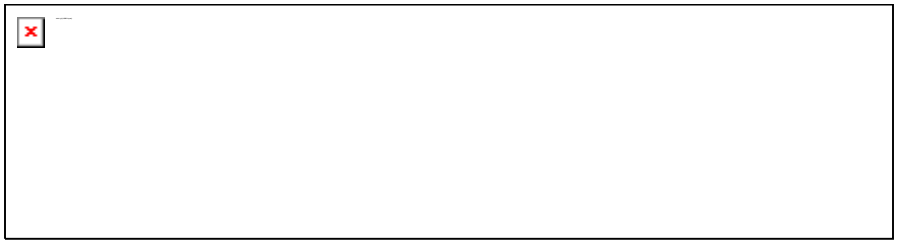
compressive strength (1)
microscopic examinations
penetron content
chloride content
water permeability
sheer and bond



Client: ICS/Penetron International Ltd. c/o All Island Testing Laboratories
Project: Information of Client
Subject: Laboratory Testing of Penetron Waterproofing Material
Report No. 94-6175 Date 12/21/94

We present herewith laboratory test results of the Penetron coated concrete samples. The Penetron waterproofing material was supplied by the client in sealed bags.

1. CONCRETE MIX
The concrete mix design used in this study consisted of the following ingredients:

MATERIALS	**ASTM NO.**	**lbs./cu. yard**
Portland Cement - Type I	C-150	517
(*) Sand	C-33	1465
(*) Coarse Aggregate, Size #57	C-33	1800
Water, Gallons	---	31.4
Admixtures, oz. -Air - mix -Water Reducer	 C-494 C-494	 3.9 12.9
Slump, Inch	---	4.0
Air, %	---	5.0

* Saturated Surface Dry Basis

The concrete mixed used is a regular placement mix with an f ' c = 3000 psi strength.

EXPERIMENTAL SET-UP

By using the concrete mix, eight 4 x 8 inch cylinders were prepared.

At the age of 24 hours, the top surface of six of the cylinders were coated with the Penetron waterproofing material.

The Penetron powder was mixed with water at the rate of:

Three Penetron by volume

One water by volume

The slurry thus formed was brushed onto the top surface of the concrete cylinders at the rate of 2 1/2 lbs. per square yard.

After the treatment, all concrete cylinders were placed into a curing room at 730 F. and 100% relative humidity for two weeks.

At the end of the two weeks, the cylinders were subjected to tests.

TESTS PERFORMED

The tests performed consisted of the following:

Compressive Strength - ASTM C39

Microscopic Examinations - ASTM C457

Chloride Content - AASHTO - T260

Chemical Analysis (Infrared Spectroscopy) Perkin Elmer Method: 990-9647

Water Permeability - Handbook of Concrete Engineering, 1974,

Edited by Mark Finkel Van Nostrand Reinhold Co.

A. COMPRESSIVE STRENGTH

The Penetron treated and the untreated (control) cylinders were treated for compressive strength with the following results:

Cylinder I.D	14 days old	28 days old
Penetron Treated	3540	4150
Control (Untreated)	3350	3915

B. MICROSCOPIC EXAMINATIONS

Both the Penetron treated and untreated concrete samples were studied under magnification to determine the depth of penetration of the waterproofing compound into the concrete surface.
Microscopic examination revealed that some components of the penetration diffusion into the concrete was as follows:

Depth from Concrete Surface, mm	Depth Penetrated
0-5	Considerable
5-10	Moderate
10-25	Some
25-50	Little
50+	Negligible

(*) These penetrations or diffusions reflect the observations made at the age of 14 days of the Penetron treatment. As the system ages, more diffusions of Penetron compo nents are expected.

C. ANALYSIS OF CONCRETE FOR PENETRON CONTENT

Several depths of the Penetron treated concrete samples were tested by Infrared Spectroscopy Methods. The test results revealed the following:

According to the Infrared Spectra attached. the amount of Penetron components at I/ 2 inch depth from the treated surface was considerable.

The spectrum of the untreated or control concrete sample had considerable less calcium, silica, and their components and reaction products than the treated concrete spectrums of the depths studied.

D. CHLORIDE CONTENT

Both the Penetron waterproofing material and the concrete were tested for water soluble chloride contents. The test results were as follows:

Sample I.D.	Chloride (CI2_) Content mg/kg
Concrete	42
Penetron	40

E. WATER PERMEABILITY TESTS

Both the Penetron coated concrete and the uncoated (control) sample of the concrete were subjected to water permeability tests. The test results showed the following:

SAMPLE I.D.	WATER PERMEABILITY, K
Control (Untreated) Concrete	1.8×10^{-11} cm/sec
Penetron Treated Concrete (14 days old)	2.1×10^{-13} cm/sec
Penetron Treated Concrete (28 days old)	21.9×10^{-14} cm/sec

CONCLUSIONS

Based on these test results, the following conclusions were drawn:

The compressive strength of the Penetron treated concrete cylinders were slightly higher than the untreated cylinders. This increase corresponds to approximately 6% gain over the untreated concrete. However, the primary benefit of Penetron is waterproofing concrete surface rather than increasing the compressive strength.

The depth of diffusion of the Penetron components into the concrete was found to be as follows:

0-5:	**Considerable**
5-10:	**Moderate**
10-25:	**Some**
25-50:	**Little**
50+:	**Negligible**

It should be noted that these penetrations were accomplished in 14 days of age. As the concrete ages, more and probably deeper diffusions of the waterproofing material may take place.

Microscopic examinations revealed that the Penetron components that diffused into the concrete surface resulted in a crystalline growth, white in color. These crystalline growths appeared to be hydration products of the Penetron components with cement's calcium-silicate gel in the matrix of the concrete.

The water permeability of Penetron treated concrete was considerably slower that the water permeability of the untreated concrete. This indicates that Penetron treatment improves the water proofing properties of the concrete considerably.

The water soluable chloride content of the Penetron was very low and about equal to that of the concrete. Thest test results indicate that beneficial effects of Penetron are not related to chlorides.