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BUBBLES, BLISTERS & OTHER UNWANTED LITTLE "BONUSES"

Don't Let a Concrete Substrate or Improper Polymer Handling Ruin Your Floor Overlay

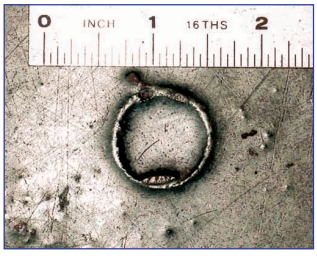
By Floyd Dimmick

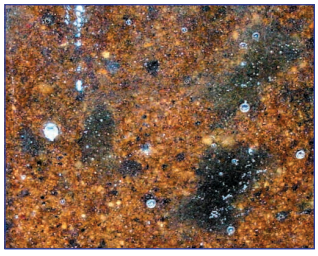
If you apply coatings on concrete, you probably don't need to be told that coating defects can cost you money and create unhappy customers.

With all of its imperfections and potential issues, concrete remains the most common surface for polymer floor overlays. Concrete can cause you grief even in the best environmental conditions. But by understanding how various polymers and environmental conditions react to this substrate, you can keep concrete's small problems – like bubbles and blisters – from becoming major ones that affect your bottom line.

First and foremost, it goes without saying that you should select a polymer system from a high-quality manufacturer who's skilled in concrete applications. Poor formulations will create application problems that cannot be corrected in the field by the best surface preparation or application techniques.

While flooring contractors and their crews don't have to be chemists or polymer scientists, they do need to understand the manufacturer's recommendations on how to precondition the products and apply them under changing environmental conditions. All formulations, even from the same manufacturer, may have some differences in application techniques or other properties, such as surface wetability, air release, and cure time. It's important not to assume that all products are the same, even when purchasing from the same polymer manufacturer. However, it is a fair assumption that, under the same application conditions, the product will provide the same workability, properties, and color each time.





Craters *(left)* **are caused during the polymer curing process. A large quantity of craters and bubbles often requires total overlay removal. Bubbles** *(right)* **are caused during the polymer initial cure. Blisters may take months to years before they occur and are noticeable.**

Concrete is a porous substrate that breathes with thermal change and will absorb liquids once the laitance has been removed or disrupted. Therefore, you should begin placement of the polymer overlay immediately after the surface preparation and surface testing have been completed and approved. Long-lasting floor systems depend on the selection of high-quality products and good application practices.

At some point, you can expect to encounter problems on concrete substrate, whether it's an interior or exterior project. Outgassing, bubbles, blisters, craters, and pinholes are the most common ones. The chart *(opposite side of page)* can help you prevent them and effectively deal with defects after they arise.

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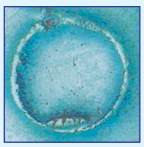
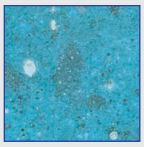
Potential Problems Causing Overlay Defects

Defect	Explanation & Cause(s)	Prevention	Repair After Defect Occurs
Outgassing	**Definition:** Air or gas that escapes from the substrate or sub-surface beneath or within the coating that causes bubbles, craters, small holes, or pinholes. **1** Outgassing will occur when the substrate temperature is changed by a heat source, such as the sun shining on the surface or a heater blowing hot air over the wet polymer. **2** Higher air temperature with lower humidity. **3** Vapor or liquid water escaping from concrete pores.	**1A** Interior — When the sun can shine through windows, skylights, or doors, close the doors and cover the windows to prevent sunlight from entering the structure. **1B** Exterior — Apply the polymers when the concrete will have the least opportunity to expand and contract, causing the outgassing. Early morning applications are OK for fast-setting polymers; late afternoon for slower-setting polymers. **2** In interior applications, reduce heat source if possible. **3A** Wet surfaces should be dried by blowing air (oil-free) over the surface. Do not use petroleum heater/blowers because the exhaust often causes carbonation of the surface. **3A** Vapor transmission treatment requires a surface-penetrating epoxy to seal the upper concrete surface before application of overlay.	**1A, 1B** **2** Outgas damage caused by air can be repaired by grinding or sanding the surface smooth and filling the surface defects with an epoxy recommended by the polymer manufacturer. **3A** When water is present in the bubble, sound the surface for adhesion. If adhesion is OK and the polymer is cured where it is adhered, grind or sand the surface and reapply coating. Drying the surface may be necessary. **3B** If testing shows vapor transmission exceeds 3 lbs/1,000 sq.ft/24 hrs., remove entire coating to the depth of penetration, so that no polymer is present on or within the concrete surface. Apply vapor barrier penetrating epoxy and then place overlay wear surface. **Note:** Correct the surface smoothness at this stage of treatment to prevent growth of high spots within future lifts.
Bubbles 	**Definition:** During the liquid to gel stages of the curing process, the bubble is formed from the pressure of air, water or solvents, causing a crown to form around the center point of pressure. As the pressure and/or liquids displace the uncured polymer, it forms a perimeter that becomes a wall. As the wall grows higher, it will eventually curl inward and meet directly over the center point of pressure, creating a bubble. If the bubble does not break and re-level with the adjacent polymer before the gel stage develops, it will remain a bubble. Bubbles may be a pinhead to 50 mm (2 in.) in diameter. **1** Over-mixing, using the wrong paddle on the mixing tool, and high-speed mixers will cause air entrapment. **2** Improper surface wetting. **3** Wrong roller covers. **4** Over-working the coating by too much rolling. **Note:** Bubbles are caused during the polymer curing process.	**1** Follow the polymer manufacturer's preconditioning, mixing, application, and curing directions. **2** Follow product's preconditioning and application directions. Check for 100% wet-out of the surface. **3** All roller covers are not equal. Test each cover to see if they perform without creating bubbles with each coating. **4** Over-rolling the coating will whip air into the polymer and may not release before the tack-free stage develops. Some coatings require spike rolling to assist air release.	**Same treatment for 1-4** A single or small quantity of bubbles are typically drilled out on thicker systems so that solid adhering coating is on all edges and a clean, solid concrete is present. Thinner systems are typically sanded or screened. Fill the void with the same overlay system and recoat the entire area. A large quantity of bubbles often requires total overlay removal. Then dry-abrasive-blast the surface. Apply the selected treatment to address the cause of bubbling, and replace overlay.
Blisters 	**Definition:** Blisters are formed by pressures created at the bond-line of the coating and concrete, or at the bond-line between two polymer layers when the upper polymer absorbs water or chemicals and the lower layer does not. The pressures develop from vapor or liquids, or a combination of both, in areas of weak bond attachment. Solar heat and other sources can also combine with liquid or vapor to induce additional stress. The heat causes vapor to expand and stretch the overlay into a dome- shaped protrusion above the adjacent polymer surface. Blisters may form in small clusters or a single large blister. Size may vary from pinhead to 50 mm (2 in.) in diameter. **1** Excess moisture in the concrete will expand when subjected to solar heat or temperature increases. **2** When microscopic voids in the concrete are present near the surface, vapor will change its state from gas to a liquid. The pure water will dissolve the soluble cement molecules and release the coating bond to the concrete. **3** Coatings with high ductility are more likely to form into a blister when subjected to pressures by moisture and heat. **Note:** Blisters are caused after the polymer has developed its initial cure. It may take months to years before they occur and are noticeable.	**1A** Select an epoxy primer that will penetrate and become a monolithic part of the concrete, with a low moisture absorption rate (below 0.3%). **1B** Test for high moisture content with the plastic sheet method, ASTM D 4263. **2** Test for vapor transmission before placement of overlay using calcium chloride test method ASTM F 1869. Treat surface if required before placement of the overlay. **3** Select polymer overlay systems with medium or medium-high ductility. **Note:** Test polymer adhesion to the concrete with tensile pull or shear test methods. Accept only 100% concrete failure, no bond line failure.	**Same treatment for 1-3** A single or small quantity of blisters are typically drilled out, so that solid coating is present on all edges and clean, solid concrete is present at the bottom of the void. Fill the void with the same overlay system. A large quantity of blisters requires total overlay removal, dry-abrasive blasting the surface, treatment to cure the blistering cause, and overlay replacement.

Additional Defects

Craters: Craters are formed in the final gel stage of the polymer curing process. During the three stages of curing, a polymer changes from a liquid to a gel and then to a solid. When the bubble is formed during the transition from the liquid to gel stage, it can not re-level when the dome breaks with the adjacent polymer, as in the liquid stage. Its temporary new consistency is pliable like rubber, and cannot flow out, leaving an outer wall around the perimeter of the bubble area. Some bubbles never form a dome and just build thicker crater walls. Both forms cure and remain in this shape as a crater. **Same Prevention and Repair Methods as Bubbles**

Small Holes & Pinholes: Small holes and pinholes are bubbles that broke but did not re-level and close. The only difference is diameter size. **Same Prevention and Repair Methods as Bubbles**