HAHN READY MIX

Scaling & Freeze-Thaw Durability Trial Update

Tech Bulletin #43 - July 2025

Freeze-Thaw Study: An Update

You might recall that we are performing a study on freeze-thaw and deicer salt scaling in concrete using local materials and methods in response to a significant experience of scaling from the winter of '23-'24. We did a Tech Bulletin on the study if you'd like to refresh on the details: Tech Bulletin #35.

In May, we took photos of each pad in the study, and sent them off to our judges. They each scored the pads from 1-10, where 1 is showing no distress and 10 is a complete surface loss.

Unfortunately for the study, but fortunately for concrete in our area, we had an unbelievably friendly winter for concrete. This winter, the pads in the study experienced 42 freeze-thaw cycles, .79" of freezing precipitation and 7.78" of total precipitation between the first freeze-thaw cycle on October 16th and the last on April 16th. Compare this to the winter of 2023-2024: 56 freeze-thaw cycles with 2.03" of freezing precipitation and 13.91" of total precipitation between the first and last cycle. Winter of 2022-2023 had 69 freeze-thaw cycles with 1.49" of freezing precipitation and 13.5" of total precipitation.

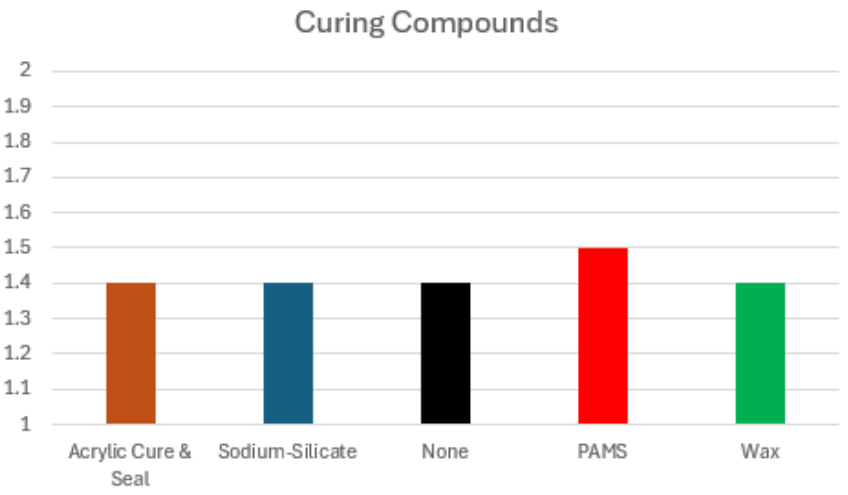
All this means that we did not have extreme stresses on the pads in the study to result in a wide variety of distress outcomes. The differences in the scores of each pad are thus small and the trends we can identify likely fall within the bounds of some statistical margin of error. Still, we will share what we're seeing thus far.

Trial Data

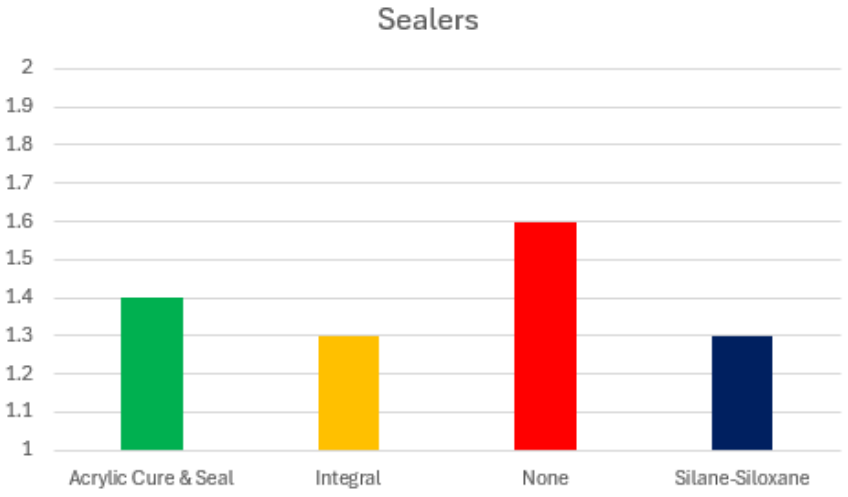
We'll look at the scores in four ways: 1) individual variables applied across all other testing criteria against the other variables in their group. 2) Combinations of two variables in different testing criteria against any other combination of two variables. 3) Combination of three variables in different testing criteria against any other combination of three variables. 4) What individual pads and their unique combinations of all variables performed above or below the average. I know, that's a lot to take in.

The average distress score of all 92 pads was **1.4**, again in a range from 1-10. The judges assed most of the pads to have nearly no visible distress. Good for the concrete, bad for our trial, where our intention is to learn what materials, products, or methods provide better freeze-thaw resistance.

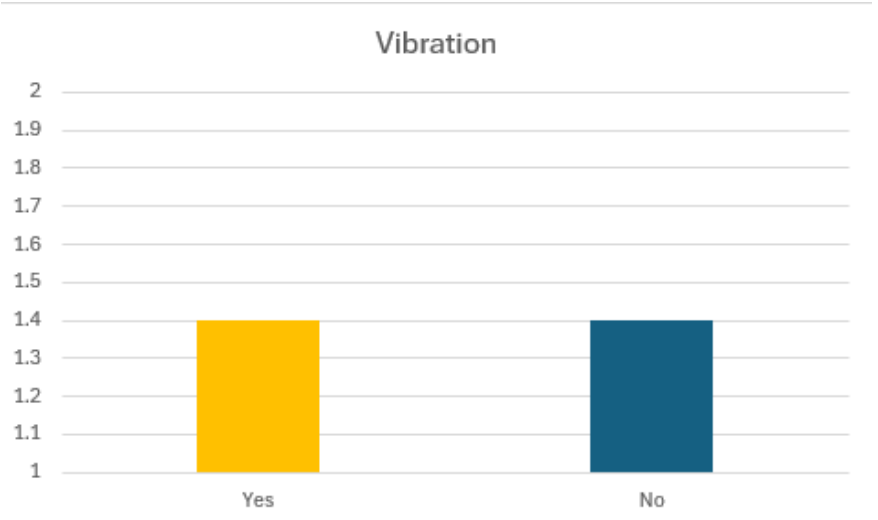
Individual Variables

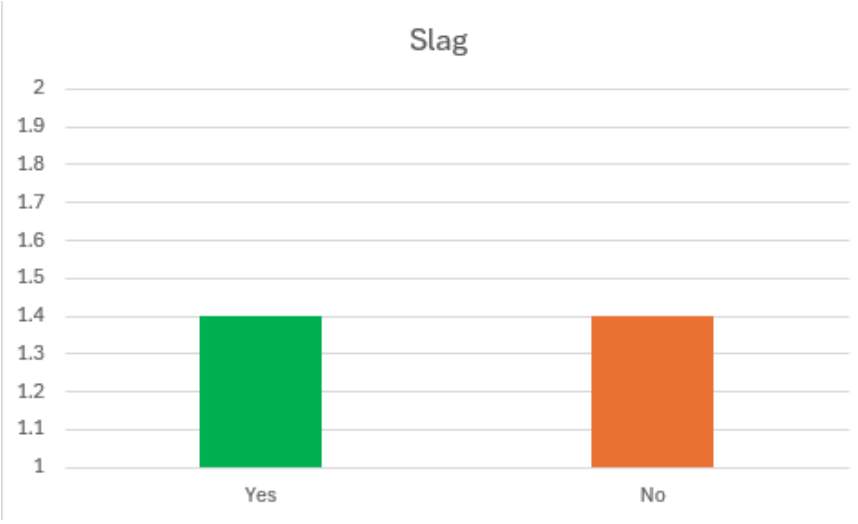


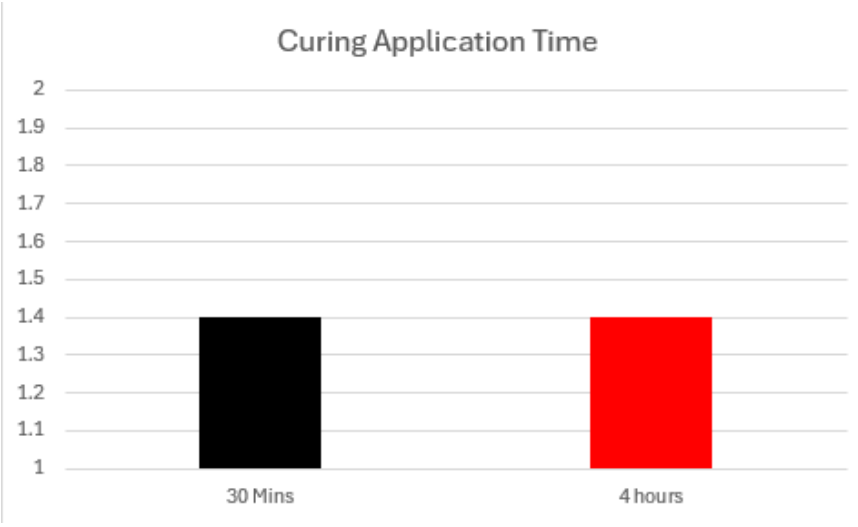
As you can see, pads scores were very consistent regardless of what kind of cure was applied, or if one was applied at all. The PAMS cure had a slightly higher average of 1.5 but this is largely insignificant based on the scoring scale of 1-10.



There was a little bit more of a difference in score with sealers. Applying no sealer had an average score of 1.6 while the integral sealer and Silane-Siloxane sealer both overperformed the average with an average score of 1.3.







The other three variables all landed exactly on the general average with no discernable difference between the options.

Two-Variable Combinations

The next question we asked was "Are there combinations of variables that outperform or under-perform against the average?"

There were some interesting outliers when looking at the scores in this manner. The best scoring combination of variables achieved an average score of **1.1**:

- Wax cure with a silane-siloxane sealer
- Silane-siloxane sealer with no slag

Right behind those were the following variables averaging **1.2**:

- No cure with a Silane-Siloxane sealer
- Sodium-silicate cure with no slag
- Wax cure with slag
- A cure & seal applied 4 hours after placement
- Sodium silicate cure applied 4 hours after placement
- Silane-Siloxane sealer paired with a curing compound applied at 4 hours after placement

On the other end of the spectrum, the worst performing variable combinations averaged a score of **1.7**:

- No curing compound and no sealer
- Wax cure and no sealer
- Cure & Seal applied 30 mins after placement
- PAMS cure applied 4 hours after placement

Right below those, with an average score of **1.6** was the following combinations:

- PAMS cure with no sealer
- Cure & seal with no slag
- Sodium-silicate cure with slag
- Sodium-silicate cure applied 30 mins after placement
- No sealer and no vibration
- No sealer and no slag

What we can gather from this is that perhaps there is some compatibility efficiencies that can be gained. For example, the wax cure appears to perform better with a slag mix while the sodium-silicate cure scored better without slag. Similarly, the Cure & Seal and Sodium-silicate cures both perform better applied at 4 hours and the PAMS performs better at 30 mins. The wax cure and silane-siloxane sealer was the best combination and the wax cure with no silane-siloxane sealer was one of the worst.

Three-Variable Combinations

Finally, we assessed the data looking at 3-variable combinations.

At **1.0**, perfect scores were applied to:

- No Cure, Silane-Siloxane sealer and no vibration
- Cure & Seal applied at 4 hours after placement with slag
- Silane-siloxane sealer with no slag and a cure applied 4 hours after placement

At **1.1**, we have the following combinations:

- Wax cure, silane-siloxane sealer, and vibration
- Sodium-silicate cure, no sealer, and no slag
- No cure, silane-siloxane sealer, and no slag
- PAMS cure, silane-siloxane sealer, and no slag
- Wax cure, silane-siloxane sealer and slag
- Sodium-silicate cure applied at 4 hours with silane-siloxane sealer
- PAMS cure applied 30 minutes after placement with silane-siloxane sealer
- Wax cure applied at 4 hours with a silane-siloxane sealer
- Cure & seal with no vibration and slag

- Sodium-silicate cure with vibration and no slag
- Cure & Seal applied at 4 hours with no vibration
- Sodium-silicate cure applied at 4 hours with vibration
- Sodium-silicate cure applied at 4 hours with no slag
- Silane-siloxane sealer with no vibration and no slag
- Silane-siloxane sealer with vibration and no slag
- Silane-siloxane sealer with vibration and a curing compound applied at 4 hours

On the higher distress end, the highest average was a **2.0**, with a sodium-silicate cure applied at 30 minutes with a silane-siloxane sealer.

At **1.9**:

- Sodium-silicate cure with a silane-siloxane sealer and slag
- Wax cure with no sealer and no slag
- Sodium-silicate cure applied at 30 minutes with slag

At **1.8**:

- PAMS cure with no sealer and no vibration
- No cure, no sealer, no slag
- PAMS cure applied 4 hours after placement with integral sealer
- PAMS cure applied 4 hours after placement with no sealer
- Wax cure applied 30 minutes after placement with no sealer
- PAMS cure applied 4 hours after placement with no vibration
- Cure & Seal applied 30 minutes after placement with no slag
- PAMS applied 4 hours after placement with slag.

Individual pads of note

20 of the 92 pads averaged a no-distress score of **1.0**, while four pads averaged a score of above 2.0. Some trends with this group: 14/20 pads with a perfect score had a silane-siloxane sealer, and only 2 had no sealer. Only two of these pads had no curing compound and only two more had a Cure & Seal. Vibration, slag, and cure time were nearly equally represented in the group.

With an average score of **3.0**: Sodium-silicate cure applied at 30 mins with a silane-siloxane sealer, slag and vibration.

With an average score of **2.4**: Sodium-silicate cure applied at 30 mins with a silane-siloxane sealer, slag and no vibration.

With an average score of **2.2**: PAMS cure applied at 4 hours with a silane-siloxane sealer, slag and no vibration.

With an average score of **2.2**: PAMS cure applied at 4 hours with no sealer, slag and no vibration.

Takeaways

Let's make sure to preface this: any conclusions that can be drawn from this data should probably be communicated with low confidence. Due to the mild winter and very narrow band of scoring differences, a single judge's score on a single pad could cause large changes in the results. The study will continue for another season, and perhaps we shall see larger differentials in performance when we evaluate the pads again next May.

The current data shows there may be some import that should be placed on material compatibility as well as application timing for certain curing compounds. Slag and a sodium-silicate curing compound don't seem to perform well together, while a wax cure looks like it can really benefit from a silane-siloxane sealer, slag or both. The PAMS cure looks like it will perform better with an early application while the sodium-silicate cure and Cure & Seal both do better at 4 hours.

If anyone wishes to see more of the raw data to draw any more theories or conclusions, let us know and we will pass it along.

Gratitude

Finally, we want to thank our judges for their participation in the study and taking the time to score each of the pads.

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