

Certificate of Test

Title:

E WOOD Ltd

Thortex Wall-Tech FP

Determination of Carbon Dioxide Diffusion Coefficient

Certificate of Test No: 7826

Client's Name & Address:

**Mr M Hutchinson
E Wood Ltd
Standard Way
Northallerton
N. Yorks.
DL6 2XA**

Our Ref:	1.205.03
Job No:	T474-3ET3
Your Ref:	47426
Date:	17.10.2005
Date Sample(s) Received:	20.09.2005
Sample(s) Received From:	Mr M Hutchinson

Sample No(s): 142971

Tested By:  D J Thompson

Authorised By:  A T Blake

Job Title: **Manager, Materials Testing Laboratories**

For

Taylor Woodrow Technology

Stanbridge Road, Leighton Buzzard, Bedfordshire,
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Registered Office Watford
England

Registered No.1090601

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Taylor Woodrow

1. SAMPLE DESCRIPTION AND ANALYSIS REQUESTED

The Materials Testing Laboratories supplied six standard ceramic tiles to E Wood Ltd. One face of each tile was coated with Thortex Wall-Tech FP. When cured, the coated samples were returned to the Laboratories. No certificate of coating was received.

The carbon dioxide diffusion coefficient of Thortex Wall-Tech FP was to be determined.

2. METHOD

2.1. Coating Application

The coating system was applied by E Wood Ltd. It was reported, by the client, that the coating system was airless spray applied to a dry film thickness of 200 μ m, and that the coated samples were cured and conditioned for 7 days at room temperature prior to being sent to the Materials Testing Laboratories. When received, the coated samples were conditioned at 23 \pm 2 $^{\circ}$ C and 60 \pm 5%RH for a minimum period of three weeks prior to testing.

2.2. Determination of Carbon Dioxide Diffusion Resistance*

One coated tile (TW Specimen No. 142971) was sealed in a circular steel rig such that the coated and uncoated faces were exposed. Carbon dioxide (15% in oxygen) at a known pressure and flow rate was passed over the coated face of the plate and helium gas was passed over the opposite face at the same pressure and flow rate. The helium gas stream was continuously monitored by gas chromatography to analyse for carbon dioxide. Equilibrium conditions were achieved after approximately 24 hours and the steady state flux of carbon dioxide was then calculated from the percentage of carbon dioxide in the helium stream and the flow rate of this gas.

The diffusion coefficient for carbon dioxide (D_{CO_2}) is calculated using Fick's Law of Diffusion and Crank's equation.

* In-House Test Procedure TP1303/90/4671 Issue 1.

3. RESULTS

The results of the analysis are tabulated below.

Carbon Dioxide Diffusion Resistance

Coating	Thortex Wall-Tech FP
TW Specimen No.	142971
D_{CO_2} (cm ² s ⁻¹)	2.32E-07
μ -value	6.44E+05
R (m)	129
S_c (cm)	32
Mean Dry Film Thickness (μ m)	200*
* See notes i and ii below	
Date of Test	13.10.2005

Notes:

- i) R (equivalent air layer thickness) and S_c (equivalent thickness of concrete) are dependent on the film thickness and are calculated here for the dry film thickness (DFT) present on the test specimens.
- ii) D_{CO_2} and the diffusion resistance coefficient (μ -value) are calculated using the mean DFT as reported by the client.
- iii) D_{CO_2} for an uncoated plate is 1.0×10^{-3} cm²s⁻¹.
- iv) S_c is calculated assuming an average grade concrete where the μ -value has been estimated as 400.
- v) Klopfer criterion for effective anti-carbonation coating is R greater than 50 metres.

END OF CERTIFICATE

Certificate of Test

Title:

E WOOD LTD

**Determination of Chloride Ion Diffusion
of Thortex Wall-Tech FP at 6 Months**


Certificate of Test No: **7730**

Client's Name & Address:

**Mr M Hutchinson
E Wood Ltd
Standard Way
Northallerton
North Yorkshire
DL6 2XA**

Our Ref: **1.205.2/KAL**
Job No: **T474-3ET3**
Your Ref: **45677**
Date: **12 August 2005**
Date Sample(s) Received: **13 December 2004**
Sample(s) Received From: **Mr M Hutchinson**

Sample No: **142686**

Tested By:  **K Lucas**

Authorised By:  **A T Blake**

Job Title: **Manager, Materials Test Laboratories**

For

Taylor Woodrow Technology

Stanbridge Road, Leighton Buzzard, Bedfordshire,
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Tel No. 01525 859111 Fax No. 01525 859112

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1. SAMPLES RECEIVED

The Materials Testing Laboratories supplied two 100mm diameter TW control concrete discs to E Wood Ltd. One face of each disc was coated with Thortex Wall-Tech FP. When cured, the coated samples were returned to the Laboratories. No certificate of coating was received.

The chloride ion diffusion coefficient of Thortex FP Wall-Tech FP was to be determined.

2. SAMPLE PREPARATION

Three concrete slices (approximately 12-15mm thick) were cut from a TW control concrete core (100mm diameter) and allowed to air dry. Any blowholes in the cut surfaces were filled with cement paste, which was allowed to harden under polythene for two days. These surfaces were then ground smooth and left to air cure. One slice was retained as a control and the remaining samples forwarded to E Wood Ltd for application of the Thortex Wall-Tech FP coating system. It was reported that the coating system was brush applied in two coats.

The received coated samples were conditioned at $23\pm 2^{\circ}\text{C}$ and $60\pm 5\%$ RH for a minimum of four weeks prior to testing.

3. METHOD

3.1 Measurement of Chloride Ion Diffusion

The top and bottom faces were then masked with tape and together with the control sample were placed in individual moulds where the edges were sealed with an epoxy resin. After allowing the resin to cure for 2 days, the specimens were demoulded and immersed in saturated calcium hydroxide solution for 4 days. (This procedure is used to avoid anomalous effects due to chloride ingress by sorption rather than diffusion). Each specimen was then mounted in a diffusion cell as shown in Figure 1. (Coated surface on side a).

The cells were maintained at $23\pm 2^{\circ}\text{C}$ and the chloride diffusing through the specimens was determined at suitable intervals using the method described in 3.2. This method required withdrawal of a 10 cm^3 aliquot and, therefore, the cells were topped-up on each occasion with 10 cm^3 of saturated calcium hydroxide solution.

3.2 Measurement By Titration

An aliquot of each sample was accurately pipetted into a clean oven dried glass container. Nitric acid 10% (approximately $50\text{-}70\text{ cm}^3$) was cautiously added to the sample which was then left to stand with occasional stirring. Automatic potentiometric titration, with continuous stirring was used to analyse the samples. The titrator used was a Metrohm 682 Titroprocessor and the course of the titration was monitored using a Metrohm electrode system.

The above titration was carried out in general accordance with In House Test Procedure TP1303/90/4670, Issue 5. The accuracy of the method was checked using control samples of known chloride content ($0.10 \pm 0.01\%$ by volume of sample).

4. RESULTS

After approximately 6 months on test (185 days), the Thortex Wall-Tech FP coated sample (142685/1) is proving an effective barrier against chloride ingress. Chloride ions just above background levels are being detected on the downstream side of the cell (see Figure 2). Therefore, at present it is not possible to determine a diffusion coefficient.

Results for the uncoated control sample after 6 months (185 days), indicate that chloride ions are diffusing through the sample, but that they have not yet reached a concentration of 0.1Mol/L, which is deemed to be when an equilibrium status is reached and a chloride ion diffusion can be calculated (see Figure 3).

Figure 1

THE DIFFUSION CELL

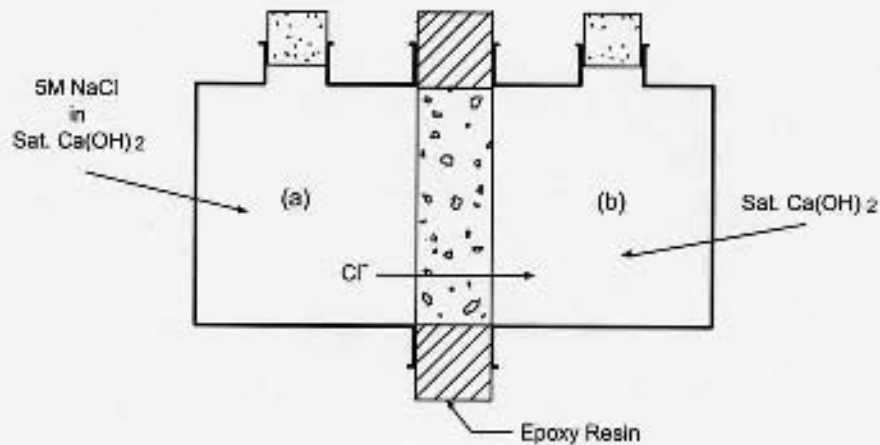


Figure 2

CHLORIDE DIFFUSION
THORTEX WALL-TECH FP
SN 142685/1

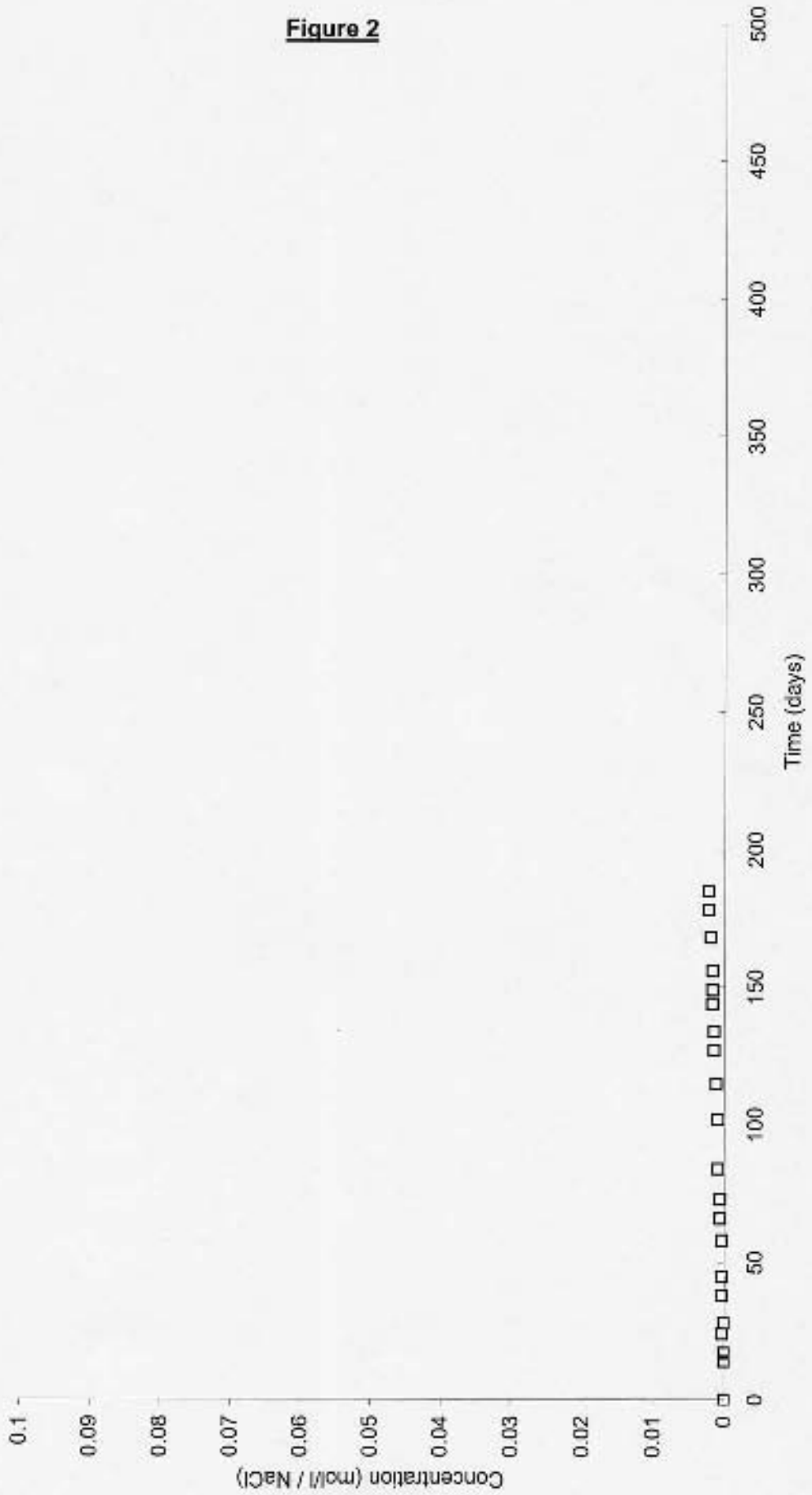
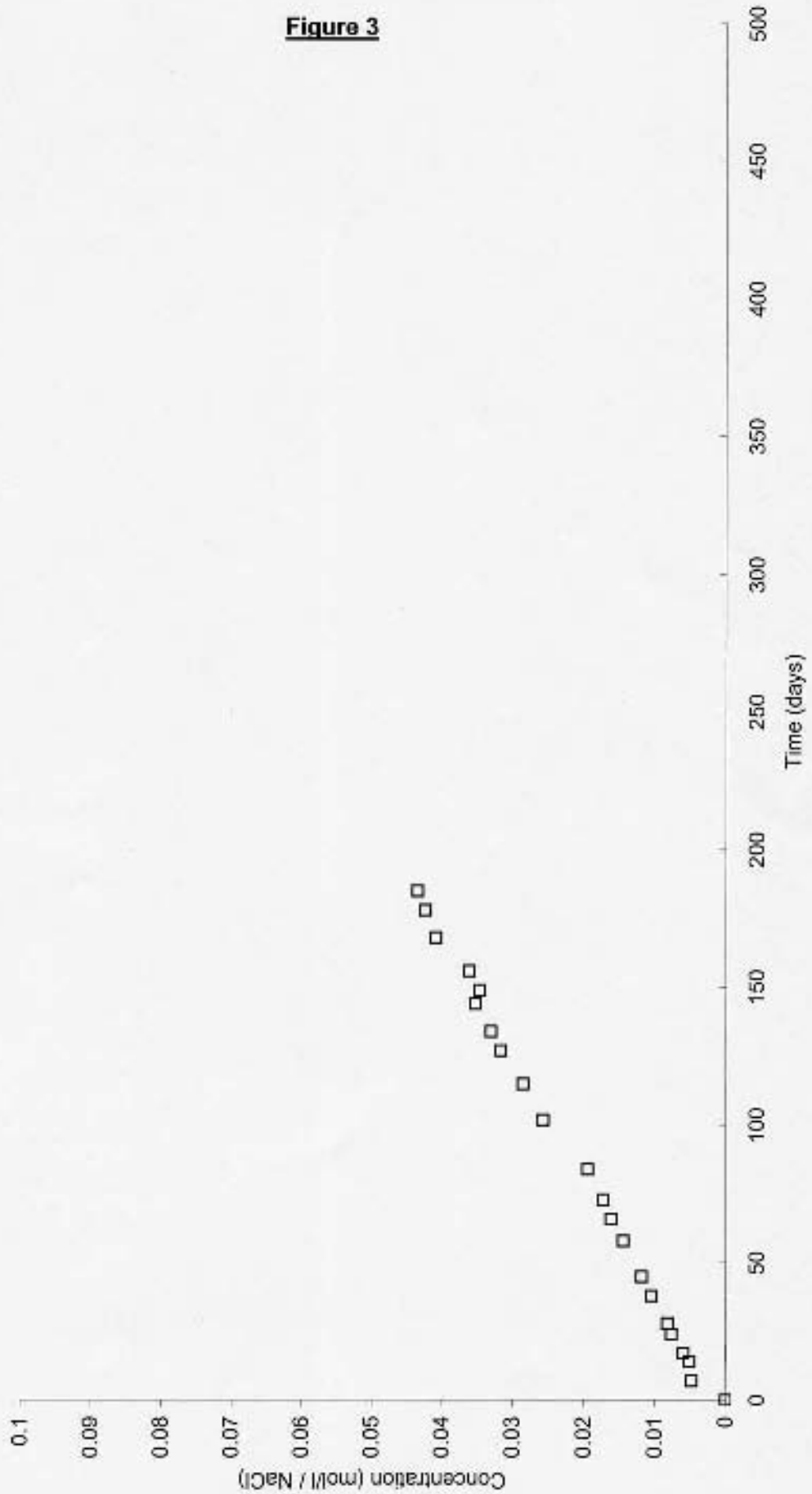


Figure 3

CHLORIDE DIFFUSION
CONTROL FOR THORTEX WALL-TECH FP



END OF CERTIFICATE