

# “Dry” vs “Cured” Acrylic Coatings: Understanding the Difference



## The Chemistry Behind Bubbling and Blistering in Uncured Acrylic Coatings

When water-based acrylic coatings are applied, it undergoes a two-stage process to form a durable, protective film: drying and curing (crosslinking).

### 1. The Drying Phase: Evaporation is Key

The initial drying phase is all about the evaporation of water from the coating film. As the water leaves, the acrylic polymer spheres within the coating are forced closer together. This process, known as coalescence, is when these tiny spheres fuse to form a continuous, solid film. At this stage, the coating may feel dry to the touch, but it is far from achieving its final strength and water resistance.

### 2. The Curing and Crosslinking Phase: Building Strength from Within

Curing is a chemical process where the polymer chains in the acrylic resin link together, or "crosslink." This creates a strong, three-dimensional network that gives the coating its durability, chemical resistance, and, most importantly, its ability to withstand moisture.

### So, what happens when it rains on an uncured acrylic coating?

When rain hits an acrylic coating that has not fully crosslinked, the water can be absorbed into the still-porous coating's film. This is because the polymer chains have not yet formed a tight, impermeable barrier. Here's a breakdown of the detrimental effects:

- **Moisture Entrapment:** The rainwater becomes trapped within the coating or between the coating and the substrate.
- **Osmotic Blistering:** If there are any water-soluble substances on the substrate that were not properly cleaned off before coating (like salts or certain contaminants), the trapped water will try to dilute them. This creates osmotic pressure, which is a force that pushes the water outwards, lifting the coating's film and forming a blister.
- **Vapor Pressure:** When the sun comes out after the rain, it heats the surface. This heat causes the trapped water to turn into vapor. This water vapor expands significantly, creating pressure underneath the coating's film. Since the uncured acrylic is not yet strong enough to withstand this pressure, it lifts and forms bubbles or blisters.
- **Loss of Adhesion:** The presence of water at the interface between the coating and the substrate weakens the adhesive bond. This makes it much easier for the paint to delaminate and peel away.

In essence, an uncured acrylic coating is like a sponge. It can soak up rainwater, and when that water tries to escape, it pushes the coating away from the surface, leading to bubbling and blistering.

### How Long Does It Take for Acrylic Coatings to Fully Crosslink?

The time it takes for an all-weather acrylic coating to fully crosslink and develop its maximum water resistance can vary significantly depending on several factors. While a thin layer of acrylic paint



might be dry to the touch in as little as 30 to 60 minutes, the complete curing process is a much longer journey.

Here are the key factors that influence the crosslinking time of acrylic coatings:

- **Temperature:** Higher temperatures generally accelerate the chemical reactions involved in crosslinking. The ideal temperature range for most acrylic coatings to cure properly is between 70°F and 90°F (21°C to 32°C). Curing will be significantly slower at lower temperatures.
- **Humidity:** High humidity slows down the evaporation of water from the coating’s film. Since the water needs to evaporate for the polymer spheres to coalesce and for crosslinking to begin in earnest, high humidity can significantly extend the curing time. Relative humidity below 80% is generally recommended.
- **Airflow:** Good air circulation helps to carry away the evaporating water, which can speed up the drying and curing process.
- **Coating Thickness:** Thicker coats of paint will take much longer to cure than thinner coats. This is because the water and any solvents in the paint have a longer distance to travel to escape from the film.

### General Timelines for Curing:

While it's always best to consult the technical data sheet for the specific product used, the following are some general guidelines for the curing of water-based acrylic coating:

- **Dry to the Touch:** 30 minutes to 1.5 hours
- **Recoat Time:** Usually after 2 to 4 hours, but this does not mean it is cured.
- **Full Cure (Complete Crosslinking):** This can take anywhere from **14 to 30 days**.

It is during this extended curing period that the coating is most vulnerable to damage from rain and moisture. Therefore, it is crucial to plan coating projects during periods of dry weather and to allow ample time for the coating to cure before it is exposed to the elements.

ADVANCED POLYMER TECHNOLOGY CORPORATION believes the information herein to be true, accurate and reliable. However, recommendations or