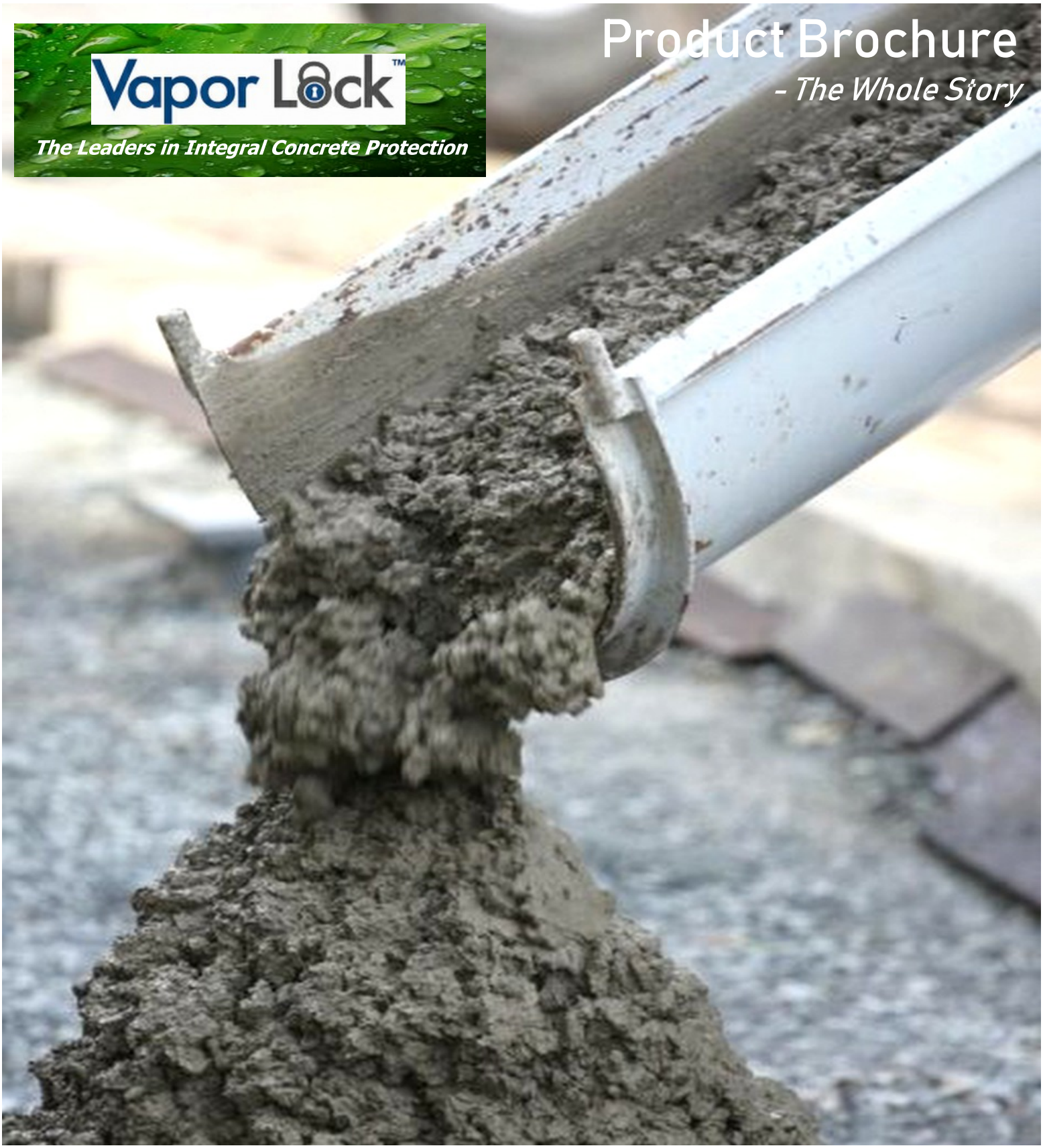
Vapor Lock™

The Leaders in Integral Concrete Protection

Product Brochure

- The Whole Story



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DURABILITY Consultants

"Enhancing the Capabilities for Those Who Build with Concrete"

concrete noun

con·crete | \ ˈkän-ˌkrēt

Definition 1 : a mass formed by concretion or coalescence of separate particles of matter in one body

Definition 2 : a hard strong building material made by mixing a cementing material (such as portland cement) and a mineral aggregate (such as sand and gravel) with sufficient water to cause the cement to set and bind the entire mass

CONCRETE in conjunction with steel is arguably the greatest achievement mankind has ever invented. The synergistic combination of both serve as the foundation of every city in every country on the planet. Concrete, the main "protective component" of Reinforced or Structural Concrete through implication, is supposedly completely "***solid"*** and "***lasts Forever"***. Our goal here is to constructively and respectfully illustrate ...both are false!

We welcome you to take 20 minutes of your time to examine our value proposition on how you can economically and efficiently make your concrete closer to ***100% solid*** and ***last 2 - 3 times longer.***

Thank you in advance for your time -

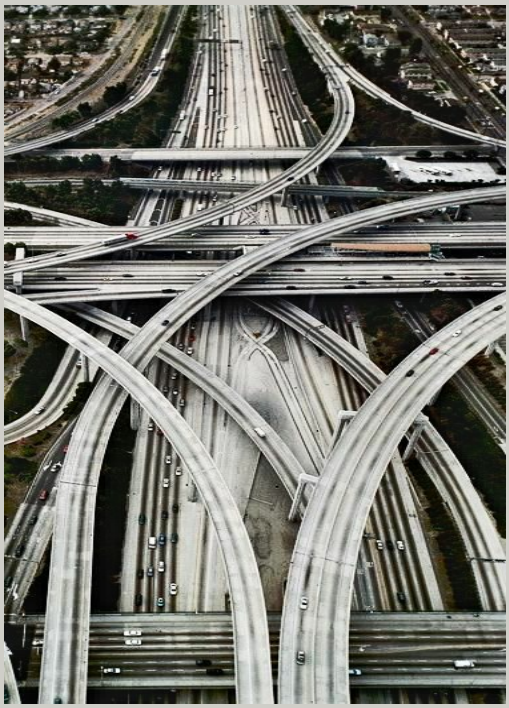
Vapor Lock™ is based around Nano-Silica & Lithium Technology, and is a precise and timely answer to formulating natural, permanent and efficient results in Portland Cement Concrete. Vapor Lock is a liquid pozzolanic admixture that works with the calcium hydroxide (present naturally in cement hydration) and water of convenience (extra water not used in cement hydration) to produce relatively large amounts of additional calcium-silicate-hydrate (c-s-h) gel that permanently disrupts the capillary system formation and locks in the moisture present for superior cement hydration. From this basis of design, we modify specific formulations to address project specific applications that are warranted and insured to meet and exceed real-world, project specific testing levels. This process produces a superior, denser concrete characterized by lower Long-Term Shrinkage with an Ultra Low Permeability. These qualities are based on the lightest Carbon Footprint coupled with the most attractive price point in the marketplace - relevant for almost every project.

CSI MasterFormat Areas of Focus with Vapor Lock:

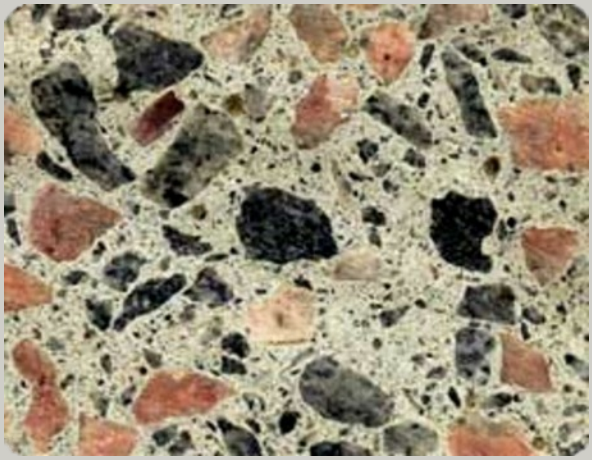
CSI Building Knowledge Improving Project Delivery

03 00 00 - Concrete
03 05 12 - WATERPROOF CONCRETE CONSTRUCTION
****03 05 13 - CONCRETE MOISTURE VAPOR REDUCING ADMIXTURE (MVRA) & POROSITY INHIBITING ADMIXTURE****
03 30 00 - Cast-in-Place Concrete
03 40 00 - Pre Cast Concrete
03 50 00 - Cast Decks and Underlayment
03 70 00 - Mass Concrete
07 00 00 - Thermal & Moisture Protection
07 01 00 - Operation & Maintenance of Thermal & Moisture Protection
*****There are several areas in this section that should be cross-referenced with 03 00 00 sections*****
07 10 00 - Damp-proofing & Water-proofing
07 16 00 - Cementitious & Reactive Waterproofing
07 40 00 - Roofing & Siding Panels
07 50 00 - Membrane Roofing
09 00 00 - Finishes
09 60 00 - Flooring
09 65 00 - Resilient Flooring
*****09 65 13 - MVRA WARRANTY & INSURANCE*****
09 70 00 - Wall Finishes
09 90 00 - Painting and Coating
31 30 00 - Earthwork Methods
31 32 33 - Shotcrete Soil Slope Stabilization
31 32 36 - Soil Nailing

BACK STORY



Concrete has long been considered one of man's most awesome achievements. Joseph Monier (1823-1906) a gardener, who began using steel and concrete, *together*, often gets the credit as the "Father of Reinforced Concrete" by his early, practical applications of both. Regardless, by inspecting anywhere in the world, one can argue the synergies of concrete and steel are truly one of the most important and practical systems ever invented. Be it structural highway overpasses, building foundations, dams, or over a 1,000 different applications, concrete & steel have been the prime component on which our civilization will be ultimately judge upon. Any city, in any country will lay testament to vastly improving the quality of our existence as a whole - Reinforced Concrete.



Merriam-Webster defines Concrete as :a hard strong building material made by mixing a cementing material (such as portland cement) and a mineral aggregate (such as sand and gravel) with sufficient water to cause the cement to set and bind the entire mass. The National Ready Mix Concrete Association goes further - "In its simplest form, concrete is a mixture of paste and aggregates (sand & rock). The paste, composed of cement and water, coats the surface of the fine (sand) and coarse aggregates (rocks) and binds them together into a rock-like mass known as concrete."

"Within this process lies the key to a remarkable trait of concrete: it's plastic and can be molded or formed into any shape when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks, and superhighways, houses and dams" - NRMCA.

The ingredients of concrete haven't changed much since the early 1900s, when the combination of steel and concrete skyrocketed. What has changed is the availability of new and beneficial admixtures used in concrete. In past times, concrete admixtures were mostly used in extreme conditions; i.e. extreme hot or cold weather for example. Today, admixtures are used on a daily basis to achieve High Performance Concrete mixes.

FOCUSING ON WHERE THERE ISN'T ANYTHING

The way concrete dries, cures, and hydrates (three distinct actions) all have to do with water leaving concrete. The voids, holes, cracks, and fissures that was once occupied by water (and un-hydrated cement) all become and contribute to a capillary system. This mechanism of concrete 'getting hard' is the same mechanism that acts as Concrete's 'Achilles heal' or vulnerability. Deleterious materials may enter into the concrete matrix, migrate towards the structural steel and eat away and weaken it. Or, it may allow moisture from within the concrete or from the sub-base below, to migrate upwards and manifest itself from failed flooring and coatings, to promoting "sweating slab syndrome", to poor roofing installations, to promoting mold and bacteria - all costly, negative impacts.

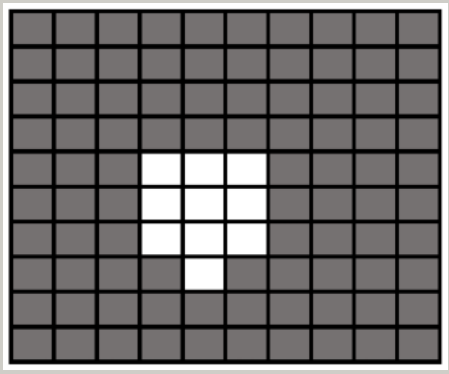
Since the 1950s, there have been studies on the benefits of a disruptive capillary system (Powers, Copeland and Mann) - Capillary Continuity Or Discontinuity in Cement Pastes. The concept of a "…dense, compacted concrete…" and the strong correlation to a "durable" concrete is born. From here numerous studies on both the permeability and durability characteristics of concrete have branched off from this primary starting point - a *Disrupted Capillary System*.

Two men, Professors Hamlin Jennings and Jeffrey Thomas, took up this concept and performed some of the most significant work in the '90s. Both from the Dept. of Civil & Environmental Engineering at Northwestern University (Evanston, IL), in 2010 were the driving forces in MIT's Concrete Hub creation - https://cshub.mit.edu/ This served as a platform for their work involving the first fully quantitative model of the nanostructure of calcium silicate hydrate (C-S-H), the major component of hydrated cement. This allowed for the first time the measurement of the capillary system in concrete - or where there is nothing….only air and quantifying the weak part of concrete.

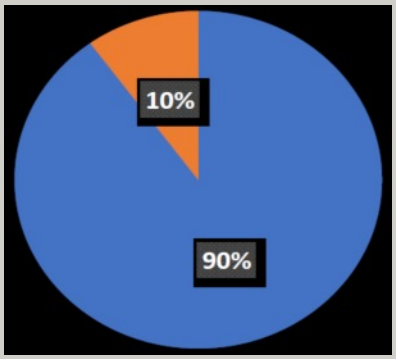
Table 5.1: Phase data for a Type I OPC paste made with a w/c of 0.45.

Phase	Density (g/cm^3)	Volume % At Mixing	Volume % Mature Paste
C_3S	3.15	23.40	1.17
C_2S	3.28	7.35	0.78
C_3A	3.03	4.42	0.00
C_4AF	3.73	2.87	1.39
Gypsum ($C\bar{S}H_2$)	2.32	3.47	0.00
C-S-H (solid)[a]	2.65	0	29.03
C-S-H (with gel pores)[b]	1.90	0	49.99
Calcium hydroxide (**CH**)	2.24	0	13.96
Ettringite (**AFt**)	1.78	0	6.87
Monosulfoaluminate (**AFm**)	2.02	0	15.12
Water	1.00	58.49	31.69
Gel porosity	--	0	20.96
Capillary porosity	--	58.49	10.73

[a] Formula 1.7C-S-1.6H. [b] Formula 1.7C-S-4.



Visual examples of 90%….



Named the Powers-Brownyard volumetric model of cement hydration, Jennings and Thomas were able to quantify the volumes of all the phases of Portland Cement paste; from birth to maturity. Their research showed at 28 days, in a normal 0.45 w/c ratio mix, almost 11% Capillary Porosity (above). And this number grows to 17% in a 0.50 w/c ratio mix (a 55% increase!). ***This is the area of focus for Vapor Lock technology; addressing that area in concrete….where there is no concrete.***

TESTING

A key component to this technology has been significant time spent with organizations including ASTM Technical Committees, ACI National Committees, numerous AASHTO and RILEM committees, and various ASCE chapters, to seek out the most illustrative and 'real-world' testing protocols that properly and conservatively show the benefits of Nano-Silica technology. With that and the thinking of "there is no perfect silver bullet test", we put forth the following tests and protocols to illustrate the benefits of a <u>Disrupted Capillary System in Concrete</u> -

ASTM D5084 - Coefficient of Permeability This protocol is borrowed from the soils folks and is encompassed in a 23-page protocol that used varying head-pressure to move water through a concrete specimen with a centimeters per second result - movement over time. As one of the key components of a 10-Year warranty and insurance package, there have been 1,000s of these tests performed. The Vapor Lock admixture as a general rule will never be higher than 0.174 US Perms per this protocol; and usually in the 0.02 US Perm range.

****Note - this protocol is very similar to the DIN 1048 (German) and BS EN12390 (British) protocols, and deviations of CRD-C48-92 (Army Corp.) used by other crystalline growth products; ASTM D5084 is a faster, non-subjective (measurable), scientific model to illustrate the same thing.****

<u>ASTM 5084 Results</u>

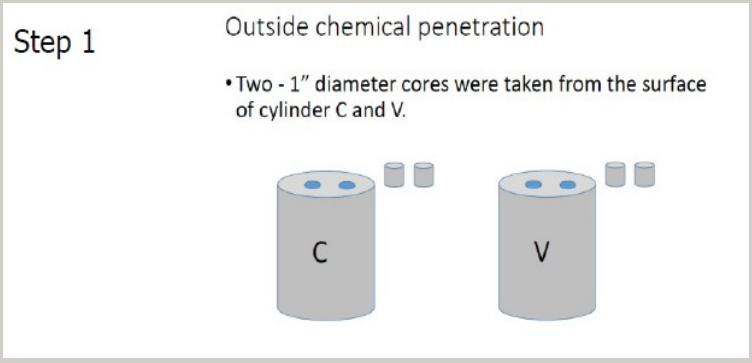
"Coefficient of Permeability"

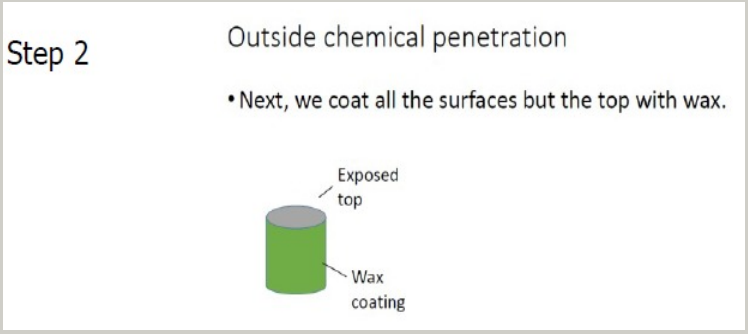
		~~SAMPLE PERM RATINGS~~	cm/second	US PERMS
		Plain Concrete	6.500E-05	1134.810169
		" "	5.69E-06	99.339536
		" "	3.20E-07	5.586758
		Stego 15	4.811E-10	0.0084
		Stego 10 Class A	1.260E-09	0.022
		Stego Class C	2.119E-09	0.037
		Raven VB 6	5.155E-08	0.9
		Koester Vap 2000 Topical	3.036E-08	0.53
		Ardex MC	6.301E-09	0.11
w/cm ratio	agg. type	SoCal Vapor Lock Projects	cm/second	US PERMS
WARRANTY	*****	VAPOR LOCK MAXIMUM THRESHOLD	1.00E-08	0.17458618
	HR & LW	UCSD Muir Housing	1.00E-09	0.01745862
0.50	HR	Grimmway Academy	4.72E-11	0.00082405
	L wt. agg.	USC Cinema	1.39E-09	0.02426748
	L wt. agg.	Lightweight @ 12oz.	7.55E-10	0.01318126
0.40	HR	Forum Rennovation	3.21E-10	0.00560422
	HR	Kaiser MOB	2.04E-09	0.03561558
0.59	HR	Memorial	1.48E-09	0.02583875
0.60	HR	Western U. Housing	2.51E-09	0.04382113
0.50	HR	Old Town Kern	2.06E-09	0.03596475
0.45	HR	USC Dance Mix #17136	2.33E-09	0.04067858
0.43	HR	USC Dance Mix #17536	1.48E-09	0.02583875
0.50	HR	Building Y, Steve Anderson	3.36E-09	0.058660956
	HR	Park Square at Seven Oaks	4.03E-09	0.07035823
0.40	HR	Theta Chi Frat	4.43E-09	0.07734168
0.45	HR	Hawaiian Gardens	5.67E-09	0.098990364
0.45	HR	Konawaena Middle School - w/out Super P	6.34E-09	0.11068764
0.45	HR	Konawaena Middle School - with Super P	2.62E-09	0.04574158
0.45	HR	SD Airport - Misc. w/VL	6.17E-09	0.10771967
0.38	HR	SD Airport - Decks & Beams w/VL	4.37E-09	0.076294161

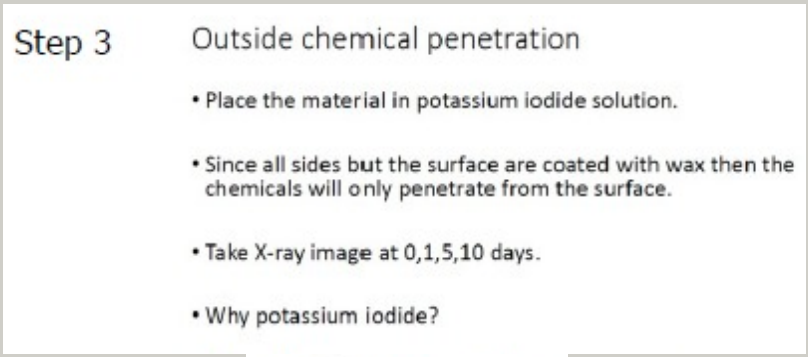
A small sampling of West Coast projects (Including Hawaii) utilizing Vapor Lock in mixes; both flooring, shrinkage reduction and general waterproofing applications. You can start to see that the benefits of Vapor Lock are most apparent in mixes from 0.45 to 0.55 w/cm ratios. And that our results rival those permeances of a Class A vapor barrier (Stego's 10-mil).

Modified ASTM C1152 - Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete

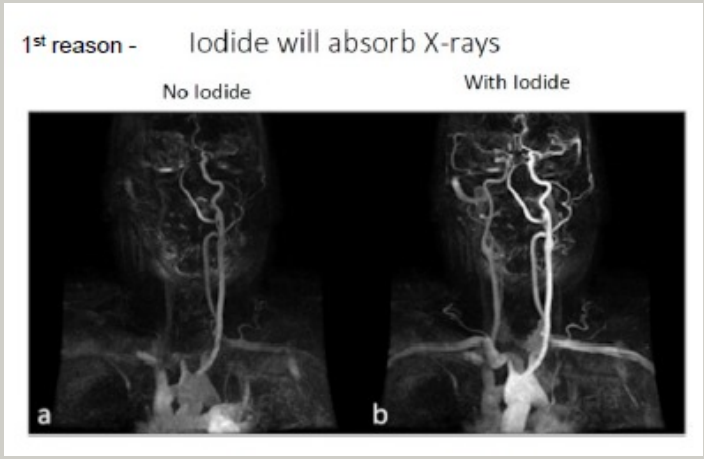
This is a genuine attempt to discern the penetration potential (or "transport mechanism") of concrete starting at the surface. Acid is injected into concrete specimens and layers are slowly pulverized and tested for chloride content. Unfortunately, this protocol always showed wide swings as chlorides are found in aggregates that usually don't have a significant impact on steel/reinforcement corrosion. Fortunately, rather recently, Dr. Tyler Ley, Ph.D., P.E., at Oklahoma State University, made popular a modified version using potassium iodide (to mimic the movement of chloride ions) and an X-Ray machine to take timed glimpses into a sealed concrete specimen. **nCT** or **nano Computed Tomography.** Below, the protocol and our latest results -



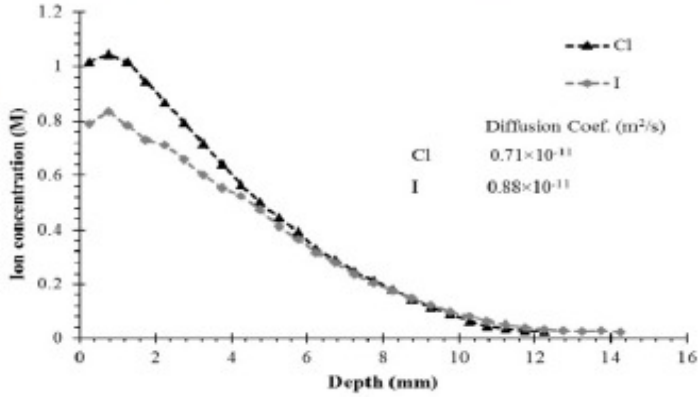




Three Reasons….



3rd reason - Iodide and chlorides act very similar in penetration of mortar/paste.



Modified ASTM C1152 - Nano X-Ray Fluorescence, Depth of Saturation Testing; continued

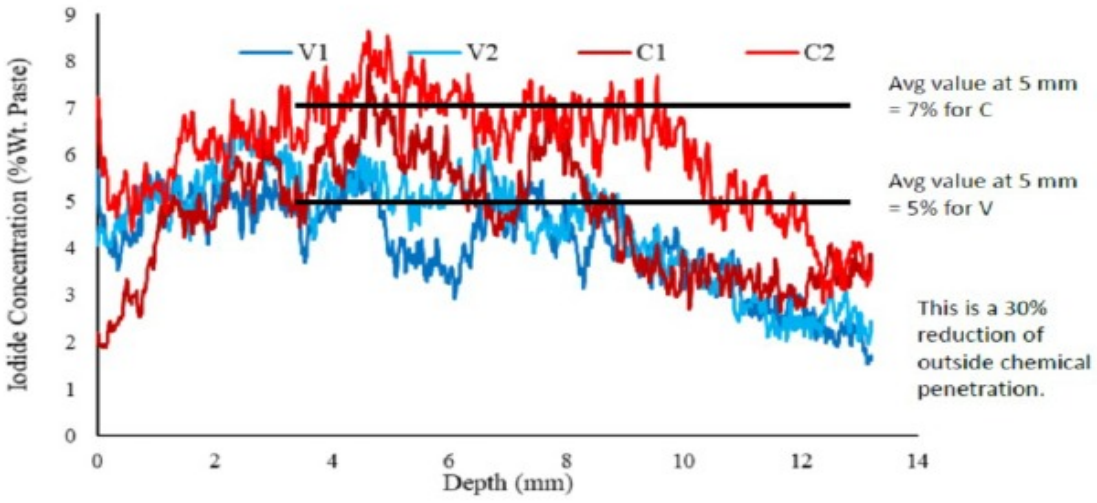
Mix Design

0.45 w/c ratio, pump mix with 1" top size agg.
28-Day comp. strengths were 6,320 psi.
*Sand was a blend of local and Polaris's Orca sand from the Pacific Northwest.
*Cement was imported from the Pacific Northwest.
*4 ounces per hundred weight of low range water reducer was added.

Materials	Weights
1" Aggregate	1,053 lbs.
3/8" Aggregate	708 lbs.
Sand	1,393 lbs.
Cement	630 lbs.
Water	283 lbs./34.0 gallons
Control C Mix - amine salts/carboxylic acids admixture	24 ounces
Control V Mix - Vapor Lock 40/40 admixture	63 ounces

Overall Comparison

Concentration profiles of all the samples after 10 days of ponding.



Summary

- Two cores were tested from each cylinder.
- Both cores showed good agreement with each other for sample C and V.
- There is a 30% reduction at 10 days of exposure for sample V when compared to C. Similar results were found at 5 days of exposure.

RESULTS - Relatively High Performance mixes tested at 75-85 days - ***Vapor Lock showed a 30% reduction.***

ASTM C441 - Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction

An interesting procedure where glass is pulverized and added at over 200% of cement (an absurd amount used to speed up a long process), and mortar bars are prepared - proportions below in Table 1. Both control and Vapor Lock enhanced samples are cast, cured in a moisture room for 24 hours, and then stored at 100 degrees F for 14 days. Results are in Table 2 -

Table 1 – C441 Mix Proportions

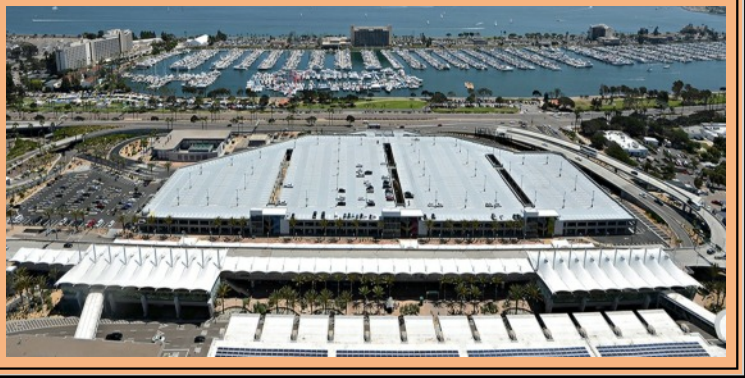
Material (g)	Control	Vapor Lock 20/20
Buzzi Cement	400	400
Vapor Lock	0	0.26
Graded Pyrex Glass	900	900
Water	217	218
Flow (100 – 115 %)	103	100

Table 2 – Expansion Due to ASR Test Results (%)

	Length (inches)		Length Change (%)
	Initial	14 Days	
Control 1	0.0536	0.0576	0.044
Control 2	0.0640	0.0678	0.042
Control 3	0.0655	0.0679	0.028
		Average	**0.038**
17-124-1VL	0.0724	0.0740	0.020
17-124-2VL	0.0665	0.0677	0.016
17-124-3VL	0.0600	0.0614	0.018
Reference	0.0438	0.0434	---
		Average	**0.018**
	Reduction of Mortar Expansion as % of Control		**52.6**

As you can see, there was on average just over 50% reduction in the mortar expansion of the Vapor Lock enhanced specimens. The less developed pore structure of Vapor Lock concrete can resist/slow the destructive Alkali Silica Reaction all too common in certain areas of the country. The Portland Cement Association has a good piece that explains ASR in more detail - http://www.cement.org/docs/default-source/fc_concrete_technology/is413-02---diagnosis-and-control-of-alkali-aggregate-reactions-in-concrete.pdf Clearly this much glass in the mix throws the mortar into a hyper-agitated state (normal shrinkage of mortar + the glass expansion), yet another way to illustrate a pore structure restricting both ingress and egress within the concrete/cement matrix.

Terminal 2 Parking Plaza; San Diego Airport - 25,000 cubic yards of Vapor Lock enhanced concrete helped contribute towards the *2019 National Design-Build Merit Award Winners in Aviation*



ASTM C1202 - Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration or Rapid Chloride Permeability Test; also known as AASHTO T277

A long-term, industry standard protocol/test for concrete "resistivity" is the ASTM C1202 - Rapid Chloride Permeability test (RCPT). This involves epoxy around a round 4" specimen and a 60-volt charge attached to it. Hydrogen peroxide solution on one side and salt water on the other side; the charge induces back and forth movement through the specimen. The total ion movement (of which chloride ions are part of) is measured after 6 hours. The fine folks at Grace do a good job explaining the pros & cons of this protocol - https://gcpat.com/sites/gcpat.com/files/2017-06/TB-0100CPT_v2.pdf

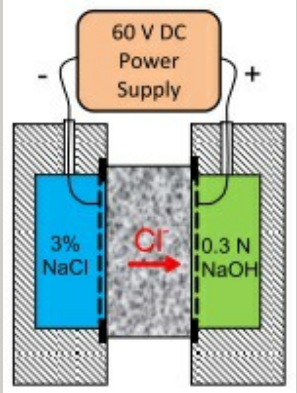
Rapid Chloride Permeability of Concrete				ASTM C 1202
Location of Specimen within Cylinder	Top			
Discription of Specimen				
Presence of Reinforcing Steel	No	Location of Reinforcing Steel	N/A	
Presence of Overlay	No	Thickness of Overlay	N/A	
Presence of Surface Treatment	No	Thickness of Surface Treatment	N/A	
Test Date 1	1/13/2017	Test Date 2		2/14/2017
Test Age 1 (Days)	29	Test Age 2 (Days)		61
Test Period (Hours)	6 hours	Test Period (Hours)		6 hours
Total Charge Passed (Coulomb)	1157.41	Total Charge Passed (Coulomb)		761.38

As part of a "pre-job" mix testing, we took a solid 0.38 w/c mix (straight cement) and performed Rapid Chloride Ion tests at one and two months. The results are judged by the criteria to the right.

Table: Chloride Permeability Based on Charge Passed

Charge Passed (Coulombs)	Chloride Permeability	Typical of
>4,000	High	High W/C ratio (>0.60) conventional PCC
2,000–4,000	Moderate	Moderate W/C ratio (0.40–0.50) conventional PCC
1,000–2,000	Low	Low W/C ratio (<0.40) conventional PCC
100–1,000	Very Low	Latex-modified concrete or internally-sealed concrete
<100	Negligible	Polymer-impregnated concrete, Polymer concrete

The highlighted areas above shows 1,157 coulombs passed at one month, towards the bottom of the "Low" side of Chloride Permeability and 761 at the two month mark - solidly in the "Very Low" range or '*internally-sealed concrete*' - An astute way to describe the solid combination of Ultra Low Permeability and inherent Corrosion Control provided by a Permanently Disrupted Capillary System.



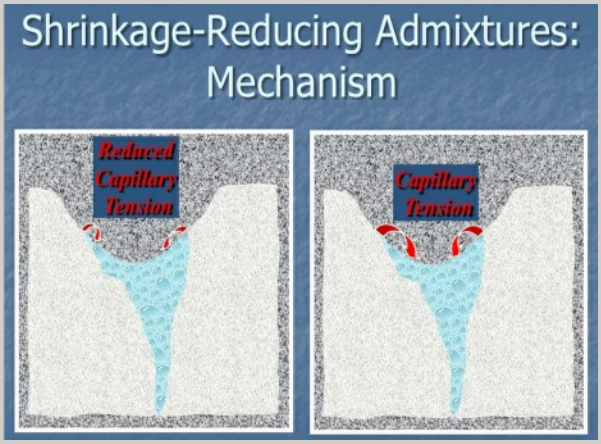
Alex Spanos Athletic facility utilized Vapor Lock in all their slabs that supported beautiful, moisture-insensitive sports floors; UCSD - La Jolla, CA

ASTM C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Another intuitive and vital element to the long-term *durability* of concrete is it's shrinkage (or creep) characteristics. The above referenced ASTM test is rather long and arduous. For this reason it is not particularly practical for pre-project testing. For that reason, many parts of the country have adopted a uniform modification established by the National Ready Mix Concrete Association (NRMCA) https://www.nrmca.org/aboutconcrete/downloads/TIP17w.pdf - In essence, we are shortening the "cure time" to 7 days, and taking a final reading at Day 28; giving us a look at <u>*35 actual days*</u> of shrinkage. Although this probably doesn't take into account "autogenius shrinkage" you can make certain assumptions; i.e. to meet a one-year spec of 500 microstrains (0.05% change), you may meet a 400 microstrain spec (0.04% change) at 35 days (28 day rack dry and 7 days "wet cure"). This is the protocol our testing lab partners have adopted and comparisons we make.

Conventional Shrinkage Reducing Admixtures

Traditional SRAs use harsh chemicals to change the surface tension of water which is designed to reduce stress on the water leaving the pore/capillary structure during curing/drying. This alone is rarely effective and needs to be incorporated with substantial mid and high range water reducers/plasticizers. Often, given enough time, the long-term shrinkage curve closes as months and years go by, lowering the overall effectiveness. Also, it is not uncommon to lose about 10% of 28 Day compressive strengths of a mix.



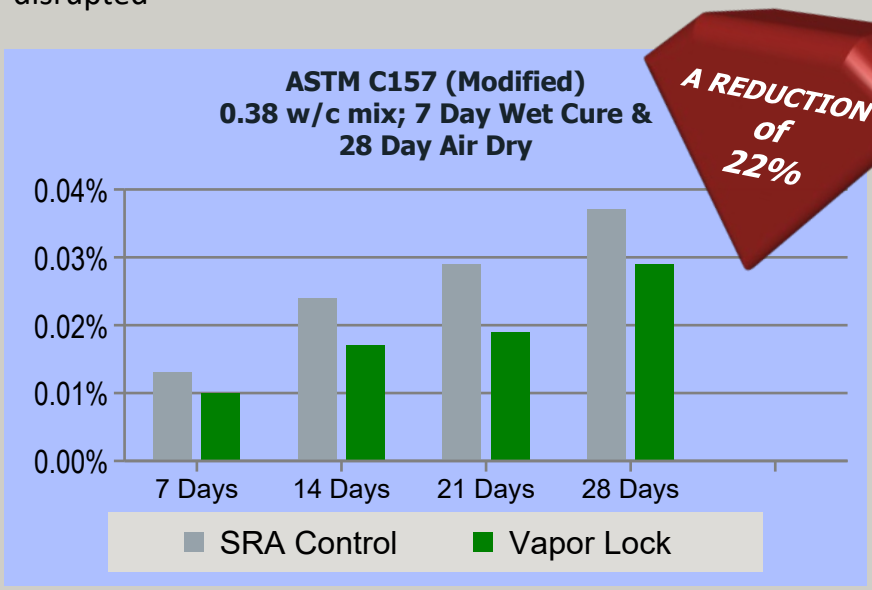
Vapor Lock's Nano-Silica technology upon contact with cement begins creating additional c-s-h gel from the available "free water" in the mix, and the calcium hydroxide present. This technology approaches Shrinkage Reduction in a drastic new way of "utilizing" water that would normally lend towards shrinkage/creep in a beneficial way of adding c-s-h product to the matrix. The disrupted capillary system locks in remaining water/moisture for further cement hydration (additional developed product).

Below, ASTM C157 Modified tests with Vapor Lock versus a popular, conventional SRA and the respective results.

5,000 psi (3,000@3 days) Boom Pump Mix

Cement	663 lbs.
Fly Ash	117 lbs.
Sand	1,313 lbs.
1" x #4 Agg.	1,051 lbs.
3/8" x #8 Agg.	554 lbs.
Water	295.7 lbs. (35.5 gallons)
WRDA 64	27.3 ounces
*SRA	64 ounces
*Vapor Lock	78 ounces

<u>28-Day (3 specimen average)</u>
Control w/ SRA = 0.037% change
Vapor Lock enhanced = 0.029% change



ASTM C876 – Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete; also known as AASHTO T259

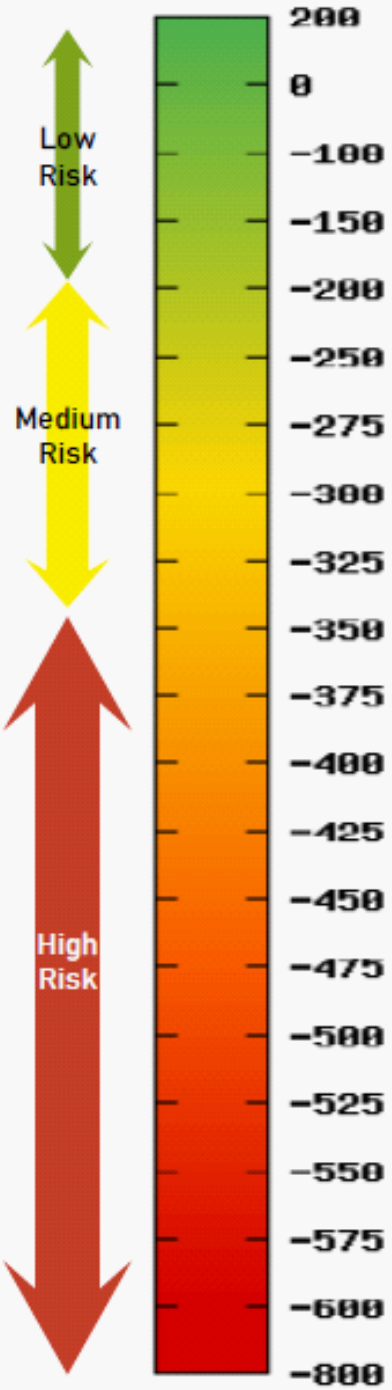
In line with the same efforts of the Rapid Chloride Permeability test (ASTM C1202/AASHTO 277) to "expedite" comparisons of corrosion inhibitors effectiveness, ASTM C876 uses electrical resistivity with a connection between the reinforcement (rebar) in the sample and the surface of the concrete using a copper sulfate electrode/probe. Falling (negative) millivolts (measured in 0.001 of a volt). The higher the negative voltage drop, the greater the probability of steel corrosion occurring; illustrated by the chart on the right.

The samples were made with three pieces of uncoated, untreated #4 rebar in a standing triangle pattern. The top bar was exactly 1" below the surface and a "weakened" plane induced with a 1/32"shim at the mid-point. The actual samples were dammed with Plexiglas and cycled with heavy saturations of salt water (20%+ sodium chloride) on a weekly basis of wetting, drying, re-wetting, etc. A common (Southern California) 4,500 psi, 1" top size agg. mix design was used, with variations of commercially available corrosion inhibiting and water proofing admixtures (cu. yard quantities);

- 5.5 gallons of calcium nitrite,
- 2.5% crystalline growth (by cement content),
- Vapor Lock 40/40 admixture,
- and a plain control.

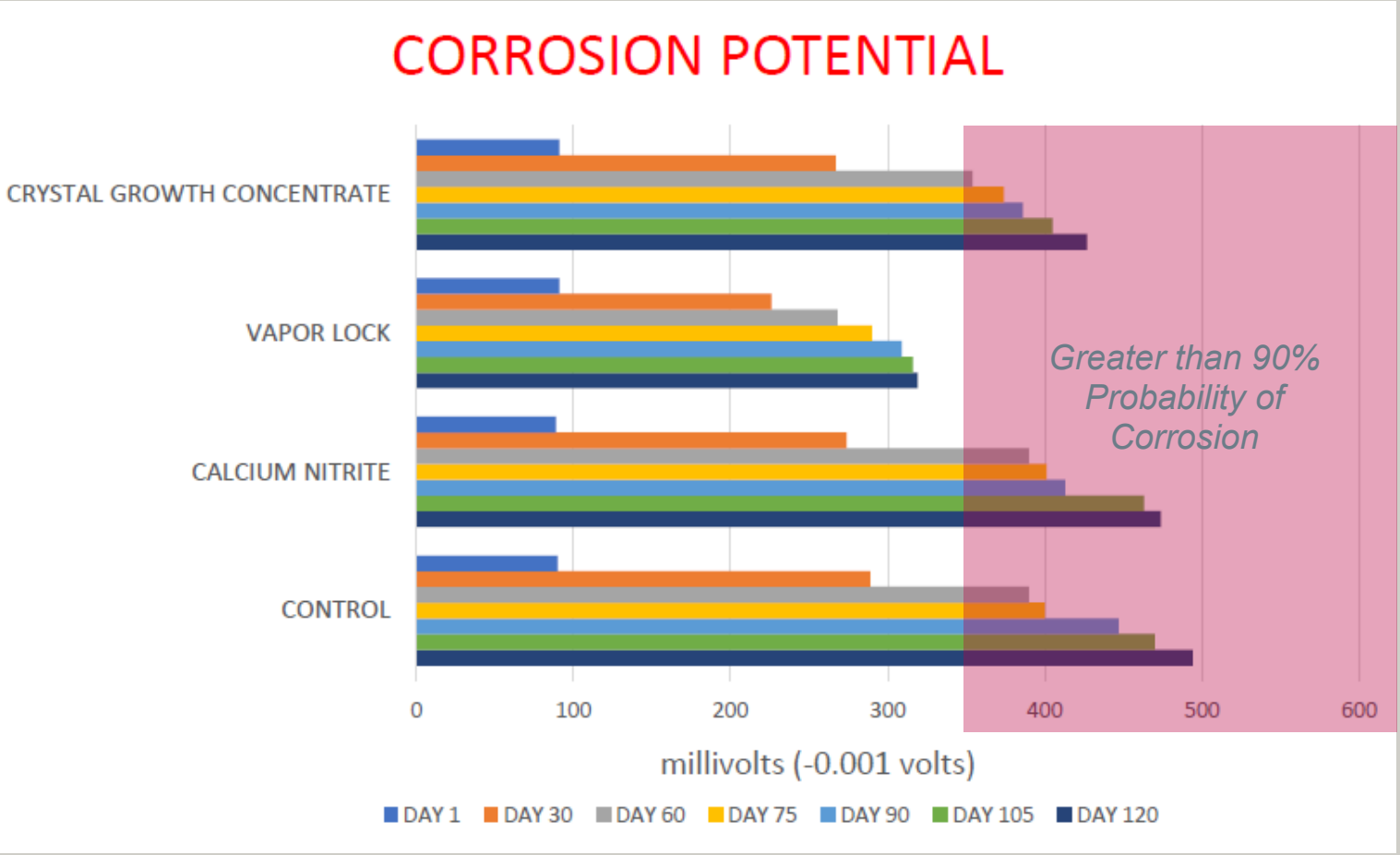
Measured Potential (mV)
w/Copper Sulfate Electrode
versus
Probability of steel corrosion activity -

> -200 Less than 10%
-200 to -350 Uncertain
< -350 More than 90%

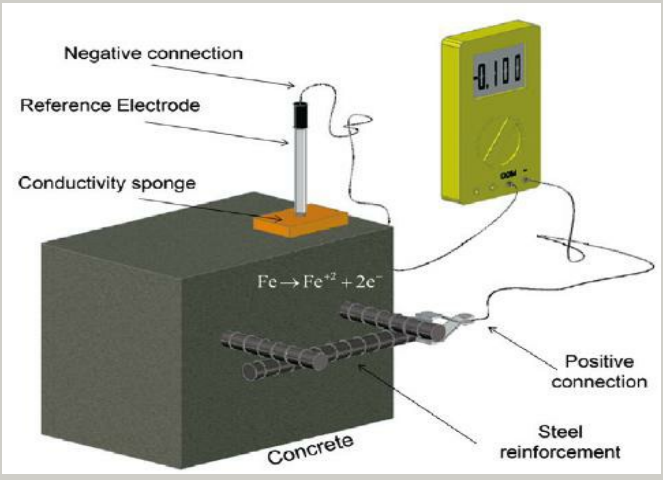


ASTM C876 – Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete, continued.

The results of the four mixes are below -



As you can see from the results above, the harsh chloride environment, coupled with a rapid wetting and drying protocol, quickly moves all the samples into the "Medium Risk" or Uncertain area of probable corrosion potential. After about 30 days, the results move apart though; with the quick production of additional product disrupting the capillary system of the Vapor Lock enhanced samples and substantially slowing the decline in "resistivity". The crystal growth product self-described takes 120-180 days to produce additional product; by then, the damage of corrosion has already occurred. The calcium nitrite sample was nearly identical to the control; with little change to the capillary structure. By Day 60, all three specimens were in the (greater than 350 mV) "High Risk" zone. The below gives some context to the Half Cell testing protocol involved -

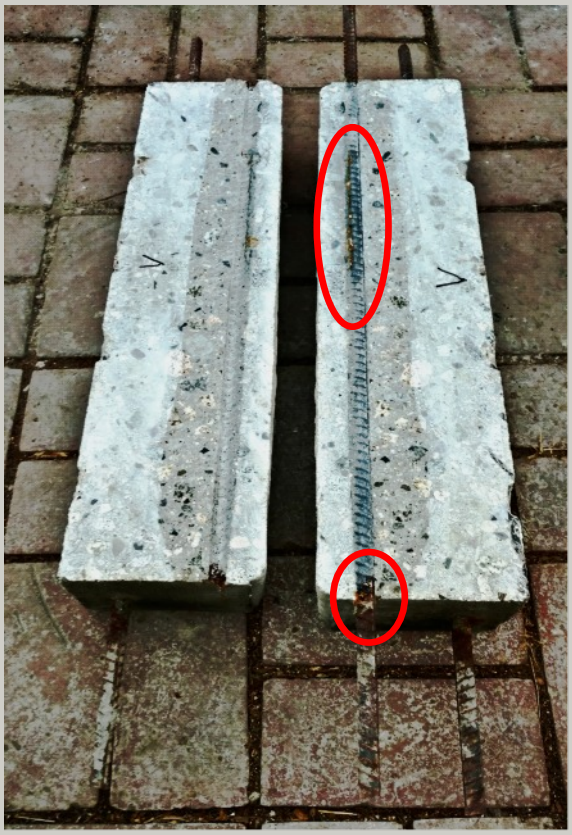


Measurements are taken from a high-impedance voltmeter. From the positive side, a connection to the (top) rebar is secured. The negative side, connected to a 360-degree copper-sulfate electrode probe. At set intervals, we can periodically measure drops in millivolts (-0.001 Volts), giving us insight towards concrete's "resistivity" or *transportation potential* of destructive elements inwards towards steel encased in concrete.

ASTM G109 - Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments From the previous ASTM C876 test, we continued ponding protocol for a full 20 weeks (140 days) with the reinforced specimens. At that point, we removed the ponding reservoirs, cleaned the specimens, and cut them in half (mid-point on axis with the top rebar). This allowed us to visually inspect the steel rebar (one side) and make subjective rankings.

Control Specimen

Vapor Lock enhanced Specimen



These specimens went through 40 weeks of the strongest calcium chloride ponding (20% plus NaCl bath) possible. Complete wetting and drying cycles with full exposure to the elements and 40 degree plus, temperature swings. The 1" of compromised concrete cover (mid-point weakened plane with a metal shim for 4 hours) over the top inspected bar. The two areas of concern; the encroachment of corrosive product from the ends, and center weak point. Substantial corrosive product is circled in red.

******Modified ASTM C1152 (nCT), ASTM C876 Half-Cell, and G109 Visual Inspection are all applicable to meet and exceed ASTM C1582 - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Concrete Reinforcing Steel in Concrete******

PCA
Portland Cement Association

What the Industry has to say about the importance of your Concrete's Permeability....

The Industry leader - the Portland Cement Association, talks about achieving **Durable Concrete** in great length. It states *"Corrosion of embedded metals in concrete can be greatly reduced by placing crack-free concrete with low permeability and sufficient concrete cover. Low-permeability concrete can be attained by decreasing the water to cementitious materials ratio of the concrete and the use of pozzolans and slag. Pozzolans and slag also increase the concrete resistivity thus reducing the corrosion rate even after it initiates."* https://www.cement.org/learn/concrete-technology/durability/corrosion-of-embedded-materials

TESTING SUMMARY -

ASTM D5084 - Coefficient of Permeability - Depending on the w/cm ratio of the mix, you can expect between a ***60% - 99.99% reduction in Permeance*** of your concrete (i.e. a 0.52 w/c ratio mix will go from roughly 200 US Perms down to 0.02 US Perms).

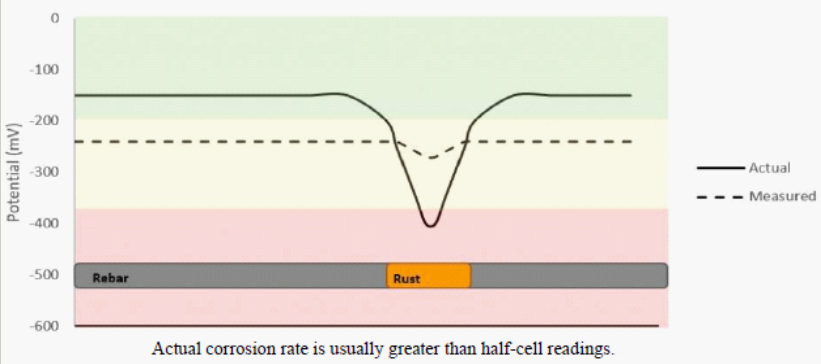
Modified ASTM C1152 - Nano X-Ray Fluorescence Depth of Saturation Testing for Acid-Soluble Chloride in Mortar and Concrete - Vapor Lock enhanced specimen showed a ***30% reduction in depth of penetration*** versus a control with Cortec MCI. Hawaiian material mixes; considered High Performance Concrete.

ASTM C441 - Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction - ***A 52.6% reduction in Alkali-Silica reaction*** versus control; greatly inhibiting negative reactions at the Interfacial zones.

ASTM C1202 - Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration or Rapid Chloride Permeability Test - A solid 0.38 w/cm mix enhanced with Vapor Lock showed 1157 coulombs (Low) at 29 days and 761 coulombs (Very Low) at 61 days.

ASTM C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete - High-sack content mix showed a ***21.6% reduction*** with Vapor Lock over a half gallon of the leading conventional SRA in the same mix. *On average, you can expect a 15 - 25% decrease over a plain control.*

ASTM C876 – Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete - In common 4,500 psi structural mixes, Vapor Lock showed ***a 35.4% improvement*** over the control mix, and ***a 32.7% improvement*** over the calcium nitrite mix; both at 120 days using a conventional Half-Cell instrument.



Actual corrosion rate is usually greater than half-cell readings.

An important note - the half-cell potential test is the only corrosion monitoring technique standardized by ASTM; giving us perhaps the greatest gauge of concrete's true "Transport" mechanism. By recording drops in millivolts ("potential" values), it allows us to gauge the loss of the protective layer around the rebar (from the destructive anodic/cathodic process) and anticipate future corrosion potential. Knowing actual values are usually 3-5 times greater than recorded values around areas of degradation (rust).

Modified ASTM G109 – Visual Inspection of Reinforcement - Vapor Lock specimen had less than one inch of corrosive product encroachment on ends and only slight product starting to develop off of weakened center point. Control specimen had over 1" of corrosive product on the end, with migration further into sample. Center point had significant product development as well.

ASTM C1582 requires the same "benign" testing as ASTM C494, Type S Admixture does, with slightly higher sack content mixes. In addition, C1582 includes comparative protocols to illustrate anti-corrosion effectiveness relative to a control specimen; ASTMs C876, C1152 Modified and G109 illustrate Vapor Lock specimens far exceed all controls (including industry acceptable admixtures) throughout.

Although some of these protocols were designed and adapted around Corrosion Inhibition, the overall disrupted capillary symptoms can be equally inferred to be helping overall Concrete Durability as well.

We continually extend the invitation for "pre-job" testing for your project's mix design considerations; no guesses….only exact targets and goals for Ultra Low Permeability, Shrinkage Reduction and Corrosion Inhibition.

PRODUCTS

The basic technology of adding silicates to the surface of concrete has been around since the week after concrete was invented. The evolution of Nano-Silicas as an Integral Concrete Admixture is over 20 years old. The preceding testing is constantly evolving and expanding, showing a value proposition not seen since Super-Ps. The following are ASTM C494, Type S admixtures based off Nano-Silica and Lithium technologies honed for precise applications; with specific warranty and insurance components:

Vapor Lock™ 20/20

MVRA - MOISTURE VAPOR REDUCING ADMIXTURE

- For Warranted & Insured Flooring, Architectural Coatings & Roofing Installations

Vapor Lock™ 20/21

ULTRA-LOW PERMEABILITY ♦ SHRINKAGE REDUCING WATER/DAMP PROOFING ADMIXTURE

Vapor Lock™ 40/40

CORROSION INHIBITING ADMIXTURE

- Combats both the Initiation & Propagation phases of Steel Corrosion

These are the core Vapor Lock concrete admixtures. The systems below are complimentary systems that enhance the admixture line above -

Shield Wall 39

A cold, spray-applied, two-part Elastomer System with outstanding characteristics make this membrane ideal for water/moisture and gas containment. * Used in High Risk situations (i.e. below water table/constant hydrostatic pressure, methane/radon, etc.)

Vapor Lock 120 & 555 for Cement Treated Bases & Soil Stabilization Systems

- A two-part system where Vapor Lock 120 replaces up to 50% of the cement or lime in the surface tilling and Vapor Lock 555 is topically applied to the surface. Waterproof with compaction and hardness similar to that of asphalt.

Product Benefits - Structural Shotcrete Applications

Shotcrete - is defined as concrete which is transmitted via hose and pneumatically projected at maximum velocity on a surface; usually walls or ceilings. It goes through placement and compaction concurrently due to force that is projected with a nozzle, and is most often less expensive than conventional poured-in-placed methods. It usually requires just one side of form-work and can accommodate a variety of finishes, making it almost impossible to distinguish from other systems. Shotcrete can cover structural steel and become a structural unit; a load bearing, shear wall element in a structural engineer's design.

If the shotcrete applicator had the opportunity to design one concrete admixture, invariably they would prefer one that would eliminate the extra mix water and provide extra "fines" or "cream" that would aid in finishing. That happens to be the two consistent and main characteristics of Vapor Lock enhanced concrete. Any place in the world you have Vapor Lock concrete, once you screed and "float" the surface, you will visually see little to no bleed water come to the surface. A dream for a Shotcrete Applicator!

Vapor Lock over Carlisle; Encinitas, CA

Vapor Lock - Hillside Pinning with NO Fly Ash; Beverly Hills, CA

The key to any successful shotcrete project is a certified and experienced nozzleman. Introducing shotcrete is a fast paced, kinesthetic exercise, with the key being consistent and total consolidation of concrete around all reinforcement. Every project should prescribe a realistic mock-up like the one on the left. These samples are usually cored and sliced to show the lack of "shadowing" behind any rebar. The consolidation rivals some of the best poured-in-place wall systems out there. Shotcrete is an economical and fast application of rich, high-sack content concrete installed in areas problematic for conventional formwork.

Product Warranties & Insurance

Specialty Products Group, the manufacturer of Vapor Lock admixtures, has done everything in it's power to eliminate RISK pertaining to everything touching your concrete. As an owner, or CM with 'skin in the game', you can rest assured with all SPG's Integral Concrete Admixture systems;

- Flooring, Roofing and Architectural Coatings Installations,
- Water/Damp Proofing (Stand-alone or Belt-and-Suspenders),
- Shrinkage Reducing & Corrosion Inhibiting.

For the first two areas of concern, SPG has secured the most substantial, third party insurance broker to secure *Project Specific (non-aggregate)* insurance through Lloyds of London. Our Warranty & Insurance samples are below -

SPG Go Green
Specialty Products Group®

6254 Skyway Road, PO Box 915
Smithville, Ontario, L0R 2A0, Canada
877.957.4626

Manufacturers' Warranty: Vapor Lock 20/20

The Specialty Products Group (manufacturer) warrants its product, Vapor Lock 20/20, to be free from material defects and that the product conforms to its current applicable specifications of stopping moisture vapor emission from the concrete itself, for a period of **ten** years. The warranty period starts from the date of the original installation. This warranty covers only those Flooring failures associated with moisture vapor emission and is provided if the Vapor Lock 20/20 is installed according to, and in compliance with the instructions and the requirements of the manufacturer. In the event there is a moisture vapor emission claim, manufacturer reserves the right to inspect and test any and all materials to determine the source of the problem. The sole and exclusive remedy of purchaser for any claim concerning Vapor Lock 20/20, including, but not limited to, claims alleging breach of warranty, negligence, strict liability or otherwise, is the **labor and materials** (like the original installed products) required for the removal, replacement or repair of floor covering materials damaged by moisture vapor emission. Repair or replacement of the damaged flooring material is at the sole discretion of the manufacturer. The manufacturer shall in no way be responsible for any acts of nature, inferior concrete, concrete additives, contaminates in the concrete, cracks or voids resulting after the product application, any incidental or consequential damage, including without limitation, damage for lost profits, business interruption, property damage, economic loss or injuries to the person. Manufacturer shall not be liable to the buyer for contribution, or indemnity, or for other losses arising from the use of Vapor Lock 20/20. Any and all disputes or claims arising out of these products or relating to the provisions of the warranty must be arbitrated utilizing the services of a neutral dispute resolution service upon which the buyer and seller agree. Manufacturer claims policy is as follows: Claims will not be considered until the flooring material and adhesive has been inspected by one or more of the following: Company representative, or independent inspection service of manufacturer's appointment. There are no other warranties expressed or implied including, but not limited to, any implied warranty of merchantability or warranties of fitness for a particular purpose. All accounts must be paid in full prior to any warranty being issued or enforced.

Project Name: _____ Vapor Lock 20/20 Project #: _____

Scott Bergbakken, President Date Greg Hart, CEO Date

Notice very few "lawyer" words. Project specific Insurance, that allows contractor & designer third party riders for everyone's confidence. $20,000,000 CAD….*about **$15.4 Million USD**.*

CERTIFICATE OF INSURANCE

DATE (MM/DD/YY): April 16, 2017

BROKER: BrokerLink, 86 Woodlawn Road West, Guelph ON N1H 1B2

This certificate is issued as a matter of information only and confers no rights upon the certificate holder. This certificate does not amend, extend or alter the coverage afforded by the policies below.

ISSUING COMPANIES AFFORDING COVERAGE

COMPANY A: Provided by Certain Lloyd's of London Underwriters B0888602277H16A

INSURED'S FULL NAME AND MAILING ADDRESS: Specialty Products Group Inc., 6254 Skyway Drive, PO Box 915, Smithville ON. L0R 2A0 — SPG Go Green Specialty Products Group® — Vapor Lock™

COVERAGES

This is to certify that the policies of insurance listed below have been issued to the insured named above for the policy period indicated. Notwithstanding any requirements, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions and conditions of such policies. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS (Canadian dollars unless indicated otherwise)	
A	GENERAL LIABILITY				EACH OCCURRENCE	$ 20,000,000
	COMMERCIAL GENERAL LIABILITY	CHES0020	04/16/2017	04/16/2018	GENERAL AGGREGATE	NO AGGREGATE
	CLAIMS MADE FORM				PRODUCTS & COMPLETED OPS.	$ 20,000,000
X	OCCURRENCE FORM				PRODUCTS AND COMPLETED OPS. AGGREGATE	$ 20,000,000
	CROSS LIABILITY				BODILY INJURY & PROPERTY DAMAGE	$ 20,000,000
	TENANTS LEGAL LIABILITY NON-OWNED				RIP AND TEAR	$ 250,000
	AUTOMOBILE				POLLUTION	$ 100,000
					ERRORS & OMISSIONS	$ 500,000
A	AUTOMOBILE LIABILITY					$
	DESCRIBED AUTOMOBILE FORM					$
	ALL OWNED VEHICLES					$
	ALL LEASED VEHICLES					$
	EXCESS / UMBRELLA LIABILITY				EACH OCCURRENCE	$
	UMBRELLA FORM				AGGREGATE	$
	OTHER -				RETAINED LIMIT	$
	PROPERTY					$
	BROAD FORM					$
	NAMED PERILS					$
	OTHER					$

sample

ADDITIONAL INSURED: The following is hereby added as Additional Insured(s) on the Commercial General Liability but only with respect to liability arising from operations performed by the Named Insured: - N/A

DESCRIPTION OF OPERATIONS/LOCATIONS/ SPECIAL ITEMS: OPERATIONS: Ad-Mixture Manufacturer

CERTIFICATE HOLDER: None

CANCELLATION: Not applicable

AUTHORIZED REPRESENTATIVE: Matt Nelson, Account Executive

Specialty Products Group will Warrant any design permeability or shrinkage specification agreed upon. We welcome and participate in all pre-submittal mix design testing. We work with several local labs to laser point an actual compressive strength, shrinkage and permeability level needed….not just ranges - and we stand behind them. On the flooring, roofing & coatings side, no conventional moisture testing is required - our system subordinates them all. On the water/damp proofing side, we offer the state-of-the-art ***ShieldWall 39 - Disruptive Membrane*** **system** to compliment our Integral Waterproofing Admixture in high risk areas (i.e. at or below water table). The combination of these technologies qualifies for the same above warranty and insurance.

Vapor Lock™ ***100% WaterTight Construction - the Integral Approach; Warranted & Insured***

LAND & BUILDING PROFILE - TYPICAL DETAILS FOR VAPOR LOCK APPLICATIONS

Vapor Lock™ 20/20 - MVRA; Insured & Warranted protection for flooring, roofing & architectural coatings

Vapor Lock™ 20/21 - Shrinkage Reduction Admixture & Ultra Low Permeability

Vapor Lock™ 40/40 - Corrosion Inhibition; SRA, ULP & a robust ferrous coating

Vapor Lock™ 555 - Soil Stabilization; lower cement content/till & topical applications

Shield Wall 39 - Elastomer Spray-Applied Disruptive Membrane; high risk areas

OWNERS & BUILDERS - Specialty Products Group has put all your site prep and waterproofing needs under one warranted and insured level of protection…which now includes the industry's most ingenious disruptive membrane system for 'high-risk' areas (at or below water table) .

ShieldWall 39

- is a water-based, two-component elastomer modified liquid rubber system which adheres to most substrates. Shield Wall is a sprayed applied, "instant-set " water proof coating. Flash cured, this seamless flexible coating functions as a high quality, protective membrane providing excellent protection from water penetration, salt, fire and most severe chemical attack on all concrete exterior surfaces. It has outstanding elongation (initially over 900%) and will maintain water tight integrity in the face of reasonable structural movement; up to a 5/16" (8 mm) crack width.

Overview & Sustainability -

The Vapor Lock systems are at the forefront of the Nano-Silica technology for permanently and consistently disrupting the capillary system in concrete for the most "set neutral" performance handling mixes available. This leads to the industry leading state-of-the-art Moisture/Vapor Proofing, Water/Damp Proofing, Shrinkage Reduction and Corrosion Inhibiting admixtures. Specific systems that do two things; ELIMINATE RISK and GUARANTEE CRITICAL PATHS - period. It is easily the *Best, Fastest, and Least Expensive way to build your project…*

Terminal 2 Parking Plaza; San Diego International Airport - the airport authority and the design team of Swinerton Builders & Watry Design chose to spend a couple of dollars more (per cubic yard) and utilize Vapor Lock to meet both the 0.036% change shrinkage specification and achieve 0.0146 US Perms permeance in all 25,000 cubic yards for the 2nd and 3rd levels and all the ramps. A truly Durable Concrete choice -

Today, the term ***Sustainability*** is one of the most overused terms out there. The Vapor Lock admixture is just one part of a system - an intelligent concrete mix design; about a half to three quarters of a gallon, overall. The results are a denser, superior piece of concrete that exhibits significantly less Long-Term Shrinkage, state-of-the-art Ultra Low Permeability, a more monolithic unichrome color, and when used with proper "ways & means" (i.e. adequate concrete coverage), will extend both the initiation and propagation stages of encased steel corrosion ***towards a doubling of the life cycle for reinforced concrete.*** Vapor Lock is priced and supplied by your local commercial ready-mix concrete producers, and should be considered at multiple levels of design where *RISK* is involved. Wether moisture/vapor concerns are effecting flooring installation critical paths, or a heavy water proofing schedule has your hands tied - Vapor Lock is the intelligent option, and worthy of consideration.

We welcome all design professionals, discerning constructors and interested owners to reach out today for a *"Hosted"* Breakfast or Lunch to discuss how the Vapor Lock systems can precisely add value to your project - while providing professional development credits. We'll leave the term Sustainability to your review and how it relates to Vapor Lock's ability to almost double the life cycle of your project.

SPG Go Green Specialty Products Group

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DURABILITY Consultants
"Enhancing the Capabilities for Those Who Build with Concrete"