

8 February 1993

Mr. D'Arcy Mainwaring  
Xypex Chemical Company  
13731 Mayfield Place  
Richmond, B.C.  
Canada V6V 2G9

Ref: Permeability Testing

Please find attached the results of the Permeability Test Program that we conducted on the treated and untreated concrete samples that were submitted to Aviles Engineering Corporation by Mr. Bill Golden.

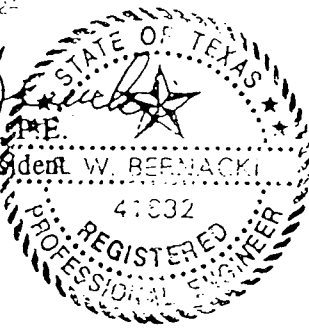
Should there be a question or should we be able to be of further service, please advise. Thank you for this opportunity to be of service.

Sincerely,

AVILES ENGINEERING CORPORATION

A handwritten signature in cursive script, appearing to read "Frank W. Bernacki".

Frank W. Bernacki, P.E.  
Executive Vice President



FWB:lm

Copies to: Concrete Solidification Tech (1)  
File (1)

**PERMEABILITY TEST OF TREATED  
 AND UNTREATED CONCRETE SAMPLES**

Synopsis

Aviles Engineering Corporation (AEC) is an independent materials testing laboratory that meets the requirements of ASTM E-329 and is accredited and certified by American Association of Laboratory Accreditation (A2LA) and Cement and Concrete Reference Laboratory (CCRL). AEC was selected to perform permeability tests on several concrete samples delivered to our laboratory by Mr. Bill Golden to represent several mix designs containing various weights of admixture. The test apparatus used by AEC for this permeability test program was furnished by Xypex Corporation, and this apparatus was modeled after the test apparatus described in the Corps of Engineers Test No. CRD-~~C487~~73, with several modifications as described herein. This apparatus was used to collect data over the period from June 25, 1992 to August 3, 1992 and this data is contained herein.

c48-73

Sample Identification

The six (6) inch by twelve (12) inch test cylinders representing several different mix designs to be tested in this permeability test program were fabricated by Hydro Conduit Corporation personnel at their Houston, Texas pipe manufacturing plant on June 25, 1992. These samples were left on site for approximately three days before they were delivered to our laboratory by Mr. Bill Golden on June 29, 1992. Mr. Golden provided us the mix designs that these samples represent with the following portions as follows:

STANDARD (CONTROL)

PER CUBIC YARD

|                  |          |
|------------------|----------|
| Type I Cement    | 482 lbs  |
| Fly Ash          | 161 lbs  |
| Course Aggregate | 2120 lbs |
| Fine Aggregate   | 1955 lbs |
| Slump            | 0 inches |

SPECIMEN A

PER CUBIC YARD

|                  |          |
|------------------|----------|
| Type I Cement    | 482 lbs  |
| Fly Ash          | 161 lbs  |
| Course Aggregate | 2120 lbs |
| Fine Aggregate   | 1955 lbs |
| Slump            | 0 inches |
| Admix            | 15 lbs   |

SPECIMEN D

PER CUBIC YARD

|                  |          |
|------------------|----------|
| Type I Cement    | 448 lbs  |
| Fly Ash          | 150 lbs  |
| Course Aggregate | 2120 lbs |
| Fine Aggregate   | 1955 lbs |
| Slump            | 0 inches |
| Admix            | 24 lbs   |

Sample Preparation

Upon receipt of the standard six (6) inch by twelve (12) inch concrete test cylinders from Hydro Conduit Corporation on June 29, 1992 and based on instructions from Mr. Golden these test cylinders were allowed to cure naturally until twenty eight (28) days cure time was obtained.

At the end of the twenty eight (28) days cure time, 1.75" thick by 6" diameter specimens were saw cut from the center of randomly selected test cylinders representing the mix designs (control, Sample A and Sample B) as outlined herein and submitted by Mr. Golden.

TEST METHODS AND PROCEDURES

A. DESCRIPTION OF TEST APPARATUS

The apparatus used for the permeability tests was supplied by Concrete Solidification Technologies, Inc. It consisted of controllers and regulators for the applied Nitrogen gas pressure to be used, and the necessary hoses, gauges, valves and fittings to carry out the test (see supplied sketch). Pressurized Nitrogen was directed through the regulator and controllers to each of the three pressure vessels. Each vessel contained a gauge to monitor the applied pressure and plastic bag containers were fashioned to allow collecting and measuring water output.

The major differences in the test apparatus and procedures are as listed below:

XYPEX TEST APPARATUS

CORPS OF ENGINEERS TEST

1. Steel Cylinders were 3" dia. X 18" high with samples 6" dia., X 1.75" thick
2. Apparatus was set up to monitor flow emitted from bottom side and/or vertical sides of concrete samples
3. Pressure started at 100 psig for two minutes, then increased to 175 psig and allowed to settle to the sustaining pressure limits of the apparatus

1. Cylinders were made to accommodate samples 14.5" dia. X 15" high
2. Apparatus was set up with standpipe to measure flow of water into concrete samples
3. Pressure started at 100 psig for five minutes then increased to 200 psig and left for duration of the test

4. RTV compound with fiber gasket was used to seal samples to cylinder

4. Paraffin-resin and asphalt mixtures were used to seal samples to cylinder

5. Rubber gasket was used at bottom holding flange

5. Plaster ring used on bottom plate to set samples on

### Test Procedure

In accordance with instructions from Mr. Golden, the three samples; one each for Standard (Control), Specimen A and Specimen D, were placed into the permeability test apparatus cylinders on July 23, 1992.

The sample-to-sample fiber gasket was lightly applied with RTV on the side adjacent to the cylinder flange and heavily applied (¼ in. bead) with RTV on the side adjacent to the sample to insure penetration into and sealing of the sample pores in contact with the gasket. The bottom cushioning rubber ring was placed into location and the holding studs were put into place and tightened. Specimens and sealant were then left to cure for five days.

On July 29, 1992 cylinder was filled with water (at room temperature approx. 78 deg. F.) and all connections were tightened. Pressurized Nitrogen was then allowed to enter into the cylinders and allowed to bear on the water contained in the cylinders. Pressure was set at 100 psig and the test begun. After observation for leaks for two (2) minutes, the pressure was increased to 175 psig and observed for leaks. Minor leakage was observed between the gasket and the cylinder flange, and the applied Nitrogen pressure was reduced to a sustained 150 psig where there was no leakage at the gasket sealing points. The pressured samples were allowed to set with 150 psig applied for a period of five (5) days while under observation.

### Test Results

1. After twenty four (24) hours of application of 150 psig applied Nitrogen pressure, the Standard (Control) sample was observed to be moist and water had permeated throughout the sample.

2. After five (5) days (120 hours) of application of 150 psig applied Nitrogen pressure, no moisture was observed on Samples of Specimen A and Specimen D. After disassembling of the test apparatus, these two samples representing Specimen A and Specimen D, were cracked to allow visual observation and measurement of the depth of penetration of water into the test samples. Observations revealed a maximum depth of water penetration of 1.5 mm into the Samples of Specimen A and Specimen D, with no apparent permeation of water into these samples. All tests for imperviousness to water were performed at a held pressure of 150 psig (350 ft.head).



ENGINEERING CORP.  
GEOTECHNICAL ENGINEERS

**REPORT OF CONCRETE CYLINDERS TESTED - ASTM C-39**

PROJECT Concrete Solidification Tech. Inc. PROJECT NO. 268-92  
 CLIENT Concrete Solidification Tech. Inc. DATE 7-22-92  
 SUPPLIER Gifford Hill REPORT NO. 8  
 STRENGTH REQ'D \_\_\_\_\_ psi at 28 days MIX \_\_\_\_\_ Sacks TYPE CEMENT \_\_\_\_\_

| CYLINDER MARK  | SLUMP INCHES | AGE DAYS | DATE MADE | DATE TESTED | TOTAL LOAD POUNDS | POUNDS PER SQ. INCH | LOCATION |
|----------------|--------------|----------|-----------|-------------|-------------------|---------------------|----------|
| 22-ACST        | -            | 28       | 6-25-92   | 7-23-92     | 255000            | 9010                |          |
| 23-ACST        | -            | 28       | 6-25-92   | 7-23-92     | 257469            | 9100                |          |
| 24-B           | -            | 28       | 6-25-92   | 7-23-92     | 226880            | 8020                |          |
| 25             | -            | 28       | 6-25-92   | 7-23-92     | 231288            | 8170                |          |
| 26-C           | -            | 28       | 6-25-92   | 7-23-92     | 231860            | 8190                |          |
| 27-C           | -            | 28       | 6-25-92   | 7-23-92     | 334298            | 11,810              |          |
| 28-D           | -            | 28       | 6-25-92   | 7-23-92     | 228460            | 8070                |          |
| 29-D           | -            | 28       | 6-25-92   | 7-23-92     | 224692            | 7940                |          |
| 30-CST control | -            | 28       | 6-25-92   | 7-23-92     | 188610            | 6660                |          |
| 31-CST control | -            | 28       | 6-25-92   | 7-23-92     | 189143            | 6680                |          |

SPECIMEN MADE BY Contractor ADMIXTURE \_\_\_\_\_  
 COPIES TO Concrete Solidification Tech., Inc. (1)  
File (1) A.E.A. \_\_\_\_\_

Dionel E. Avilés, Ph. D., P.E.

The results are applicable only to the sample tested and/or inspected and are not necessarily indicative of the qualities of apparently or similar products. This report is for the exclusive use of the client to whom it is addressed. The use of our name must receive our prior written approval.

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