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## A WHITER SHADE OF PALE

By Bob Cusumano

This case involves color change on the exterior of an assisted living facility that was constructed in the year 2000. The specifications called for the use of two coats of acrylic flat finish paint on exterior concrete and stucco surfaces. The color selected for the exterior walls was a bright yellow from an interior color chart.

Approximately four months after completion of the exterior painting, the painting contractor returned to perform extensive touch up. About six months later, the owner called to complain that the building was unacceptable due to non-uniformity of color. The building manager explained that the "blotchy" paint appearance was not originally apparent, but has gotten progressively worse since first noticed. A visual inspection of the exterior walls indicated that certain wall areas were distinctively different in color than other areas. These conditions are depicted in photographs #1 through #4.



Photo 1



Photo 2



Photo 3



Photo 4

A few ground level wall panels were nearly white in color as shown in photo #5.



Photo 5

The testing performed included determination of adhesion, surface chalk, substrate pH, and paint thickness at both light and dark areas of the building. The adhesion of the paint to its stucco substrate was found to be good at all locations tested, indicating that delamination of the paint should not occur. The amount of chalk on the surface of the paint was found to vary from "very slight" at dark yellow areas; to "light" at areas where the paint was a lighter yellow; to "heavy" where the paint was almost white such as the lower panel shown in photo #5. The pH of the stucco was found to be in the normal range at all locations tested. Therefore, alkalinity of the substrate was not a factor in the discoloration. Only one of the samples was slightly lower than the specified paint thickness with all other samples equal to or exceeding the required thickness. Therefore, coating thickness is not a factor in the discoloration.

There are two major reasons why paint can drastically lighten in color after application. The first reason is chalking. A cured paint film is composed of resin, the binder and film former, and pigment, the component that provides opacity and color. As the paint weathers, the resin degrades exposing the pigment as a "chalk" on the surface. The paint then has a lighter color and surface chalk test results are generally found to be "heavy". Low quality resins will degrade more quickly in an exterior exposure than those of higher quality.

This condition was found only at a few locations and only on very low building panels. It is our understanding that maintenance personnel may have applied chemicals for the eradication of rust stains that may have contributed to the degradation of the paint at these areas. Based on the chalk tests performed, "chalking" is not the major reason cause of paint discoloration, except at these few areas.

The second reason that paint can drastically lighten in color after application is fading. Fading occurs when the pigment portion of the dried paint film is "bleached" out, resulting in a lighter color. When fading occurs, the drastic color change is not associated with heavy levels of surface chalk. Fading can be caused by the following factors:

- exposure of the coating to heat or chemicals
- excessive alkalinity on a coating
- ultraviolet radiation from direct sunlight over time

- application of a color obtained through non-lightfast pigment
- application of an improperly tinted paint

Other than the low panels already discussed, there is no indication that heat or chemicals affected a majority of the applied paint. The pH tests performed indicate that alkalinity is not a reason for paint discoloration in this instance. While prolonged exposure to sunlight can cause some fading in a stable pigment, the discoloration at this facility was found to occur quickly and to a greater degree than would be considered normal.

The chemical oxidation resistance of the pigments used to make the paint that remained dark yellow was tested by swabbing samples with a sodium hypochlorite solution. The samples were allowed to dry. No color change was noted.

It is clear that the drastic color difference between dark yellow areas and light yellow areas as shown in the photos is due to some areas being repainted after the original application. The discoloration has a very distinct rectangular "block" pattern which is a result of touching up with a roller. This condition was confirmed by microscopic observation where the darker yellow coat could be clearly identified as overlaying the lighter yellow color. This was also confirmed in thickness tests.

Obviously, immediately after the touch up painting was performed, this drastic color difference did not exist. If it did, the painter would not continue to repaint with a color that did not match. Chemical oxidation tests performed on the new touchup paint indicated that it has a stable pigment. Therefore, it appears that the originally applied paint faded over time due to containing unstable pigments, whereas the touch up paint did not. Therefore, the color difference between the original unstable paint and the new stable touchup paint became obvious.

The color selected for this project was from an interior chart and as such would be subject to fading in an exterior exposure. There are two main types of colored paint pigments; inorganic and organic. Inorganic pigments are naturally occurring pigments that are mined from the earth. These pigments tend to be more stable in exterior exposures and include such tints as raw umber, raw sienna, venetian red etc. When bright, clear colors are needed, organic pigments are utilized. These tints are less stable in exterior exposures and are prone to fading. Often similar colors can be made from either inorganic or organic tints. When the inorganic pigments are used, the resultant color has a somewhat "muddy" appearance.

Another factor that can affect the stability of the paint pigment is whether the paint is manufactured and tinted at the factory where "ground in" colors are used versus made at the paint store where colorants are added. The factory made colors tend to be more stable, but large enough batches of paint must be ordered to warrant this type of paint/color production.

The lessons in this case include:

1. Always save enough paint from the original batch to perform touch up painting.

2. Make sure that colors selected for use are stable enough to be used in exterior exposures
3. Order one or two factory batches, rather than several small store tinted batches when possible for a large project.
4. Don't assume that different batches or paints will "weather" in the same fashion.

Like many paint failures, this problem could have been avoided with better communication between the painting contractor, the paint supplier, and the owner to ensure that the paints and colors selected would provide the intended level of service.