TECHNICAL DATA

WBS 301 - WATERLOO BARRIER® GROUT PERMEABILITY TESTING

TDS 4-2001 Date: February, 2001

1.0 Introduction

Chemical resistance of portland cement based products is generally taken to be related to the density of cured material. The higher the density (the lower the permeability) the more durable the product. A private testing laboratory was engaged to perform an independent test on the permeability of WBS301. The following procedure was used for determining the coefficient of permeability. The procedure involves measuring the inflow and outflow rates through a sample with a pressure difference of 8 bar. The coefficient of permeability is computed using Darcy's Law. If no measurable inflow or outflow occurs as was the case for this sample, the coefficient of permeability is determined using the CHLORPEN computer program by Mott MacDonald based on the measured chloride profiles on the core specimens.

2.0 Sample Preparation and Test Procedures

1. Prior to testing, the cylinder samples were wet cured for a period of 28 days under standard laboratory conditions (i.e. 23 ± 2°C R/H 100%)

2. One (1) 100 mm cylinder specimen from the grout mixture was tested for Coefficient of Water Permeability, with the remaining cylinders being retained as a spare sample.

3. One (1) 50 mm thick slice was removed from the test cylinder.

4. The 50 mm thick slice was placed under vacuum for three (3) hours. After this period of vacuum, distilled water was introduced into the vacuum chamber for one (1) hour.

5. The slice was then immediately placed into CACA type water permeability cell.

6. The CACA permeability cell, including the sample, was placed into a permeability rig as illustrated in Figure 1. The inflow was NaCl (19,000 ppm) at 8 bar gauge pressure at 40°C. A transducer was provided to measure the required pressure.

7. The sample was maintained under these conditions of pressure and temperature for a period of 40 days. The level of fluid in the outflow reservoir was maintained under these conditions of pressure and temperature for a period of 40 days. The level of fluid in the outflow reservoir was measured with respect to time during this period. All discharge rates were in volume of water at 40°.

3.0 Determination of Coefficient of Water Permeability

1. Measurable Outflow

In the case where there is a measurable outflow, the coefficient of permeability is computed using the outflow rate and Darcy's Law.

$$K = Q/AI$$

Where Q is the water outflow rate in m^3/second, A is the cross sectional area of the sample (m^2), I is the hydraulic head (dimensionless) and K the coefficient of permeability (m/s). No outflow was measured, therefore, the following procedure was used to calculate coefficient of water permeability.

2. No Measurable Outflow

In the case where, at the end of the 40 day period, no measurable outflow had occurred, the coefficient of water permeability was determined by comparing the chloride ion profile in the sample, with predicted profiles using the CHI.ORPEN program.

The chloride ion profile was determined at 1 mm intervals to a depth of 10 mm from the inflow face of the sample. The results of these tests are shown on the attached Table No. 1 and are graphically presented in Graph No. 1.

Formulae

The coefficient of water permeability was calculated using the following Formulae:

Equation No. 1

$$K = x^2v/2ht$$

where
- K = the coefficient of water permeability (m/s)
- x = the depth of chloride penetration (mm)
- v = the porosity of the grout (%)
- h = the head of pressure (m)
- t = the time duration of the test(s)

and Equation No. 2

$$H = P/pg$$

where
- P = the gauge pressure (N/m^2)
- p = the density of water (1000 kg/m^3)
- g = acceleration due to gravity (9.81 m/s^2)

Test Results

The above mentioned formulae yields a coefficient of permeability of 3.19×10^{-15} m/s.

TABLE No. 1

Water Soluble Chloride Ion Contents
for Grout Sample Tested for
Coefficient of Water Permeability

Sample No.	Test Horizon (mm)	Water Soluble
1	0 - 1	0.430
2	1 - 2	0.290
3	2 - 3	0.181
4	3 - 4	0.110
5	4 - 5	0.046
6	5 - 6	0.034
7	6 - 7	0.037
8	7 - 8	0.044
9	8 - 9	0.033
10	9 - 10	0.038

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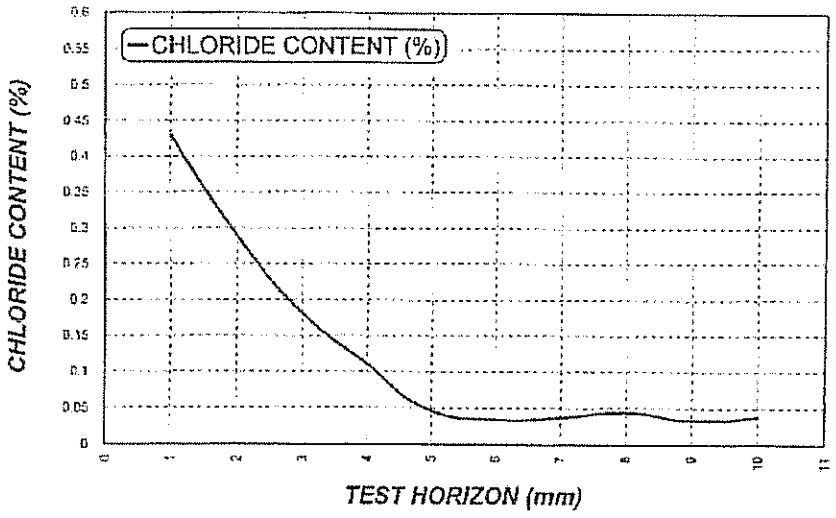
GRAPH NO. 1

Water Soluble Chloride Ion Content Profile - Grout Sample Tested for Coefficient of Water Permeability



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