8 Ways to Reduce Pinholing When Coating Concrete

by Paul Oman

Industrial concrete comes in a wide range of qualities, particularly in terms of capillary voids, intergranular spaces, and trapped air pockets. When protecting concrete with an epoxy or any coating, pinholes sometimes form through the coating. Pinholes have two possible causes.

First, they can be caused by air trapped below the coating in tiny surface voids. The air expands outward before the coating has cured due to solar heating. This type of pinholing is common on exterior surfaces coated during the cool morning hours. As the air temperature climbs during the day, the concrete (and the air filling its near-surface spaces) warms. The warming air expands against the uncured fresh surface coating producing a bubble or blister that frequently opens, leaving a tiny crater and a central pinhole opening revealing the throat of the underlying air space.

Secondly, and perhaps more commonly, pinholes form when the liquid coating forces itself into interconnected surface voids displacing and concentrating the air into other adjoining spaces where a blister or pinhole forms. Simply put, air forced out of some voids finds its way into adjoining spaces. Push the air out of Space A and it reappears in Space B. The combined air from Space A and Space B, both now in Space B, push outward toward the surface, forming a blister or pinhole.

Don't confuse pinholes with fisheyes, which occur when the coating comes in contact with a foreign particle (e.g., grease or silicon). The coating pulls away from the contaminant, leaving a tiny crater-like structure in the coating. Fisheying is almost always a surface prep problem.

Either way, air forced out of freshly coated concrete can ruin the integrity of the coating. The problem, of course, is not with the coating but rather with surrounding conditions associated with temperature, expansion and capillary action.

Fisheyes. Pinholes should not be confused with fisheyes, which occur due to surface tension differences between the coating and a grease, silicon or even dust particle. The coating pulls away from the contaminant, leaving a tiny crater-like structure in the coating. This crater is not connected to a subsurface air-filled space. Fisheying is almost always a surface preparation problem.

Pinhole Solutions

Coatings applicators have several options for minimizing the formation of pinholes. Here are eight of the top strategies.

1. Only apply coatings when surface temperatures are at or near their afternoon peak. A cooling surface will actually suck coatings into its matrix as trapped cooling air contracts. However, should the temperature drop below the dew point, some lower quality epoxies will blush (creating a waxy surface film that must be washed away prior to topcoating).

2. Additional or extra abrasive blasting of new concrete surfaces may more completely open matrix void spaces, thus reducing the number of tiny pinhole-causing "throats."

3. Completely wetting down the surface with water will tend to displace air-filled void spaces with water. Water expands much less than air when warmed. This

approach requires the use of water-tolerant epoxies to coat the still damp or wet concrete. Fortunately such solvent-free epoxies are becoming increasingly available and are now routinely specified in design plans.

4. In addition to moisture-tolerant epoxies, there are non-epoxy concrete fortifiers and sealers on the market. The water-like material soaks completely into the concrete reacting with it to form tiny crystals between the concrete matrix grains. The result is a less porous, denser concrete. These products help fill the pinhole, causing air-filled void spaces with a solid crystalline grain.

5. If the coating is applied by spray, a quick splatter coat can be applied. This quick coat covers approximately 50 percent of the surface with discrete paint blobs. Air displaced from surface voids by capillary action pulling the coating into the concrete migrates into adjoining spaces. This additional air can easily be vented to the surface over these uncoated areas. When the final complete coating is applied there is less air to be trapped, concentrated and expelled.

6. The surface can be primed with a water-based epoxy primer. These new-generation of epoxies are approximately 50 percent water. They have a pot life of hours and a surface dry time of an hour or less. Thinning and clean-up is accomplished with ordinary water. Such epoxies are commonly used for safety striping and as a thin film epoxy primer. This technique combines the method of wetting down the surface with water plus at least partially filling the intergranular space with epoxy. When topcoating with an epoxy (or other coating) that cannot be applied to a water-wet surface, this method has obvious advantages.

7. Apply a very low viscosity, penetrating, solvent-free, epoxy seal coat. This will fill the capillaries, reinforce the surface and provide an ideal substrate for the epoxy topcoats. Any air bubbles that form will simply pop and the thin epoxy will reseal the surface. This coat will also serve as a bond or tie coat to the often thicker and sometimes drier (especially patching epoxies) topcoat.

8. The surface can be coated with a very thick (thixotropic) coating. The thixotropic gel is strong enough to resist the expulsion of subsurface air. Note that the air will remain trapped at the coating interface. Several of these coatings contain Kevlar™ microfibers that provide exceptional surface strength and durability. These coats are probably 30, 4 or more mils thick.

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Sealing Basements and Concrete Pits

Infiltration and influx of water through concrete or block surfaces located below grade is a common problem. Homeowners with cellars, city managers with manholes and businesses with sumps and collection pits frequently have problems with seepage or leakage. Such problems can be solved thanks to several new products now on the market. These products will work on moisture-saturated surfaces and on the "inside" negative pressure surface (the inside wall of a leaking basement as opposed to the outside surface where the water presses the coatings into the concrete instead of away from the concrete).

The ease and cost of fixing this problem is largely determined by the extent of the leakage and the composition/density of the wall material. Concrete or cinder block is a common basement wall material. The density, porosity and void space size vary greatly from manufacturer to manufacturer. Some cinder blocks do a reasonable job of holding back water while others seem more characteristic of a window screen. A less dense building block will require more dramatic measures to stop its leaking.

Concrete density and porosity can also vary, particularly as the concrete deteriorates due to slightly acidic ground water or due to the initial mix of cement and sand. Simply put, each case is unique and the contractor/applicator must decide which solution will work for the least cost.

Concrete Sealers

The simplest solution is to use a concrete fortifier/sealer. This water-like product soaks completely into the concrete and reacts with the cement grains to form new crystal grains between the existing cement particles. With fewer air-filled void spaces, water migration through the concrete is stopped or greatly reduced. There remains adequate pore space, however, to allow the block to breathe. A single application by brush or roller is generally all that's required. Its effectiveness on cinder block varies. This product works well on denser blocks, less well on coarser blocks.

Epoxy

The next level of sealing involves applying a coat of thin, solvent-free, water displacing epoxy over the surface. These special epoxies can be applied to a damp, saturated or completely submerged surface and will form a tough, non-porous surface coating. Problems can result if the surface is dirty, greasy, weak, or dusty and the epoxy cannot get a good bond to the surface. Another possible concern, primarily with the more porous cinder blocks, is that the thin epoxy cannot completely fill the larger voids and spaces in one application. In such situations a thicker water displacing epoxy is recommended.

Thixotropic Coatings

The best protection against water seepage is to apply a thickened, thixotropic, water displacing epoxy. Often fiber-thickened (frequently with Kevlar™ microfibers), these products can be applied by plastic edger (or 'float') to the surface. Application literally pushes the thick epoxy into surface spaces and the thick gelled epoxy resists air or water expulsion while it cures to an extremely hard, durable and even attractive surface. As with the thinner versions of these 100-percent solid epoxies, surface preparation and surface condition are critical for a firm bond.

For commercial applications such as manhole repair and restoration, a two-coat system consisting of water-displacing epoxies of contrasting colors is often specified. The different colors help to visually insure uniform and complete coverage, compensating for thick or thin zones during the application of each coating. An even better system would include using a sealer before applying the one or two coats of the epoxy. The best sealers help resist the influx of water. Sealed concrete will also better resist chemical deterioration when and if the epoxy surface coating integrity is breached. Such products also reduce the possibility of pinholing through the coating by reducing the volume of air spaces in the surface of the concrete.

Material costs for the above treatments vary from about $0.40 per square foot to $3.00 per square foot. ■