

Blisters and Bubbles in Paint Coatings

Introduction

Blisters and bubbles in paint and protective coatings can occur for several different reasons. They may look similar, but the cause can be quite different.

For application person, the important point is that blistering does not automatically mean the coating itself is faulty. The problem may come from contamination, trapped moisture, trapped solvent, application conditions, temperature changes or the condition of the surface underneath.



Understanding the likely cause is important before deciding how to repair the problem.

Osmotic Blistering

Osmotic blistering mainly occurs where coatings are exposed to water for long periods, particularly in immersion service.

The coating acts as a partly permeable barrier. Small amounts of moisture can gradually pass through it. If water-soluble salts or other contaminants are trapped underneath or within the coating, the moisture is attracted towards the more concentrated area.

Pressure can then build beneath the coating until it becomes greater than the coating's adhesion to the surface. A blister forms.

Common causes include:

- soluble salts such as chlorides, sulphates and nitrates left on the surface;
- water-soluble material or solvent trapped within the coating;
- prolonged exposure to moisture or immersion; and
- temperature differences across the coated surface.

In severe situations, the pressure created by osmosis can be surprisingly high.

Temperature and the "Cold Wall" Effect

Blistering can also occur where one side of a coated surface is warmer than the other.

For example, warm water on one side of a coated structure and a cooler substrate behind it can encourage moisture to move through the coating and condense at the cooler interface.

Over time, liquid can accumulate and form a blister.

Bubbling During Application

Not every bubble is caused by osmosis.

Applying paint to a hot surface in direct sunlight can cause the surface of the coating to dry too quickly. A skin forms while solvent remains underneath. As the trapped solvent heats and expands, bubbles can appear.

Applying a coating too thickly can create the same problem.

Refer to INFOSheets: “Why measure Wet Film Thickness”, “Precision Wet Film Thickness Measurement for Optimal Coating Application”,

Cold temperatures and high humidity can cause the opposite problem. The coating dries too slowly and solvent cannot escape properly. If another coat is applied too soon, solvent may become trapped and bubbles can appear later when the coating warms up.



Concrete and Other Porous Surfaces

Concrete naturally contains pores which may hold air and moisture.



When a non-breathable coating is applied over porous concrete, that air or moisture can become trapped. If the surface later warms, the air expands and moisture can turn to vapour.

The resulting pressure pushes against the back of the coating and can produce bubbles.

Polyurethane and Moisture

Some polyurethane coatings are particularly sensitive to moisture during application.



The isocyanate component can react with water and produce carbon dioxide gas. If this gas becomes trapped in the coating, it can create very fine bubbles or a foam-like layer.

This may occur at the surface, inside the coating or between coats, and in some cases can affect adhesion.

Key Facts for Contractors

Good surface preparation and correct application conditions are critical. Check for contamination, moisture and porosity before coating.

Avoid painting excessively hot surfaces in direct sun, and do not exceed the recommended film thickness. Allow each coat enough time to dry and cure before applying the next one.

With moisture-sensitive coatings, pay particular attention to surface moisture, humidity, condensation and weather conditions.

Summary

Blisters and bubbles can have several different causes, and their appearance alone does not necessarily tell you what went wrong.

The cause may be osmotic pressure, soluble salts, trapped solvent, moisture, temperature differences, porous concrete or incorrect application conditions.

Before carrying out repairs, identify the likely cause. Simply cutting out a blister and repainting it may only hide the problem temporarily if the underlying moisture, contamination or application issue remains.

Importantly, some flexible, high-build coatings can continue to perform even when isolated blisters are present. If the blister remains intact and the protective coating system is still functioning, repair may not always be necessary.

Carry out the cleaning procedures thoroughly, and follow recommended coverage rates and curing times and measure the wet film thickness to be sure no too thin or too thick!



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