

Guidelines

Paint Coalescing & Film Formation

Introduction

As paint dries, water evaporates and the plastic spheres (or colloids) are forced together, fusing to form a thin layer of plastic that gives the paint a smooth finish. Acrylic paint contains water compatible solvents which soften the outside of the spherical colloids enabling them to fuse together during the drying process forming a cohesive film. This process is called "paint coalescing" and the solvents which evaporate as the paint dries are called "coalescing solvents".

Factors Affecting Paint Coalescing & Film Formation

A number of problems can result when recently applied paint is not able to coalesce correctly due to application, environment or substrate conditions. The following sections discuss the conditions which detrimentally affect paint coalescing;

1. Low Temperature

Below a certain temperature - usually about seven Degrees Celsius- the plastic colloids in paint do not fuse properly. At these temperatures water is unable to evaporate from the paint film. However, the coalescing solvents can evaporate from the film at temperatures of nearly zero degrees Celsius. At low temperatures the coalescing solvents can completely evaporate from the paint leaving the water trapped and the plastic colloids inadequately fused together. In this example the paint may become flaky and/or bubble and develop adhesion problems. This process is described as paint de-coalescing and results in the paint remaining water sensitive and lacking normal paint properties such as cohesion, adhesion and short/long term durability

2. Freezing Temperature

If moisture is trapped in a newly applied paint film due to low temperature, the water can freeze when the temperature drops to zero degrees Celsius. As the water freezes the expanding ice crystals prevent the plastic colloids from fusing and seriously damage the plastic film. This is common when paint is applied after 2:00pm in winter and subsequent low overnight temperatures result in heavy frosts. In this example the paint may crack, wrinkle, blister, bubble and develop adhesion problems. When morning temperatures rise the frozen paint will thaw out leaving the coating susceptible to moisture damage and de-coalescing resulting in the additional problems outlined above.

3. High Temperature

A roof surface temperature can be up to 30% hotter than the ambient air temperature. When the air temperature is over about 30 degrees Celsius the surface of a roof for example can be up to 40 degrees Celsius. At this temperature the water and coalescing solvents evaporate so rapidly from newly applied paint that the plastic colloids do not fuse properly. Instead of a smooth, shiny finish, the paint will develop a dull appearance due to the heavily cratered surface that can be seen when the surface is examined under magnification. In this example the paint may become dull, patchy, and flaky and develop adhesion problems. The paint will lack normal properties such as cohesion, adhesion and long term durability.

4. Moisture

Complete paint coalescing can take between 12 and 48 hours subject to temperature, wind, moisture and surface texture and porosity. Freshly applied water based acrylic paint can skin within 20 to 60 minutes at 20 Degrees Celsius. However the paint has not fully cured, it has simply begun the coalescing phase. At any time during the coalescing phase moisture on the surface of the paint due to rain, hail, dew or fog can cause considerable damage. The presence of coalescing solvents in newly applied paint will always allow moisture to be re-absorbed into the uncured paint. At the same time, similar to cold temperature conditions, the coalescing solvents continue to evaporate from the coating. While moisture continues to affect the film, the coalescing solvents continue to evaporate from the paint, leaving the moisture trapped and the plastic colloids inadequately fused together. This is a particular problem with dew, because the surface of a newly painted surface can remain wet for many hours at night. In this case the uncured paint is particularly vulnerable to additional moisture such as rain even up to 24 hours after the paint is applied. Under these conditions the plastic colloids inadequately fused together and the paint may become wrinkled, bubble, blister and develop adhesion problems.

5. Wind

A strong wind can cause a paint to dehydrate too rapidly preventing the plastic colloids from adequately fusing together. When the wind is cold the additional chill factor can reduce the surface temperature also adding to cold temperature problems. If the wind is hot it can rapidly dehydrate the coating causing similar problems to high surface/ambient temperature application. In these cases the paint may become flaky and/or bubble and develop adhesion problems.

6. Substrate Conditions

Surface conditions including the texture and porosity of the substrate also influence the film coalescing process. On a rough porous and moderately sloping surface such as a cement roof tile at a 21 degree pitch, the effects of moisture such as dew and light rain are minimised. Being porous the substrate absorbs moisture and blisters and bubbles are rare except on the south side of a structure which is colder and often shaded. Moisture damage is also more likely on a low pitched roof which will allow moisture to sit on the surface longer. Problems of moisture damage and in particular dew damage are exaggerated when the substrate is non-absorbent, such as on a metal or previously painted surface. On a cement roof tile for example, water in new paint can be absorbed into the substrate as well as evaporate into the atmosphere. The water in a primer or first coat can still be absorbed into the tile even if an additional coat of paint is applied before the first coat is completely cured. For this reason blisters and bubbles are less common on absorbent cement tiles and more common on lower pitched previously painted and sheet metal roofs.

7. Applying Multiple Coats

A single coat of paint is unlikely to suffer from moisture related damage, unless it is seriously rain affected in the first several hours after application or it is applied very late in the day and does not cure adequately before it is rain or freeze affected. This problem is always more likely on the south side of the house. Although a single coat will surface dry within 20 to 60 minutes at 20 Degrees Celsius, recoating at this stage is only possible if there is adequate time for the complete coating to cure (coalesce) adequately before adverse weather conditions such as moisture or freezing occur. Where multiple coats are applied the top coat skins trapping moisture in the first coat. Coalescing solvent continues to evaporate and allow moisture such as dew or rain to be re-absorbed into the film resulting in problems discussed above. Where more than two coats are applied i.e. primer/sealer and two top coats, the chance of moisture damage is significantly increased particularly on a non-porous substrate. Where two or more coats are affected by adverse weather conditions before complete coalescing results, the first coat will often re-emulsify and bubbles or blisters containing a milky or coloured liquid result.

8. Dew Point Consideration

Dew usually forms as a result of night temperature inversion and high humidity. It is likely when temperatures drop during the night and it is cloudless with no or light wind conditions. Dew Point Calculators are available which determine the likelihood of dew conditions on a particular day. Painters are advised to observe sensible application procedures which take the dew point into consideration, particularly where multiple coats will be applied and the risk of moisture damage increases substantially. In warmer summer conditions dew is unlikely and bubbling problems are experienced less. Dew is more common in spring and autumn when the majority of moisture problems occur, particularly on sheet metal roofs for example.

Can Paint Damaged During Coalescing be Repaired?

There is no simple answer to this question. The extent of the damage needs to be carefully assessed and a suitable rectification process undertaken to ensure a serviceable and durable finish. It may be that paint damaged due to moisture resulting in minor bubbles may self repair in hot weather resulting in no problems. Alternatively, serious bubbles may require removal and recoating. A dull coating resulting from hot weather application may require re-coating to restore an even glossy finish. Minor damage may also be repaired by applying a coat of Flexible Membrane followed by a coat of gloss acrylic such as Nuflex or TileFlex 2000 on a roof for example. Providing an absolute guarantee regarding adhesion and durability is always difficult after damage has resulted. Nutech recommends that you consult your supplier when damage is suspected to obtain expert advice.