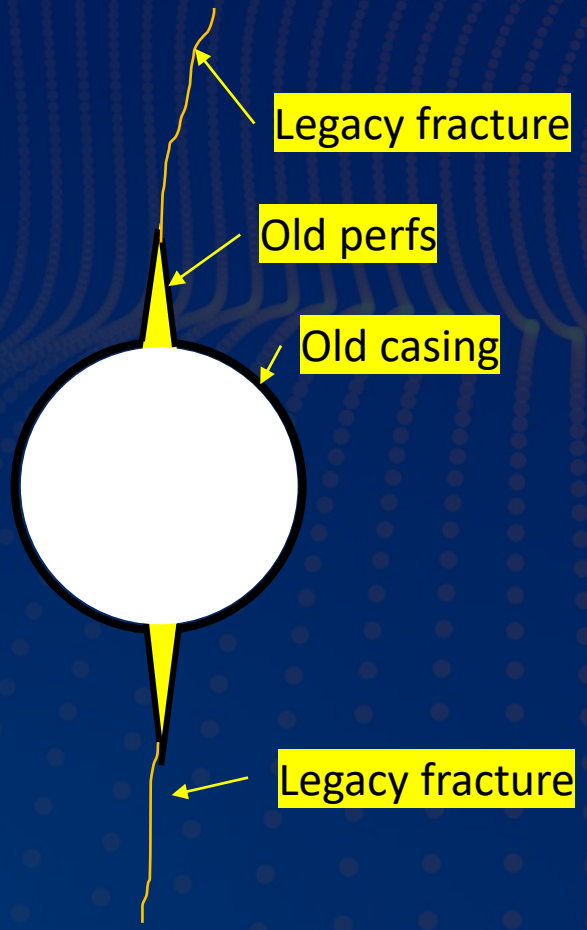


Compared to Dynamic Diverter

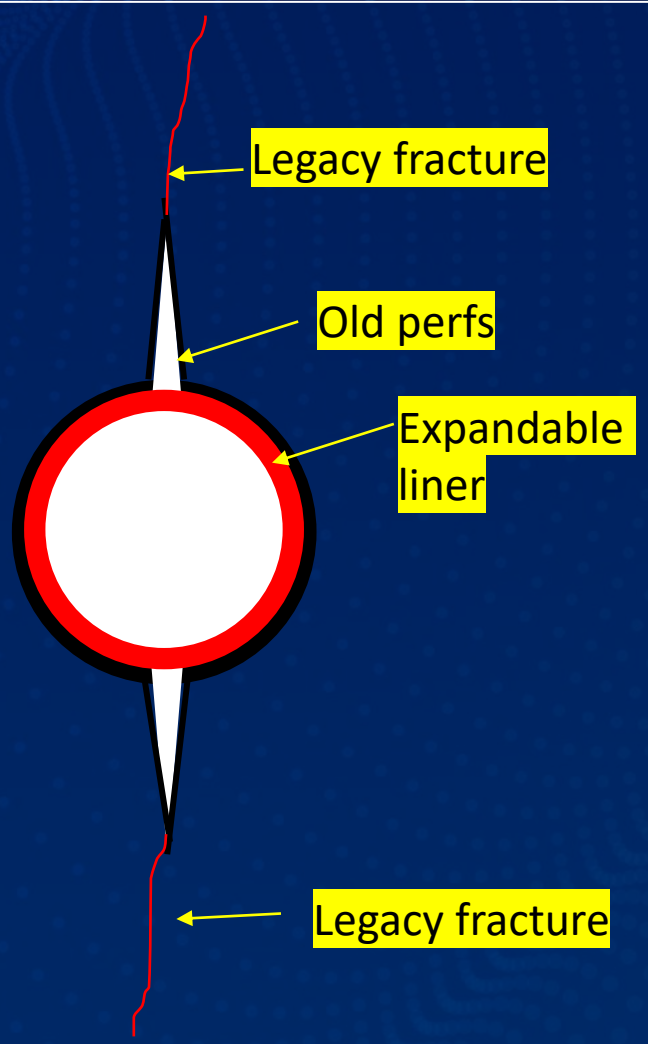


Challenges of Dynamic Diverter:

- Solid materials only block entrance of perforation
- Hard to determine the exact amount of diverter needed for diversion
- Precise execution is critical to success
- Lowest cost

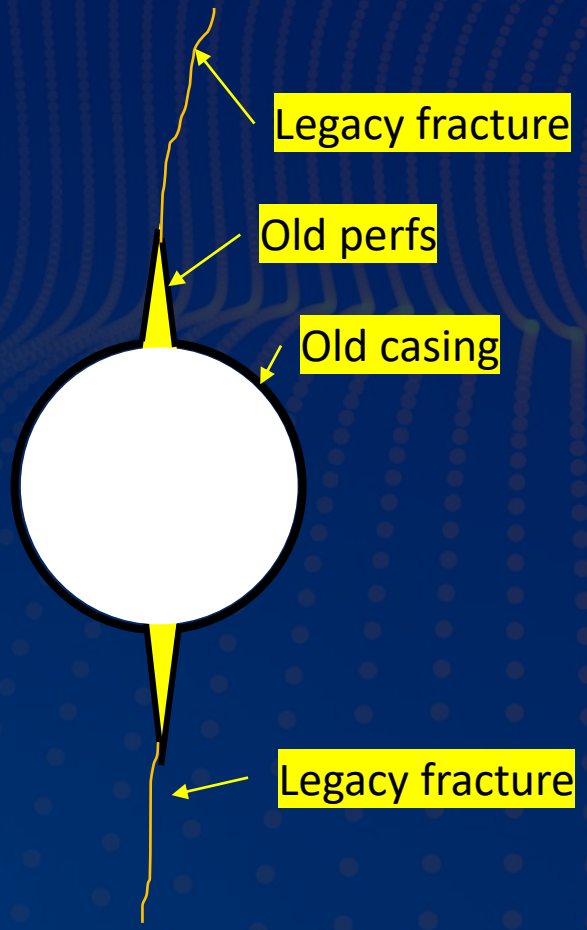


Compared to Expandable Liner



Challenges of expandable liner:

- Expandable liner only blocks entrance of perforation/leak
- Communication from nearby multiple fractures, cement channeling still exists



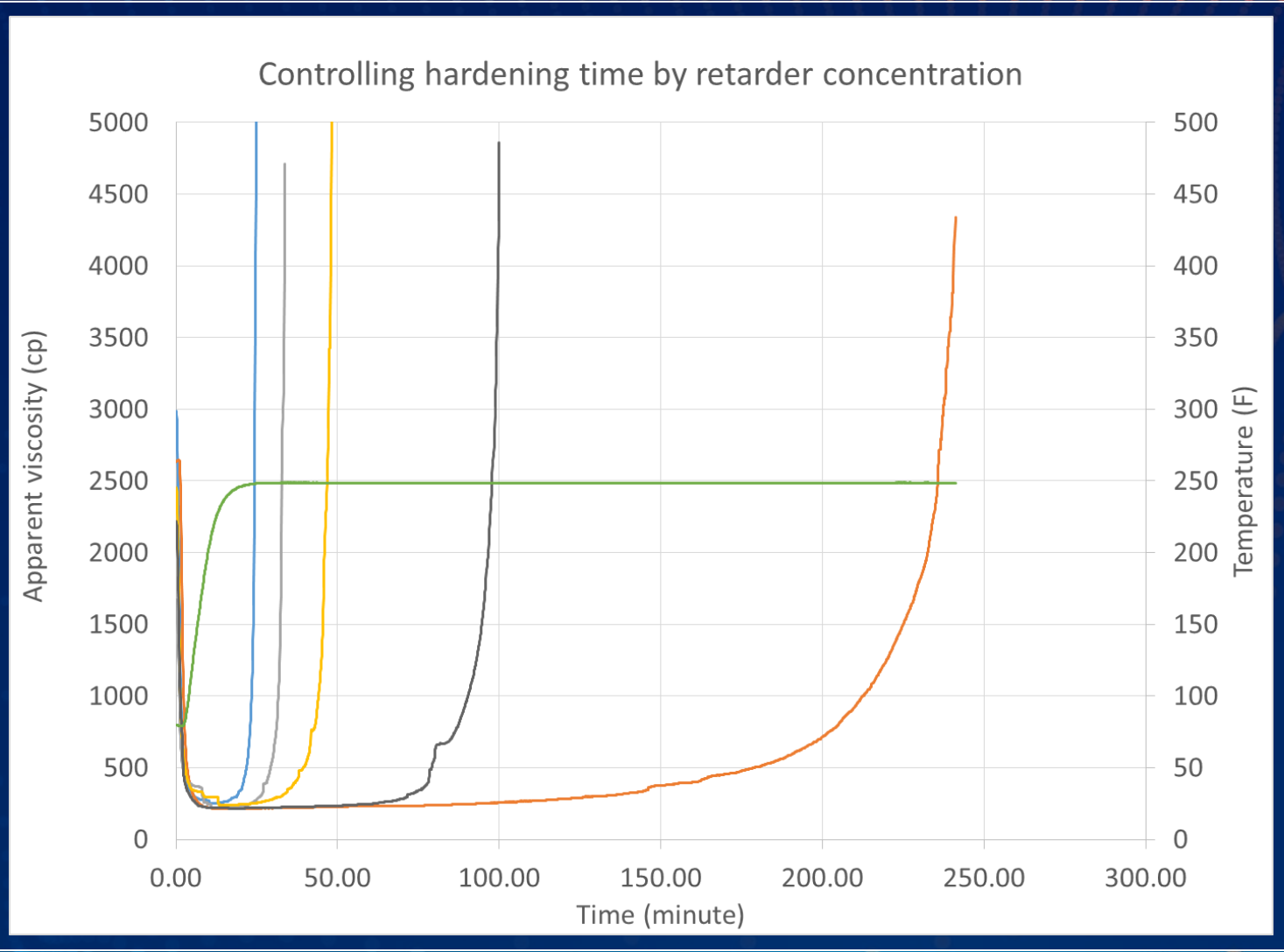
Synergy with other Refrac Methods

- Combine with refrac liner methods
  - Run sealant first before well clean out. Stabilize wellbore
  - Decreases risk during clean out and liner placement
  - Minimize fluid loss in cementing the liner
- Combine with diverter methods
  - Run sealant material before refrac in well preparation stage
  - Increase the chance of creating new fractures with diverters
  - Small incremental cost
- Enhances other refrac methods

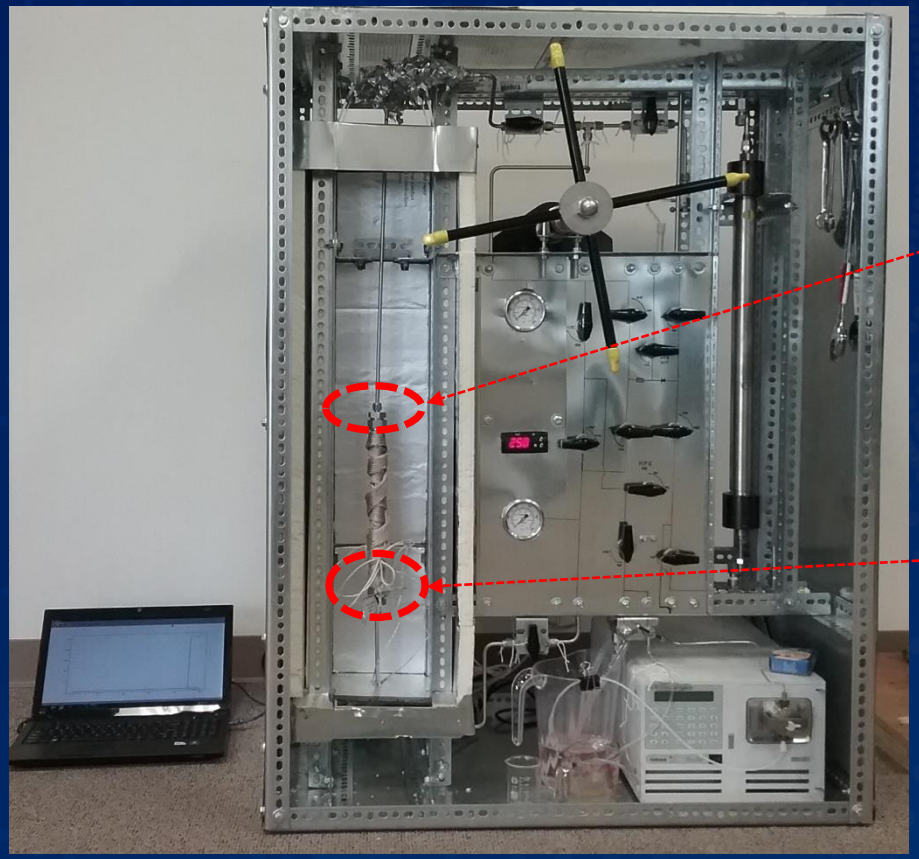
Fixing Casing Leaks/Breaches

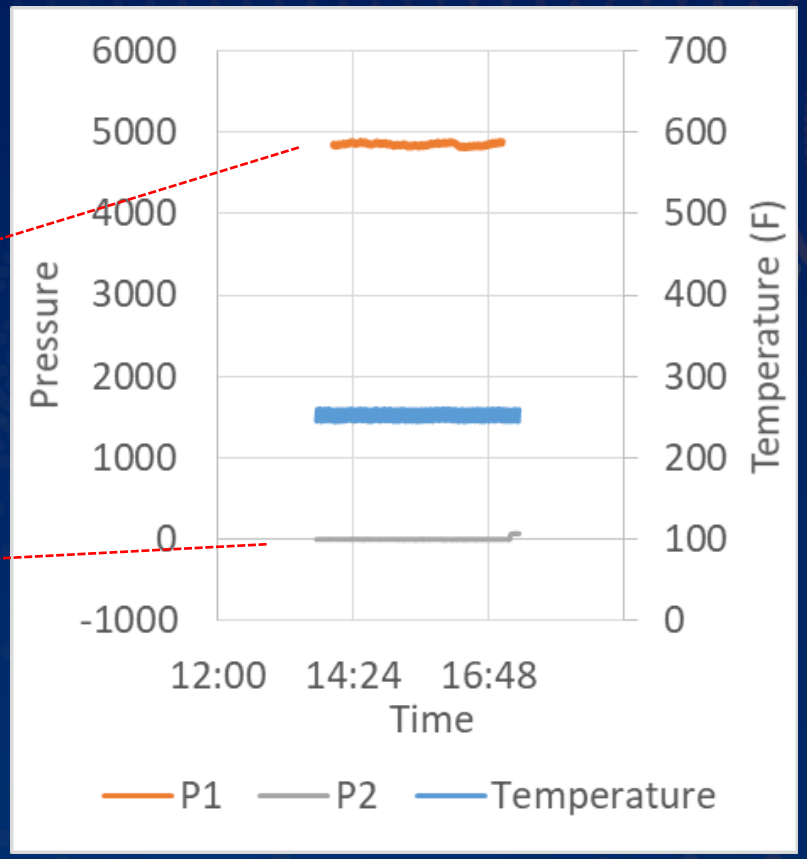
- Sustains high differential pressure
- Easy to apply
  - Squeeze into the leak, then clean out residue
  - Reasonable set-up time
  - Drills out easily
- Holds multiple pressure cycles
  - Elastic material, not brittle like cement
- Low operational risk
- User friendly

Controllable Crosslink Time

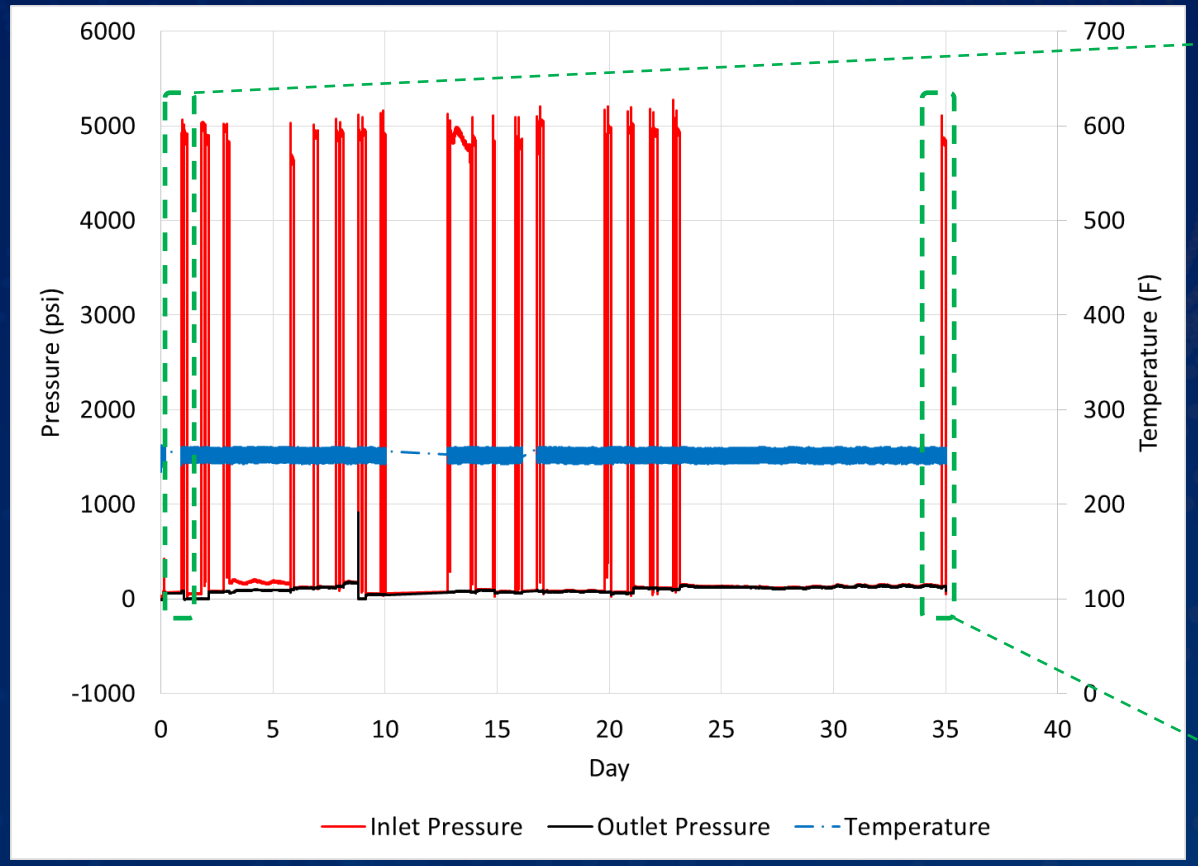


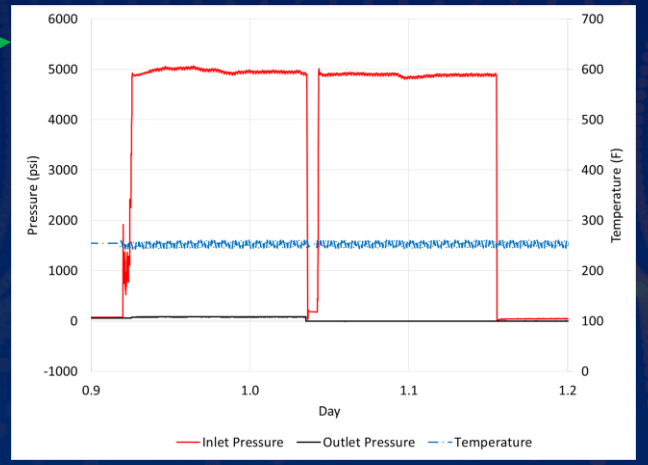
Sustains Differential Pressure at Well Conditions

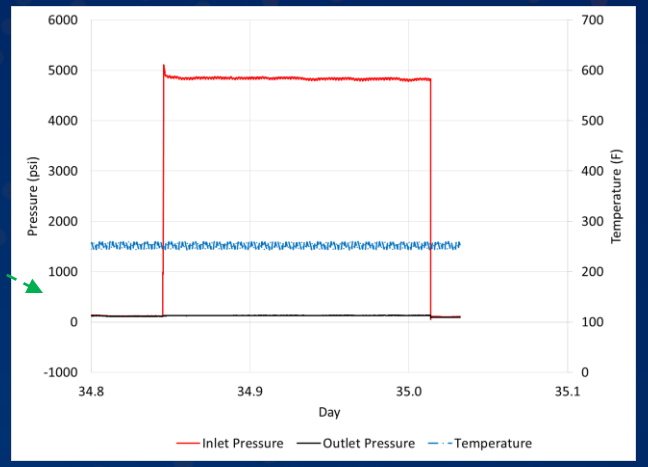




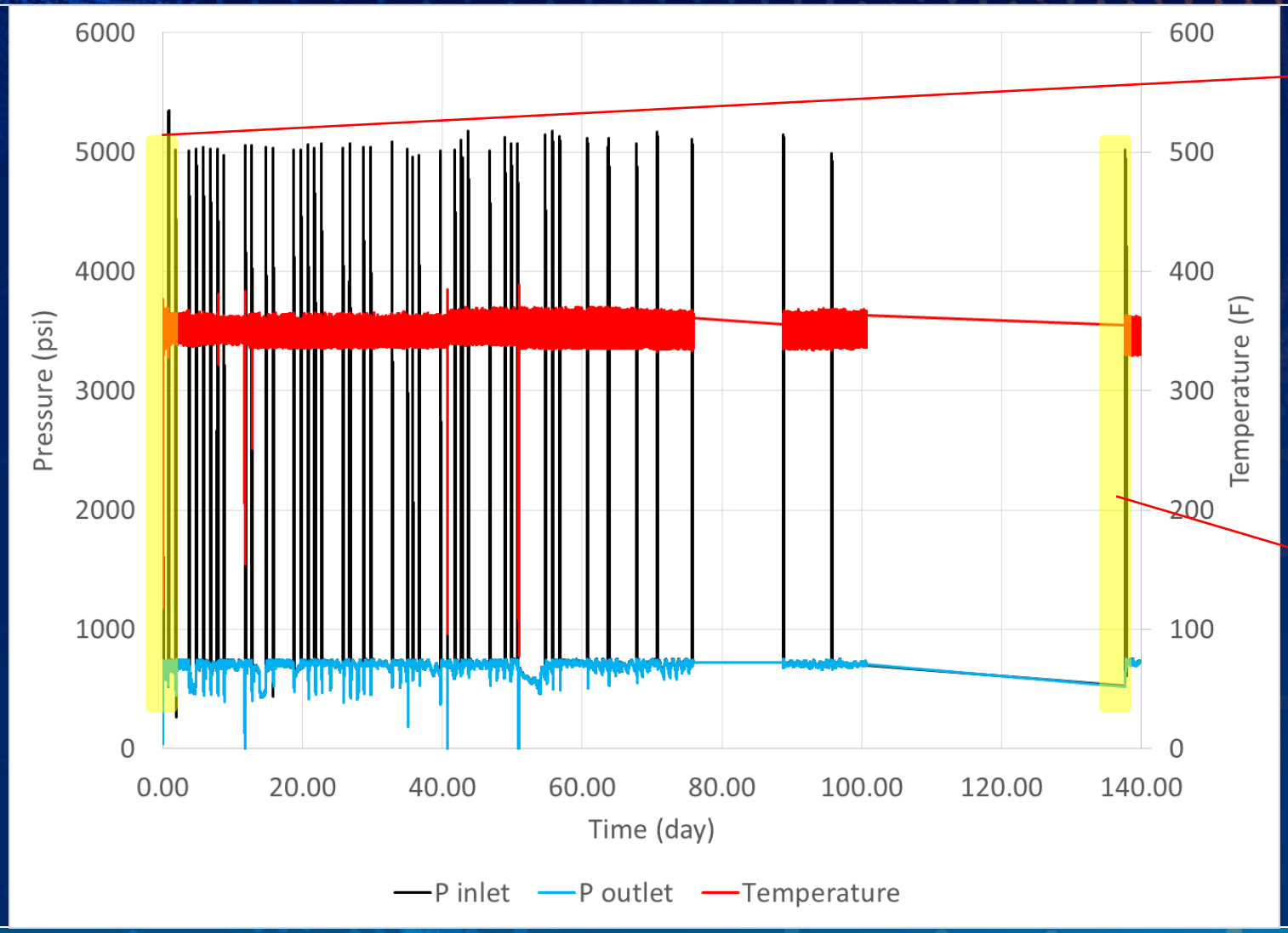
Withstand Multiple Cycles for Extended Durations

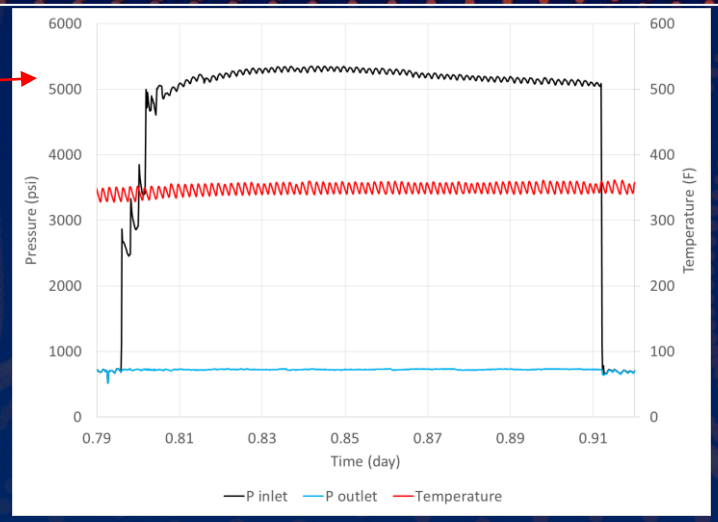


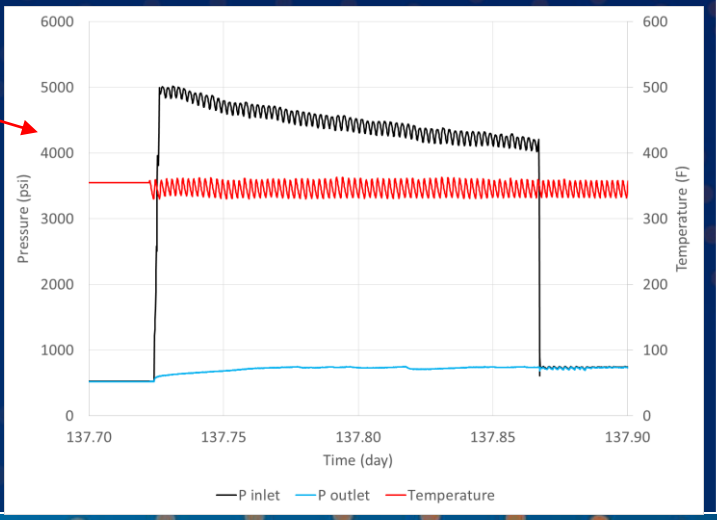




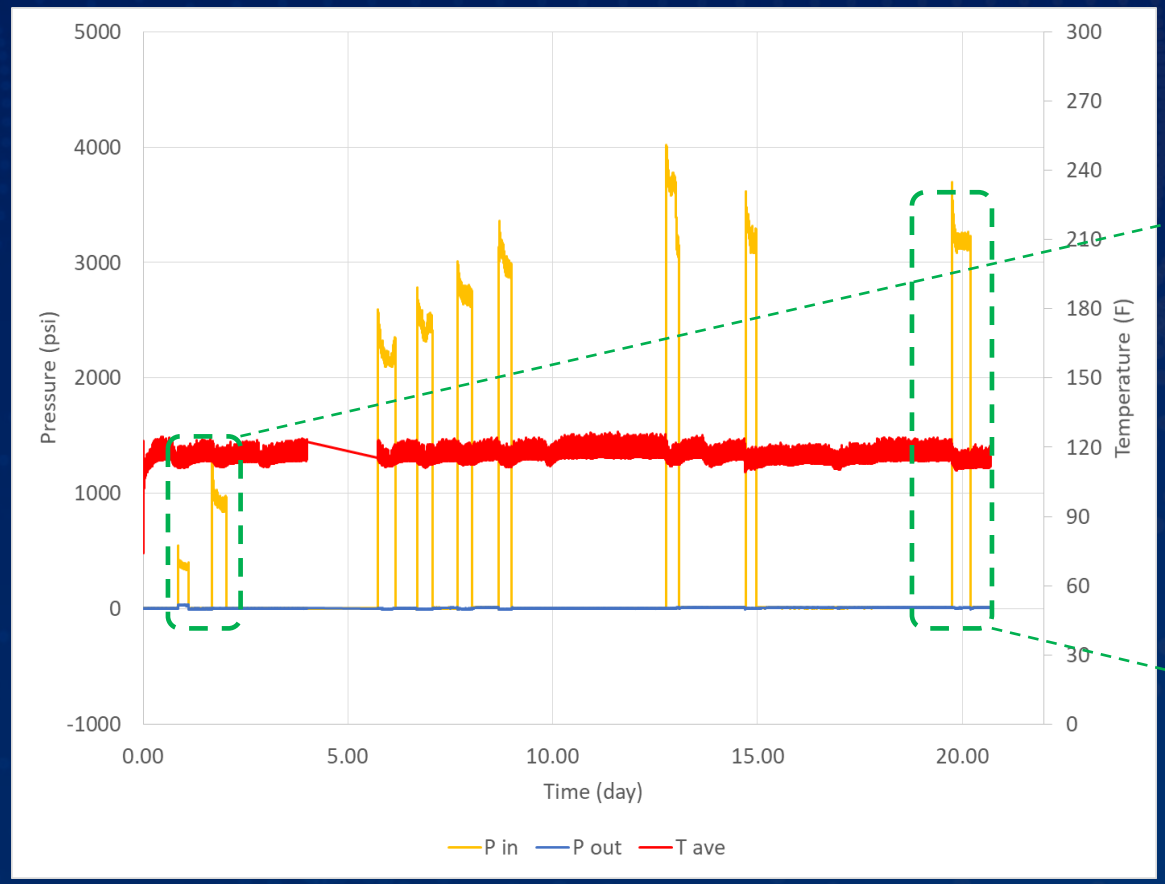
High Temperature Test: 350 F

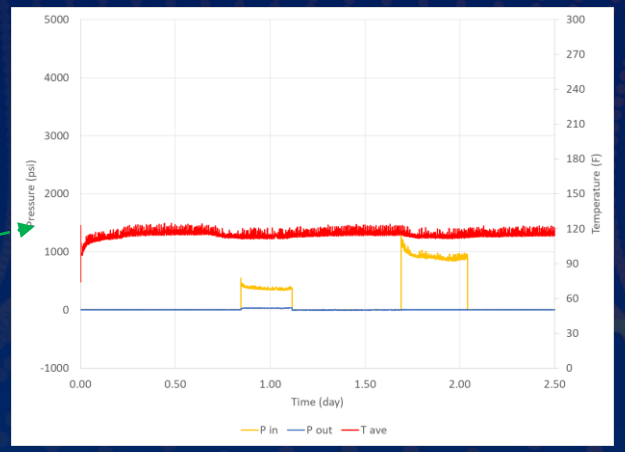


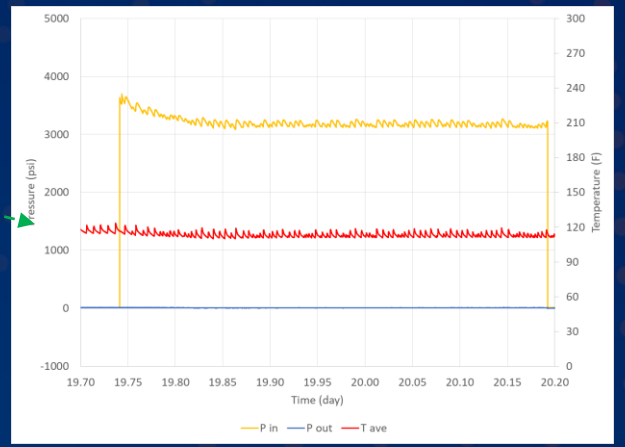




Lowest Temperature Tested: 115F







Proof of Concept

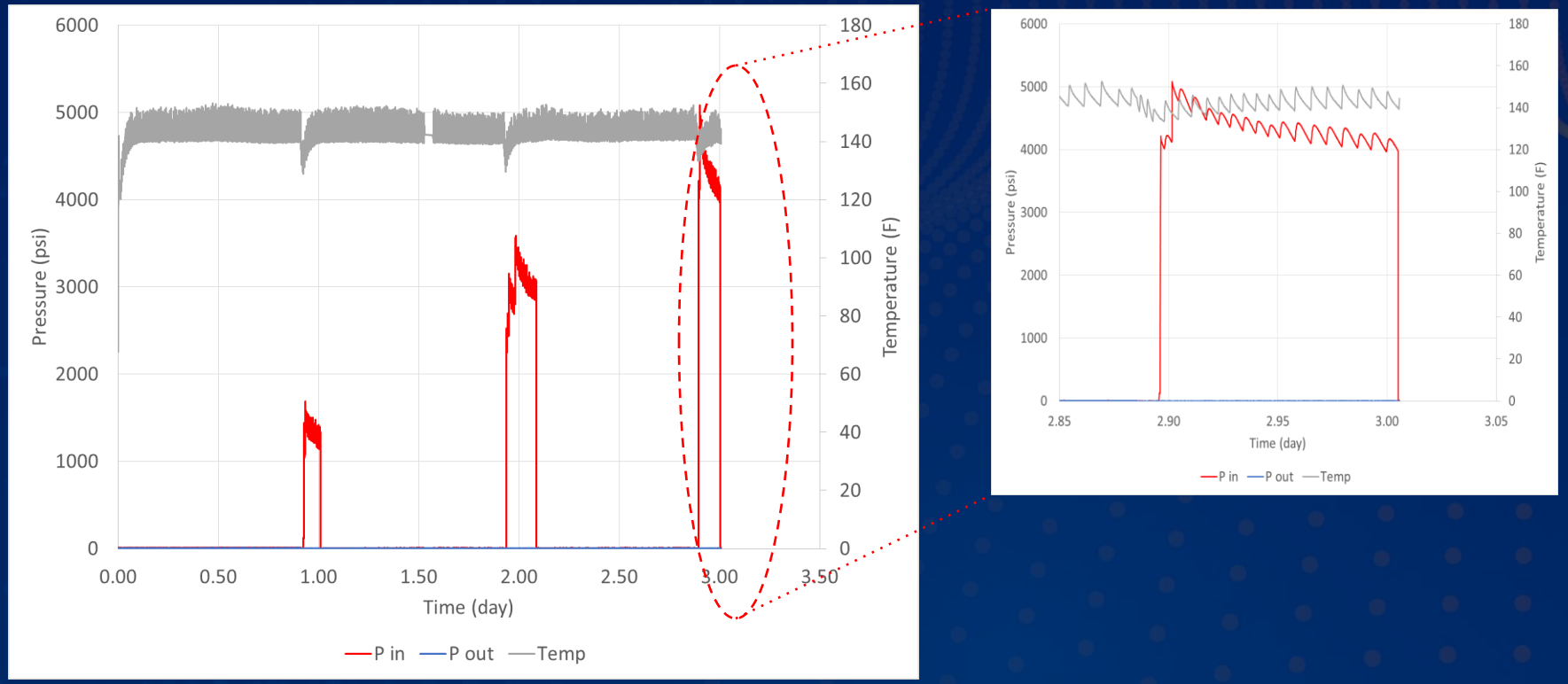
Case Study
Beaver County, OK

Case Study Summary

- A case study was pumped in a vertical well across 2 zones.
- Depths of ~7600’ and ~7700’. BHST 144 F.
  - 85,000# frac on the Upper
  - 8,000# frac on the Lower
- Diverters were used to assist in distributing the Sealant to all perf sets.
  - Drill-out was done with a simple blade bit.
  - The Upper zone was tested separately
  - The Lower zone was tested in combination with Upper

Differential Pressure Test for the Field Study

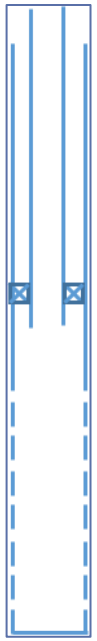
- Hold 4000 psi differential pressure after 3 days



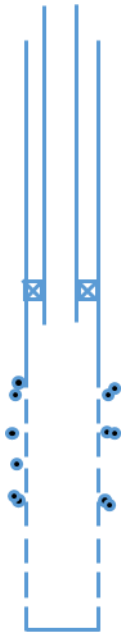
Case Study- Western OK

Pumping Procedure

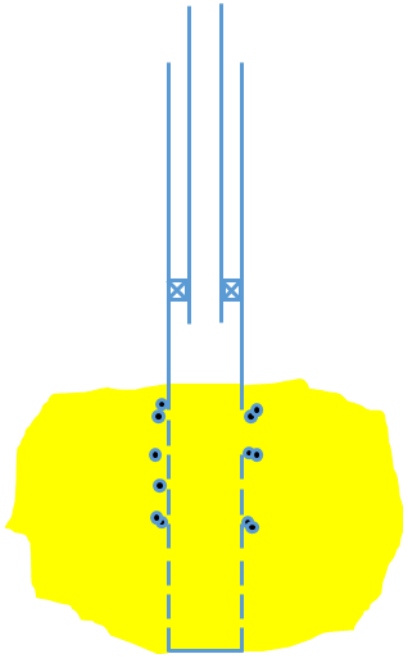
1. Test annulus



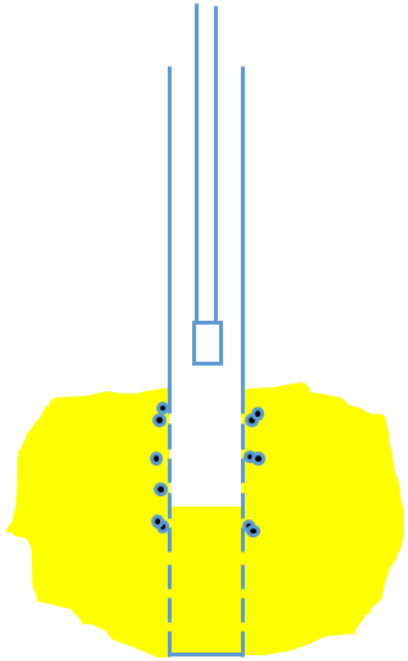
2. Pump diverter



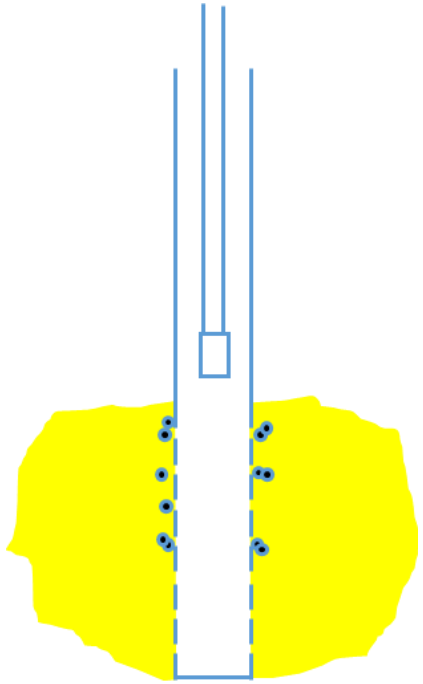
3. Pump Sealant



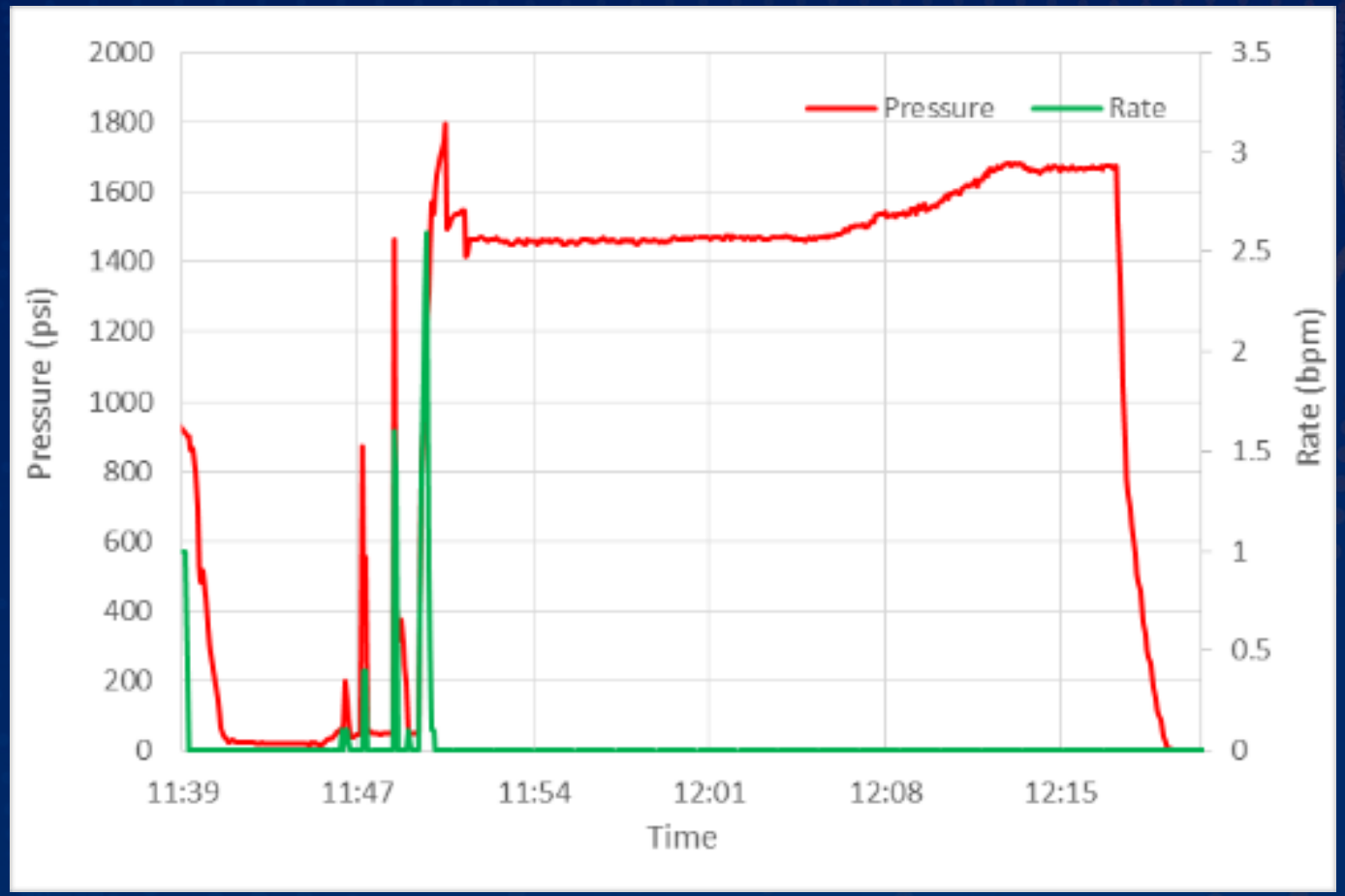
4. Drill out, pressure test top perf set



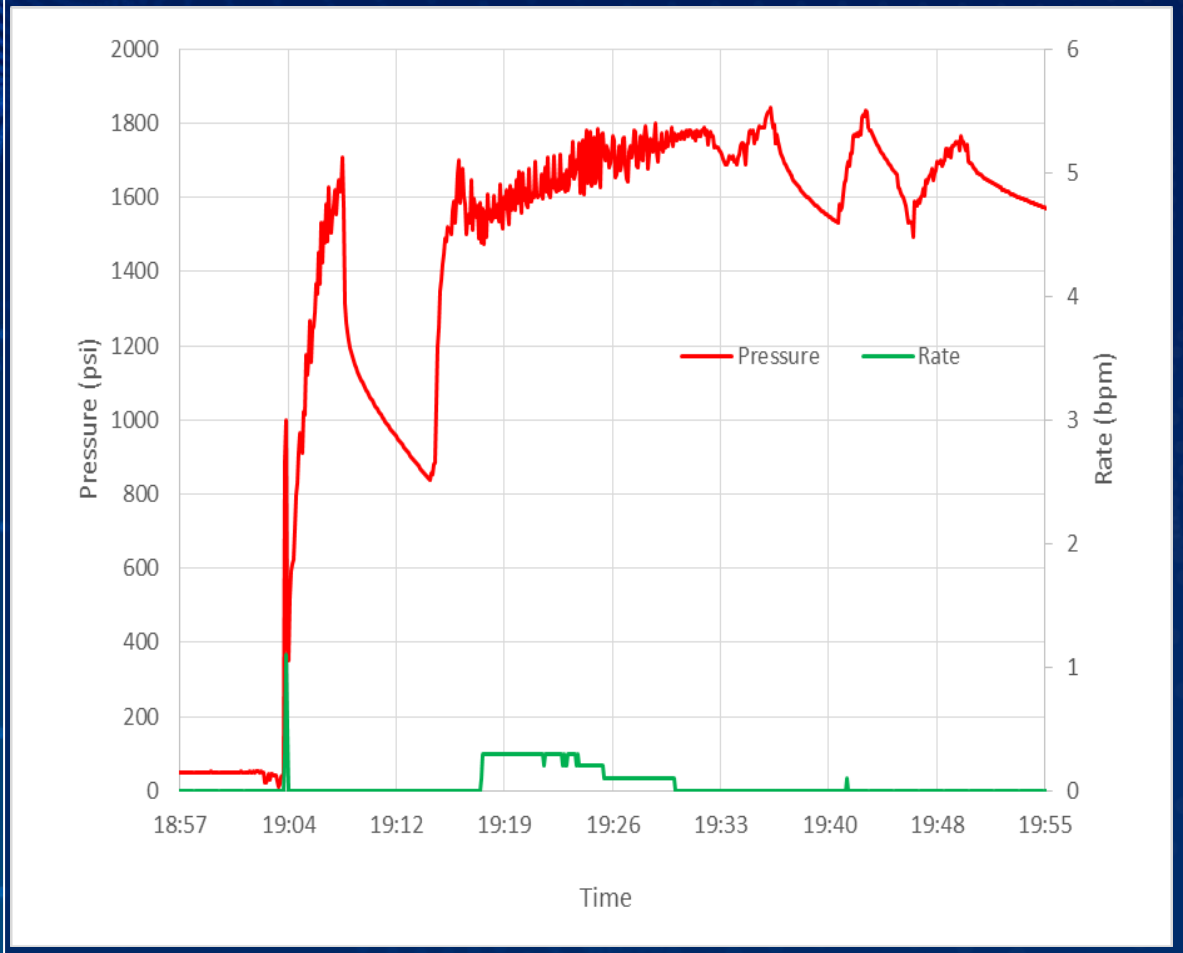
5. Drill out, pressure test both perf sets



Diverter 1 - Graphs (198 psi)



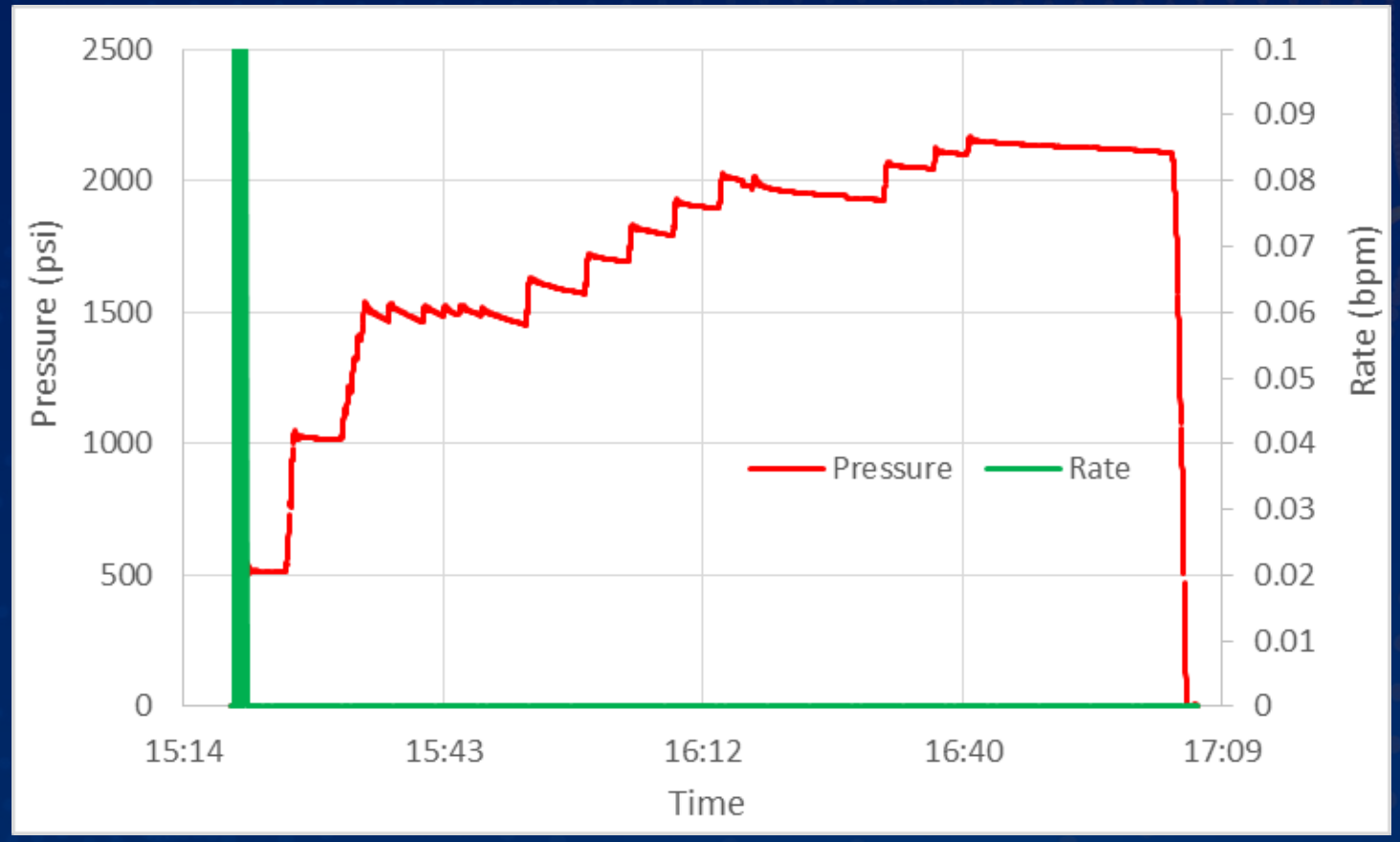
Injection and Drill Out



Drill Cuttings

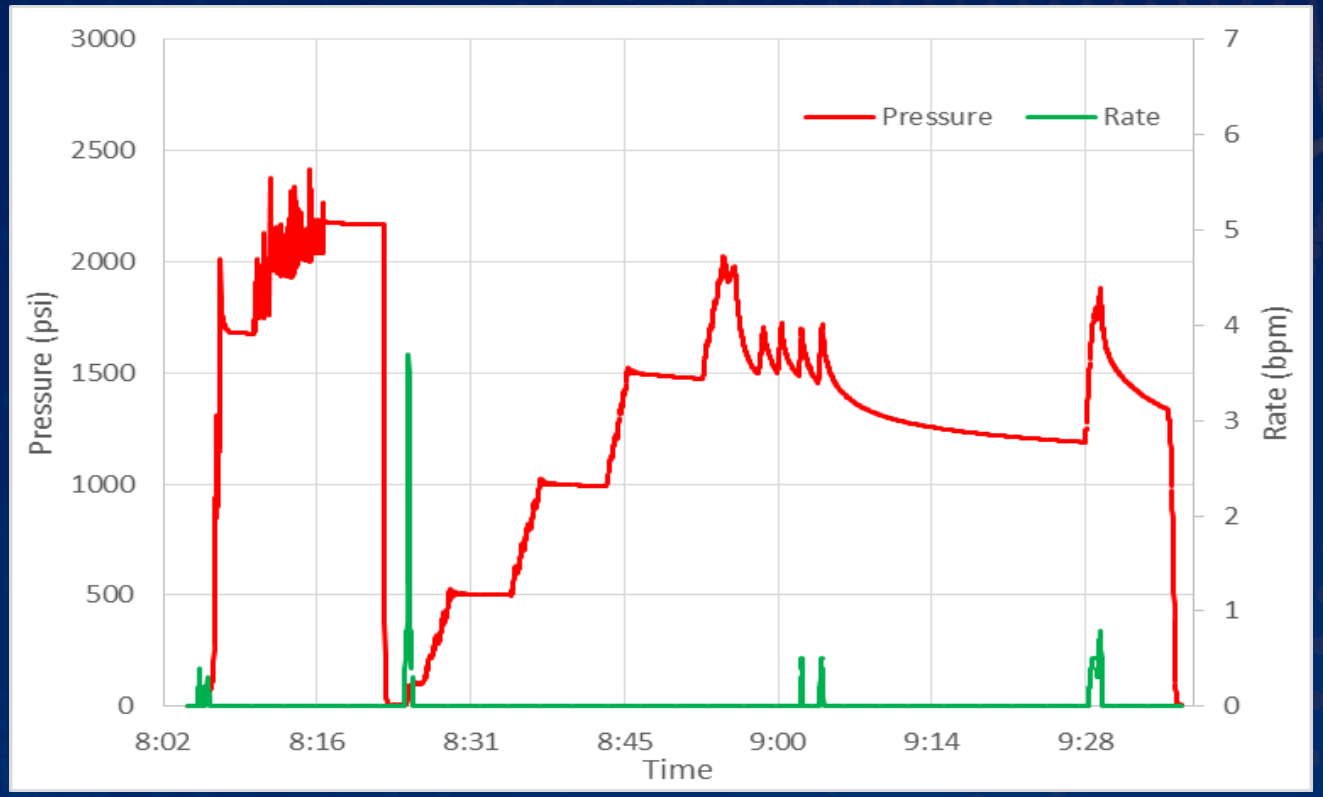
Pressure Test Top Cluster

- ***Held 5065 psi BH differential pressure***



Pressure Test both Perf Sets

- Pressured up to BH 4976 psi (2000 psi) then the pressure slowly started bleeding off.

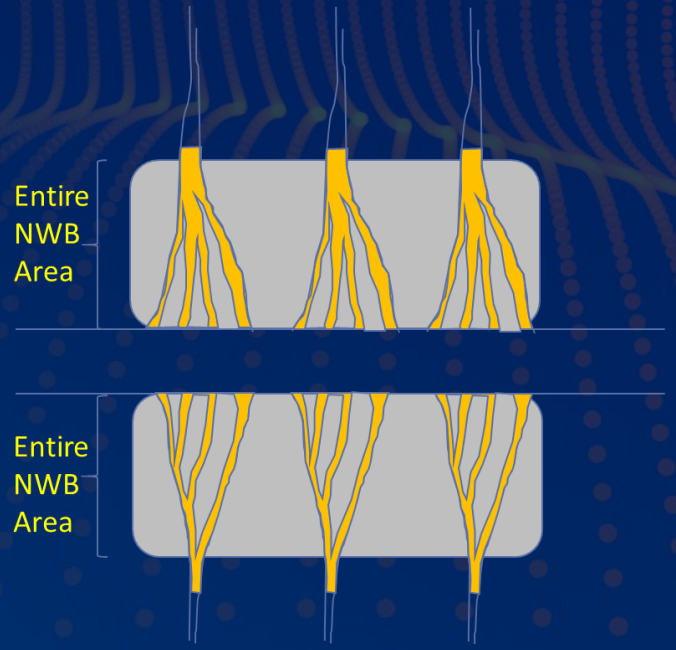


Case Study Summary

- A case study was pumped in a vertical well across 2 zones.
- Depths of ~7600’ and ~7700’. BHST 144 F.
- Drill-out was accomplished with a simple blade bit.
- ***Sealant material was able to support differential pressure of 5000 psi.***
- Diverters seemed to assist in distributing the Sealant to all perf sets.

Advantages:

- Pumped as a liquid which infiltrates the smallest fracture pathways
- Non-brittle to withstand multiple pressure events
- Drills out easily
- Leaves full open wellbore ID & access
- Applicable at a wide temperature range
- User friendly/environmentally friendly
- Can combine with other refrac/sealant methods
- Cost effective. Requires only small volumes to block the near wellbore area of the fracture



Thank you!

Chat and Questions

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