Glass-Based solutions for Barrier Repair, Decommissioning and Carbon Storage

For: Accelerated Deployment workstream of the Technology Leadership Board

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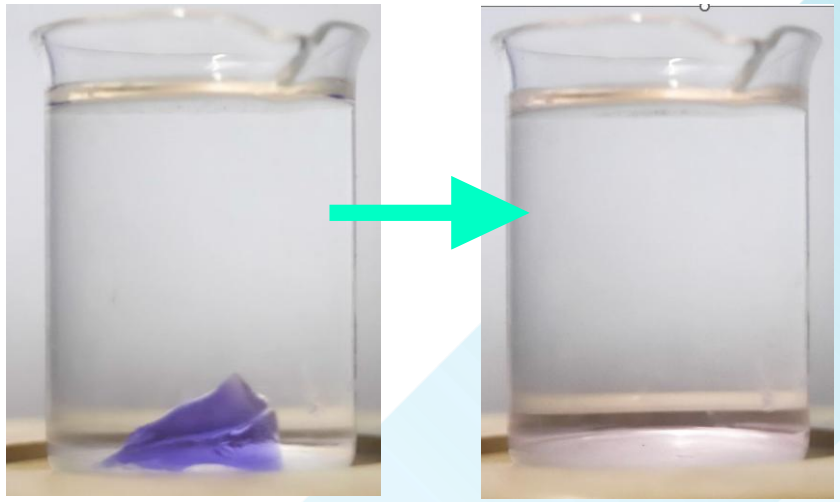
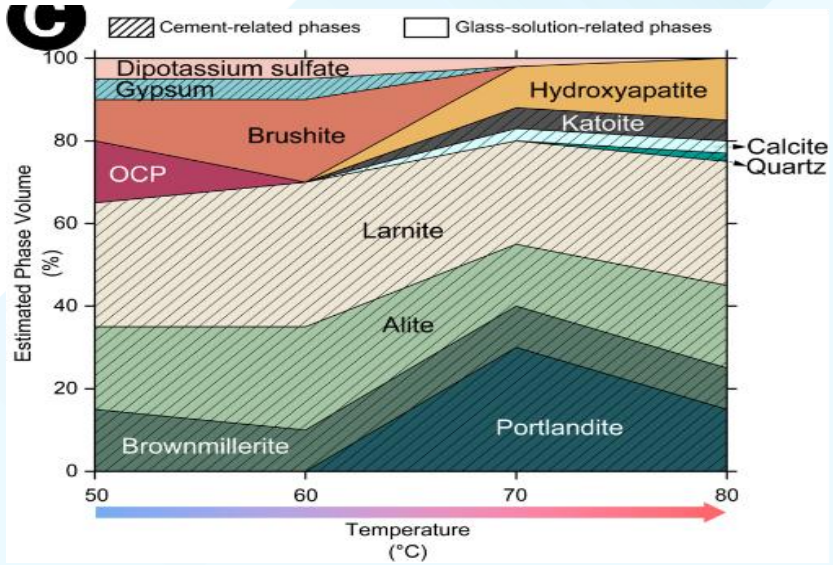
Injectable, Reactive, and Durable Mineral Sealing System

- Stable, low viscosity and <35 µm particle size solution enables injection into micro-annuli and <1 mD permeability zones.
- Acidic solution that upon contact with calcium in cement and reactive rock forms stable minerals (e.g., hydroxyapatite, brushite) that bind to cement, steel, and formations.
- Forms naturally occurring, geochemically stable mineral phases with well-documented behavior in subsurface and biological systems.
- Mineral growth expands post-set when exposed to water or brine; fills larger voids and reseals fractures after damage.
- Demonstrated repeated self-healing under brine and nitrogen gas exposure.





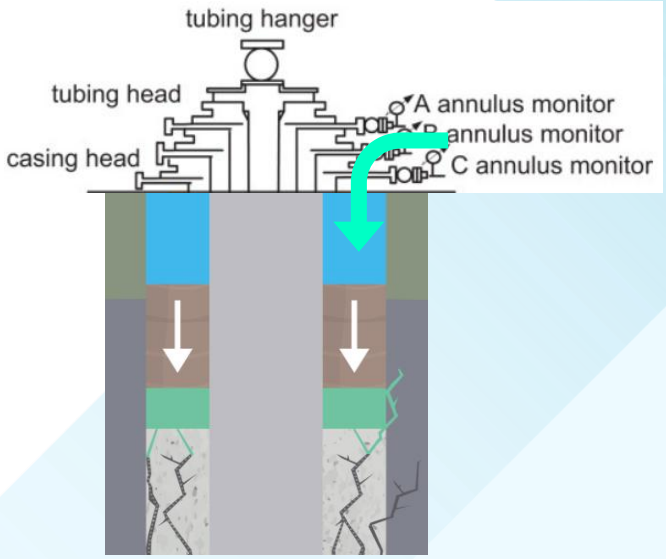
Targeting High Cost and Critical Integrity Challenges in CO_2 Wells and Decommissioning

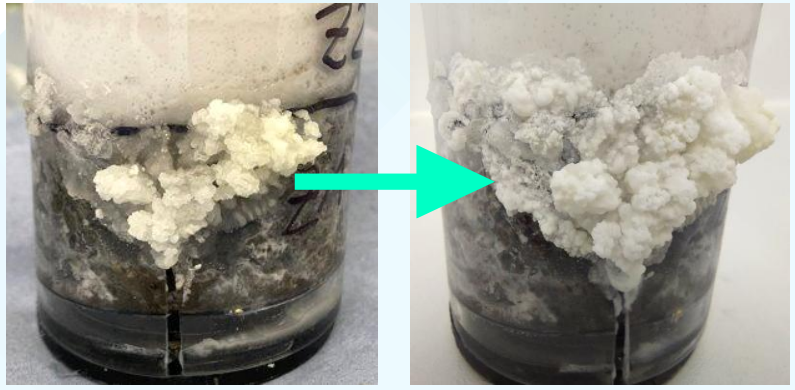
Challenges Addressed:

- Sustained Casing Pressure (SCP) and annular leakage in legacy and repurposed wells
- Cement degradation from carbonic acid and thermal cycling
- High abandonment and repurposing costs due to section milling and sidetracking

Solution:

- Penetrates inaccessible leakage paths with a low-viscosity, mineral-forming fluid.
- Forms expanding, self-healing durable minerals that can create barriers in accordance with OEUK and NORSOK requirements under temperature cycles and acidic environments
- Increase cements resistance to carbonic acid and stops the carbonation process





Why This Is Better Than Today's Options

Traditional Cement	Resin Sealants	Geopolymers & Alt. Cements (wide range with some promising solutions)	VitriSeal Glass-Based Solution
Poor injectability	Environmental / Hazardous issues	Limited injectability	Proven micro-annulus and low permeability injection and sealing
Prone to CO_2 degradation	Limited understanding of material, Uncertain CO_2 durability and lifetime	Range of resistance to acidic fluids (none to strong)	Acid-resistant minerals
Shrinkage	No self-healing	Minor expansion, No self-healing	Self-healing + expanding mineral growth
Sensitive to downhole contamination	High cost, some two-part systems, sensitive to contamination	Placement issues under temperature (Geopolymers), limited field use	Simple, low-cost deployment, not sensitive to downhole contamination

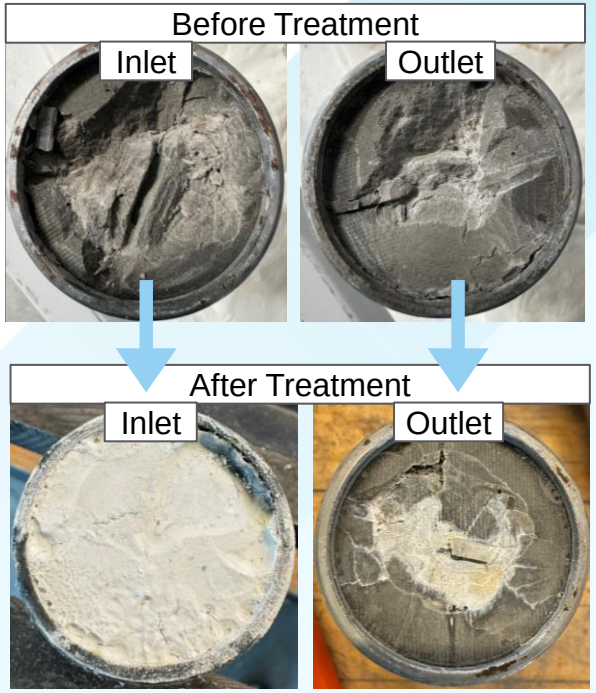
Field Readiness & End User Benefits

Field Readiness:

- **Validated in 5 North Sea field trials with AkerBP** with related glass-based fluid system
- **Single-fluid system** compatible standard pumping equipment (cement units, mud tanks, coil tubing).
- **Safe for deployment** in Norwegian North Sea operations. (HOCNF Green & Yellow)

End-User Value:

- **Repairs and strengthens cement** to withstand thermal cycling and CO_2.
- **Prevents Sustained Casing Pressure (SCP)** and long-term barrier failure in both injection and legacy wells.
- **Eliminates need for costly section milling**, sidetracks, or full plug replacements.
- **Cuts repurposing and abandonment costs**, accelerates CCUS deployment and decommissioning.
- **Reduces leakage risk** and future liability in CO_2 storage and P&A zones



Glass-based solutions that extend well life, reduce abandonment costs, and enable secure long-term CO_2 storage

Check out our SPE papers:

- **SPE-205155** "The use of controlled dissolution glass to consolidate a high porosity chalk"
- **SPE-205445** "The use of controlled dissolution glasses to consolidate and create permeable or impermeable minerals in formation"
- **SPE-218426** "Extensive Testing of Glass-based Chemical Consolidation on Carbonate Reservoir"
- **SPE-223669** "Assessing A Novel Glass-based Fluid For Annular Barrier Remediation In Cemented Well Sections"

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