Programmable Sealant-Loaded Mesoporous Nanoparticles For Gas/Liquid Leakage Mitigation

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Outline

- Benefits to the Program
- Project Overview
- Technical Status
- Synergy Opportunities
- Accomplishments and Summary

Benefits to the Program

1) Our technology benefits the CCS program objective[1]:

✓ Works with a variety of CCS storage site material (concrete/cement, rock, metal).

✓ Fills nearly any size fluid escape channel (>50 nm).

✓ Easily integrates into existing remediation procedures.

2) Our technology benefits one of CCS program's main goals[2]:

✓ Programmable for specific conditions (high acidity, etc.).

✓ Designed to seal all types of fluid escape channels for over 99% gas/liquid barrier efficiency.

3) ↑ Durability/Stability = ↓ Cost = $$ Savings

4) Expediting CCS program = Faster reduction in environmental CO_2 = Reduction in Global Warming

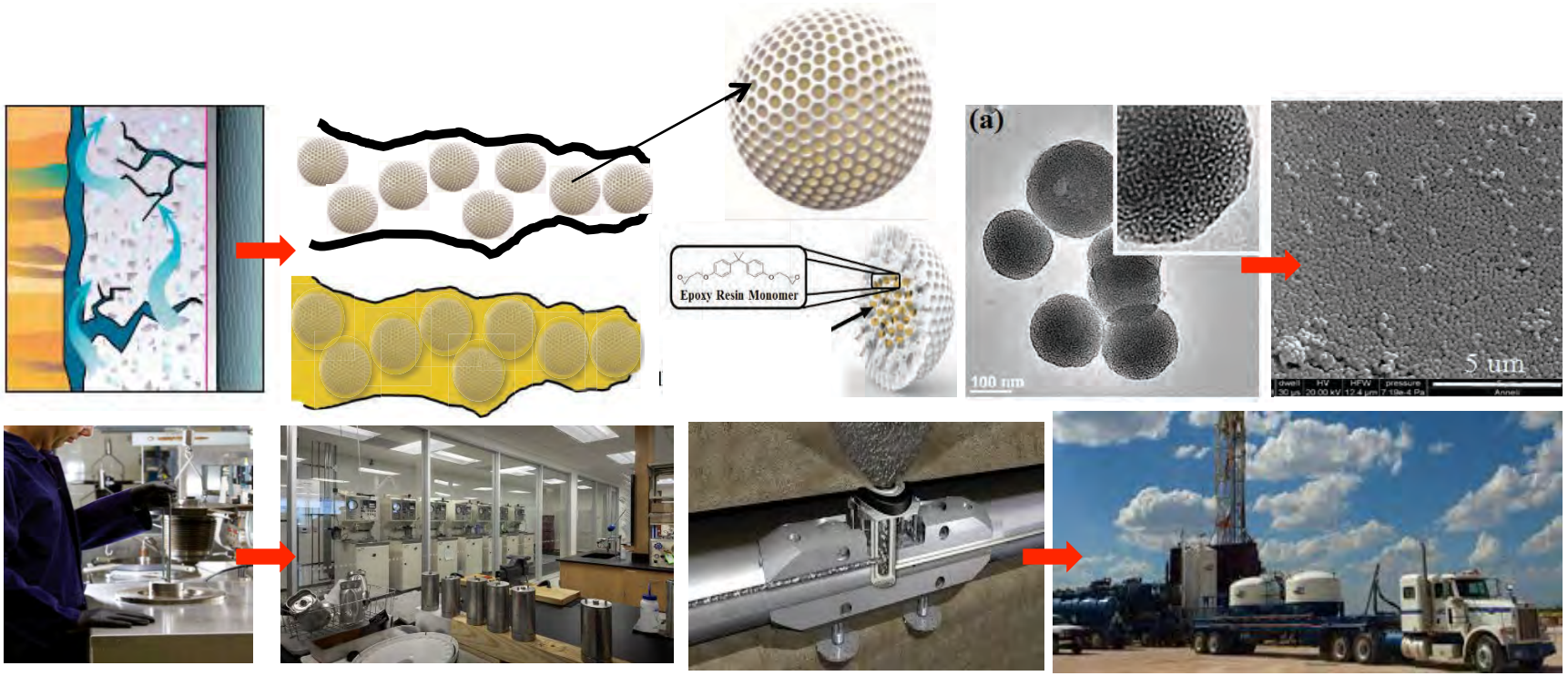
5) Multifunctional technology = Wide applicability = Extension to other industrial sectors (oil, construction, etc.)

[1]DOE's CCS program objective = "To develop and advance technologies that will significantly improve the effectiveness and reduce the cost of implementing carbon storage, both onshore and offshore, and be ready for widespread commercial deployment in the 2025–2035 timeframe"

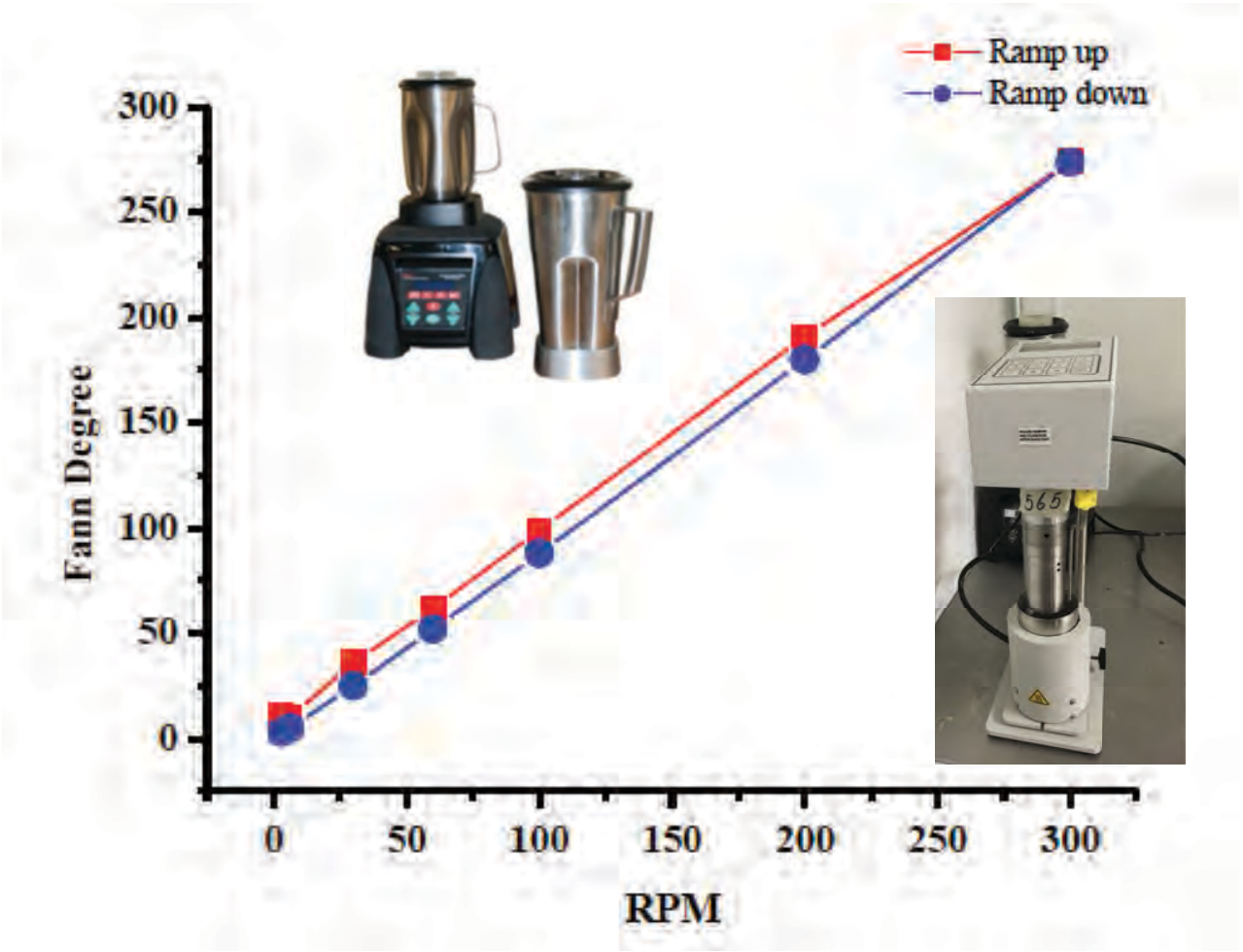
[2] A DOE's CCS goal = "Develop and validate technologies to ensure 99 percent storage permanence."

Overall Project Goal

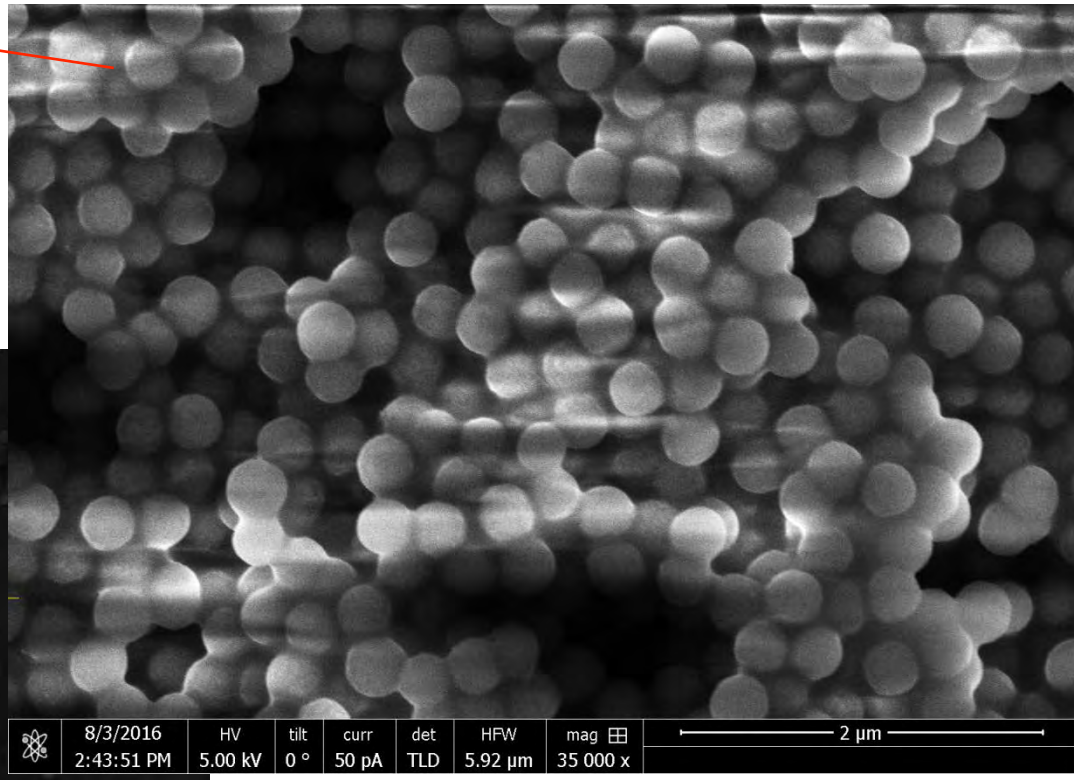
To obtain and validate a programmable nanocomposite technology that significantly mitigates gas/liquid leakage in wellbores.

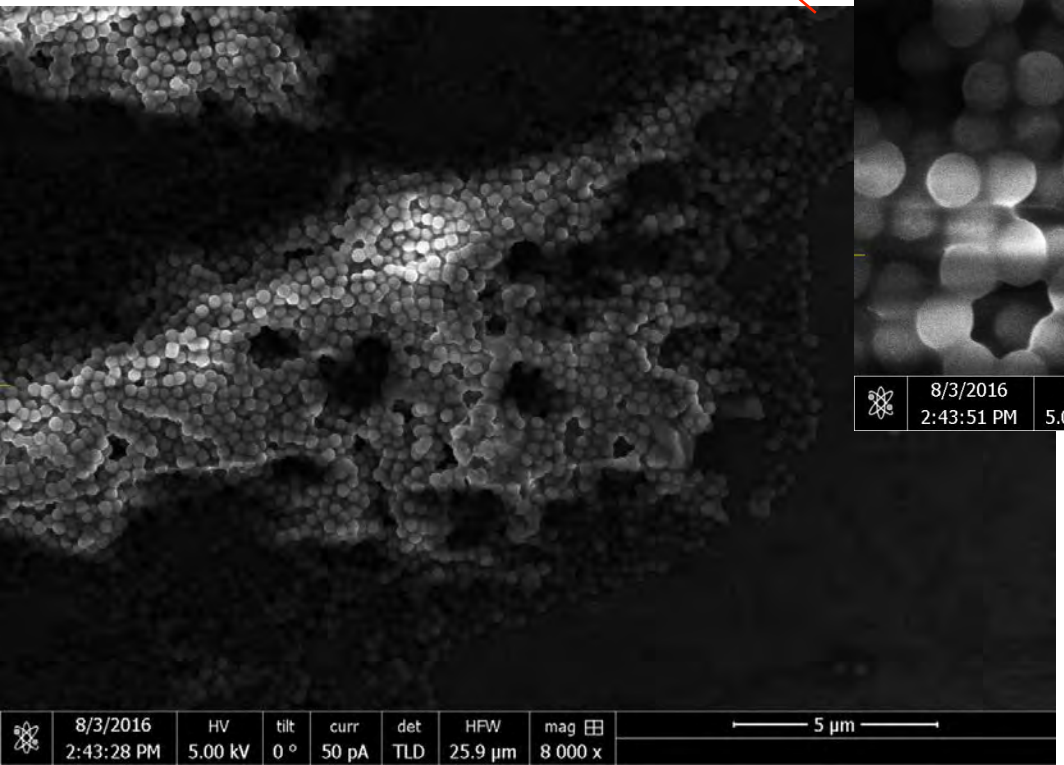


Strong & Pumpable in the Field



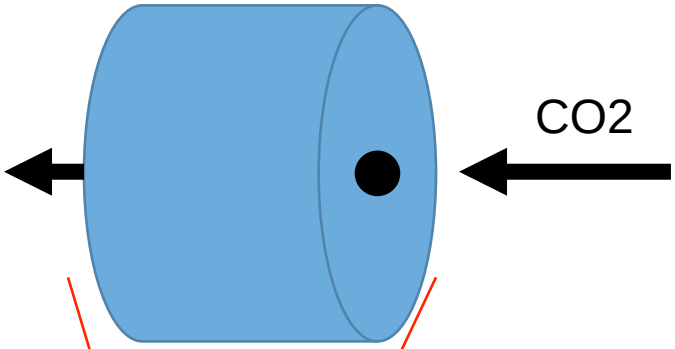
Structural and Leakage Characterizations

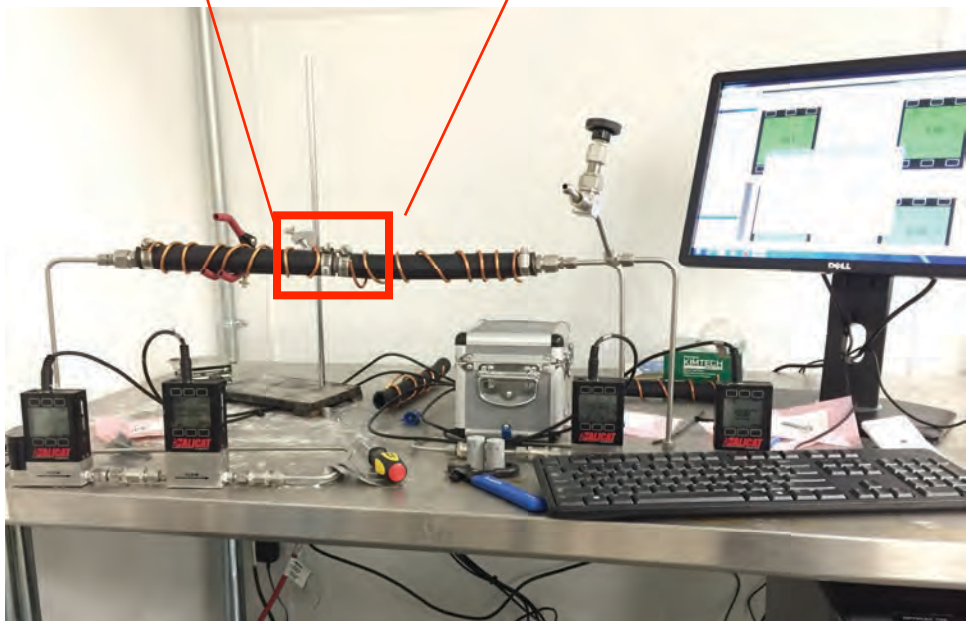




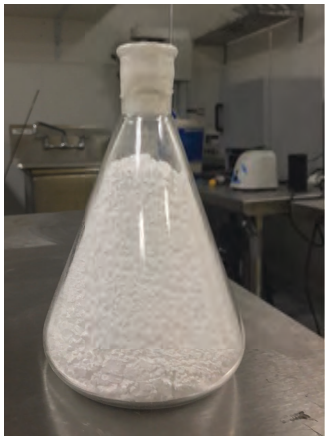
Permeation Testing

Results show promising CO_2 blockage



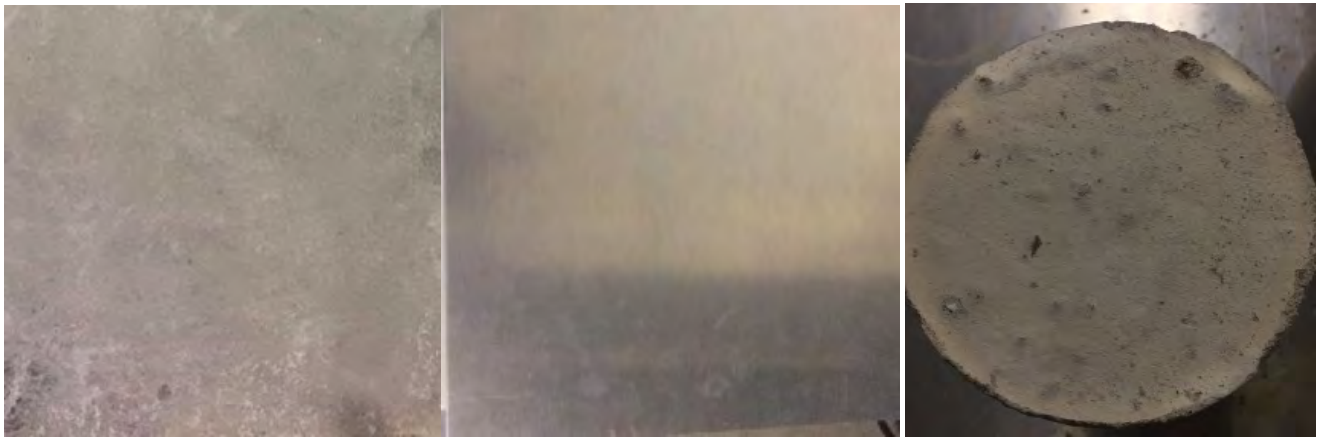


Scaled-up Reactions

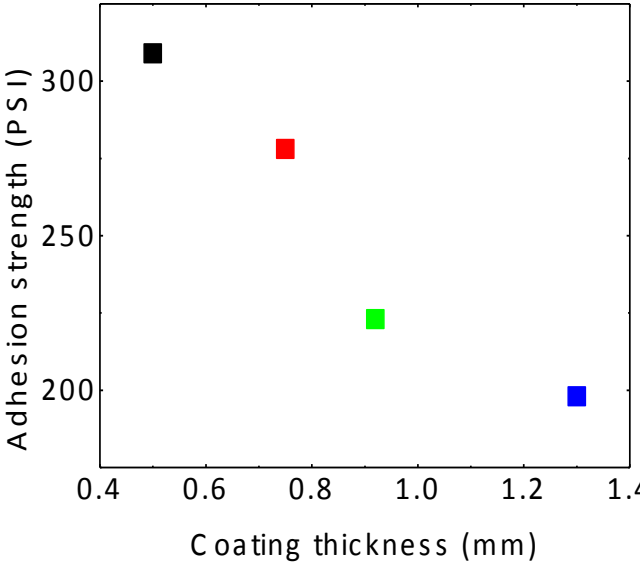


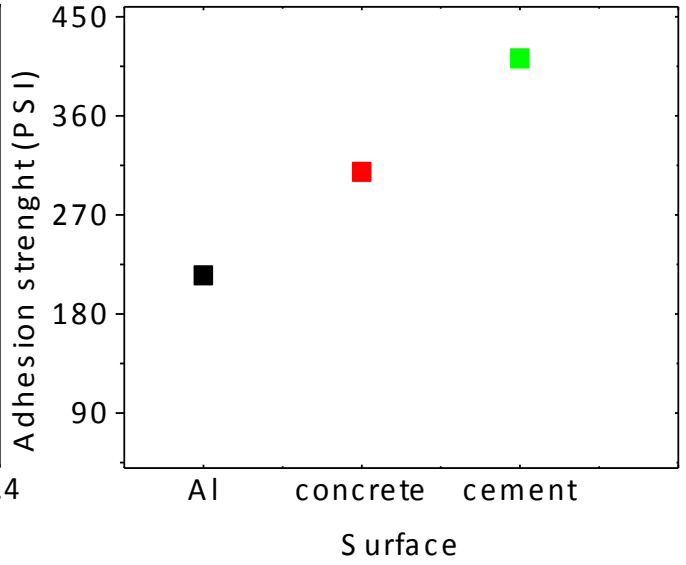
- Easily scalable via Industrial mixing vat and centrifuge
- No loss of consistency
- No loss of reproducibility

Adhesion Tests on Various Surfaces



Cement Surface **Aluminum Surface** **Concrete Surface**

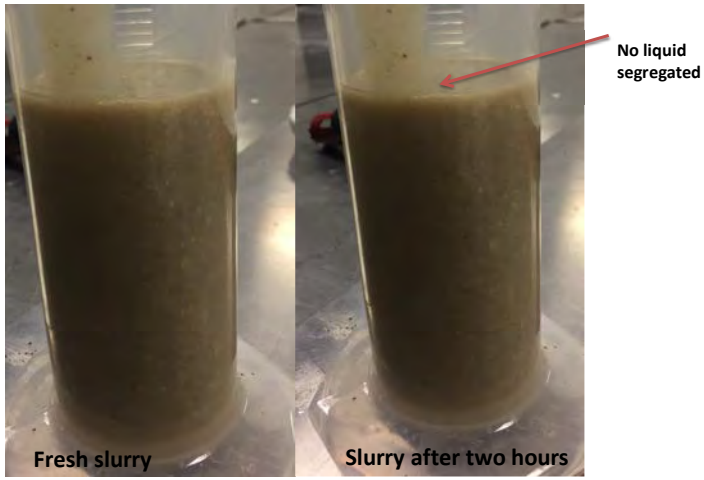




Several API Tests

Thickening time

High temperature viscosity



Free Fluid

Filter Cake

Testing and Running on various Industrial Centrifuges

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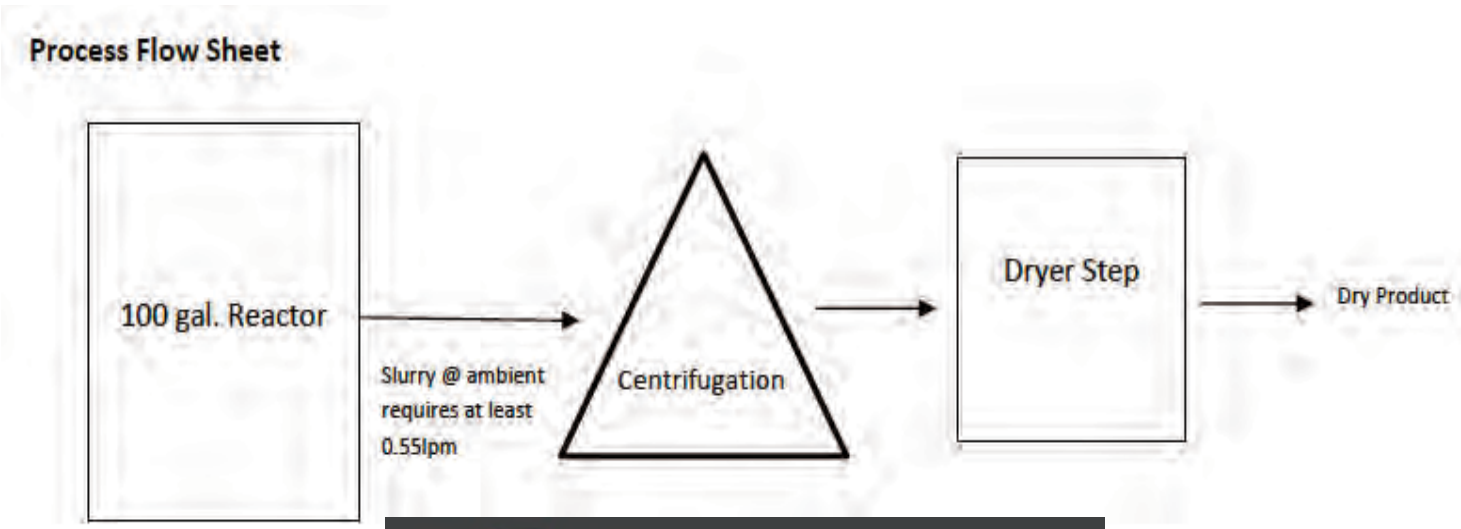

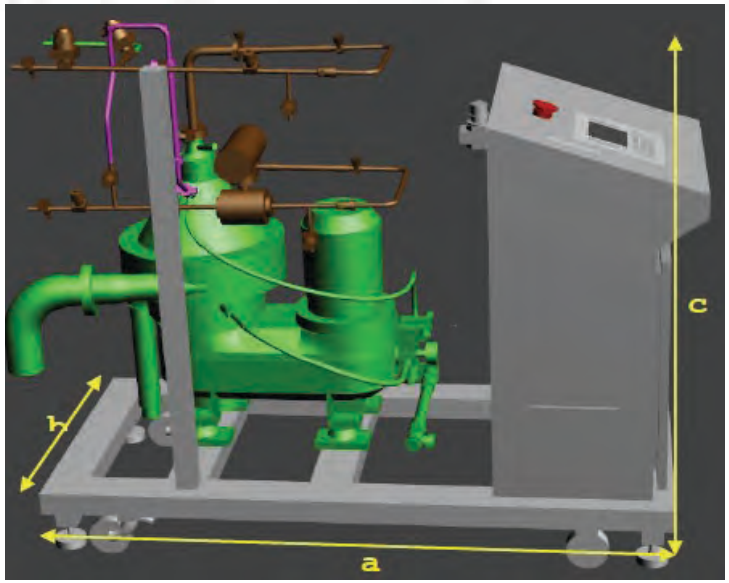

Mobile Unit/Field Test

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Synergy Opportunities

- Add other nanoparticles (e.g. microbes from Montana State Univ.) to the list of our sealants while providing feedback about the ability and effectiveness of those nanoparticles for sealing CO2 under wellbore conditions
- Use swelling-rate-controllable particle gels
- DOE National Labs

Accomplishments & Summary

1. Full synthetic control over particle size, composition and morphology -> programmable depending on the wellbore needs

2. Optimum ratios of sealants and its conjugates

3. High strength & low viscosity (pumpable in the field)

4. Meeting API tests, adhesion, carrier matrix, etc

5. Easy scale-up capability, centrifuge & field test