Material Testing of Enhance 1 (EPC-120) Enhance Repel (ESC-007) Enhance (NST-060) for Concrete/Masonry Protective Properties

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Prepared for:

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INTRODUCTION

For many years sodium silicate solutions and other compounds have been used for protection of concrete and masonry structures against water-permeation and other destructive elements. Sources such as the environment and man-made contaminants constantly assail these seemingly indestructible materials. Graffiti also is a constant irritant and cost in the upkeep of structures. The primary purpose of protective materials is to prevent deterioration from contaminants in addition to which, some are equally successful in negating the effects of vandalism.

The focus of this evaluation is three types of products marketed under the name “Enhance”. The products are all surface applied materials for existing structures. All three are used independently and in combination with each other as part of a concrete enhancing and protection system. Application methods are brush, roller, or low pressure spray for the ready to use liquid materials.

Enhance EPC-120 is a multi-component water based sodium silicate material with catalyst which aggressively penetrates concrete or masonry structures even when saturated, and designed for breathable moisture and chemical proofing through controlled permeability. The material is an architectural, clear coating.

Enhance Repel ESC-007 is a water based potassium silicate material designed to repel moisture and provide protection against the elements. The cured material is a breathable invisible architectural protectant.

Enhance NST-060 is similar in formulation to EPC-120 with minor modifications. Its purpose is to create a high density near surface barrier. NST-060 and EPC-120 products both contain catalysts which are stated to cause an ionic exchange within the concrete or masonry structure to create permanent, insoluble silica aerogels.

The purpose of this examination is to establish the extent of protection provided to concrete/masonry structures by the application of the “Enhance” materials. All three materials will be evaluated individually and as a concrete/masonry protection system.

Evidence from commercial applications, impericle data, and anecdotal evidence shows substantial improvement of permeability and thus, increased durability. There is also the suggestion that the densification increases strength and resilience properties. These latter issues will not be tested.

Tests specimens will be subject to the effect of moisture and graffiti intrusion upon varying degrees of protected surfaces in comparison to an unprotected “control”. A low strength, high porosity precast split-block was chosen as the most critical sample for performance testing relevant to on site real world conditions.

EXPERIMENTATION

MATERIALS

Enhance Products:

Three types of concrete/masonry densifier solutions were tested - two modified water based sodium silicate materials with catalyst, EPC-120 (**E1**) and NST-060 (**E2**), and a potassium silicate material ESC-007 (**E3**). These were applied to precast masonry blocks (90mm X 90mm X 150mm). Materials were applied independently at the manufacturer specified rate of 9.3 M^2 per unit of 3.8 L (4.73 ml per specimen).

Testing Specimens:

Standard low strength high porosity precast split-block of one type from one manufacturer were used throughout the examination for comparison of treated and untreated surfaces.

Test Conditions:

Testing location was maintained at 20^0 C with a relative humidity of 30-40%. All materials used were stored 24 hours in lab before initiation of test procedures. When required potable water was used to saturate and clean all specimens.

Testing Specimens:

C1(a) Control
C1(b) Control
S1(a) Pre-moisten surface and apply E1.
S1(b) Pre-moisten surface and apply E1.
S2(a) Pre-moisten surface, apply E1 then E2, stand cure.
S2(b) Pre-moisten surface, apply E1 then E2, stand cure.
S3(a) Pre-moisten surface and apply E1 then E2, stand cure, apply E3 and stand cure.
S3(b) Pre-moisten surface and apply E1 then E2, stand cure, apply E3 and stand cure.
S4(a) Apply E3 to dry surface and stand cure.
S4(b) Apply E3 to dry surface and stand cure.
S5(a) Saturate sample in water tank two hours, drain, let samples stand until no collected water on surface, apply E1 then E2, stand cure, apply E3 and stand cure.
S5(b) Saturate sample in water tank two hours, drain, let samples stand until no collected water on surface, apply E1 then E2, stand cure, apply E3 and stand cure.
S6(a) Submerge sample in water tank two hours, drain, let samples stand until no collected water on surface, alkali prime, apply E1 then E2, stand cure, apply E3 and stand cure.
S6(b) Submerge sample in water tank two hours, drain, let samples stand until no collected water on surface, alkali prime, apply E1 then E2, stand cure, apply E3 and stand cure.
S7(a) Apply E1 then E2 to dry surface, stand cure, apply E3 and stand cure.
S7(b) Apply E1 then E2 to dry surface, stand cure, apply E3 and stand cure.

Application Procedures:

Table 1: Record of Materials Application to Blocks.

Specimen ID	H20 Pre-wet	Tank Saturated	**E1** EPC-120	Date & Time	**E2** NST-060	Date & Time	**E3** ESC-007	Date & Time
C1 (a & b)	-	-	-	-	-	-	-	-
S1 (a & b)	YES	-	YES	29/02-1pm	-	-	-	-
S2 (a & b)	YES	-	YES	29/02-1pm	YES	29/02-1pm	-	-
S3 (a & b)	YES	-	YES	29/02-1pm	YES	29/02-1pm	YES	01/03-2pm
S4 (a & b)	-	-	-	-	-	-	YES	01/03-2pm
S5 (a & b)	-	YES	YES	29/02-1pm	YES	29/02-1pm	YES	01/03-2pm
S6 (a & b)	-	YES	YES	29/02-1pm	YES	29/02-1pm	YES	01/03-2pm
S7 (a & b)	-	-	YES	29/02-1pm	YES	29/02-1pm	-	01/03-2pm

Graffiti material:

For this experiment a typical fluorescent solvent based marking paint and a solvent based interior enamel was applied to the all specimens, then left to cure 18 hours. In addition, Emulsion 36 (raw commercial chemical) penetrant was applied to all specimens.

Graffiti removal:

Removal of graffiti was performed by using a standard grease removing cleaner on all specimens. Percentage of graffiti removed is recorded in Table 3. Cleaner #1 was a citrus based heavy duty degreaser/cleaner. Cleaner #2 was an Enhance extra heavy duty paint and grease remover. No Methelene Chloride materials were used. Cleaner #1 was diluted 3:1. Cleaner #2 was applied at full strength.

TEST RESULTS

Since the materials were applied to both wet and dry surfaces it is important to note the actual curing time for each specimen. Curing times were consistent with product claims and product combination characteristics were also consistent with manufacturer claims.

Table 2: Material Cure Times for all Specimens

Sample ID	E1 Cure Time Wet	E2Cure Time Wet	E3 Cure Time Wet	E1 Cure Time Dry	E3 Cure Time Dry
C1	-	-	-	-	-
S1	8 hrs.	-	-	-	-
S2	8 hrs.	8 hrs.	-	-	-
S3	8 hrs.	8 hrs.	2 hrs.	-	-
S4	-	-	-	-	5 hrs.
S5	48 hrs.	48 hrs.	1 hr.	-	-
S6	48 hrs.	48 hrs.	1 hr.	-	-
S7	4 hrs.	-	-	4 hrs.	-

The E1 material proved to be an effective moisture barrier. When the E1 material reduced penetration performance of additional applications. Cure times were shortened when materials were applied in combination.

Compared with other specimens **S6** exhibited a higher concentration of silicate materials in the surface pores. The ESC-007 product had an extremely short curing time when applied over the saturated and densified block specimens. This is believed to be due to the densification process and reduced absorption of the **S6** specimen.

Enhance materials are stated to dry clear with no color change. A slight color shift does occur (slightly darker shade of natural) as should be expected. The change is consistent and the only means of detection would be before and after comparisons. Figure 1 shows the color variation between two blocks (the lighter block being the **C1** specimen - the darker being **S7**).

Note: The **C1** specimen was not subjected to the graffiti cleaning process thus it exhibited a lighter appearance due to the presence of cement residue. The **S7** specimen is slightly darkened from what would be its' natural, on site, untreated appearance (see site photograph Fig. 2).

Table 4: Degree of Graffiti Removed and Processes Required

Specimen ID	Paint #1 (%)	Paint #2 (%)	Emuls. 36(%)	Cleaner #1	Cleaner #2	Press.-Wash
C	88	84	92	yes	yes	yes
S1	94	97	100	yes	yes	yes
S2	97	100	99	yes	yes	yes
S3	99	100	100	yes	yes	yes
S4	100	100	100	yes	yes	yes
S5	98	98	100	yes	yes	yes
S6	100	100	99	yes	yes	yes
S7	99	100	99	yes	yes	yes

Fig. 1
Split-block samples – paint cured

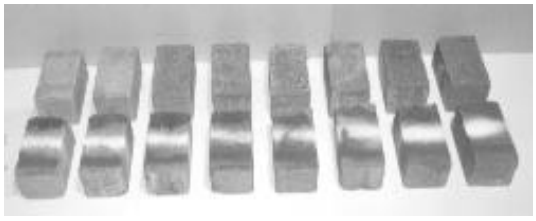
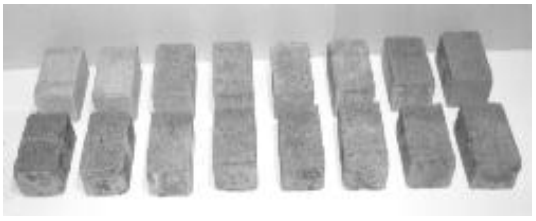


Fig. 2
Split-block samples – after graffiti cleaning



The rough face of the block made cleaning by scrubbing impractical. Cleaner #1 was used in the scrubbing process and had little effect. All specimens were rinsed and allowed to dry. Cleaner #2 was applied, let stand 2 minutes, then followed by 10 seconds of 1000 psi pressure-wash to each specimen. Pressure washing was efficient and may not have required use of a cleaner material.

Satisfactory graffiti removal could not be completed on the control within the perameters of the test due to deep ingress of paint in the pores of the unprotected specimen.

Quality Assurance:

An Enhance recommended test to evaluate the consistency of the Gel formation was performed on the two reactive products EPC-120 (**E1**) and NST-060 (**E2**). Samples (approx. 50 ml.) of **E1** and **E2** were mixed with an small amount of alkaline compound. Results were as follows:

Table 3: Quality Assurance Test for Reactive Materials

Enhance Material	Reactive Gel Time	Result
E1	120 sec.	Consistent Med. Hard Cloudy Gel
E2	120 sec.	Consistent Hard Gel

This procedure is of no practical value in the evaluation of the materials being tested except that it provides evidence of product consistency and supports the manufacturers claims with respect to the test. Under the right circumstances the materials are gel forming. The same test was performed with the addition of a small amount of cement powder. After curing 48 hours all materials formed a homogenous, very hard mass. No conclusions are made from this form of "litmus test".

SUMMARY

Statements made below are relevant within the scope of tests performed and reported above with respect the materials tested. This test it not intended to confirm the suitability of the materials tested for any particular purpose. Product performance as tested however should be easily duplicated.

As expected, graffiti applied to the untreated control resulted in difficult to remove stains best suited to removable by sandblasting. The "Enhance" treated specimens were resistant to contaminant penetration. The most effective protection process seems to be attained by a combination of the EPC-120 and ESC-007. This method is currently recommended by the manufacturer.

The ESC-007 material did suffer degradation during the clean-up process proving it to be a sacrificial coating in conformance with the manufacturers claims. Used at recommended yield in combination with other Enhance materials ESC-007 is an efficient protectant. Breathability is a significant benefit.

A more comprehensive study involving concretes and other masonry products should be performed to evaluate further the influence of Enhance materials on moisture penetration.