

An Innovative Process for the Direct Utilization of CO₂ in Solid Synthetic Pozzolan Production | IEDO

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Project Outline

Innovation: An innovative process for direct utilization of CO₂ in solid synthetic pozzolan production

Project Lead: Solidia Technologies, Inc.

Timeline: July 1, 2021 - March 31, 2023 (100% complete)

Budget:

	Budget Period 1			Budget Period 2				Total Planned Funding	
	FY21		FY22			FY23			
	Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Jan - Mar		
DOE Funded	\$ 249,415	\$ 133,582	\$ 266,803	\$ 215,777	\$ 587,731	\$ 345,459	\$ 268,391	\$ 2,100,000	
Solidia Cost Share	\$ 63,135	\$ 33,814	\$ 67,537	\$ 54,620	\$ 148,774	\$ 87,447	\$ 67,939	\$ 532,626	

End Project Goal:

1. Develop a process for producing a solid synthetic pozzolan through direct capture, utilization, and storage of CO₂ from the flue gas stream of an operating cement plant through reaction with Solidia Cement®, a non-hydraulic cement, without any disruption to the clinker production process
2. Use the carbonated Solidia Cement as a supplementary cementitious material (SCM) in concrete with comparable or superior performance to concrete with traditional SCMs such as fly ash and slag cement

Strategic Approach

REDUCE CO₂ Emissions



Cement Plant
↓ calcination CO₂
↓ thermal CO₂

USE & STORE Waste CO₂



SCM Processing
*Active functional,
synthetic pozzolan*

Fundamental process development

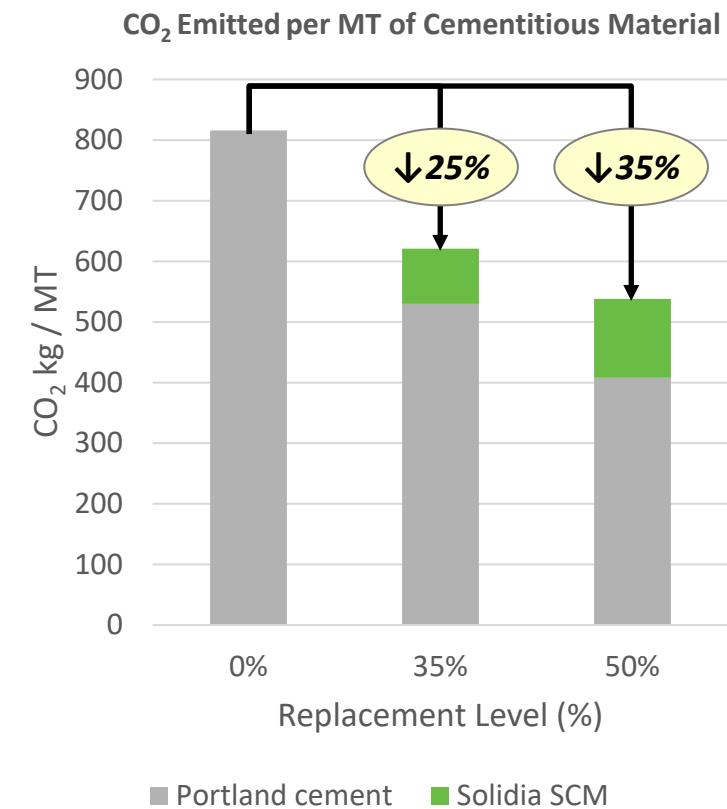
- carbonation
- flue gas utilization

Concrete

Product Performance Validation

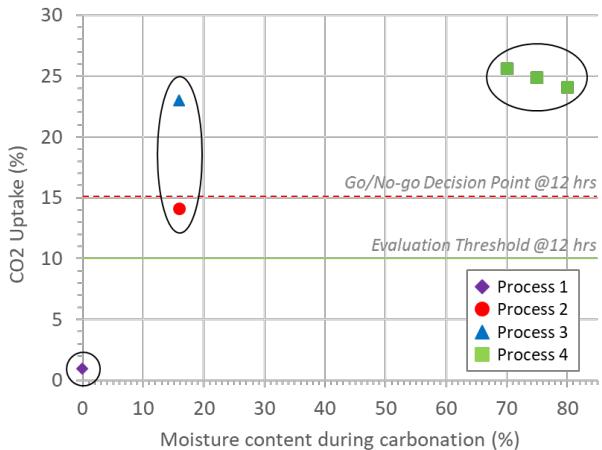
- workability
- strength & durability

AVOID high embodied CO₂

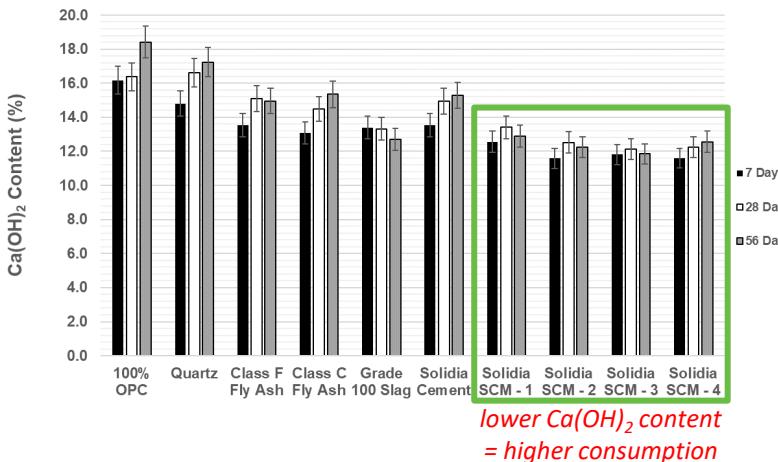


Results and Achievements

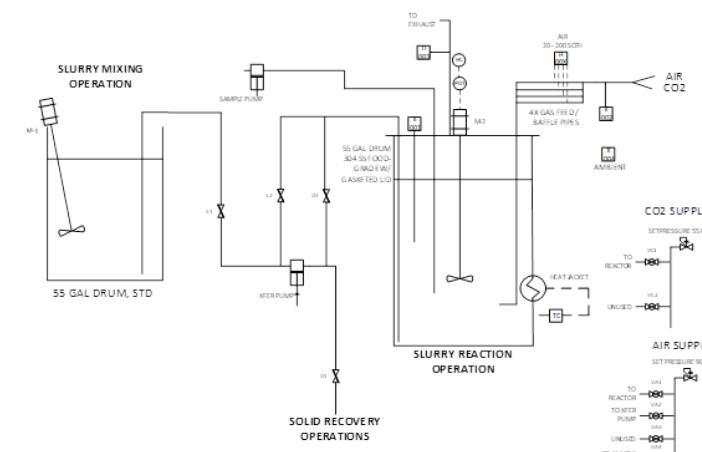
Carbonation: Two methods meet CO₂ uptake and time thresholds



SCM Viability: The resulting product has high pozzolanic activity



Process: Designed a slurry reactor

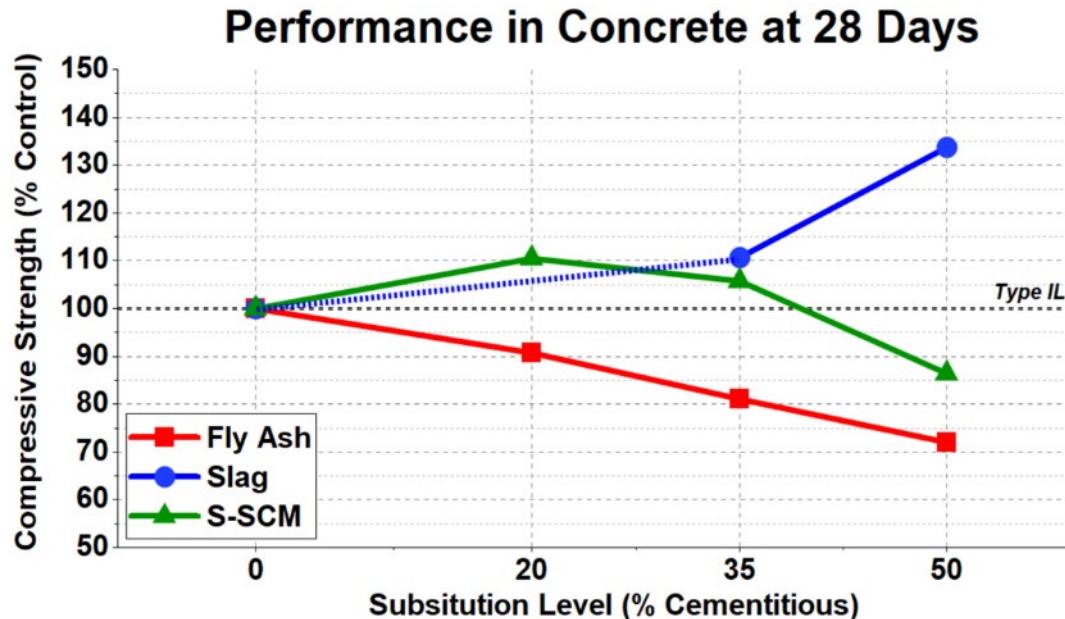


Production: Built the batch reactor



Results and Achievements

Comparable performance to traditional SCMs



Type II Cement
Lean mix 460 lbs/yd³
Concrete W/C = 0.45
Slump target 6 ± 1 inch

Compressive Strength of Control
1 day : 2500 psi
7 days: 4390 psi
28 days 4860 psi

Confidence following suite of ASTM tests

- ASTM C1567: Alkali-Silica Reactivity (ASR)
- ASTM C1202: Chloride Permeability
- ASTM C1157 & C595: Sulfate Expansion
- *completing all tests per ASTM C1709*

Future Work, Technology Transfer, & Impact

Future Work:

- Commission large lab line at HQ to produce 1,000 MT per year of Solidia SCM to seed market (material qualification and trial pours with DOTs and ready-mix producers)

Technology Transfer:

- Build pilot line at a cement kiln for direct utilization of flue gas CO₂ to produce and deliver Solidia SCM into the market
- Extend technology application to waste streams to reduce CO₂ footprint and expand market access (remove supply chain constraints)

Impact:

- Grant provided access to critical resources (people, equipment, labs) necessary to conduct experiments, measure impact, and develop repeatable process and product
- Accelerated development to prove viability and instilled confidence in next phases of investment