Combination Barriers for P&A: Flexible/Impermeable plus Solid-State

Complementing, not replacing solid state barriers.

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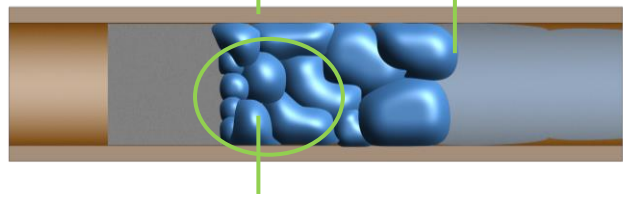
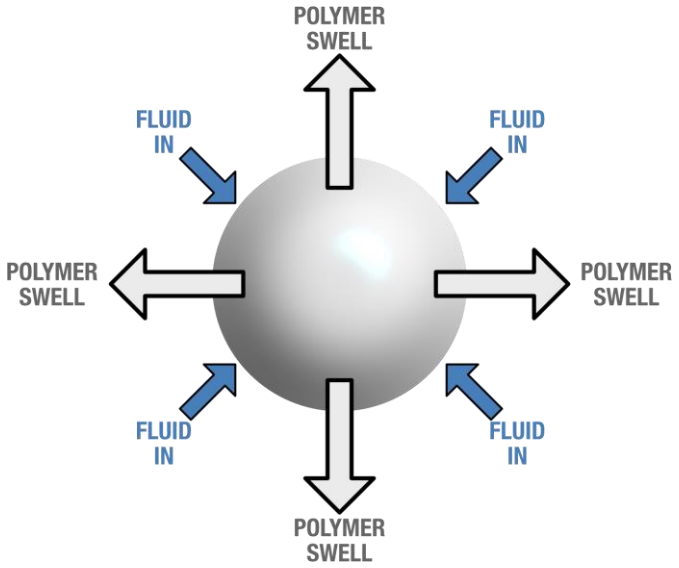
Flexible, impermeable seals
Base concept

- Superabsorbent Expanding Polymer Grains (EPG)
  - deployed in particulate form to absorb specific fluids,
  - quickly forms an impermeable, flexible, self-healing and pressure resistant seal.

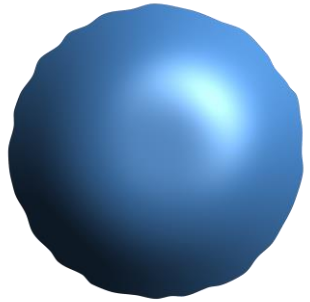
Reality: seal made up of many EPG elements, retaining significant expansive energy. May be capped with cement.





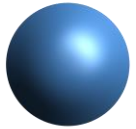
Original size. Can range from microns to centimetres in diameter.

Most applications <0.5mm.



EPG can absorb/adsorb up to 400 times its original weight in fluid.

Becomes soft at this point, enabling gel sweep applications.

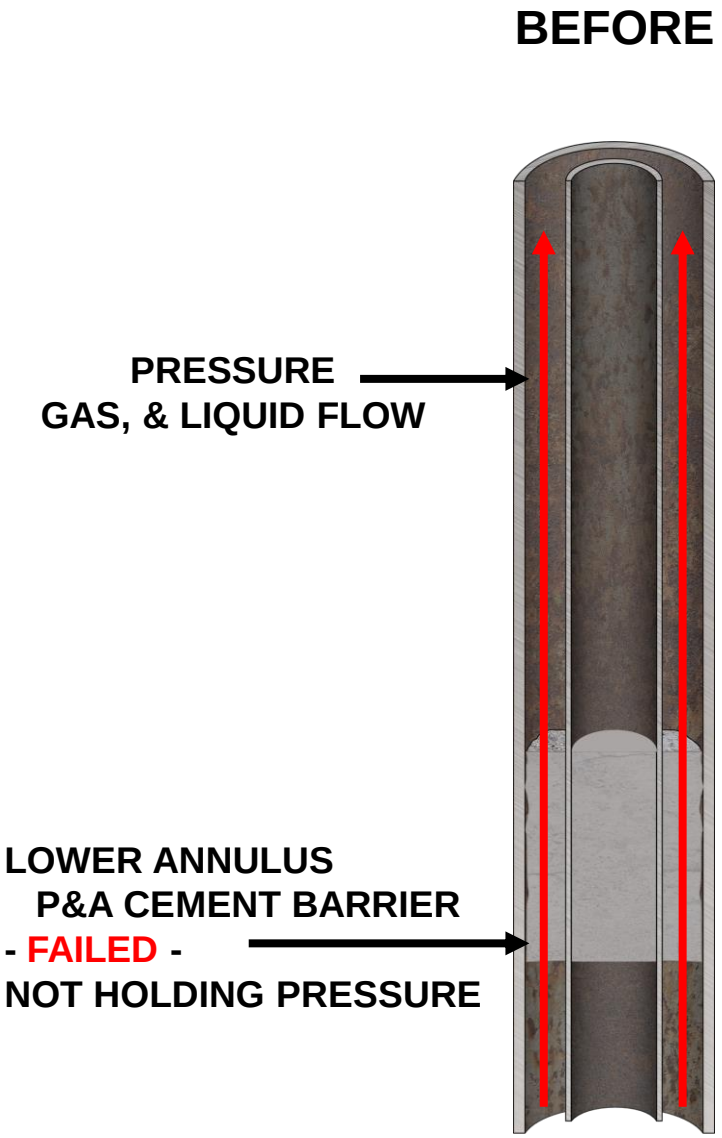


Ideal expansion between 5 & 30 times original weight.

Enables optimal strength with retained expansive energy & self-healing capability.

Case Study – problem

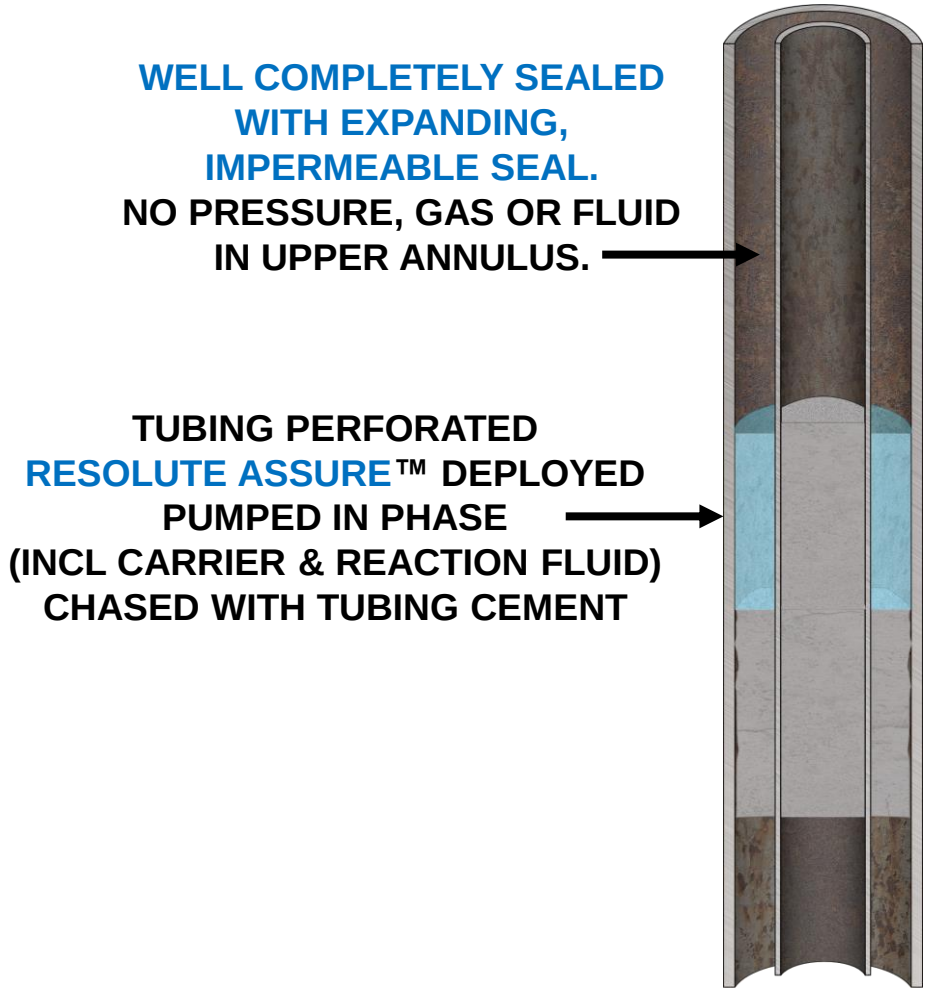
- Client had SCP problems on two wells
- During well abandonment operations, existing and new cement barriers failed to contain gas from the formation below, resulting in pressure in the upper annulus.
- Attempts to cement had been repeated and there was serious concern about the lack of length for a final cement barrier to surface



Case Study – solution

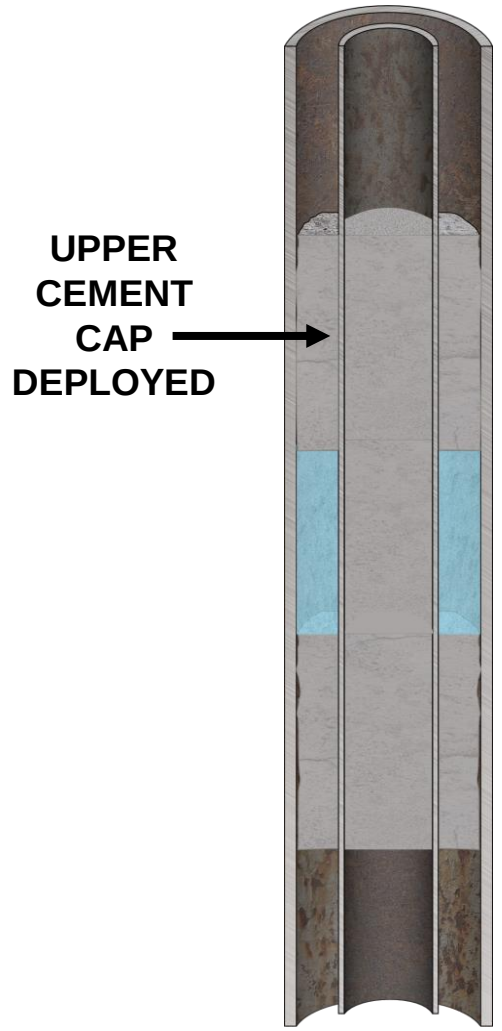
- With tubing already retrieved, the inner casing was perforated above the failed cement barrier,
- Resolute's Assure® Expanding Polymer Grain (EPG) solution deployed into the annulus, chased with cement to balance fill the inner casing.
- Assure® EPG successfully secured the well, preventing the flow and pressurised build up of gas.

ASSURE TREATMENT



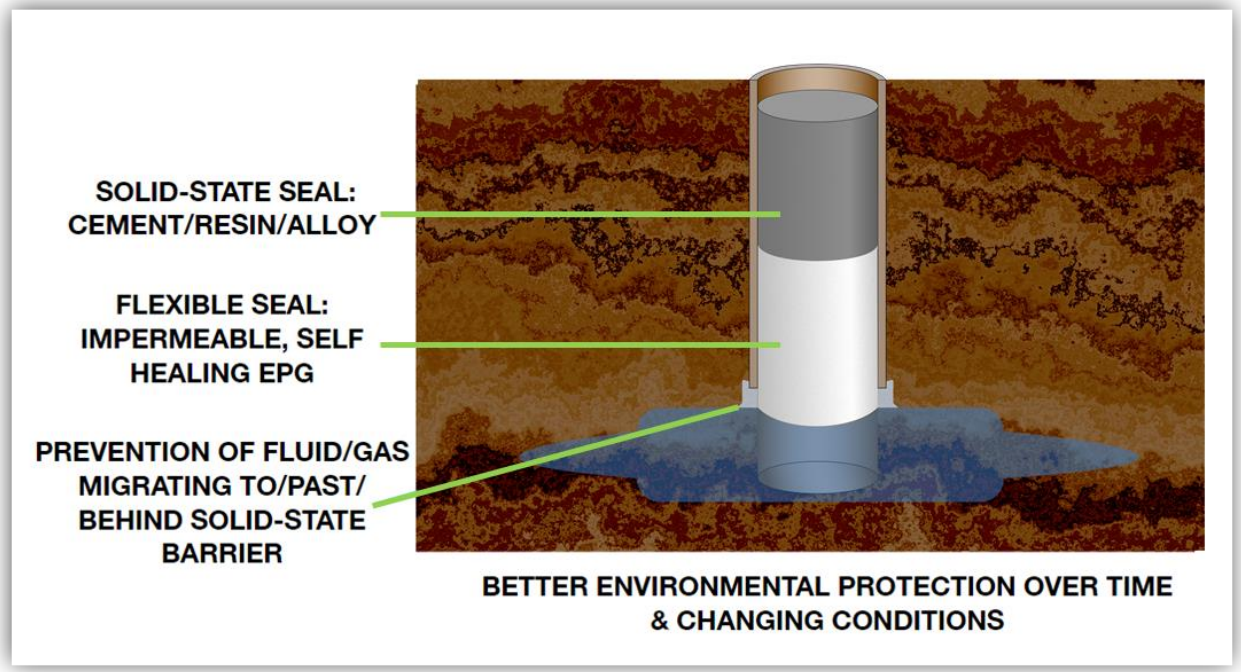
Case Study – result

- Extended period of monitoring to ensure the operational success
- Casing then perforated above the Assure® layer, and a further cement plug successfully set.
- Resolute successfully resolved the issues
- Plans underway for further wells.



Conclusion

- Dual barrier with a flexible, impermeable seal and a solid-state barrier (cement/resin/alloy)
- Reduce the volume of retrieved tubulars
- Reduces risks of emissions from wells



- Enables a range of functions
  - reservoir isolation
  - micro annuli isolation
  - control line sealing (internal/external)
  - dormant barrier placement
  - rig-less abandonment via the capability to seal control lines and leave tubulars in place