Winter 2019/20
VOL. 33, NO. 3

TENNESSEE CONCRETE MAGAZINE

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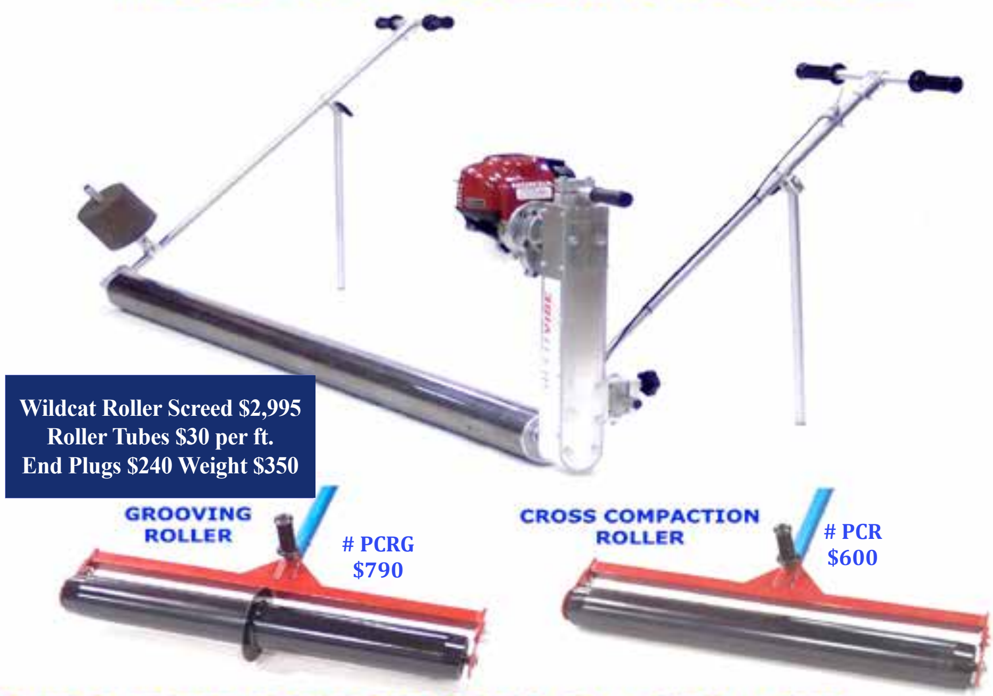

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Tennessee Concrete welcomes response and rebuttal and will make every effort to print these responses. Send comments to: Editor, Tennessee Concrete, 699 President Place, Suite 400, Smyrna, TN 37167.

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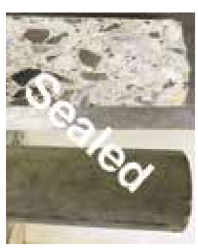

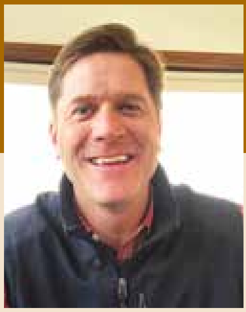

Tim Costo
2019 TCA President

Predicting the future isn't easy, and we don't all see the same things when we look ahead. That's actually a good thing . . . because those different viewpoints help us to consider a wider range of possible outcomes and challenges.

TIME FOR REFLECTION

The beginning of a new year is always a time for reflection and thinking about the year ahead. The beginning of a new decade might cause some of us to think even a little bit further ahead, and perhaps to pause for reflection about the decade just passed. I have a few reflections as we enter both a new year and a new decade in 2020.

My term as TCA President is drawing to a close but my excitement about what lies ahead for TCA is only growing. The year 2019 was an incredible year for your association as we sold our property near downtown Nashville, purchased new (larger) property in south Davidson county, and began planning for the construction of a new home for TCA. Not bad for a single year!

It has been my privilege to lead your Board of Directors this year and I deeply appreciate the time and commitment demonstrated by each of our Board members. Your Board is thoughtfully considering the best path forward for TCA as we look to make this new decade even more exciting and more productive than the decade just passed.

Of course, predicting the future isn't easy, and we don't all see the same things when we look ahead. That's actually a good thing for Boards (and companies!) because those different viewpoints help us to consider a wider range of possible outcomes and challenges. I am confident in the leadership we have on our Board and this for me creates optimism and excitement about what our future holds.

Let me conclude by urging you to deepen your involvement with TCA. It's difficult to commit time in today's fast-paced world but the commitment of your time to your industry is necessary and worthwhile. If you haven't already registered for AL & TN Summer Meeting on June 25-28, please do it today. You won't regret gathering with your peers and you will take back valuable ideas and insights that will help your organization today and in the decade to come.

—Tim Costo

LONGTIME DREAM

Alan Sparkman
Executive Director

Our new five-acre campus has plenty of room for TCA to grow into new activities that will support and enhance the concrete industry across our state.

Looking ahead to the new year is pretty common as the calendar flips from one year to the next. As TCA looks ahead to the new year—and the new decade—I think it's fair to say that this may be the most exciting period in TCA's 34-year history.

For 2020, much of the focus will be on the design and then the actual construction of TCA's new office and concrete lab. This will be the fulfillment of a long-time dream for TCA and it is sure to be an exciting project. Stay tuned for more information as we get closer to the actual construction, and be on the lookout for ways that you can help TCA as we build our new home.

Our new office will be located on our (also new) five-acre campus. The campus has plenty of room for TCA to grow into new activities that will support and enhance the concrete industry across our state. Initial plans include the establishment of a more active research program, growing our certification and training offerings, and re-creating a bigger and better concrete showplace to demonstrate all the ways that concrete can enhance the built environment.

As you will see elsewhere in this issue, TCA has added a new staff position to help with the establishment of our new campus and to expand the services that TCA offers to our members. Mr. John Pearson, PE is stepping into his role as TCA's Director of Technical Services and will be a key part of TCA's journey into this new decade.

Even as we look ahead with anticipation and excitement it is very important to not forget all of the support from our members during the past 34 years that is making this exciting future possible. The support of our faithful members is the foundation of all that TCA does and I am thankful for that support!

Happy New Year and a blessed 2020!

—Alan Sparkman

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To Register to Attend or For More Information Visit:

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SCHEDULE

Thursday, June 25
Joint Registration ....4:30-6:30 p.m.
Registration for Alabama and Tennessee will be held together.

Joint Opening Reception...................................6:30-7:30 p.m.
Come join Alabama and Tennessee for the kick-off reception to celebrate the opening of the 2020 AL & TN Summer Meeting!

Joint Dinner...7:30-9:00 p.m.
Time to eat and drink and visit with friends old and new!

Friday, June 26
Open Day full of Beach Time

Saturday, June 27
Morning Sessions
Breakfast ....7:00-8:00 A.M.
Program..8:00-11:30 A.M.
Beach Time, Golf Tournament, Scramble........................ Noon
Joint Closing Dinner ....7:30-9:00 p.m.
Dinner & entertainment with friends.

by L. K. Crouch, Samuel Mathews, Daniel Badoe, and Alan Sparkman

Going Beyond ACI 332: Commercial/Residential Enhanced Durability Concrete

FIRST LOOK

INTRODUCTION

The use of commercially-available deicing salts containing magnesium chloride (MgCl) on residential and commercial concrete such as sidewalks, driveways, etc. can lead to premature deterioration of the concrete. The Tennessee Concrete Association (TCA) approached Tennessee Technological University (TTU) researchers for additional ideas, beyond those in American Concrete Institute Residential Code Requirements for Structural Concrete (ACI 332-14) and Commentary. TTU researchers postulated that the rate and amount of damage to commercial and residential concrete would be controlled by the chloride permeability and absorption of the concrete. TTU researchers began a pilot study to determine if lower chloride permeability and absorption mixtures could be developed that met (or nearly met) Code Requirements for Residential Concrete (ACI 332-08) requirements. The TTU pilot study will be discussed shortly but let us look at some pertinent literature.

LITERATURE REVIEW

According to the Federal Highway Administration (FHWA), over 70% of the nation's roads are located in areas that receive on average five inches of snowfall per year in addition to almost 70% of the U.S. population inhabiting these areas (1). While this refers to asphalt and concrete pavements, roadways are not the only thing effected by winter weather. Since these areas that are prone to winter weather are densely populated, steps must be taken in order to maintain the navigability of roadways, sidewalks, parking lots, driveways, etc. In order to do this, deicing solutions such as MgCl and sodium chloride (NaCl) are applied to deter snowfall or ice from building up on concrete surfaces (2). Unfortunately, deicing solutions can negatively affect concrete (3).

Damage caused by NaCl can be seen physically, whereas damage caused by MgCl cannot be seen by inspecting visually which is the common method for assessing the condition of a bridge (4). When a concrete is exposed to low concentrations of NaCl, there is very little impact on the properties of the concrete. At higher concentrations, there is a greater impact but this impact is still small (5). The majority of physical damage caused by the exposure to deicing solutions is in the form of scaling which does not debilitate the concrete by itself. However, scaling invites more deicing solutions or other chemicals that may be present to enter into the concrete matrix (3). When a concrete is subject to low concentrations of MgCl, considerable damage can occur to the concrete. At high concentrations, there is significant damage that occurs including the loss of material, strength, and stiffness (5).

In order to extend the service life of concrete that is exposed to winter weather and deicing solutions, one of the most effective methods is to incorporate the use of a low permeability concrete (6). According to the American Concrete Institute (ACI), "Permeability is a measure of the amount of water, air, and other substances that can enter the concrete matrix" (7). There are several strategies that can be used in order to reduce the permeability of concrete. Some of these strategies are as follows: incorporating the use of a supplementary cementitious material (SCM), lowering the water-to-cement ratio, employing the use of superplasticizers, proper placement, proper finishing, and adequate curing (8, 9, 10, 11).

SCM's like Class C and Class F fly ash increase the ability for concrete to withstand freeze-thaw damage and even effects of other chemicals that enter the concrete matrix such as acids, salts, or sulfates (12). Other SCM's like ground granulated blast-furnace slag (GGBFS) also are used to reduce permeability of concrete. Although, the use of GGBFS decreases the permeability of the concrete matrix, the FHWA reports that, "concrete containing high concentrations of GGBFS may be susceptible to salt scaling" (13). If the application of the concrete will be exposed to deicing salts, tests should be performed prior to placement in order to find any potential durability issues due to the use of high substitution of GGBFS (13).

TTU PILOT STUDY

TTU researchers discussed the MgCl problem with the TCA Executive Director in 2018 and attempted to develop commercial and residential enhanced durability (CRED) mixtures with the properties shown in Table 1. The CRED mixtures were intended to meet ACI 332-08 Type 3 Severe requirements for minimum compressive strength. However, the CRED mixtures were to be focused on limiting chloride permeability and absorption after boiling in an attempt to reduce both the rate and amount of MgCl entering the concrete.

Table 2 shows a comparison of an ACI 332 concrete mixture commercially available in middle Tennessee and the three CRED mixtures developed in the TTU pilot study. The three CRED mixtures achieved their respective surface resistivity and absorption after boiling goals. Similarly, the three CRED mixtures easily met compressive strength goals. Additional compressive strength was not desired but the much higher strength values attained were a consequence of enhanced durability. The superiority of the engineering properties of CRED mixtures is evident, but does it result in enhanced MgCl durability?

—Continued on page 10

TABLE 1. PROPOSED COMMERCIAL & RESIDENTIAL ENHANCED DURABILITY (CRED) CONCRETE

	CRED LEVEL 1	CRED LEVEL 2	CRED LEVEL 3
14-day Mean SR (kΩ-cm)			V Low (SR ≥37)
28-day Mean SR (kΩ-cm)	Low (SR ≥21)	V Low (SR ≥37)	
28-day Mean Absorption (%)	HPC Level (≤5%)	HPC Level (≤5%)	HPC Level (≤5%)
28-day Mean Strength (psi)	≥ 4500-psi	≥ 4500-psi	≥ 4500-psi
w/cm	≤ 0.45	≤ 0.45	≤ 0.45
Total cementing material (pcy)	520	520	520

TABLE 2. COMPARISON OF RESULTS IN THE PILOT STUDY

MIXTURE	ACI 332	CRED LEVEL I	CRED LEVEL 2	CRED LEVEL 3
Total Cementing Material (pcy)	564	520	520	520
Percent Portland Cement	80	60	50	50
Percent and Type of Primary Supplementary Cementing Material	20 Class C Fly Ash	36 Class F Fly Ash	50 Slab Grade 100	46 Slag Grade 100
Percent and Type of Secondary Supplementary Cementing Material	0	4 metakaolin	0	4 metakaolin
W/CM	0.443	0.39	0.39	0.39
Mean SR Category 7-days	High	Moderate	Moderate	Moderate
Mean SR Category 14-days	High	Low	Low	Very Low
Mean SR Category 21-days	High	Low	Very Low	Very Low
Mean SR Category 28-days	Moderate	Low	Very Low	Very Low
Mean Strength (psi) 14-days	5067	6457	7347	8300
Mean Strength (psi) 28-days	5597	7097	8767	9130
Mean Percent Absorption 28-days	4.96	4.48	3.15	2.75

TABLE 3. TCA STUDY DURABILITY EVALUATION MIXTURE RATIONALE

MIXTURE	CEMENTING MATERIALS (PCY)	W/CM	RATIONALE FOR INCLUSION IN THE TCA STUDY
Commercial 3500-psi	480	0.52	Lower-end of commercial spectrum
Commercial 3500-psi w/Penetrating Sealer	480	0.52	Effect of penetrating sealer
Commercial 4000-psi	500	0.49	Middle of commercial spectrum
Commercial ACI 332	564	0.44	Upper-end of commercial spectrum
CRED Level 1	520	0.39	Effect of Low Chloride Permeability
CRED Level 2	520	0.39	Effect of Very Low Chloride Permeability

by L. K. Crouch, Samuel Mathews, Daniel Badoe, and Alan Sparkman

Going Beyond ACI 332: Commercial/Residential Enhanced Durability Concrete

FIRST LOOK

TCA STUDY

Concrete Mixtures

TCA and TTU researchers agreed to include four commercial and two CRED mixtures in the MgCl durability study. The rationale for including each mixture in the study is shown in Table 3. Designs for each mixture are shown in Table 4. Table 5 shows a comparison of three mixtures with ACI 332-14 RF3 requirements. ACI 332-14 Commentary indicates that the RF3 Exposure Class should be used for concrete elements such as driveways, curbs, stairs, steps, and porches exposed not only to freezing and thawing in a near saturated state but also exposed to deicing chemicals. CRED Level 1 did not meet ACI 332-14 requirements for substitution of supplementary cementing materials. CRED Level 2 did meet ACI 332-14 requirements for substitution of supplementary cementing materials. The 3500-psi and 4000-psi mixtures were included since they are commonly used in middle Tennessee and were not expected to meet ACI 332 requirements.

Conditioning and Testing Procedure

Only one batch of each mixture in the study was used due to limited space in the low temperature (125°F) drying oven. Each batch contained twelve 4-by-8-inch and nine 3-by-6-inch cylinders. Table 6 shows the conditioning protocol for the study. Table 7 shows testing protocol for the TCA study. Compressive strength was determined as per ASTM C 39-18 (14). Split tensile strength was determined as per ASTM C 496-17 (15). Static modulus of elasticity was determined in accordance with ASTM C 469-14 (16). Absorption after boiling was determined as per ASTM C 642-13 (17) at 28-days. For later absorption after boiling test, the MgCl salt had to be removed from the cylinders by alternating cycles of boiling and oven drying prior to determining absorption after boiling. Table 7 also shows the number and type of samples used for each testing procedure.

Results and Preliminary Analysis

Table 8a and Table 8b shows plastic property results for each mixture and applicable requirements. Table 9 and Figure 1 show mean 3-by-6-inch cylinder weight gain in percent using the mean cylinder weight after the first drying cycle as a control weight. Table 10 and Figure 2 show mean MgCl penetration depth into 4-by-8-inch cylinders from the post-failure cylinders used in 196-day split tension test. Penetration depth seems to qualitatively correlate well with chloride permeability. Surface resistivity (AASHTO T 358-17) was conducted only on 28-day 4-by-8-inch samples since it was not clear to the TTU researchers what effect the MgCl salt residue would have on later chloride permeability results. Tables 11, 12, and 13 show compressive strength, split tensile strength, and static modulus of elasticity results for 4-by-8-inch cylinders, respectively. Table 14 shows absorption after boiling results for 3-by-6-inch cylinders.

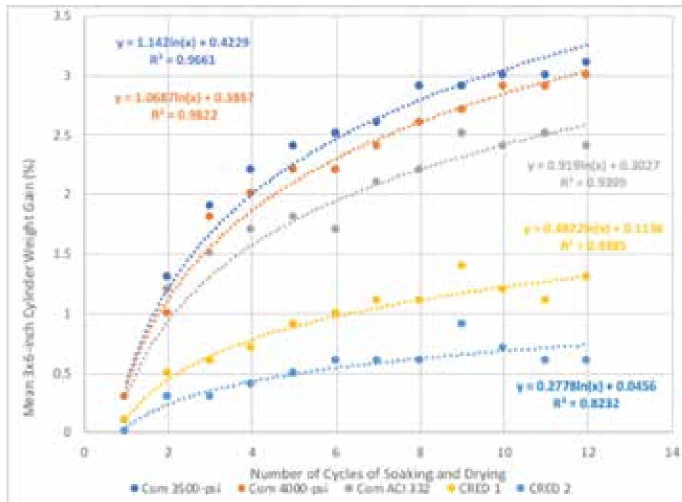

Figure 1: Mean 3-by-6-inch Cylinder Weight Gain vs. Number of Cycles

Figure 2: Magnesium Chloride Salt Solution Penetration Depth in 4-by-8-inch Cylinders (a) 3500-psi (b) CRED Level 1

The percent losses calculated in Tables 11, 12, and 13 were determined by subtracting the 196-day result from the 28-day result and dividing the difference by the 28-day result. The answer was expressed as a percent loss. The percent loss was reported

TABLE 4. TCA STUDY DURABILITY EVALUATION MIXTURES

MATERIALS	COMMERCIAL 3500-PSI	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
Type I/II PC, (lbs/CY)	375	398	451	312	260
Grade 100 Slag, (lbs/CY)	0	0	0	0	260
Class F Fly Ash, (lbs/CY)	0	0	0	187,2	0
Class C Fly Ash, (lbs/CY)	105	112	113	0	0
Metakaolin, (lbs/CY)	0	0	0	20.8	0
No. 57 Stone, (SSD lbs/CY)	1816	1860	1854	1911	1927
River Sand, (SSD lbs/CY)	1279	1210	1215	1250	1258
Water (lbs/CY)	250	250	250	203	203
Design Percent Air	6	6	5	6	6
Air Entrainer, (oz/cwt)	1.05	1	1.05	0.6	0.44
Mid-Range Water Reducer, (oz/cwt)	4.18	5.37	7.42	8.75	7.32
High-Range Water Reducer, (oz/cwt)	0	0	0	7.25	6.22

TABLE 5. COMPARISON OF TCA STUDY DURABILITY EVALUATION MIXTURES WITH REQUIREMENTS

PROPERTY	ACI 332 EXPOSURE CLASS RF3 REQUIREMENT	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
Cement Content (lbs/CY)	None	564	520	520
Water-Cement Ratio	None	0.44	0.39	0.39
Percent Class F Fly Ash Substitution (by weight) for PC	25 maximum	0	36	0
Percent Class C Fly Ash Substitution (by weight) for PC	25 maximum	20	0	0
Percent Grade 100 Slag Substitution (by weight) for PC	50 maximum	0	0	50
Total of Fly Ash, Silica Fume, Slag and other Pozzolans Substitution (by weight) for PC*	35 maximum	0	40	0

*No more than 25% fly ash and no more than 10% silica fume

TABLE 6. TCA DURABILITY CONDITIONING FOR TCA STUDY MIXTURES

PROCEDURES	FIRST 28-DAYS	ODD WEEKS 5-35	EVEN WEEKS 6-36
Limewater Curing	X		
Drying at 125°F		X	
Weight Determination		X (end of drying)	
Digital Image	25 maximum	X (end of drying)	
Soak in 15% (by weight) solution of commercial de-icer containing MgCl	50 maximum	0	0

by L. K. Crouch, Samuel Mathews, Daniel Badoe, and Alan Sparkman

Going Beyond ACI 332: Commercial/Residential Enhanced Durability Concrete

FIRST LOOK

to the nearest positive number (increases in engineering properties were ignored). Percent gains in Table 14 were calculated in a similar manner.

Table 15 shows rankings (1 to 6, 1 best) for each evaluation used in the TCA study. The mean ranking is also included to provide a relative comparison of mixture performance.

PRELIMINARY CONCLUSIONS

Based on the limited data available (only one commercially-available magnesium chloride deicing salt and five different concrete mixtures) the following conclusions can be drawn:

1. Using a low permeability concrete mixture or a concrete mixture treated with a penetrating sealer greatly reduces both the rate and amount of magnesium chloride deicer salt intrusion into the concrete.
2. Using a low permeability concrete mixture or a concrete mixture treated with a penetrating sealer greatly reduces the concrete compressive strength loss due to magnesium chloride deicer salt intrusion.
3. Using a low permeability concrete mixture or a concrete mixture treated with a penetrating sealer reduces the concrete split tensile strength loss due to magnesium chloride deicer salt intrusion.
4. Using a low permeability concrete mixture greatly reduces the concrete static modulus of elasticity (stiffness) loss due to magnesium chloride deicer salt intrusion.
5. Using a low permeability concrete mixture greatly reduces the increase in hardened concrete absorption due to magnesium chloride deicer salt intrusion.
6. Preliminary indications are that using a low permeability concrete or a concrete mixture treated with a penetrating sealer should substantially increase the service life (greatly delay deterioration) of commercial or residential concrete exposed to commercial deicing salts containing magnesium chloride.

WHAT'S NEXT FOR THE TCA MAGNESIUM CHLORIDE DURABILITY STUDY?

The TCA study continues and final results are expected by spring 2020.

DISCLAIMER

The opinions expressed herein are those of the authors and not necessarily the opinions of the Tennessee Concrete Association (TCA).

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TABLE 7. TESTING PROTOCOL FOR TCA STUDY MIXTURES

TEST OR PROCEDURE	28-DAYS (curing only, no conditioning)	196-DAYS (after 28-days of curing and 12 cycles of conditioning)	280-DAYS (after 28-days of curing and 18 cycles of conditioning)
Comprehensive Strength	(2) 4x8 cylinders	(2) 4x8 cylinders	(2) 4x8 cylinders
Split Tensile Strength	(2) 4x8 cylinders	(2) 4x8 cylinders	(2) 4x8 cylinders
Static Modulus of Elasticity	(1) 4x8 cylinder	(1) 4x8 cylinder	(1) 4x8 cylinder
Absorption after Boiling	(3) 3x6 cylinders	(3) 3x6 cylinders	(3) 3x6 cylinders

TABLE 8A. PLASTIC PROPERTIES AND REQUIREMENTS FOR TCA STUDY MIXTURES (A) ACI 332 AND CRED MIXTURES

PROPERTY	ACI 332 EXPOSURE CLASS RF3	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
Slump (inches)	4 ±1 without mid- or high-range water reducer 9 maximum with mid-or high-range water reducer	3.50	5.75 (has HRWR)	5.50 (has HRWR)
Air Content by Pressure Meter (%)	6 ± 1.5	5.4	6.2	6.0

TABLE 8B. PLASTIC PROPERTIES AND REQUIREMENTS FOR TCA STUDY MIXTURES (B) COMMERCIAL MIXTURES

PROPERTY	COMMERCIAL REQUIREMENT	COMMERCIAL 3500-PSI	COMMERCIAL 4000-PSI
Slump (inches)	3 to 6	5.00	5.50
Air Content by Pressure Meter (%)	4.5 to 7.5	6.3	5.5

TABLE 9. MEAN 3-BY-6-INCH CYLINDER WEIGHT GAIN (%) FROM MAGNESIUM CHLORIDE SOAKING

CYCLE	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
1	0.1	0	0.3	0	0.1	0
2	1.3	0	1.0	1.2	0.5	0.3
3	1.9	0	1.8	1.5	0.6	0.3
4	2.2	0	2.0	1.7	0.7	0.4
5	2.4	0	2.2	1.8	0.9	0.5
6	2.5	0	2.2	1.7	1.0	0.6
7	2.6	0	2.4	2.1	1.1	0.6
8	2.9	0	2.6	2.2	1.1	0.6
9	2.9	0	2.7	2.5	1.4	0.9
10	3.0	0	2.9	2.4	1.2	0.7
11	3.0	0	2.9	2.5	1.1	0.6
12	3.1	0	3.0	2.4	1.3	0.6

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FIRST LOOK

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TABLE 10. MEAN MAGNESIUM CHLORIDE SALT SOLUTION PENETRATION DEPTH IN 4-BY-8-INCH CYLINDERS (INCHES) AND 28-DAY CHLORIDE PERMEABILITY CATEGORY

CYCLE	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
196-days	1.27	0	1.21	1.21	0.31	0.40
28-day Surface Resistivity Chloride Permeability Category	1.3	0	1.0	1.2	0.5	0.3

* **D**ue to drying and sealer application the test was conducted on day 32

TABLE 11. MEAN COMPRESSIVE STRENGTH OF 4-BY-8-INCH CYLINDERS (PSI)

	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
28-days	5200	5360	6070	6610	8770	10330
196-days	3160	5070	4060	5590	10200	11430
Percent Loss	39.2	5.4	33.1	15.4	0	0

TABLE 12. MEAN SPLIT TENSILE STRENGTH OF 4-BY-8-INCH CYLINDERS (PSI)

	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
28-days	440	445	520	530	565	770
196-days	280	320	290	325	615	575
Percent Loss	36.4	28.1	44.2	38.7	0	25.3

TABLE 13. MEAN STATIC MODULUS OF ELASTICITY OF 4-BY-8-INCH CYLINDERS (PSI)

	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
28-days	3950000	4050000	4150000	4300000	4650000	5550000
196-days	2500000	2650000	2650000	2500000	4900000	5300000
Percent Loss	36.7	34.6	36.1	41.9	0	4.5

TABLE 14. ABSORPTION AFTER BOILING OF 3-BY-6-INCH CYLINDERS (%)

	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
28-days	5.28	2.27	5.25	4.96	4.28	3.80
196-days	6.65	6.03*	6.65	6.20	4.71	4.32
Percent Gain	25.9	*	26.7	25.0	10.0	13.7

*The iterative process of boiling / drying for removing MgCl salt proved inappropriate for penetrating sealers (sealer melted). Penetrating sealers were not designed for such high temperatures. Therefore, the authors ignored the 196-day absorption after boiling results of the 3500-psi sealed mixture.

TABLE 15. SUMMARY OF PRELIMINARY ANALYSIS BY PERFORMANCE RANKING TO DATA

	COMMERCIAL 3500-PSI	COMMERCIAL 3500-PSI WITH SEALER	COMMERCIAL 4000-PSI	COMMERCIAL ACI 332	CRED LEVEL 1	CRED LEVEL 2
Minimum Salt Intrusion Depth	6	1	4 TIE	4 TIE	2	3
Minimum Weight Gain	6	1	5	4	3	2
Minimum Compressive Strength Loss	6	3	5	4	1	2
Minimum Split Tensile Strength Loss	4	3	6	5	1	2
Minimum Static Modulus of Elasticity Loss	5	3	4	6	1	2
Absorption after Boiling Gain	4	*	5	3	1	2
Mean Ranking	5.2	2.2	4.8	4.3	1.5	2.2

STOP!

Read this BEFORE you apply de-icer to your concrete…

TCA recently conducted research showing that allowing deicing salts containing magnesium chloride (an ingredient in most commercial de-icing products)to penetrate into concrete can cause **SERIOUS** damage to your concrete. How can this damage be minimized and the life of your concrete extended? Not surprisingly, limiting the amount of deicing salts that enter the concrete greatly reduces the damage.

A Little Dab Will Do You

Most people think more is better when it comes to applying deicers. But over-application of deicers just allows more of this chemical to seep inside your concrete and cause damage. Always apply deicers according to the application rate recommended on the package. It is a surprisingly small amount. And, finally, always remember to wash it off when weather permits.

For New Construction

A less permeable concrete reduces both the rate and amount of deicing salts that enter concrete. Homeowners can think ahead and specify a lower permeability concrete mixture when building concrete structures and your TCA concrete producer member can help with this. Does less permeable concrete cost a little more than normal concrete? Yes, however, routinely changing the oil in your vehicle costs a little more but results in tremendous savings in the long run. Think of your concrete as the same kind of investment.

For Existing Concrete

If you just bought a new home or installed a new patio, sidewalk or driveway (and it isn't lower permeability concrete) the most important thing you can do is apply a penetrating sealer to the concrete per manufacturer's instructions. These sealers will act as a barrier to deicing salts and water. **Untreated normal concrete can lose more than half of its strength as a result of using deicers** but when sealed properly is much more resistant to such adverse impacts. Those are numbers that literally can be tallied in dollars and cents in just a few short years.

Call Tennessee Concrete Association with questions at 615-360-7393 or watch our video on de-icers on our website at: https://www.tnconcrete.org/homeowner-consumers

TCA

Available to reprint for customers.

A Picture is Worth $$$$ - YOUR Dollars?

Your concrete is a significant investment so making sure **YOUR** concrete is protected should be your number one goal. Specifying lower permeable concrete is great but sealing normal concrete can also make a **HUGE** difference. Take a look to see!

Cross Section of a Sample of Normal Concrete WITH A SEALER. **Deicer didn't make its way into this concrete. This is the goal.**

Exterior of Normal Concrete WITH A SEALER. **Deicer didn't make its way into this concrete. This is the goal.**

Normal Concrete WITHOUT A SEALER. Notice the deicer has penetrated deep into the concrete.

Normal Concrete WITHOUT A SEALER. Notice the deicer has penetrated the exterior of the concrete and damage is beginning to appear.

TCA's New Director of Technical Services

John B. Pearson, P.E.

TCA is pleased to announce the addition of a new staff position to better serve our members and the concrete community in Tennessee. Beginning February 17th, John B. Pearson, P.E., will join the TCA staff as Director of Technical Services. John will be working to expand TCA's certification services, bolstering our educational and marketing efforts, and working to extend TCA's research projects as well as other member services.

Getting to Know John B. Pearson

For the past 25 years John has assisted producers, contractors, government agencies, architects, engineers, and nuclear clients across the country with technical matters related to concrete and construction materials. He is recognized for his extensive knowledge of concrete testing, concrete troubleshooting, and concrete mix development. John began his career in 1994 as part of a highway design team at Florence & Hutcheson in Paducah, Kentucky before returning to Tennessee to work at S&ME, Inc. John has held various roles while working in the concrete construction industry including Construction Services Project Manager, Concrete and Aggregates Laboratory Manager, Construction Materials Technical Committee Chairman, and Technical Principal Engineer.

John received his BS and MS degrees in civil engineering from Tennessee Technological University (TTU). John is an active member of the American Concrete Institute and is qualified as an examiner for numerous ACI certification programs. John is also a member of ASTM C09 Committee on Concrete and Concrete Aggregates, and Subcommittee C09.50 Aggregate Reactions in Concrete.

John has ties across the state of Tennessee. He was born the youngest of nine children to a farming family in West Tennessee and spent his college years at TTU in Middle Tennessee. John currently lives in East Tennessee with his wife Susan and their three children, Rachel, Madison, and Nathan.

Continued from page 14—

by L. K. Crouch, Samuel Mathews, Daniel Badoe, and Alan Sparkman

Going Beyond ACI 332: Commercial/Residential Enhanced Durability Concrete

FIRST LOOK

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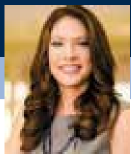

CIM UPDATE

by Dr. Heather J. Brown

SCHOOL OF CCM AT HOMECOMING!

We can't believe it took us nearly 20 years to participate but Concrete Industry Management really rolled out for this year's homecoming parade. Chris Davenport, owner and president of Southern Concrete Machinery and graduate from the first class of CIM grads in 2000, organized six concrete mixers to participate. Local ready mix providers, all donors to the new CCM building coming soon on campus, even placed the CIM logo on the side of the trucks for the event. Alumni, staff and current seniors had a great time alongside the trucks and enjoyed wrapping up the end of the parade.

WRIGHT MUSIC COURTYARD RENOVATION

The Concrete Industry Management program donated labor to assist the Music Department with a renovation of their courtyard in the back nook of the Wright Music Building. Last summer, the project started with a small patio finished by a local alumni, Jake Shaw. This summer Lab Manager, Kevin Overall, along with some strong student athletes poured 96 oversize concrete pavers for a new outdoor space. Then, to wrap the project up this fall, Mr. Huddleston's Flatwork class placed and finished a concrete sidewalk through the space.

FASTEST TROWEL AT MTSU!

This year's regional Bricklayer 500 was hosted here at MTSU, in the Bell Street parking lot. MTSU alumni, Will Scott, sales representative with Quikrete organizes the regional event and brought this year's teams to campus to connect his piece of the industry with our program. CIM had students involved mixing mortar, assisting with logistics and marketing the day on social media, and a group of students attended to learn, network and witness the skill of these professionals.

See photos on next page—

Info Link

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FASTEST TROWEL AT MTSU!

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