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PROPERTIES OF "SPECTRA-GLAZE",

A GLAZED-FACE CONCRETE BLOCK

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PROPERTIES OF "SPECTRA-GLAZE", A GLAZED-FACE CONCRETE BLOCK

1. INTRODUCTION

"Spectra-Glaze" is a high-pressure steam-cured, concrete-masonry unit with a glazed face. It is made in two types, Type A, with a sprayed-on, transparent coating, and Type B, a tile-face unit made in several colors. At the request of the Engineering Division, Military Construction, Office of the Chief of Engineers, Department of the Army, the National Bureau of Standards has performed a variety of evaluation tests on Type B Spectra-Glaze, a cinder-block unit made by Concrete Pipe and Products Co. of Richmond, Virginia. There are several other manufacturers of this product, but it is not known whether their product is identical with the one tested.

The units tested were three-cell stretcher units, 15 3/4 x 7 3/4 x 3 3/4 in. in overall dimensions. Three colors were tested, light green, beige, and blue; some uncoated blocks were also tested for comparison purposes. It is understood that other shapes, sizes, and colors are available.

Type B Spectra-Glaze, the tile-face unit, is made by giving conventional concrete block a smooth, colored facing. Three coats of "Cermac" glazing compound are sprayed on the block at 180° F; it is then baked for one hour at temperatures of from 250° to 375° F.

Dimensions of typical blocks as received from the manufacturer are listed in table 1. Sample blocks are shown in figure 1.

TABLE 1.

Dimensions of Typical Blocks [a]

	Coated	Uncoated
Length, in.	15.60	15.60
Block thickness, in.	3.70	3.60
Gross area, in^2	57.72	56.16
Shell thickness, in.	1.00	1.05
Web thickness, in.	1.05	1.05
Depth, in.	7.65	7.65
Proportion of cored spaces, percent	70.	68.

[a] As received from manufacturer.

The OCE request for the tests of Spectra-Glaze (letter of January 9, 1953) asked for an evaluation of the durability of the material. Tests requested included determination of resistance to freezing and thawing, to strong cleaning solutions, to stains likely to be encountered in bathrooms, and to penetration of greases normally encountered in kitchens. Tests we were also requested to determine whether the coating would be likely to craze and whether the colors would be unfading.

2. FLAME-SPREAD TESTS

Eight coated units were bolted to each other to form a specimen 32 by 32 in. Mineral-wool pads were placed between blocks to simulate mortar joints. The specimens were subjected to the fire test as described in Federal Specification SS-A-118a for Acoustical Units, Prefabricated, using the standard time-temperature curve for 20 minutes.

Three specimens were tested. The face flamed during each of the tests but did not touch the angle-iron frame during or after the tests. This performance requires the classification of "slow-burning."

3. COMPRESSIVE STRENGTH

Compressive strengths were determined for five coated specimens and five uncoated specimens in accordance with procedures given in Standard Methods of Sampling and Testing Structural Clay Tile, ASTM C112-36, and are given in table 2, except that only three specimens were tested.

TABLE 2.

Compressive Strengths of Blocks

	Compressive strength lb/in^2
Coated blocks, average	1310
Uncoated blocks, average	1780

Air dry, using gypsum plastic capping mortar.
Average of three specimens.

4. ABSORPTION

Absorption data were obtained for two samples, one coated and one uncoated. The methods used were similar to those specified in ASTM Specifications for Structural Clay Facing Tile, C212-49T, except that only two specimens were used and the absorption by boiling was carried on for five hours rather than one. The pertinent data are given in table 3.

TABLE 3.

Weight and Absorption of Blocks

	Coated	Uncoated
Weight, dry, lb	8.38	8.18
Moisture content as received, percent of absorption (24-hr cold)	23	22
Specific gravity	1.9	1.8
Absorption, 24-hr cold, percent	13.6	13.6
Absorption, 5-hr boil, percent	19.4	19.5
Saturation coefficient, percent	70	70

5. CRAZING

Two blocks were autoclaved at a steam pressure of 150 lb/in^2 for one hour in accordance with ASTM Specifications for Glazed Masonry Units, C126-50T. No crazing was observed.

6. FREEZING AND THAWING

Four specimens, two coated and two uncoated, were subjected to 24-hour freezing and thawing cycles. The methods used were similar to those of ASTM Standard Methods of Testing Brick, C67-44. The specimens were stored in air in a chamber at 0° F for 17 hours and then thawed and stored in water at 50° F for 7 hours. They were immersed in water for three days prior to the tests.

The effects of the treatment were based on visual observations and weighings as the test proceeded. The weights of the specimens after each two days of cycling are given in table 4. The four specimens were carried through 20 freezing and thawing cycles, as shown above, without apparent crazing or other failure. Some slight spalling was observed in the latter cycles.

TABLE 4.

Freezing and Thawing

	Weight of coated sample		Weight of uncoated sample	
	#1	#2	#1	#2
	lb	lb	lb	lb
Dry	8.470	8.245	7.985	7.995
12 hour cold	9.700	9.430	9.155	9.240
2 cycles	9.815	9.500	9.275	9.380
6 cycles	9.840	9.525	9.300	9.400
10 cycles	9.875	9.530	9.315	9.410
20 cycles	9.885	9.570	9.340	9.430

After the completion of the 20 cycles, two of the specimens, one coated and one uncoated, were removed from the chamber and subjected to compressive tests. For comparison purposes, two similar blocks which had not been subject to the freezing and thawing cycle were soaked for three days and subjected to compressive tests at the same time as the above two blocks. The results are shown in table 5.

TABLE 5.

Effects of Freezing and Thawing

	Length	Width	Depth	Compressive strength
	in.	in.	in.	lb/in^2
Specimens after 72-hr soak [a]				
Coated	15.65	3.75	7.70	1110
Uncoated	15.65	3.75	7.70	1640
Specimens oven-dry				
Coated	15.65	3.75	7.70	1200
Uncoated	15.65	3.75	7.70	1720
Specimens after 20 freezing and thawing cycles				
Coated	15.65	3.75	7.68	1390
Uncoated	15.65	3.75	7.70	1270

[a] At room temperature.

7. SPOTTING RESISTANCE

Tests were made to determine spotting resistance to some common kitchen and bathroom agents. Whenever the supply of specimens permitted, all three colors, beige, blue, and light green, were subjected to test. The test conditions are given in the following sections and the test results in table 6.

7.1 Cottonseed oil

Three drops of cottonseed oil of U.S.P. grade were applied to the coated surfaces at 70-80° F, covered with a watch glass, and allowed to remain for periods of 5, 15, and 30 minutes and 5 hours. At the expiration of each exposure period the oil was wiped from the surface and the surface rinsed with carbon tetrachloride. All panels were allowed to dry for 24 hours and examined at a distance of five feet for staining.

7.2 Bacon grease

The coatings were tested in the same manner as described in section 7.1 except that hot bacon grease (320° F) was used.

7.3 Sodium hydroxide

The procedure was the same as in section 7.1 except that the coating was exposed to a 10% solution of sodium hydroxide and the surface rinsed with distilled water.

7.4 Dishwashing compound

The procedure was the same as in section 7.3 except that a 10% solution of dishwashing compound was used conforming to the requirements of G.S.A. Specification 207, Type II.

7.5 Tincture of iodine

Three drops of tincture of iodine (U.S.P. grade) were applied to the coated surface at 70-80° F, covered with a watch glass, and allowed to remain for 5 minutes. The solution was then wiped from the surface with absorbent cotton and rubbed with three successive alcohol (95% ethanol)-moistened wads of absorbent cotton. The surface was rinsed thoroughly with the alcohol, allowed to dry, and examined for staining at distance of five feet.

TABLE 6.

Spotting Resistance and Cleanability

Test	Beige coating	Blue coating	Green coating
	Spotting resistance		
Cottonseed oil	Slight oily stain[a]	Distinct oily stain[a]	Distinct oily stain[a]
Bacon grease	" " "	Slight " "	Slight-distinct oily stain
Sodium hydroxide	No visible "	No visible "	No visible stain
Dishwashing comp.	" " "	" " "	" " "
Tincture of iodine	" " "	Slight brownish "	Distinct brownish stain
Blue-black ink	" " "	" bluish "	
	Cleanability		
Cleaned with white soap	No visible stain	Slight oily stain	Slight oily stain
Cleaned with grit soap	Barely visible oily stain	Distinct " "	Slight-distinct oily stain

[a] Describes appearance of coating after the 5-hour exposure test. Staining was never more than barely visible after the 5-, 15-, and 30-minute exposure tests.

7.6 Ink

The test was made in accordance with the method described in ASTM Designation C126-50T, section 17(c), except that one specimen of each color was used.

8. CLEANABILITY

The coatings were soiled by exposure for 5 hours to cottonseed oil in the manner described in section 7.1. The excess oil was wiped from the test area and the surfaces subjected to two cleaning procedures. In one, the surface was rubbed with a wad of absorbent cotton moistened and soaped with plain white toilet soap, using a circular motion. The rubbing consisted of 35 clockwise and 35 counter-clockwise cycles. The surfaces were then rinsed with warm distilled water (52° C), allowed to dry for 24 hours, and examined at a distance of five feet.

The other cleaning procedure was the same as the above except that cake grit soap, conforming to the requirements of F.S. P-5-571, Type A, was used in place of the plain white soap.

The test results are given in table 6.

9. WATER-VAPOR TRANSMISSION

Discs, 1/2- to 3/4-in. thick, were cut from the coated and uncoated sections of the beige-coated and green-coated units and the water-vapor transmission rate determined in accordance with ASTM Standard Methods of Test for Water Vapor Permeability, D988-48T, except that specimens 11.46 sq in. in area and a balance sensitive to 0.01 gram were used.

The test data are given in table 7; the results are reported both in grams per square meter per day and in "perms". The latter was calculated from the following equation:

$$\text{"perm"} = \frac{W}{At\Delta p}$$

where:

W = weight in grains of water-vapor transmitted
A = area, in square feet, of specimen
t = time, in hours
Δp = water-vapor pressure difference, in inches of mercury, across the specimen

The Housing and Home Finance Agency in their publication "Condensation Control" has defined a vapor-barrier material as one having a vapor-transmission rate of less than one perm.

TABLE 7.

Water-Vapor Permeance and Color Fastness

	Water-Vapor Transmission at 73±1° F and 50±2% R.H.			
	Beige coating		Green coating	
	g/m²/day	perm	g/m²/day	perm
Uncoated section	66	9.9	89	13.5
Coated section	4	0.7	4	0.7

	Reflectance		
	Beige coating	Green coating	Blue coating
	percent	percent	percent
Before exposure	22.7	23.4	20.9
After exposure /a	22.2	22.7	20.4
	NBS units	NBS units	NBS units
Change	0.4	0.6	0.5

/a Exposure consisted of 325 hours of accelerated testing, 51 minutes of light and 9 minutes of light and spray water every hour.

10. COLOR FASTNESS IN ULTRAVIOLET LIGHT

Panels cut from the coated sections of the units were exposed to 325 hours of accelerated test for durability in a "Type HVKL-X Weather-ometer" manufactured by the Atlas Electric Devices Company, Chicago, Ill. One carbon arc, centrally located, with a power consumption of 1.8 KW was used as the source of radiation. The 60-minute exposure cycle consisted of 51 minutes of light and 9 minutes of both light and spray water (demineralized).

Reflectances were determined both before and after exposure using a Hunter Multipurpose Reflectometer with the green "Tri-stimulus" filter. Change in reflectance was used as the indication of color change and was expressed in NBS units which were obtained as follows:

$$\text{NBS Units} = 10(\sqrt{A} - \sqrt{B})$$

where: A = reflectance before exposure
B = reflectance after exposure

The test results are given in table 7.

Color comparison was also made with duplicate panels kept in dark storage by visual examination from a distance of five feet. No difference was observed between the exposed and unexposed surfaces.

11. SUMMARY

Although there are no standard specifications for products of this type, their performance can be compared with the performance of similar products in applicable tests from specifications such as ASTM Standard Specification for Hollow Non-Load-Bearing Concrete Masonry Units, C129-39, ASTM Tentative Specifications for Glazed Masonry Units, C126-50T, and ASTM Tentative Specifications for Structural Clay Facing Tile, C212-49T.

The performance of the coated faces of the blocks classified them as "slow-burning" in the flame-spread tests.

Compressive strengths of both coated and uncoated blocks were roughly equivalent to "standard" tile in ASTM Specifications for Structural Clay Facing Tile, C212-49T, which requires a minimum average compressive strength of 1400 lb/in^2 for end-construction tile.

Absorptions were roughly equivalent to the requirements of C212-49T for type FTS tile, which specifies the 24-hr cold absorption as not exceeding 13% and the 1-hr boiling absorption as not exceeding 16%. The moisture content of the blocks, as received, was better than the requirements of ASTM Specifications for Hollow Non-Load-Bearing Concrete Masonry Units, C129-39, which requires that the moisture content as received not exceed 40% of the total absorption.

Resistance to crazing was satisfactory when tested in accordance with ASTM Specifications for Glazed Masonry Units, C126-44T.

Freezing and thawing data on comparable materials are not available. However, the results may be considered to have been satisfactory in that the blocks did not break, did not lose weight as compared with the original conditions, and showed an increase in compressive strength after 20 freezing and thawing cycles.

Of the reagents used, cottonseed oil appeared to produce the most pronounced staining of the coating. Some of the reagent appeared to be retained by the matt surface of the coating after the five-hour exposure test and was not completely removed by the solvent. In the 5-, 15-, and 30-minute exposure

tests staining was no worse than barely visible. Although staining was discernible when bacon grease was used, it was not as pronounced as that produced by cottonseed oil. Except on the green coating, staining was slight. In the tests with iodine and ink, the only pronounced staining occurred with the former on the green coating. Sodium hydroxide and the dish-washing compound did not affect the appearance of any of the coatings.

Although standard requirements of performance for products of this type do not exist, perhaps the most nearly applicable one is ASTM Designation C126-50T (Tentative Specifications for Ceramic Glazed Structural Clay Facing Tile, Facing Brick and Solid Masonry Units) which permits a slight discoloration of the surface on matt finishes when ink is used as a reagent. If this is used as a criterion, the product may be considered satisfactory in spotting resistance to all reagents used in the tests except tincture of iodine (green coating only) and five-hour exposure to cottonseed oil.

The stain was not completely removed in every case by the cleaners in the tests, but in only two instances (blue and green coatings, cleaned with cake grit soap) were the residual stains classed as greater than slight.

The test results showed that the coating was effective in reducing the rate of water-vapor transmission of the cinder-block units under the test conditions. Assuming that the rate of water-vapor transmission is proportional to the water-vapor pressure difference across the specimen, the coated units can be classified as vapor barriers under the present HHFA definition.

Close examination of the coatings revealed a large number of light spots about the size of pin points distributed over the entire surface of the panels after exposure to ultraviolet light and water. However, when examined at a distance of five feet, these spots were not visible. The comparatively small changes in reflectance, as well as comparison of the exposed specimens with duplicates kept in dark storage, indicate that no significant color changes occurred during these tests.

This Bureau has no data correlating the specification requirements given above for other materials with the performance in service of the subject material. The fairly satisfactory performance of this material in the laboratory tests, although informative, does not necessarily indicate that the performance in service would be equally satisfactory.