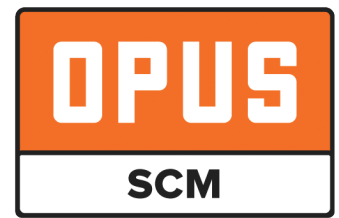


Technical Bulletin

Performance of OPUS SCM with granitic feedstock



Why use OPUS?

Substituting OPUS SCM for fly ash in concrete results in performance and strength that is on par with fly ash. OPUS has been tested under a wide variety of conditions to ensure its durability and strength meets or exceeds equivalent concrete batched with Class F fly ash. OPUS SCM has similar results for time of set, workability, and bleeding in concrete as compared to concrete batched with Class F fly ash.

Terra's OPUS SCM also presents a solution to the decreasing supply of Class F fly ash sources as coal-fired plants are either converted to gas-fired plants or shutdown.

OPUS SCM has been evaluated in accordance with ASTM C1709 and meets all requirements for a Class F fly ash or Class N Pozzolan.

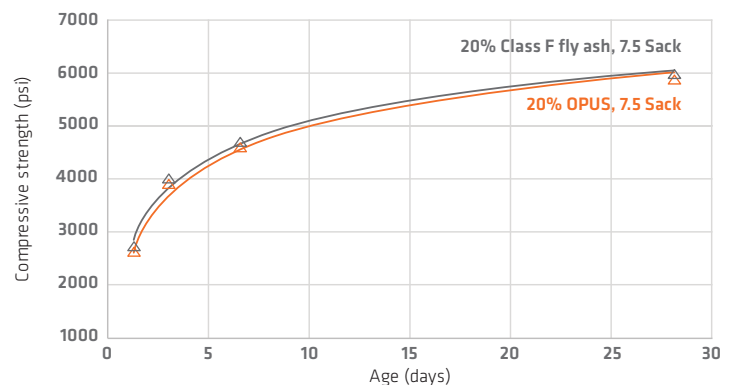
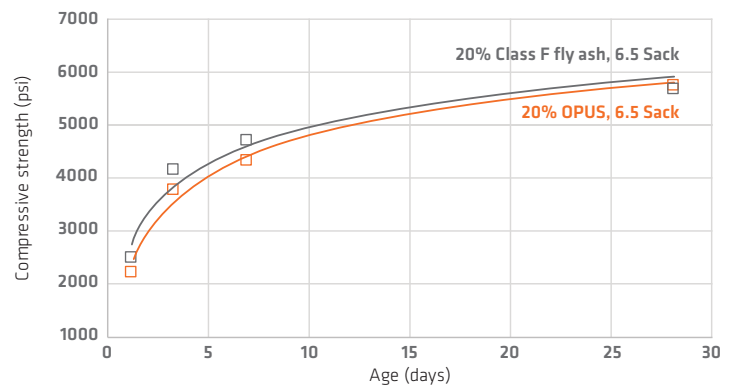
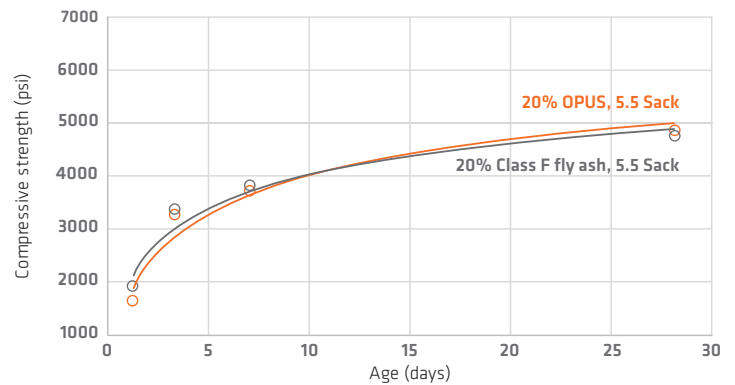
All testing has been performed by an AASHTO accredited third party laboratory. All cement, fly ash, and chemical admixtures were sourced from AASHTO accredited national and international suppliers. Additionally, aggregates utilized were sourced from major suppliers in the local market.

Per the requirements of the Buy America Act under section 1605 of the American Recovery and Reinvestment Act, OPUS is qualified as being goods produced in the United States using Raw Material Sourced from the United States.

Application Guidelines

Concrete properties depend on the characteristics of the aggregate, sand, water, and cement used, as well as the batching and curing processes. OPUS SCM has consistently performed well during repeated tests in laboratory conditions. Terra recommends that end-users test OPUS SCM in concrete mix designs using their local materials to confirm performance.

Strength of OPUS SCM vs. Class F fly ash in concrete

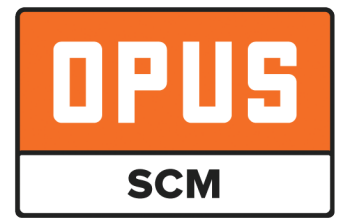


For additional information, please contact us:

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Technical Bulletin

Properties of OPUS SCM in concrete



Summary of ASTM Test Results

ASTM Standard	Unit	5.5 Sack		6.5 Sack		7.5 Sack	
		570 lbs/yd ³		611 lbs/yd ³		705 lbs/yd ³	
		OPUS Mix	Control Mix	OPUS Mix	Control Mix	OPUS Mix	Control Mix
C39: Compressive Strength at 28 days	psi	4,870	4,770	5,820	5,770	5,930	5,980
C78: Flexural Strength	psi	750	690	810	740	890	840
C138: Unit Weight	pcf	145.6	145.8	145.4	146.8	145.8	145.2
C143: Slump retention at 90 minutes	%	N/A	N/A	38%	35%	N/A	N/A
C403: Initial Time of Set	Hours: Minutes	5:41	5:27	5:42	5:30	5:18	4:47
C403: Final Time of Set	Hours: Minutes	7:18	7:44	7:07	7:00	6:34	6:14
C157: Length Change	%	0.03%	0.03%	0.04%	0.04%	0.04%	0.04%
C1012: Length Change by Sulfate Exposure	%	N/A	N/A	0.02%	0.02%	N/A	N/A
C1202: Chloride Permeability	N/A	Low	Low	Low	Low	Low	Low
C232: Accumulated Bleed Water	%	1.43%	1.21%	1.24%	1.15%	0.90%	0.55%
C469: Modulus of Elasticity	psi	5.25×10^6	5.46×10^6	5.64×10^6	5.88×10^6	5.81×10^6	6.11×10^6

Note: all concrete mixes above used 20% SCM by mass. The control mix was poured using a Class F fly ash. Each mix had a target slump of 4" and was poured at an average temperature of 75 °F.

Terra recommends proper testing of concrete mix designs before use as chemical variability of feedstock will alter results.



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