



Dynamic Sealing Systems for CO₂ storage wells

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The oil & gas legacy

Current state

- More than a century of experience in drilling, producing, and abandoning oil & gas wells
- We are now living with the fallout
 - SCP – shut in wells
 - Leaks from previously plugged wells,
 - Greenhouse gas emissions,
 - Toxic contamination of land and water
 - Remediation hits hard environmentally & financially
 - Costs pass to public liability



What's wrong with cement?

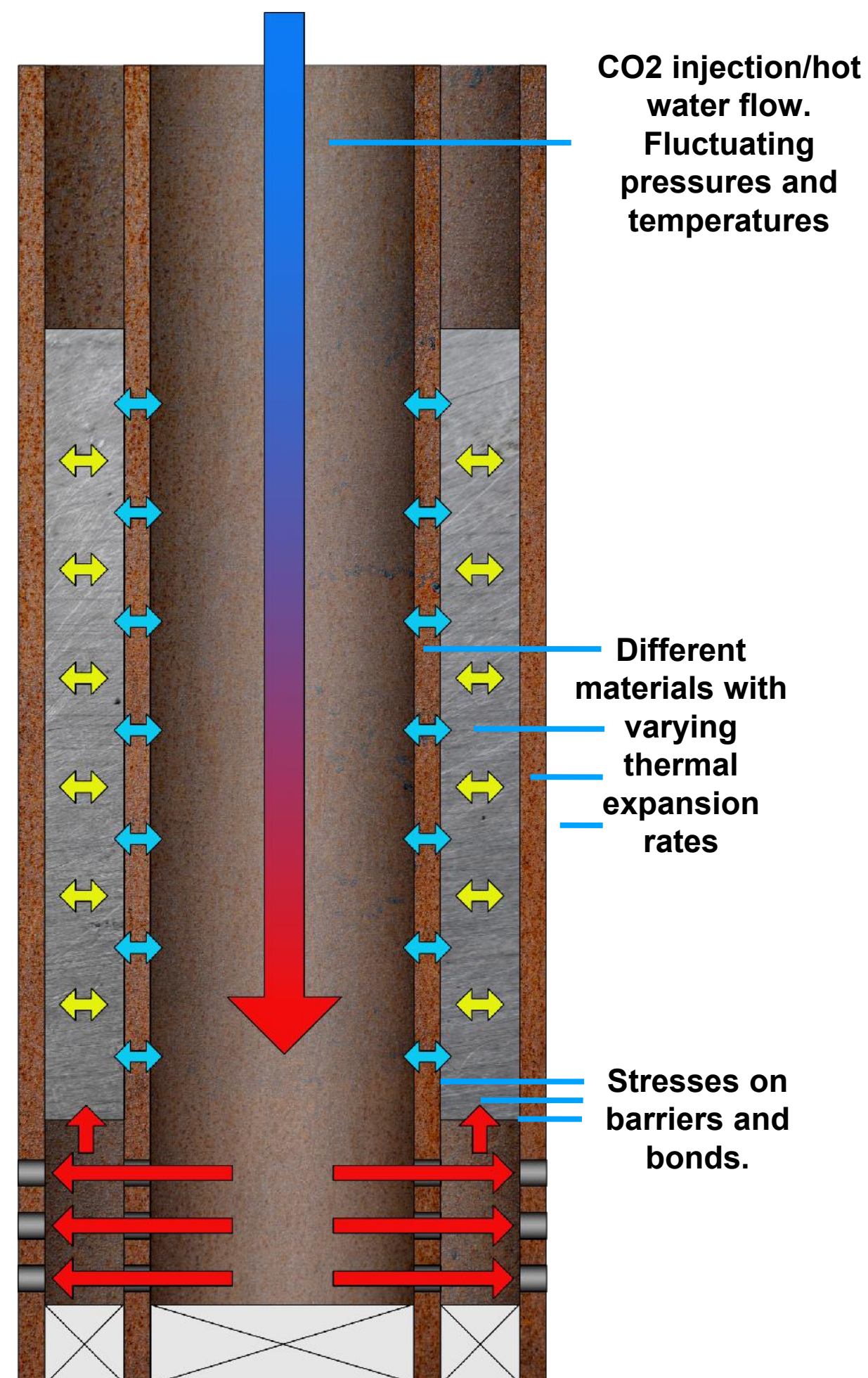
Traditional methods are failing

- Wellbores provide a conduit to surface
- Cement is traditional structural & sealing material
 - Cement has high failure rates
 - Gas can form a flow path before it sets
 - Cement shrinks and cracks
 - Poor with thermal cycling
- Emissions to atmosphere, and contamination of land/water table



CCS vs oil & gas wells

Thermal cycling, pressure fluctuation, corrosion



CCS wells have additional failure modes

Solid state barriers like cements, alloys and resins will struggle to cope with two vital characteristics; *fluctuations in temperature and pressure*.

Thermal expansion coefficients of the different solid materials will logically lead to failures; e.g. alloy/tubing/casing/formation will expand/contract at different rates, causing barrier breakdown.

And let's also mention CO2 gas plus water = carbonic acid which = corrosion of steel tubulars and components

So, what is the solution?

A Different Approach

Dynamic Barrier Materials



EPG[®]: Expanding Polymer Grain

- A fast acting, impermeable, flexible and self-healing barrier
- Fluid deployed, using standard industry equipment, no rig required
- Blocks leak paths in seconds
- Unaffected by weak or dilute acid, absorbs any water and will protect steel tubulars
- Robust from sub-zero up to >200deg C
- Enables cement to work properly



Fine, dry, EPG particles



Mixed in a carrier fluid



React with second fluid to create dynamic plug

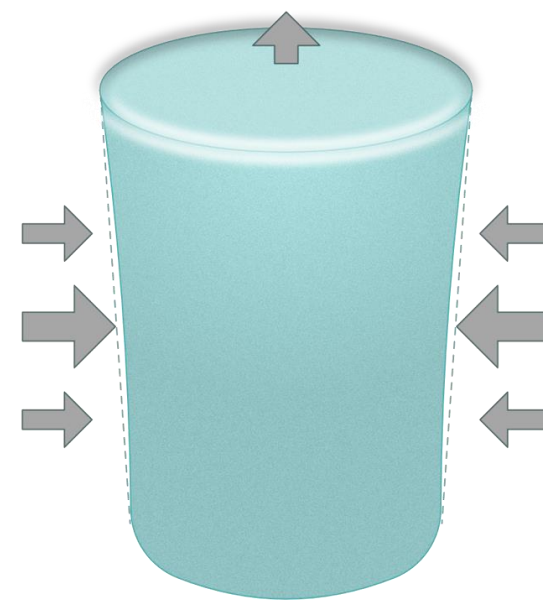
EPG[®]

Flexible & Expanding Barriers

- Designed to be different to solid state barriers like cement:
- Remediation of existing wells, and lifetime planning for new wells right through to p&a
- Cut rig/equipment time, enable rigless p&a
- Small volumes required, small footprint
- Environmentally friendly material
- Low cost, high value – proven in 35 wells



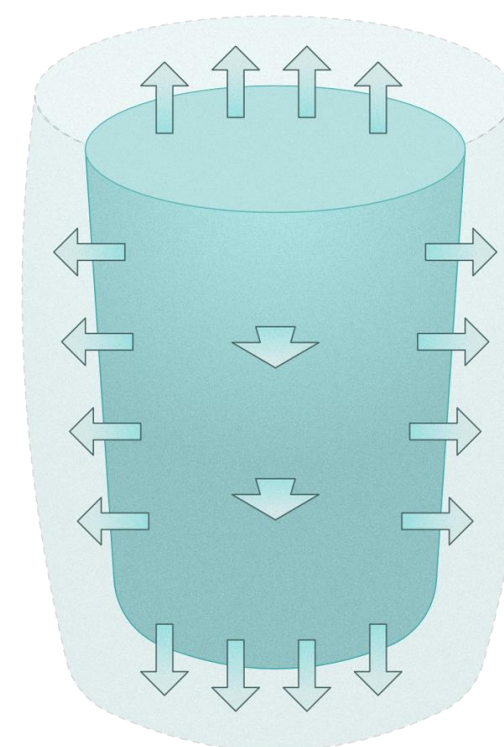
EPG Plug



Axial Flexing



Compression
Absorption



Absorb Moisture to
Expand & Fill New Voids



Dynamic Barrier Layer -
flexible, self-healing
Resolute EPG



Solid State Barrier -
crack formed in cement

Thank you for listening!



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