

Deicer Scaling Resistance of Concrete Mixtures Containing Slag Cement

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Got a problem?

Scaling is small flakes falling off from concrete surface due to deicers and freeze and thaw. Slag is limited to 25% for replacement level in concrete due to the poor performance in scaling test ASTM C 672, but C672 does not correlate well with field. Thus, a new test method was proposed by Hooton (2012).



Ok, what if...

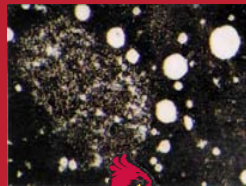
- We use new method, can we raise the replacement level up to 50%?
- slag is the problem, a longer curing time and temperature will help?
- air system is a factor in scaling, how does it impact scaling resistance

What we've done:

Air system test (Spacing factor)



Spacing factor is the maximum distance between paste and air voids, which is believed to be a key to scaling resistance. By scaling slice of concrete (left), Rapid air (C457) is able to detect size and distance of air voids in concrete (right), smaller the better



Scaling test

Method	Deicer	Curing
ASTM C672	4% CaCl ₂	14 days 100 % RH, 14 days 50% RH

Calcium Chloride is believed to be more destructive than other deicers, and 28 days is believed to be not enough for SCMS including slag

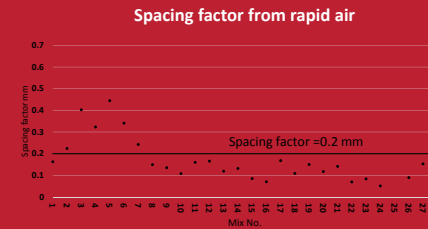
Method	Deicer	Curing
New Method	3% NaCl	28 days 100 % RH, 14 days 50% RH

Sodium Chloride is believed to be less destructive than other deicers, and a longer curing time could help to increase the maturity of slag

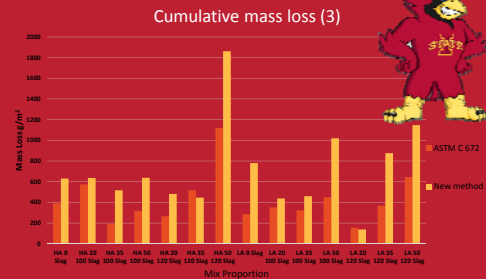
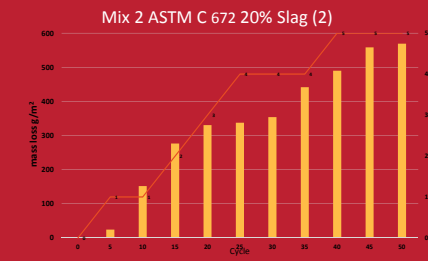
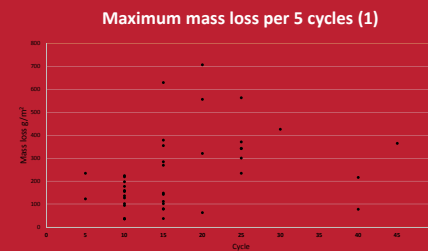
What did we find:



Concrete suppose to have a spacing factor smaller than 0.2 mm, and most of samples achieved that (left).



Mass loss per 5 cycles and visual damage rate is measured. From results, most damage happen in early age (1). Mass loss has a good correlation with visual rate(2), while either one of them is accurate. C 672 caused slightly less damage than new method (3). Scaling mass loss has no direct relationship with slag replacement level (3)



What's our conclusion?

- No direct relationship was found between replacement level and mass loss
- No clear relationship was found between spacing factor and scaling resistance
- The data indicate that for the new method, similar trends are observed in both laboratories but correlation between them is not as good as desired

What's in store?

Scaling resistance is believed to be determined by air system, which is indicated by spacing factor. But mechanism of scaling could not explain this relationship, neither did we find this relationship in this project. So it is critical to really understand scaling damage, and the mechanism behind it.