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LEARNING PROBLEM
By Bob Cusumano

A coating problem occurred while painting was being performed on interior veneer plaster walls at a new school being constructed in rural central Florida. The painting specifications called for gypsum plaster to receive one coat of acrylic primer and two coats of acrylic semi-gloss enamel with a total dry film thickness not less than 4.0 mils.

Areas of Building 1 were painted approximately four weeks after plastering was completed. The painting contractor indicated that the material method of application was spray and back roll. Within thirty days of paint application on wall areas of Building 1, bubbles were evident and areas of paint started to peel (photo #1). A short time later, it was discovered that walls in Building 2 had also begun to peel.

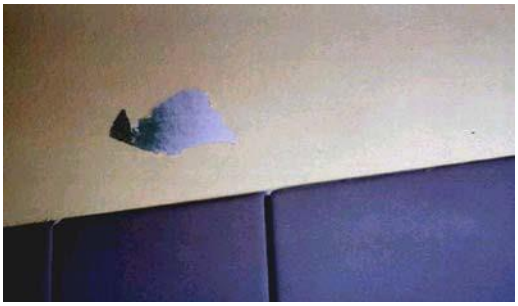

Photo 1

Various tests were performed on randomly selected wall areas in Building 1, Building 2, Building 4 and Building 6. The amount of moisture present in the plaster substrate was measured using an electronic moisture meter. The readings were taken on the plaster/concrete scale of the meter. All areas tested in all buildings, including both painted and unpainted plaster, were found to be very low and in a normal range.

The adhesion of the paint to its plaster substrate was tested in general accordance with ASTM D3359, Adhesion by Tape Test, Method A. Incisions are made through the coating in an X pattern. Permacell adhesive tape is firmly applied to the area and then sharply removed. The adhesion of the coating was then evaluated by the amount of paint that is removed. Certain wall

areas in all four buildings exhibited poor paint adhesion, while other walls in the same buildings were found to have good paint adhesion.

pH is a measure of the acidity or alkalinity of a substance. A pH of 7 indicates neutrality. pH readings decreasing from 7 indicate increasingly acidic conditions. Likewise, pH readings increasing from 7 indicate increasingly alkaline conditions. The pH of properly cured plaster is generally in the range of 8 to 10. Higher numbers could indicate an improper mix or cure, or the presence and migration of moisture. The pH on the surface of unpainted plaster was measured by marking the area with a pH pencil, moistening the area with distilled water, and comparing the color to the pH chart. The pH of the unpainted plaster at Building 1 and Building 6, was found to be in the normal range of 8 to 9.

The rear of delaminated paint removed during the adhesion tests was examined using a stereo zoom microscope. The presence of plaster on the rear of all paint samples was readily identifiable due to its crystalline nature (see photo #2) and was confirmed by the violent reaction when a drop of mild hydrochloric acid was placed on the surface (photo #3). Photo #4 shows the rear of the paint sample after the plaster has been removed.

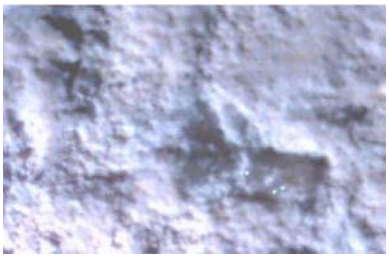

Photo 2

Photo 3

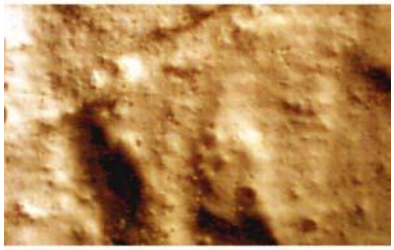

Photo 4

The degree of chalking, on both unpainted bare plaster surfaces and the immediate exposed area after the adhesion tests were performed, was evaluated in general accordance with ASTM Standards D 4214- 82 and D 659. Surface chalk is transferred to a black cloth by rubbing it against the surface being tested. The amount of chalk on the cloth is compared to a photographic standard. On bare plaster surfaces, the surface chalk was found to be light. On plaster surfaces exposed by the removal of paint during the adhesion tests, showed that chalk to be heavy. The total thickness of both the paint and plaster removed during the adhesion tests was measured using an electronic mil gauge. The samples were then placed in a mild hydrochloric acid solution to dissolve the attached plaster. The thickness of the remaining paint was then measured in the same manner. The thickness of the plaster only was calculated by subtracting the thickness of the paint only from the total thickness of the paint and plaster. The resultant thicknesses were measured to be as follows:

Location	Paint + Plaster	Paint Only	Plaster Only
Building 1, reception	10.6 mils	5.3 mils	5.3 mils
Building 1, west hall	5.9 mils	4.2 mils	1.7 mils
Building 1, men's room	5.1 mils	3.0 mils	2.1 mils

Building 1,waiting/reception	6.2 mils	4.2 mils	2.0 mils
Building 2, 2nd fl, waiting	5.6 mils	3.8 mils	1.8 mils
Building 2, 2nd fl, teacher	8.9 mils	4.8 mils	4.1 mils
Building 2, 2nd fl, storage	6.8 mils	4.0 mils	2.8 mils
Building 4, 2nd fl, waiting	8.0 mils	5.0 mils	3.0 mils
Building 6, 1st fl, east rm	8.7 mils	5.5 mils	3.2 mils
Building 6, 1st fl, G.C. rm	7.4 mils	4.4 mils	3.0 mils

The adhesion tests performed indicate that there are many areas where the adhesion of the applied paint is poor and further delamination is likely. In all instances where the adhesion was found to be poor, there was plaster adhered to the rear side of the delaminated paint and the remaining substrate was found to have a heavy to moderate surface chalk.

Moisture and pH measurements were found to be in a normal range, indicating that they are not factors in the poor adhesion found. The average thickness of the paint was measured to be 4.4 mils dryfilm thickness, and was in conformance with the project specifications.
The average thickness of the plaster adhering to the rear side of the delaminated paint was measured to be 2.9 mils, indicatingthat the delamination occurred well beneath the paint/plaster interface.

The testing performed indicates that the paint has adhered to the surface of the plaster, but that the plaster itself has low cohesive strength. The delamination that occurs when adhesion tests are performed is due to fracturing within the plaster itself, not due to poor adhesion of the paint to the face of the plaster. Unfortunately, the application of additional coats of paint at this time, rather than rectify the situation, would in fact worsen it. Each additional coat of paint increases the amount of surface stress. When the stress exceeds the strength of the weakest link of the chain, delamination occurs. In this instance the weak link is the cohesive strength of theplaster.

Had the condition been noted before the paint was applied, the use of a masonry conditioner as a primer would have penetrated and may have added strength to the plaster, thus providing a more suitable surface for painting. Now that paint has been applied, any remedy must include removing the existing paint.