

Every spring, after the winter snow and ice have disappeared from the tops of concrete driveways, sidewalks and other exterior flatwork, homeowners are uncovering what first appear to be surface blemishes that were not apparent in the fall or in the case of freshly installed concrete, when it was first placed.

The concrete slab looked so good, so hard and durable and yet now it appears to have a number of localized areas of blemishes, pock marks or surface blemishes. These blemishes appear to be affecting the top surface of the concrete as the paste can be easily picked off and yet the aggregate bond may appear quite sound and intact.

This condition is not so uncommon, especially to those of us that live in the colder climates of the Northeast. This is a topical condition known as scaling. It can be easily be avoided by adhering to a few basic principals when ordering and placing concrete for an exterior flatwork project.

Unlike most manufactured products where the manufacturer has sole responsibility for the final quality of its production, concrete is sold to a project before it is a finished product. Responsibility for a high quality, durable finished product is equally shared by the concrete contractor placing the concrete slab.

Selecting an appropriate mix for the given service application is critical to getting a durable concrete product but equally important is the finishing and curing of the concrete after it is placed. In order for concrete to have maximum durability the plastic concrete must not be overworked.

It must be screeded, floated, saw cut and cured. Never use a jitterbug or vibrating screed and never finish when bleed water is still visible. Under no circumstance is it permissible to add water to the surface during finishing. The concrete must be protected from the elements when concrete is placed late fall or winter. It must be thoroughly cured before it is put into service. This means that the concrete must be kept at temperatures above freezing until it reaches design strength usually at 28 days. Durability of concrete slab is dependent on how well the concrete is cured.

Under no circumstances should a deicer be used on concrete that has not fully cured. While deicers are efficient in melting snow, they can play havoc with freshly placed concrete. We generally recommend that deicers not be used in the first year of the pavement's life. Typical deicer chemicals are as follows:

- Sodium chloride (Table Salt)
- Calcium Chloride
- Magnesium Chloride
- Potassium Chloride

• Calcium Magnesium Acetate, Urea, Ammonium Sulfate, Nitrogen Salts

While there are many types of deicers on the market, they all work on lowering the freezing temperature of water. There is a common misconception that concrete is relatively inert. Concrete, in fact, continues to cure and change properties as it matures. The use of these types of chemicals can significantly affect the concrete durability. If you have any doubt of their destructive nature, place a small amount of calcium chloride on a tin pan and observe what effect it has on the tin pan. Deicers tend to amplify freeze-thaw deterioration which can lead to surface defects and possible structural failure.

There are long term performance studies published by the Portland Cement Association which quantify the impact of various known deicers. These same studies also evaluate the impact of w/ c ratio and curing membranes or sealers. Sealers will seal in moisture in the concrete which will allow the slab to gain strength as it cures. A sealer will also prevent chloride-.laden moisture from migrating into the concrete slab. Never use ammonium sulfate or ammonium nitrate as a deicer as these chemicals are too aggressive and will easily destroy a concrete surface.

Deicing chemicals can also impact vegetation and hardscape. They damage plants, change the properties of soil, corrode steel or iron railings and can make a Pet ill through ingestion or simply from continued and prolonged contact.

Note ACI 332-04 Requirements for Residential Concrete Construction recommend for a climate or exposure such as found in the Northeast, a maximum water to cement ratio of 0.45 for exterior pavements, curb and sidewalk. This concrete should also have an appropriate amount of air entrainment as detailed in table 4.2 of that document.

In conclusion, it is not enough to simply purchase the correct mix design for your specific region. It must also be placed, finished and cured correctly. Avoid the use of deicing agents during the critical first year after placement. For more information on this subject or any other aspect of concrete construction please contact the Pennsylvania Aggregates and Concrete Association.

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Figure 1



Figure 1—Typical concrete pavement surface that is severely effected by the application of deicers and the effects of freeze-thaw in a moist environment. This concrete may not have an adequate design strength or w/c ratio and may not have receive proper initial curing.