ISLAND TESTING EGP. ASSOC. INC.
61G AIR DRIVE
BAYSHORE, NEW YORK 11760

June 10, 1983

INTRODUCTION:

This report presents the results of laboratory tests conducted on the Penetron Waterproofing System manufactured by ICS Penetron International Ltd., 25 Autumn Drive, Mount Sinai, New York 11766.

Tests were conducted to evaluate this material when used as a surface coating for concrete pavement.

SURFACE TREATMENT FOR CONCRETE:

Method of Test -

Durability of concrete and penetration of de-icing chemicals into concrete were evaluates by freeze-thaw testing of treated and untreated concrete panels.

Testing was done essentially in accordance with the Durability Test outlined by the New York Department of Transportation "Procedures for Evaluating Surface Coatings for Concrete" except the cycling periods were modified due to the larger size concrete panels used. Also, a commercial gravel aggregate concrete pavement mix was used.

Concrete Mix Data -

Type of Mix	NY/DOT 2A455C
Mix Proportions (1 yard)	
Cement (Type I)	567#
Air-Entraining Admixture	7.0 oz
Fine Aggregate (#4 Down Sand)	1290#
Coarse Aggregate (3/4"-#4 Gravel)	1850#
Water	268#
Properties of Plastic Concrete	
Slump, in.	3.112
Air Content, %	4.7
Compressive Strength	
7 Days, psi	3810
28 Days, psi	5320

SURFACE TREATMENT FOR CONCRETE: (Cont.)

The slabs were inspected after each 10 cycles to assure no cracking of the panels or deterioration of th dams which would affect the comparison test.

CHLORIDE PENETRATION DETERMINATION:

General- -

At the conclusion of the 50 cycles, the panels were flushed with clean water and allowed to air dry. Th chloride concentration was then determined at various depths by chemical analysis.

Procedure -

Samples of the concrete were taken from each of the six panels at three depths by a dry 3/4" drill bit. The depths measured from the treated surface of the concrete were 5/8" to 1 3/8", 2 5/8" to 3 3/8" and 4 5/8" to 5 3/8". Chemical analysis was conducted on each sample to determine the soluble chloride concentration.

Test Results - Treated Panels

Depth	Chloride Content (ppm)			
Tested, in.	Sample 1	Sample 2	Sample 3	Average
5/8-1 3/8	380	440	470	430
2 5/8-3 3/8	350	400	420	390
4 5/8-5 3/8	270	290	340	300

Untreated Panels

Depth	Chloride Content (ppm)			
Tested, in.	Sample 4	Sample 5	Sample 6	Average
5/8 -1 3/8	820	790	880	830
2 5/8-3 3/8	550	590	570	570
4 5/8-5 3/8	410	370	380	390

CHLORIDE CONTENT OF CONCRETE MATERIALS:

Casting and Curing -

Six test panels approximately 6 3/4" deep, 5 1/2" wide and 15 1/2" long were cast in two layers in plywood forms. A 3/4" deep "dish" or "trough" was cast into the top of the panel. Each layer was consolidated by rodding 25 times with a 5/8" diameter rod.

After casting, the slabs were covered with plastic curing paper for 24 hours, then removed from the forms and placed in the laboratory moist room. Upon removal from the curing room, the dam around the trough was coated with a heavy epoxy and the surface to be tested was etched with a 20% solution of muriatic acid to remove any concrete laitance. All samples were flushed off with distilled water and maintained in a saturated surface moist condition.

Surface Treating -

With the concrete in a saturated surface dry condition, three of the panels were treated on the bottom surface with Penetron at the rate of 2.0 pounds per square yard The Penetron was mixed 3 powder to 1 water by volume and applied within 10 minutes after addition of the water.

After treating, all panels were kept moist for 3 days with a fine mist of water four times each day. At the end of this period, the samples were returned to the laboratory moist room for an additional 14 days.

FREEZE-THAW CYCLING:

Procedure -

All six panels, three treated and three untreated, were freeze-thaw cycled as follows:

The trough was filled with a 2% solution of calcium chloride for 30 minutes at room temperature. At the end of this period, the solution was poured off and the concrete flushed with clean water.

The trough was again filled with a 2% solution of calcium chloride and placed in the freezer at -10F$\pm$2F for a minimum period of 18 hours.

The samples were removed from the freezer and immediately placed in a water bath thaw tank at 40F$\pm$2F for a minimum period of 4 hours.

The panels were then removed from the thaw tank, flushed with clean water, and the trough filled with a 2% solution of calcium chloride.

This cycling was repeated until a total of 50 cycles were completed.

FREEZE-THAW CYCLING:

Evaluation -

Material	Chloride Content, ppm
Type I Portland Cement	Less than 400
Fine Aggregate	Less than 50
Coarse Aggregate	Less than 50
City of New York water	Less than 10

NOTE: The contribution of chlorides from the concrete-making materials in the mix used would be approximately 60 ppm.

CONCLUSIONS:

For the conditions of this test the surface treatment reduced the chloride concentration at the 1" depth by 50%, at the 3" depth by 67%, and at the 5" depth by 75% of that in the untreated panels.

REMARKS:

Photographs were taken of the treated and untreated specimens, and are included in the report. Visual examination of the panels after completion of the cycles showed a markedly increase in surface erosion of the untreated panels over the treated panels.

Available technical data indicates that at a chloride ion concentration of around 500 ppm at the reinforcing steel negates the calcium oxide coating and promotes electrolytic corrosion of the reinforcing steel embedded in the concrete near the surface. It is for this reason that 2" cover over the reinforcing steel is recommended for concrete exposed to de-icing salts.

Resectfully Submitted,
ALL ISLAND TESTING ASSOCIATES INC.

Doug Quick

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