

TECHNICAL BULLETIN
Concrete Slab Outgassing

Concrete slab outgassing may result in “fish eyes” craters and pinholes in the self-leveling product. This happens frequently; however, steps can be taken to minimize this effect.

Concrete by definition consists of portland cement, this being the binder system, minimal aggregates, water and perhaps admixtures. The drying time or hydration of the concrete is called the removal of the uncombined water and starts at the concrete surface and proceeds inward. Some factors that may influence this process are:

- Water cement ratio of the mix
- Thickness of the concrete
- The surface area of the concrete
- The ambient relative humidity
- Air temperature
- How the concrete is cured

By its nature concrete is inherently porous, usually 2-7%. These air voids are a direct result of concrete placement, mixing water, surface conditions and admixture use. There is a positive side to entraining air even up to 10-12%. In those areas where freeze/thaw resistance is needed higher air content avoids damaging concrete and actually increases its durability, however, this can also lead to problems when self-levelers and coatings are applied, such a problem is outgassing. Thus air entrainment in concrete, while enhancing durability, adds to outgassing. The more air entrained, the more the chance of outgassing. Outgassing is an annoyance that can result in surface pinholes and craters. Proper installation of the self-leveling primer and awareness of surrounding and ambient conditions can minimize such problems.

The outgassing effect is explained as follows: concrete releases air and water vapor that expands when temperatures rise, and conversely, concrete absorbs air and water vapor that constricts when temperatures drop. This is because air and water vapor, like all elements in nature, seek thermal equilibrium with their surroundings. When outgassing occurs, it produces pinholes in the coating. The degree of outgassing is sometimes increased by some coatings that generate heat during their initial cure, adding even more heat to the surface of the concrete.

This outgassing condition can be aggravated when abrasive blasting or scarifying breaks the thin concrete crust thereby opening more air packets and bug holes. Concrete is very dynamic. It cracks, leaks, shrinks, moves, breathes, absorbs water and releases water vapor. These characteristics make coating difficult.

Summary

Vapor (air) moves in and out of concrete with changes in ambient and concrete temperature, as well as barometric pressure and humidity fluctuations. This air expansion or release, as temperatures increase, through the concrete pores is called outgassing. Self-Leveling Primers, such as ProSpec® Level Set® Primer and Level Set Primer Plus are meant to stop or reduce the outgassing effect that produces pinholes. It is important to note that air and water vapor, not liquefied water must be sealed. Water in the liquid state has a higher surface tension than water vapor and can be easily deterred in its movement through the capillaries of the concrete.

Under certain circumstances when such a surface is covered by a coating such as a self-leveling primer and self-leveling compound blistering cratering or pinholes can be created at the pore location. As the coating cures these surface imperfections remain on the surface. Under most situations these present no structural concerns and are only cosmetic. Improper surface preparation prior to the installation of the self-leveling system may also lead to surface blemishes. See technical bulletin: Surface Preparation.

How to Eliminate or Minimize Outgassing

First be aware what outgassing is and that it can happen. Be aware of surrounding circumstances, i.e., current and pending temperature of both the air and slab, relative humidity, slab curing etc. Always apply a primer before the application of the self-leveling compound. See the Priming section in the corresponding Level Set literature.

There are several methods available to reduce the impact of concrete outgassing. The primary method is based on monitoring the surface temperature of the concrete substrate to which self-levelers are to be applied. An increasing surface temperature is a strong indication that outgassing will occur. Therefore, shading the area or application of self-leveler in the afternoon or evening when temperatures are decreasing will likely reduce the possibility of outgassing.

The secondary method requires close observation of the initial coating. If pin-holing is excessive, the coating will have to be applied in increments. The applicator will have to allow the previous increment to dry, gain tensile strength, and cool down from its exothermic reaction before applying additional increments. The thinner the increment, the lower the exothermic effect. In addition, the initial increment acts as insulation, radically reducing the outgassing effect caused by the exothermic reaction of subsequent coats.

The applicator should try to program coating application to coincide with a cooling trend on the concrete's surface, usually late in the afternoon. Before job start-up, surface temperatures should be monitored to determine the cooling-heating trends of the areas to be coated. If a cooling trend is not detected, then the only thing one can do is be patient and put the self-leveler on in increments.