Hybrid Multifunctional Well Cement for Extreme Conditions

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Outline

Project Overview

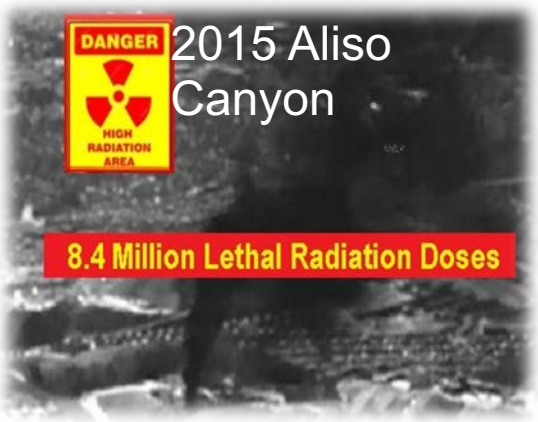
Technical Status

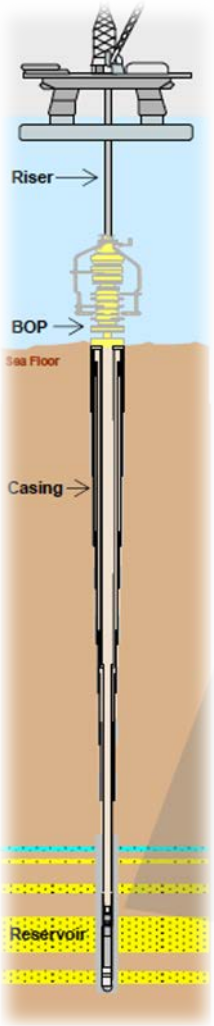
Accomplishments to Date

Summary

Challenges

- ✗ Halts the Production
- ✗ Costly remedial Jobs
- ✗ Huge Environmental Impact
- ✗ Limits Further Development Opportunities





Drawback of exiting Cement products

C-Crete TECHNOLOGIES

Primary

- ✓ Halliburton's FineCem™
- ✓ Schlumberger's EverCrete
- ✓ Schlumberger's Futur™
- ✓ Halliburton's WellLife™
- ✓ Baker Hughe's Ensureset™

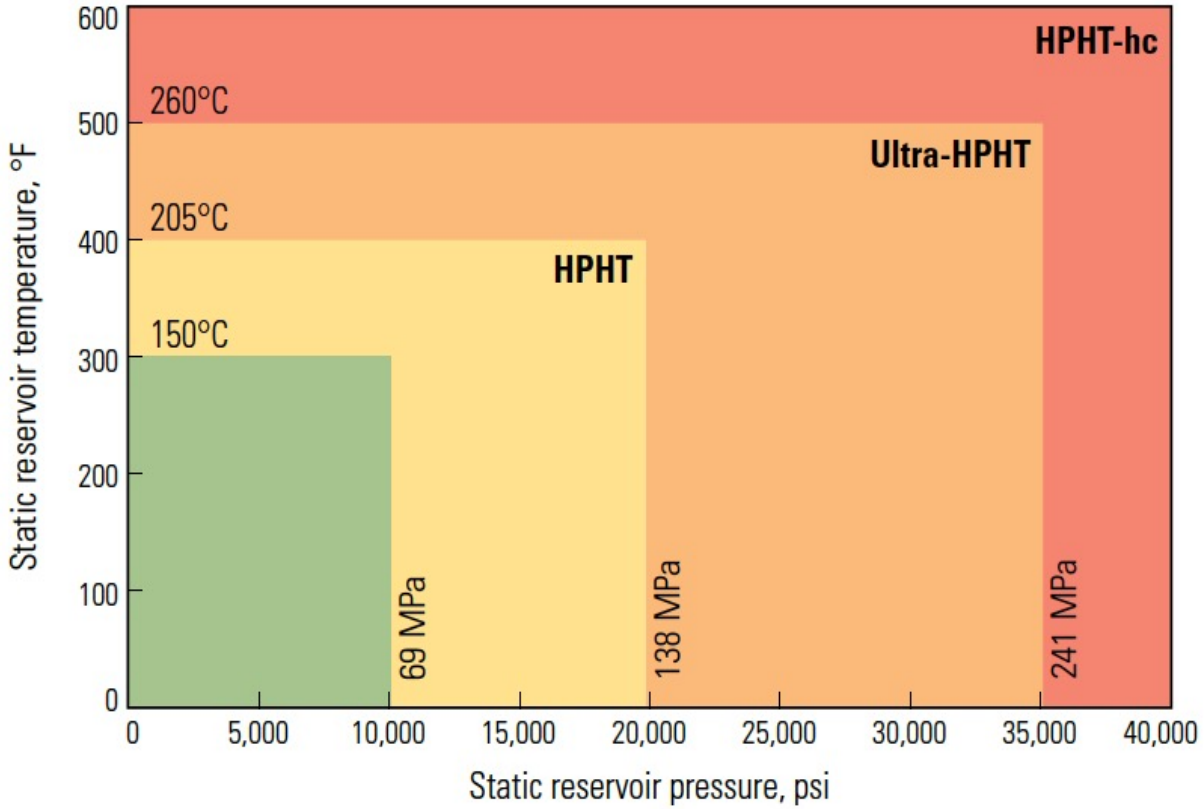
Remedial

- ✓ Schlumberger's Squeezcrete™
- ✓ Halliburton's WellLock™
- ✓ Halliburton's SqueezeSeal™

Limitations

- ✗ **Fit-for-purpose**
- ✗ **Cost/scarcity of additives**
- ✗ **Trial-and-error methods**
- ✗ **High failure Rate**

HTHP Conditions



HT:
phase transformations

HP:
Early strength,
Microchannels, etc

HTHP:
Complex phenomena

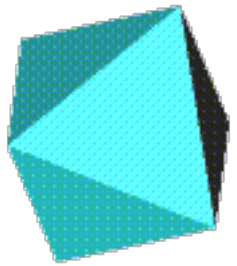
- ✓ Schlumberger's FlexSTONE HT,
- ✓ Baker Hughes XtremeSet™

Courtesy: SLB

What is at stake ?

How to design a reliable and multifunctional well cement that can address multiple extreme conditions (HTHP, corrosive environment, etc) at once?

- Changing backbone of well cement?
- Starting from the cement crystals ?
- Modifying chemical pathways ?
- Nanoscience and nanotechnology ?



Project Goals

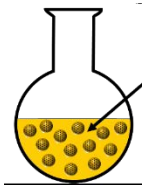
Overall Objective: To develop the next generation of well cement with remarkable mechanical, thermal, rheological and durability properties, thus preventing offshore spill and leakage at extreme HTHP and corrosive conditions.

Phase 1: Development of hybrid-cement to offer the best nanostructure, optimum slurry, and properties for a variety of extreme conditions including HT, HP, and high acidity.

Phase II: Product validation (API, etc), cost-risk analysis, scale-up and integration with current methods and equipment used for wellbore cementing.

Methodology

C-Crete TECHNOLOGIES



Material Synthesis

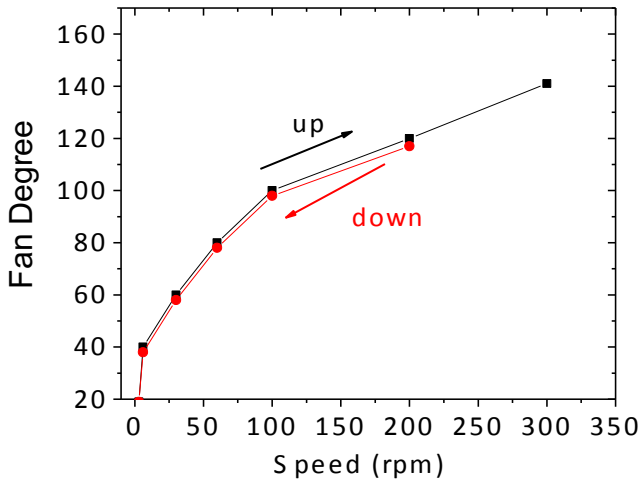
Advanced Characterization

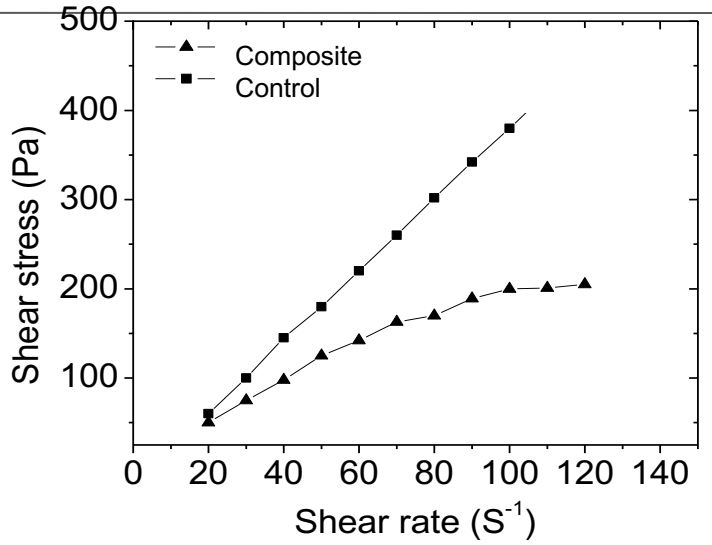
Lab Testings

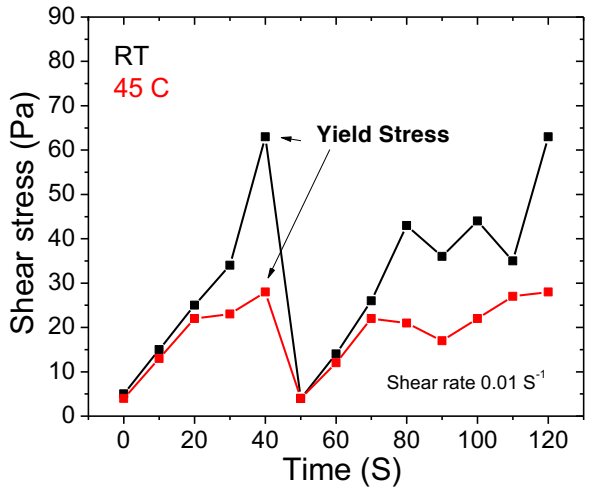
Scale-up & Pilot Test

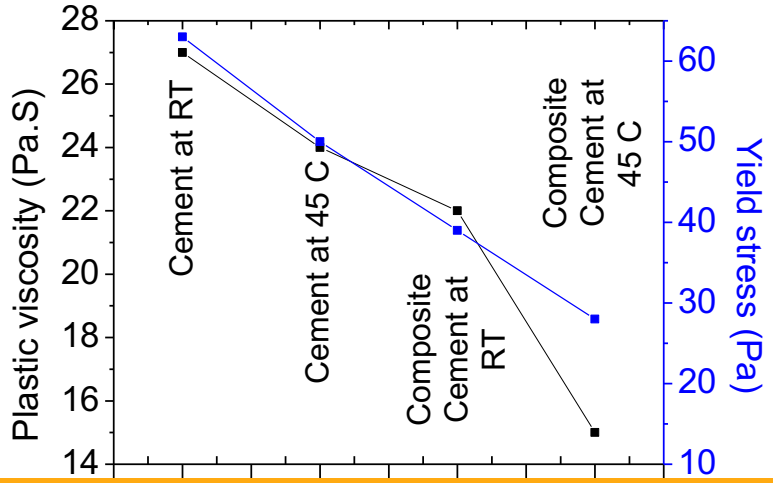
Socioeconomical, Analysis

Great Pumpablity





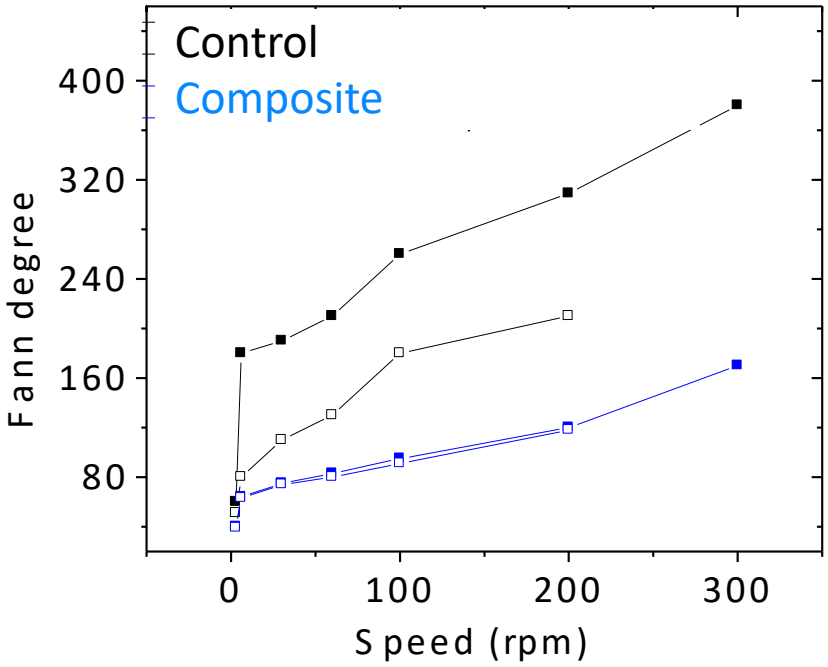




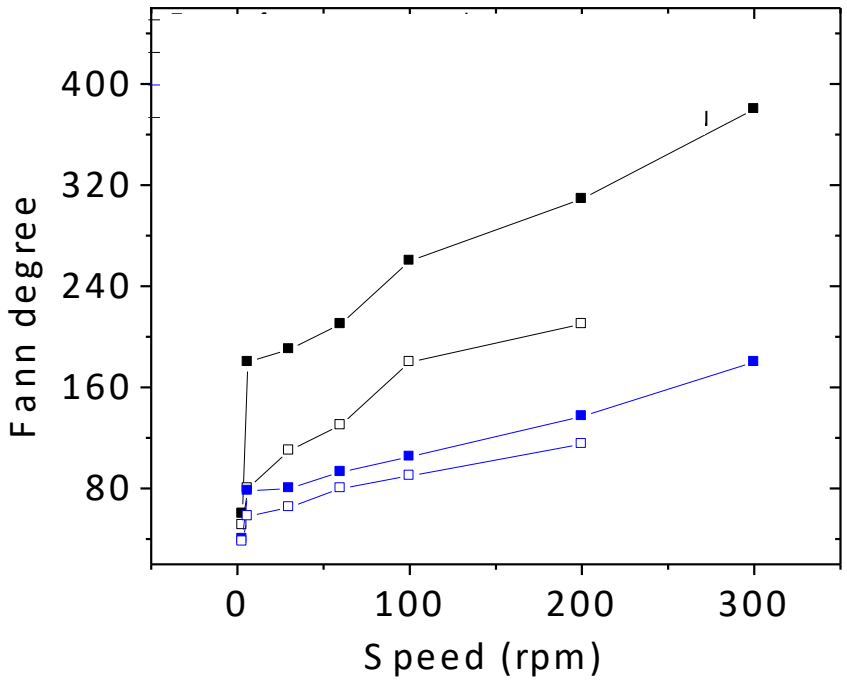
65% lower yield stress & 40% decrease in plastic viscosity
→ lower pump force/energy

Homogenous Slurry Mix

Water/Cement=0.45

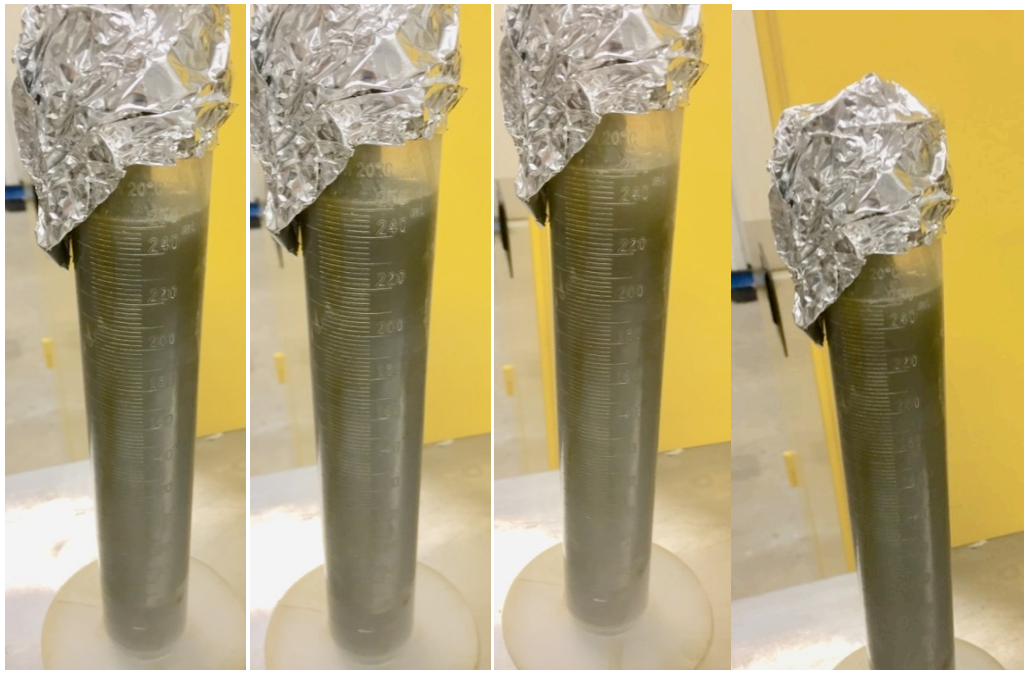


Water/Cement=0.40



Ramp up and down coincide in composite slurries → no segregation

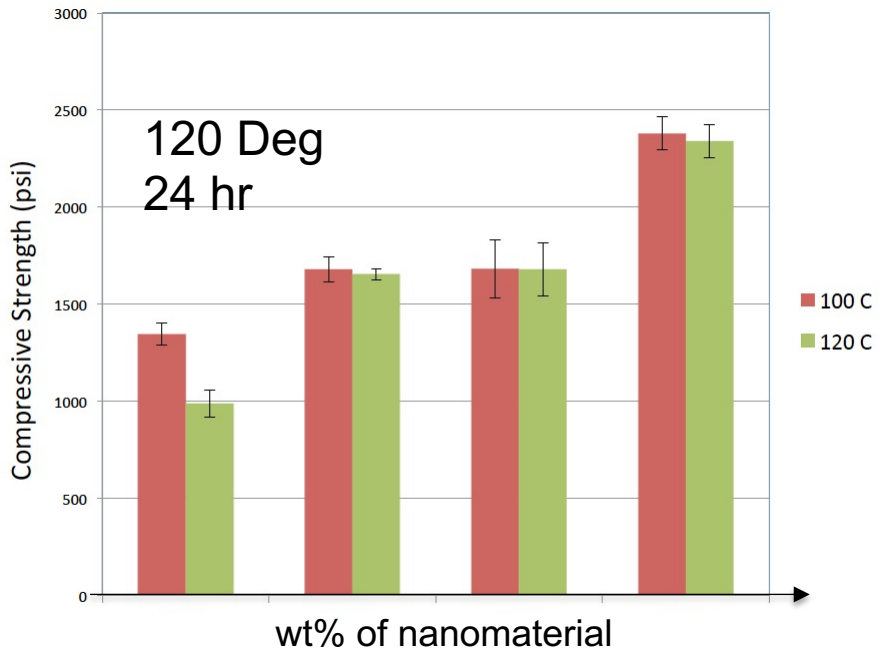
Free Fluid Tests

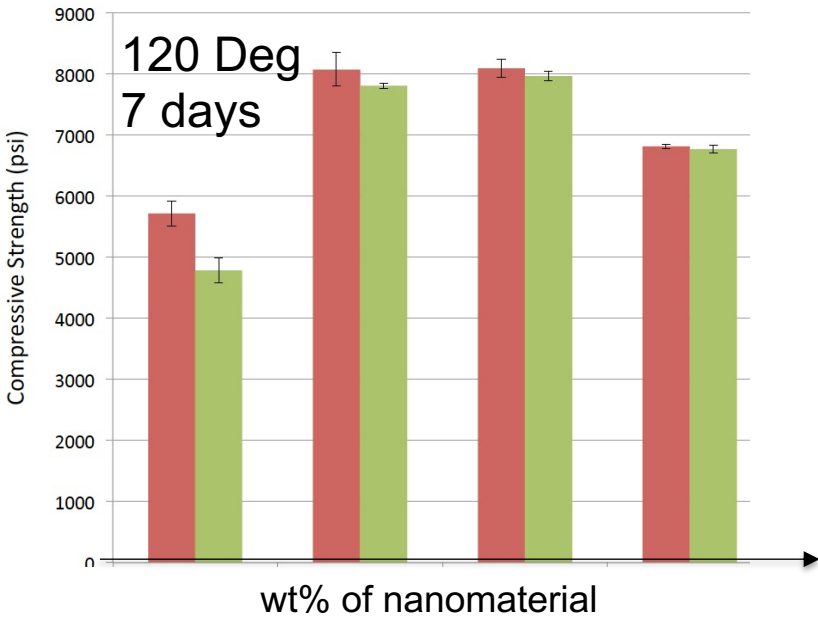


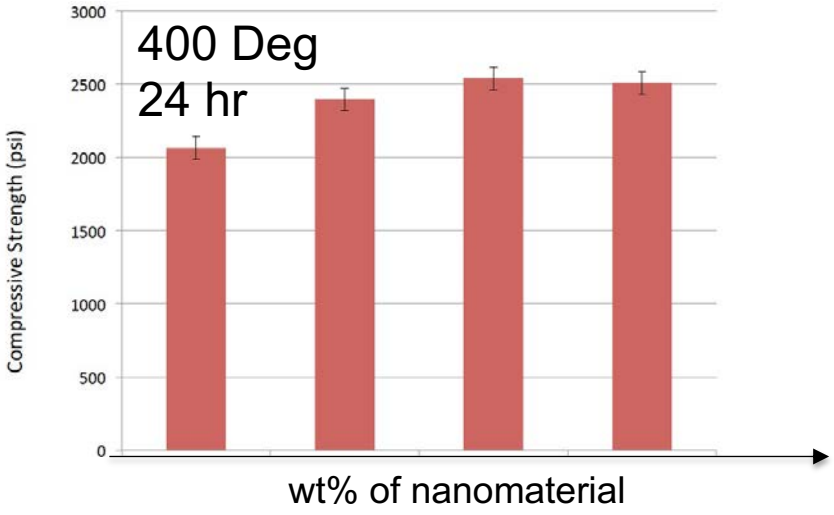
Control → After 3 hr Composite → After 3 hr

No free fluid with composite class H cement slurries

Extreme Conditions

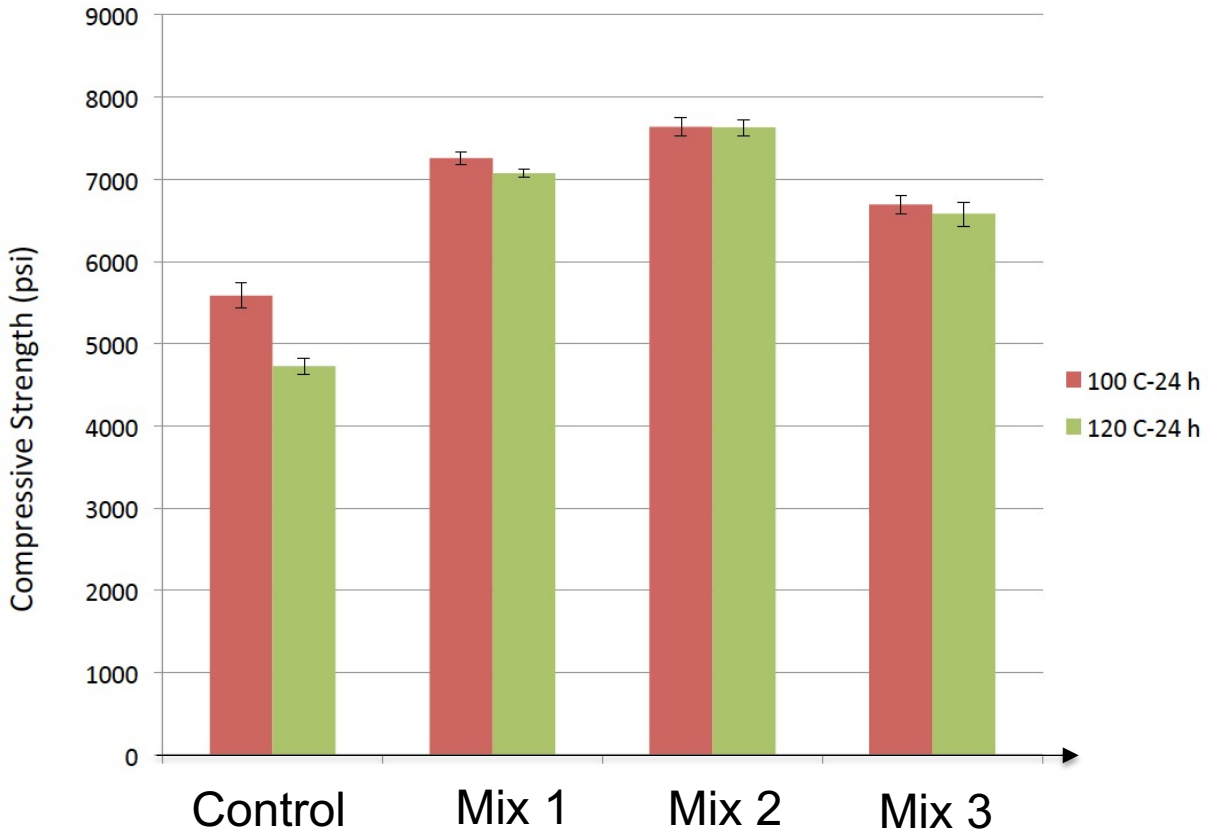






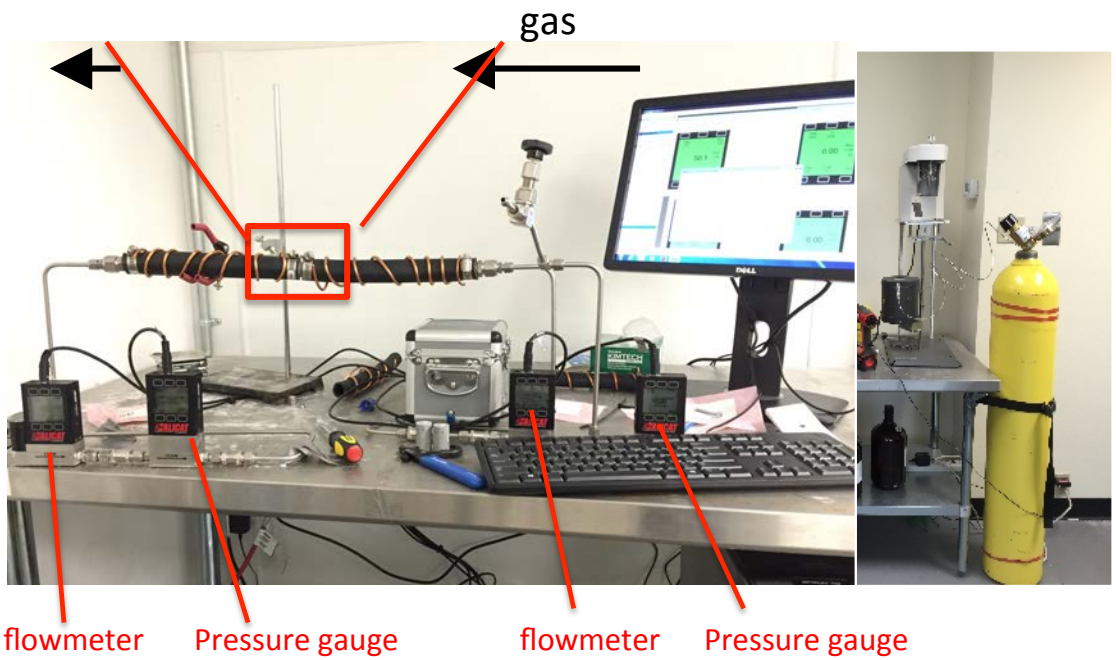
Significantly higher thermal tolerance vs control sample

High Temperature & Corrosion

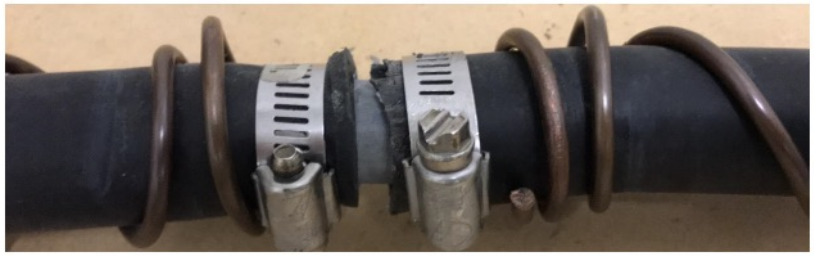


7 day strength after high heat and immersion in acidic solutions

Gas Leakage Performance



Leakage Barrier Performance after exposure to extreme conditions



Summary

- Created a hybrid well cement prototype that exhibits enhanced strength (>30%) with minimal nanomaterials--> Cost-effectiveness
- Best synthetic conditions to create/disperse ultrathin nanomaterials in cement → Scalability.
- A stable composite slurry with no fluid loss & great pumpability via >80% lower plastic yield → requiring less pump energy in the field
- Ability to tolerate and extreme conditions such as high T, corrosion and gas leakage → preventing spill

Acknowledgments

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