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UNITED STATES GYPSUM COMPANY

RESEARCH CENTER

PROGRESS REPORT

SUMMARY

3-7-66

E. M.

J. W. B.

Project No. : J-301 Ready Mixed Simulated Acoustical Spray Finish

A yellowish discoloration was found to develop when Ready Mixed Simulated Acoustical Spray Finish has aged. A cure has not yet been found, but this much has been learned:

1. No color developed when the product was stored from one to four days in a dark container, but the yellow color did develop when the mix was dried in a lighted area.
2. The clear liquid fraction of the mix did not contribute to the color. It contained no iron ions that could change color and no organic molecules that would yellow when exposed to light.
3. The discoloration comes from the product and not from the metal container.
4. The discoloration is not dependent on the binder alone, as both casein and polyvinyl acetate based systems have discolored.
5. The color is associated with light and is noticable when the wet Acoustic is dried with light shining on it. The Acoustic dried in the dark or at low light levels does not discolor.
6. Removal of the asbestos from the formula and replacing it with paper tape sander dust fiber reduces the discoloration.

James W. Braid
4/14/66

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Project: No. J-301 Ready Mixed Simulated Acoustical Spray FinishSynopsis

In the last report period, formula SA-223a was bulletined to be made at the New Brighton Mill for field tests. A trial batch was made and a sample sent to Research. It was tested and found to be good and ready for field tests.

Age Discoloration

When the SA-2223A formula Ready Mixed Simulated Acoustical Spray Finish was made up as a large scale laboratory test batch in the Champion mixer on 6/12/65, a five gallon sample was saved in a five gallon pail with a Harrisite lining. The sample was covered air tight and held for six months. When the sample pail was opened, the following was noted.

The lining of the can was scraped off for about 90% of its circumference at the top lip. This area was mostly covered by a brown gritty material (the grit was perlite) which was very easily washed off with warm water and very light rubbing with a finger. The side seam of the pail was in sound condition with no discoloration in the Acoustic or on the coating. The bottom seam was greatly attacked with visible brown and blue-gray gritty lumps that were semi firm, much like the ring of material found at the surface of the mix, an inch and a half below the lip of the pail. This colored material was also easily washed out of the seam. The coating on the flat bottom and side of the pail was sound with no discoloration.

The lid of the pail had much discoloration inside of the lip seal. This washed out easily in warm water and light rubbing. Some semi-dry Simulated was on the inside top and this had a slight brownish color when rubbed with the fingers.

On opening the pail two things were noticed about the mix. First, the liquid separation which was about 1/2" deep was quite light and clear. The second, was that there was a ring of brown and blue-gray discoloration at the surface at the pail wall and extending no more than 3/4" out from the wall and only about 1/2" deep into the mix. This discoloration was firm when blue-gray in color but very soft when iron oxide brown.

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The mix was soft, uniform, filled with air bubbles and with no sediment in the bottom of the pail. The pH was 8.1. The viscosity was normal at 225 Brabender using the 5/16" flag paddle.

Tests of the MI.

Three small display panels were sprayed out on fresh 3/8" SHEETROCK. They were dried on the drying rack in the Pilot Plant. When the panels were examined, when dry, it was noted that over the major part of the panels the color was a yellow tan while on the very bottom of the panel, a strip about 1 1/2" wide of white non-colored texture was found. The white strip corresponded to the height of the lip of the drying rack. The panel color should have been at least as white as the 1 1/2" strip.

The material sprayed onto the panels was taken from the top center of the five gallon sample pail. Care was taken not to include any of the darker discoloration at the top edge of the mix. Thus the color did not come from the discoloration already viewed in the pail.

Check for Color Change

A fresh batch of SA-223A was made up and this was tested side by side with the retain sample. The mix had a 5/16" flag Brabender of 185, a pH of 8.15 and a consistency of 2125cc /100 gs. of dry mix. A panel each of the aged and fresh SA-223A were sprayed and dried in each of the following conditions:

1. 90°F and 90% Relative Humidity in the Light
2. 75°F and 10% Relative Humidity in the Dark
3. 40°F and 70% Relative Humidity in the Dark
4. The storage rack facing east toward the outside windows
5. and on the work table in the Pilot Plant facing up, well away from the windows.

When the panels were dry, they were examined and the following was noted:

1. All panels of the fresh SA-223 were white and equal in shade.
2. Again, the panel dried in the Pilot Plant caring the aged texture was yellow tan with a white strip along the bottom equal to the length of the lip of the drying rack tray.
3. The panel of aged texture dried on the table was not as yellow as the rack dried panel.
4. The panel with the aged texture dried in the 90°F-90% R.H. room with the lights on was as yellow as the panel dried in the Pilot Plant on the rack facing the windows. There was no white strip at the bottom and there was no lip on the drying rack in the 90-90 room.
5. The panel with the aged texture dried in the 77°F-10% RH room was only slightly tannish and was the lightest of the aged samples.
6. The panel of aged texture dried in the cold room was less yellow than the panel from the 90-90 room but darker than the sample from the dry room.

7. All the panels had the same texture and build. The bond of the texture to the board was comparable between panels dried under similar conditions.

Analytical Tests

A sample of the liquid separation found on the top of the aged sample of SA-223A was drawn off and centrifuged to remove solids suspended in it. The super latent liquid was then tested for ferrous and/or ferric ions. If ferrous ions were present in the wet mix they could be oxidized to the brown colored ferric oxide or acetate hydroxide.

A nine hole spot plate was cleaned and to each hole eight drops of the super latent liquid were added. To holes 3, 6 and nine, one drop of 6N Ammonium hydroxide was added. To holes 2, 5, and eight a drop of 6N Hydrochloric acid was added. To holes 1, 2 and three one drop of 1.0% $K_3Fe(CN)_6$ was added. To holes 4, 5 and six, one drop of 1.0% $K_3Fe(CN)_6$ was added. In a separate spot plate a blank was prepared using the $K_3Fe(CN)_6$ at one drop in each of three holes. To each hole eight drops of deionized water was added. To one hole a drop of Hydrochloric acid was added and to another a drop of Ammonium Hydroxide was added.

The two spot plates containing their liquid contents were set in the sun light on a window sill. There was no initial color change in any spot hole. In the holes with super latent liquid and acid, a white skin and precipitate were formed. This was probably the Methocel precipitated from the liquid.

After about an hour the blank and super latent liquid spots treated with HCl and $K_3Fe(CN)_6$ began to turn a light blue green.

If ferrous ion were present, even in slight quantities, a dark blue precipitate should form. If ferric ion were present, a Prussian blue precipitate should form. No blue precipitate formed, though no iron ions were present.

Photo Chemical Staining of Ready Mix Simulated

The previous work showed that the staining of might be due to some photo chemical reaction. To test this possibility four test panels were prepared with aluminum foil light shade.

The test panels were 12" x 16". The material was 3/8" SHEETROCK. The light shades were made of 1 mill aluminum foil, five inches wide and bent so as to stand about 1 1/2" from the lower surface of the panel and bent in at the top about an inch so as to cut down on the light entering from the top and y. to allow air to move across the shaded surface and dry the panel.

The panels were sprayed with the same stored samples as test. before and found to yellow. One panel was sprayed, covered and placed on the Pilot plant drying rack facing the east windows. A second panel was sprayed, covered and placed in the 75°F - 10% R.H. room to dry with the incandescent lights left on. A third panel was sprayed, covered and dried in the 90°F - 90% R.H. room with the fluorescent lamps on.

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A fourth panel was sprayed, covered and dried in the Photographic dark room (at about 77°F - 50% R.H.) with an initial two hours exposure to a soft Ultra violet light source, than dried in the dark.

Two 2' x 2' panels of 3/8" SHEETROCK with a simulated joint of CS topping were also sprayed with the suspect texture. One was dried with a small test panel in the 77°F - 10% R.H. room with the lights on. The other panel was dried along with one of the small test panels in the 90°F - 90% R.H. room. These two large panels were to check for any color variation between the board paper and the joint compound or white banding.

A sample of the suspect texture was centrifuged to separate a nearly clear whitish liquid from the aggregate and fillers. Two films were cast on glass with the liquid. One was dried in bright sunlight by a window with one half of the film shaded, with aluminum, from the sun and the other film was dried in the Photographic dark room with half the film exposed to an Ultra violet light.

Two small panels were prepared using a sample of SA-223A prepared on 8-7-65. One was exposed to bright sunlight with half of the panel shaded with aluminum foil and the other panel was exposed during drying to 2 hour of Ultra violet light while half of that panel was also shaded from the radiation source.

Test Results

Of the four shaded test panels dried under various conditions, the first panel from the 77°F - 10% R.H. room showed very little difference between the exposed area and the shaded section. The drying conditions were fast and the light was from 150 watt incandescent lamps.

The panel dried in the 90°F - 90% R.H. room under fluorescent lamps showed a very marked contrast between the exposed and shaded areas. The exposed area was a yellowish tan while the shaded area was a white color with only a trace of yellow in it.

The panel dried in the photographic dark room after a two hour exposure to an Ultra violet light source was equivalent to the 90°F - 90% R.H. room panel, the shade of the exposed area was the same but the color seemed a little less yellowish.

Of the two test panels with CS Topping Joint compound on them, the one dried in the 77°F - 10% R.H. room with the incandescent lamps on did not have a trace of white banding over the joint compound or any other color variation over the total surface. However, the panel dried in the 90°F - 90% R.H. room exposed to the fluorescent lamps did have a distinctly white band over the joint compound while the field of the board turned a quite yellowish tan. The color of the white banded joint was a little more creamy colored than the shaded section of the small panel sprayed with the same compound and dried a long side the larger panel in the 90°F - 90% R.H. room.

Of the two glass plates covered with the nearly clear super latent liquid of the aged Ready Mixed Simulated Acoustic, neither showed change of color after exposure to sun light or Ultra violet light.

Of the two panels applied to 3/8" SHEETROCK using an aging sample stored in a half pint can made 8-7-65, the panel dried in bright sun light with one half the panel shaded at 77°F - 50% R.H. showed very little difference in color between the exposed and shaded areas. A slight trace of yellowing was noted in the exposed area but that would be considered to be no problem in the field. The panel dried in the photographic dark room showed a color difference between the exposed and shaded areas the same as the large scale aging sample.

Check Photo Sensitivity of Acoustics

The color development of the SA-223A made on 8-12-65 was not noticed until the material was sprayed out six months later. Freshly made Acoustic showed no color development when exposed to light. Work was done to find out when the chromophore developed.

Three Ready Mixed Simulated Acoustics were mixed. The first was the standard SA-223A formula which has shown color development on aging. The second was SA-223 E which contained 3.0% Ammonium Pentaborate in place of the 1.0% found in SA-223A. The increase in Pentaborate was to see if it could suppress any rusting of the raw iron in the 7MF5 asbestos which might be the source of the color. The third formula, SA-223F contained no asbestos but instead contained 5.0% wood fiber from the paper tape sanding operation at the Gypsum Mill. This formula also contained 3.0% Ammonium Pentaborate as a preservative for the wood fiber. The wood fiber contained no free iron to possibly rust and cause color.

Tests

Each mix was made up and stored in small glass bottles wrapped in aluminum foil. The glass containers removed the possibility of contamination of the Acoustic by a metal container. The aluminum foil was used to make the glass bottles light tight, thus producing all of the conditions of Acoustic stored in a metal can with out the possibility of contamination.

The samples were then stored for a few days, then opened and the contents spread on to two small 3/8" SHEETROCK panels. The bottom half of each panel was masked with aluminum foil shade which darkened the surface of the panel yet allowed enough air across the surface to dry the Finish. One panel was then dried on the Pilot Plant drying rack and the other dried in the 90°F - 90% R.H. room with the fluorescent lights on.

Test Results

SA-223A showed no discoloration of the texture, either in the Pilot Plant or in the 90°F - 90% R.H. room, on the day it was made up. A tan color developed over the exposed area of the 90°F - 90% R.H. room panel after one days storage, however. After four days storage the tan color developed over the exposed surfaces of the Pilot Plant and 90°F - 90% R.H. room panels.

SA-223 E showed no color development until after the fourth day of storage when both the Pilot Plant and 90°F - 90% R.H. room panels showed a trace of tan over the exposed surfaces. After eleven days, the color development was only trace and not nearly as bad as the four day storage of SA-223A material.



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SA-223 F was unusual. No color developed over the exposed areas of any samples dried in the 90°F - 90% R.H. room, even after sixteen days. However, after four days storage, the Pilot Plant panels developed a trace yellowish tan color over the exposed area. This did not increase in intensity with age but remained the same. This color was barely discernible.

Check of Other Simulated Acoustics

To check the possibility of photo discoloration of other older Acoustics three dry powder formulas were tested. The compounds were mixed then part of each was stored in aluminum foil covered glass bottles four two days. Each Acoustic was spread on two small test 3/8" SHEETROCK panels when first mixed. Half of each panel was masked off with aluminum foil in the usual manner, then one panel was dried on the Pilot Plant rack and one in the 90° - 90% R.H. room. After the compounds were aged two days in the bottles they were likewise tested on small panels.

Test Results

Formula SA-65A, the old Regular Simulated Acoustic discolored over the exposed area on the first day in both conditions. Formula SA-161 A did not discolor under either condition, either the first day or two days later. Formula SA-1801, the L.C. formula to replace the SA-65A showed a slight discoloration over the exposed areas after two days storage.

Thus SA-65A would discolor when sprayed as a fresh mix and exposed to light. SA-1801 would possibly discolor if exposed to light if it were kept over a week end, wet in the mixer. SA-161A would not discolor if exposed to light if held as a wet mix in the mixer tank over a weekend.

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4/14/66