Laboratory Evaluation

Product:

CeRam-Kote 54 flexible ceramic epoxy is a two-part epoxy. Component A (lot #720904, Formula ATM) and Component B (lot 561515). A 13:1 mixture ratio is used A: B.

Discussion:

CeRam-Kote 54 is manufactured by Freecom Inc., Box 2119, Big Spring, TX 79721-2119 (915-263-8497). The coating is a ceramic particle loaded epoxy resin system for use in the harsh environments. Product literature indicates that it is an excellent corrosion barrier, has high adhesion, low permeability, high sliding abrasion resistance, high surface lubricity, and is extremely flexible. Two formulations are available CeRam-Kote 54 ABR and CeRam-Kote 54 ATM. ABR is the recommended formula for most critical service environments. ATM is recommended for specific color applications or cleanability.

Application:

Panel Preparation:

Panels 3334-1 through 3334-5:

3" x 9" x .0625" cold-rolled steel panels were selected for paint application. These panels were first wiped with a 50/50 mixture of Methyl Isoamyl Ketone (MIAK) and an aromatic naptha (HI-SOL 10) to remove any deposits of oil or grease. After solvent cleaning the panels were abrasive blasted to SSPC-SP5 White Metal Blast Cleaning, using a suction-feed abrasive blast cabinet. Surface profile measurement were taken according to American Society of Testing Materials (ASTM) D 4417 Method C (Replica Tape); profile measurements proved to be in the 1.5 to 2.2 mil range.

Panels 3334-6 through 3334-9:

Freecom Inc. supplied 4- 4" x 4" x .250" panels precoated with CeRam-Kote 54 ABR. Specifications are listed in the table below. The backside of panels 3334-8 and 3334-9 have been coated with V-766e vinyl.

Application:

Coatings were applied using a DeVilbiss MBC conventional spray gun. This spray gun was equipped with a DeVilbiss MBC 444-E needle, a 0.070 inch fluid tip, and a #30 air cap. The air pressure was maintained at 55 psi. A standard gun-to-substrate distance of 8 to 10 inches was maintained. The coatings were sprayed at average laboratory temperatures (approximately 70^0 F). A Positector 500 thickness gage was used to measure the dried film thickness according to ASTM D 1186 Method B. After a cure time of one week, a diagonal cut (approximately 3 inches long) was made on the lower half of one side of each exposure panel. This cut extended through the surface of the coating to the substrate.

Panel #	SSPC	Profile	1st Coat	WFT	DFT	Exposure
3334-1	SP5	1.85	CeRam-Kote 54 ATM	8.0	7.21	C

3334-2	SP5	1.85	CeRam-Kote 54 ATM	8.2	7.31	C
3334-3	SP5	1.97	CeRam-Kote 54 ATM	8.1	6.33	S
3334-4	SP5	1.91	CeRam-Kote 54 ATM	7.8	7.09	S
3334-5	SP5	1.71	CeRam-Kote 54 ATM	8.3	6.61	W
3334-6	SP5	2.6	CeRam-Kote 54 ABR	6.89	5.72	C
3334-7	SP5	2.7	CeRam-Kote 54 ABR	7.71	6.54	C
3334-8	SP5	2.4	CeRam-Kote 54 ABR	6.61	5.44	C
3334-9	SP5	2.7	CeRam-Kote 54 ABR	7.37	6.22	C

Discussion:

The manufacturer's representative was on hand during coating application. The received quart can of Component A was more than ¾ full. It had hard settling and was mixed on a Red Devil for 5 minutes. Component B was added to Component A and mixed with a spatula. Application of the coating was easy and it looked excellent. An 8 mil wet film thickness was achieved easily and did not exhibit sagging tendency.

Exposures:

Following application and cure, test panels were exposed to several environments. All panels were evaluated after on year and will remain in test indefinitely to determine long-term performance of the coatings. Exposure conditions included: warm (85^0 F) aerated tap water immersion- designated "W", cold (70^0 F) aerated tap water immersion- designated "C", cold (70^0 F) aerated synthetic sea water immersion (ASTM D 1140)- designated "S", and atmospheric exposure (ASTM G 7; 45^0 south, Champaign, IL)- designated "A". The panels will remain in test until a failure is noted. Evidence of failure is detected through visual inspection. Signs of failures included: color variations, blisters, poor adhesion (e.g., peeling or flaking of the coating), any difference in texture, and presence of "chalking" or any other abnormal films on the surface.

Adhesion was evaluated in accordance with the adhesion test for V-766e vinyl type paints detailed in CWGS-09940, Painting: Hydraulic Structures. A pocketknife is used to make two parallel cuts at least 1 inch long approximately ¼ inch apart. A third cut is made perpendicular to and passing through the end of the first two cuts. Using the tip of the knife, the film will be loosened from the panel. The adhesion is acceptable if the strip of paint breaks when pulled or if the strip elongates a minimum of 10% during its removal. In addition to this adhesion test, panels were evaluated in accordance with ASTM D714, Evaluating Degree of Blistering of Paints.

Evaluation after 1 year:

Panel No.	1st Coat	Adhesion	Comments
3334-1	CeRam-Kote 54 ATM	Excellent	Slight rust present at score, no undercutting present No blisters present
3334-2	CeRam-Kote 54 ATM	Excellent	Slight rust present at score, no undercutting present, No blisters present
3334-3	CeRam-Kote 54 ATM	Excellent	Slight rust present at score, no undercutting present, 6-#4 blisters present near score on front side, 13-#4

			blisters present at waterline on front side, 1-#3 blister present on lower back side
3334-4	CeRam-Kote 54 ATM	Excellent	Slight rust present at score, no undercutting present, 1-# 3 blister present at bottom of score on front side
3334-5	CeRam-Kote 54 ATM	Excellent	Slight rust present at score, no undercutting present, black corrosion present at score
3334-6	CeRam-Kote 54 ABR	Excellent	Slight rust present at score, no undercutting present
3334-7	CeRam-Kote 54 ABR	Excellent	Slight rust present at score, no undercutting present
3334-8	CeRam-Kote 54 ABR	Excellent	Slight rust present at score, no undercutting present
3334-9	CeRam-Kote 54 ABR	Good-Excellent	Coating is removed more easily than other panels, film is brittle and crumbles under knife pressure

An impact resistance test (ASTM D 2794) was run on the blistered area of 3334-3 to determine if the blistering would be detrimental. Impact areas were chosen close to blisters and testing commenced in 5 in.-lbs increments to failure. Direct impact failures were between 40 and 42 in-lbs. Reverse impact failures were markedly lower at 10 in-lbs. Direct impact values are markedly less than company literature indicates.

Conclusions:

CeRam-Kote 54 ABR and ATM formulas appear to be performing excellently in all service environments. It is noted that panels immersed in fresh water did not exhibit blistering; those exposed in salt water exhibited a tendency for blistering in areas where the coatings' integrity had been compromised. The low impact test results raise concern for satisfactory performance of the coating on Corps of Engineers hydraulic structures subjected to the impact of ice and floating debris.

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