



sCMT
—
sustainable
Cementitious
Materials
Technology



WHITEPAPER

INTRODUCTION

The cement industry is a major contributor to carbon dioxide emissions annually. Portland cement dominates in the construction industry. It is typified by vast mining of raw materials, extensive processing, and large amounts of waste generated such as kiln dusts and carbon dioxide (CO₂).

Each tonne of portland cement produces approximately one tonne of CO₂. It is fortcem's mission to help minimize these and other emissions by marketing and producing an alternative hydraulic cement. This cement is competitively based on performance and cost. Other benefits are realized with fortcem sCMT products.

Fortcem's sCMT is based on beneficial reuse of industrial by-products thereby minimizing the impact to the environment. These by-products are available practically everywhere adding the further benefit of lower transportation costs. Other components are agriculturally derived, lowering the carbon footprint to essentially zero. Fortcem's sCMT also alleviates some of the difficulties with construction in difficult climates. No longer are temperature constraints an issue of work completion.

THE PRODUCT

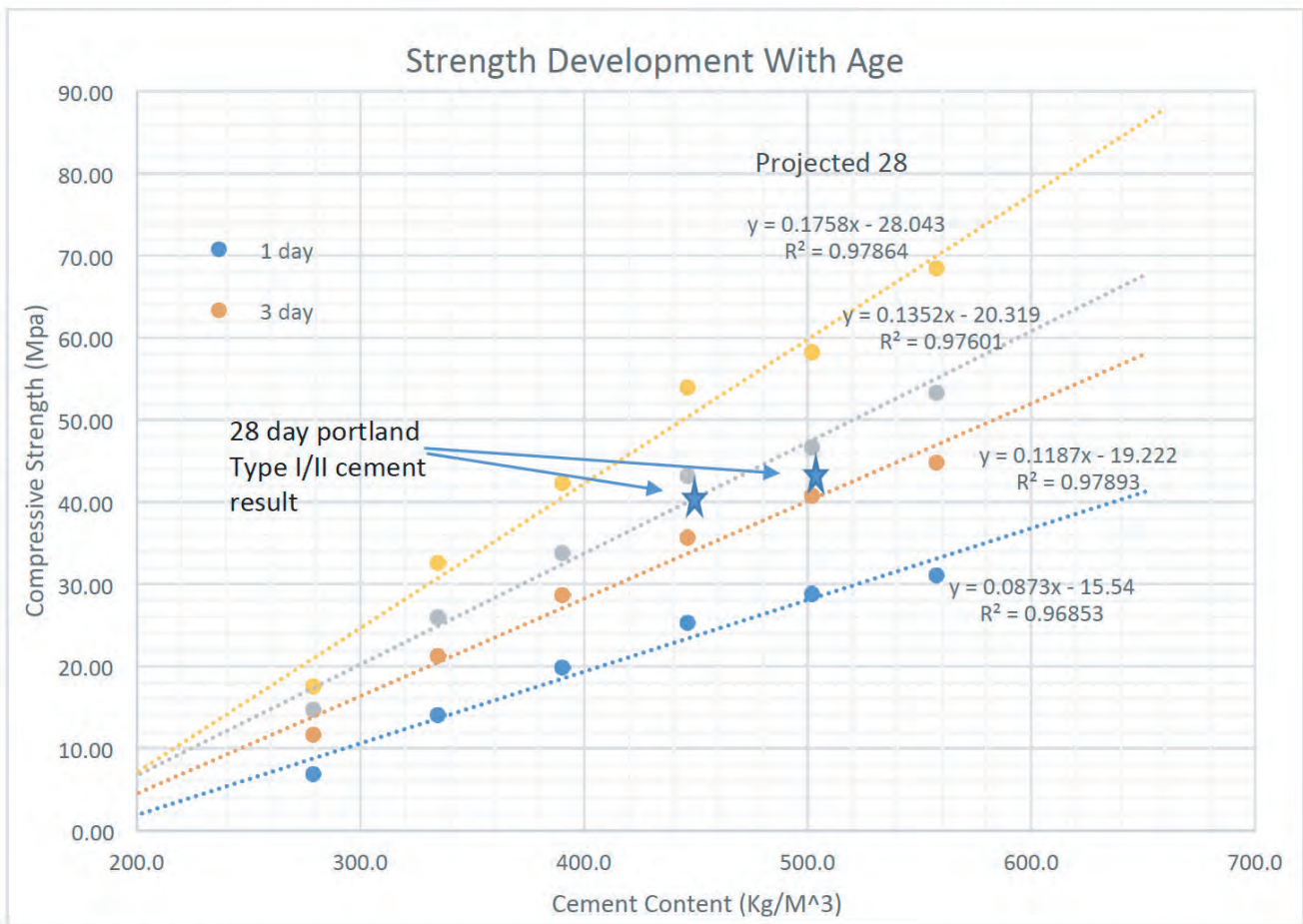
Unlike portland, fortcem's sCMT is an all-purpose composition. Fortcem sCMT meets EN197 specifications for a 52.5 cement, except for composition. Additionally, sCMT meets all specification for ASTM type I, II, III, IV, and V. It is comprised of a three-part system of powder binders and liquid chemicals. By varying the chemicals and keeping the total mixture constant, performance may accommodate any temperature or speed of construction concerns. Data shown below was generated at standard laboratory conditions. Similar performance would be expected at higher temperatures by increasing the component containing the retarding chemicals or decreasing them in the case of lower temperatures. In all instances the total cement or binder content does not change.

PERFORMANCE

Fortcem cement may achieve a wide range of strength, only requiring proportion changes to the concrete design. Mixtures ranging from as little as 258 Kg/M³ to 558 Kg/M³ will achieve both common normal strength mixtures and also high-performance mixtures. Higher strengths may be achieved when needed with minor changes. Portland cement mixtures either require chemicals referred to as admixtures to accomplish this range or special formulations in the base chemistry or both to accomplish this. This leads to added costs in the production of the grouts, mortars, or concrete.

Test data for fortcem sCMT performance is shown below. The formulations for these mix designs was in accordance with American Concrete International Standard 211.1-4, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete. This test data, unlike portland, represent air cured samples (23± °C and ambient (~50%) RH). The target requirements of the below mixtures are 100 mm slump and a set time of approximately 4 hours. The testing conditions for portland cement are biased to give the best possible results which normally are not attainable.

For comparative purpose, limited results from a similar design performance utilizing portland cement has been included. As seen, portland 28 day results are achievable in only 7 days with sCMT. One point to note, with higher cement contents there is beneficial effect to slump increase without water change. This is the case of the 500Kg/M³ and 550 Kg/M³ mixes. Conversely low cement contents strength development is less due to increased water demand. The performance of these mixes may be improved with a proportioning change to reduce the effect of the additional fine aggregate used.



Benefits of utilizing sCMT is seen another way. In the case of what would normally be considered structural concrete the below table shows the relative strength difference between portland and sCMT mixtures. Options now exist to either yield higher strength concrete or the ability to reduce the binder content and cost per cubic meter.

Average strength gain per Kg (MPa)			
	Portland	sCMT	Increase
1 Day	0.051	0.055	107%
3 Day	0.064	0.079	124%
7 Day	0.073	0.093	127%
28 Day	0.084	0.117	140%

PROPERTIES

- 0°F-122°F
- Color from Grey to Buff Yellow
- Low Water to Cement Ratios (0.15 to 0.30)
- Temperature Compensated Time of Set
- Performance from 0 ° C to 50 ° C
- High Density
- Heat Of Hydration < 60 cal/gram
- Strength Maximum > 20,000 Psi (140Mpa)
- Bond Strength – will bond to Portland concrete as well as self.
- No special curing conditions required.
- No specialised Admixtures required except where air entrainment is needed.

ADVANTAGES FOR CONTRACTORS

Easy to apply and work with.

Sustainable cement can be mixed in all standard industry mixing apparatus including barrel mixers, pan type turbo mixers and continuous mix systems. Depending upon product or project specifications, Sustainable Cement Technology may require standard industry portland cement concrete admixtures such as AEA's & SRA's. Other admixtures used with portland cement are no longer needed.

Working times, slump, strength development and finishing times can be easily adjusted by varying Sustainable Cement liquid additive ratios.

Concrete construction contractor will see little difference in handling sCMT concretes compared to traditional portland cement concretes. sCMT's concretes can be pumped, placed and finished in the same manner with the same tools and equipment as portland cement concrete mixes and they are safer to handle without risk of cement burns.

Concrete mix designs can be easily adjusted for warm or cold weather, slump and set times. Concrete can be delivered in both standard drum transit trucks or volumetrically. Some of Terra's specialty cements can actually be site activated for remotely located projects or to facilitate unique project timelines.

Cured sCMT concrete is self-drying, enabling coating with as early as 72-96 hours ensuring you can keep the job moving, leveraging the limited amount of shut down times available on industrial projects. Enhanced curing rates and high early strengths allow for vertical construction to begin much sooner in the construction timeline.

APPLICATIONS

Sustainable Cement is a general use, planet friendly, sustainable solution for a wide variety of concrete construction applications. sCMT concrete is suitable for roads and bridges, aviation runways, boat ramps, building foundations, roller compacted concrete, precast concrete products and most any other new construction application.

Place concrete in accordance with [ACI 301] [ACI 318].

Finish concrete floor surfaces in accordance with [ACI 301] [ACI 318].

Cure floor surfaces in accordance with [ACI 308.1] [ACI 301] [ACI 318].

Meets or Exceeds ASTM-C-1157 and 1600 Specifications.

ROAD CONSTRUCTION

Environmental Benefits of a One Mile, Two Lane Roadway Constructed With sCMT Concrete In Place of Portland Cement Concrete (12 foot lane widths)

Total concrete required = approximately 4,700.00 yards for one mi

- Eliminates 1544 tons of CO₂
- Diverts 1544 tons of fly ash from landfills
- Reduces water demand by 66,232 gallons (uses less mix water)
- Preserves 78 tons of virgin mineral resources
- Utilizes rapidly renewable resources
- 1738 barrels of crude oil

SCS provides low permeability, exceptional freeze-thaw, scaling and sulfate resistance coupled with an inherent immunity to an alkali silica reaction (ASR).



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Using data from the table above a concrete may be proportioned using forty percent (40%) less binder while achieving the desired strength. The saving in material costs can be significant. The table below illustrates the difference in both the savings afforded by switching to fortcem sCMT on a one to one basis, as well as on an equal performance basis (at 28 days). This table reflects a price of portland at \$110 per tonne.

Percent of portland cost			95%		Reduced sCMT	
Kg/M ³	Portland	sCMT	Savings/M ³		Binder Content	Savings/M ³
223	\$ 24.53	\$ 23.30	\$ 1.23		Not recommended	
278	\$ 30.58	\$ 29.05	\$ 1.53		Not recommended	
334	\$ 36.74	\$ 34.90	\$ 1.84		200.4	\$ 20.94
390	\$ 42.90	\$ 40.76	\$ 2.15		234.0	\$ 24.45
446	\$ 49.06	\$ 46.61	\$ 2.45		267.6	\$ 27.96
501	\$ 55.11	\$ 52.35	\$ 2.76		300.6	\$ 31.41
558	\$ 61.38	\$ 58.31	\$ 3.07		334.8	\$ 34.99

Of course, the performance of any mix design needs validation with local materials and some adjustments will be warranted effecting the final cost benefit.

SUSTAINABILITY

Fortcem sCMT is uniquely a sustainable product. Currently there are no other commercialized products that can make the claim of zero carbon footprint. This positions products made with fortcem sCMT in an unparalleled category. Both from the fact that all components are beneficially reused to produce new products but also the reduction of cementitious materials needed to make those products. Fortcem sCMT offsets about one tonne of CO₂ from the manufacture and use of portland cement.

Consequently, reductions of green-house gas emissions may be reduced by up to 140%!

Concrete products utilizing fortcem sCMT is advantageous. Utilizing sCMT in your grout, mortar or concrete may result in:

- Lower costs
- Design changes utilizing less cement providing carbon credits
- Design changes producing higher strength leading to taller buildings or longer span lengths of equal dimension
- Productivity increases providing quicker time to service. More rapid strength development leads to decreased turnaround times and increase productivity.