THE RADCON FORMULA # 7 TEST REGIME

TEST THE FOLLOWING: -

1. **PERMEABILITY**
2. **CHLORIDE RESISTANCE**
3. **ELASTICITY**
4. **OUTGASSING**
5. **PENETRATION**
6. **CRACK BRIDGING**

As you may be aware our products functionality is unique in the world of waterproofing so the test methods employed are also critical to judge performance.

What Radcon #7 does in the first 15 millimetres of concrete is form a sub-surface membrane in the matrix and cracks to create a continuous seal which uses “water to waterproof”.

To come to grips with this concept and accept our philosophy of testing, the best product comparison is “Volclay” or bentonite.

Bentonite a volcanic clay does over the surface of concrete what Radcon does inside the surface of concrete.

Put simply, bentonite uses water to swell and stop water passing through the clay thus keeping the concrete dry.

Bentonite also accepts some chloride ions in the surface layer but they become trapped and cannot reach the concrete surface.

With this principal or mechanism in mind I will now outline appropriate tests for Radcon #7.

Wherever possible I will attach test extracts confirming the statements made herein from approved Internationally recognised N.A.T.A. approved test laboratories.

Extracts of tests will be hand numbered to assist with your collation of documents.

Page one covers a standard test programme conducted in 1988 / 89 by Warnock Hersey.

Page two covers American standards testing and standard concrete mix design, no fly ash added.

1. Permeability.

Page three 5.2 referred to as water absorption is a standard test which does not show good performance for Radcon as Radcon uses water to waterproof.

Our hand marked page 4 explains the poor result.

The appropriate test to show Radcon waterproof barriers follows on marked page 5.

A Radcon treated block should have a Rilem tube sealed onto surface and filled with water.

On each occasion there will be a small loss of water to create a barrier and then no more water will permeate through.

By comparison an untreated control block should show a continual metered loss of water until the tube empties.

2. Chloride Resistance.

Unlike all other waterproofing products Radcon in fact improves with age. When Radcon is applied to spec in the field i.e. spray applied with three waterings, the concrete slab and cracks present will be all sealed and waterproof. However the product will be in its early formation cycle which means a soft gel has been formed.

In this state the product will be more prone to absorb salt, therefore salt ingress will be on the higher side. No salt will get to the reinforcing but be held in suspension just like bentonite volclay.

To show best performance in reducing chloride ingress, Radcon treated specimens should go through periodic watering for about 90 days.

With water triggering more reactivity Radcon will develop from a soft gel into an amorphous glass hard state, thus showing much better salt reduction in the penetrated zone.

Please refer to 5.4 hand marked pages 6 & 7. This represents the only effective way to ascertain reduction in salt ingress.
Any salt test which crushes up the core and measures total salt content is not appropriate and will not pass the threshold as high salt concentrations will be present in the first 2 – 3 mm.

The chloride ion test represented is a “slice” test showing that no salt can penetrate through the entire Radcon system, thus the steel is offered total protection.

3 & 4. Elasticity and Crack Bridging.

I have lumped these two tests together as given Radcon is inside the concrete we must not only seal cracks present but show how much movement the crack can entertain prior to failure. Concerning this matter I refer you to our Bologna Test Rig paper.

This issue is fairly complex so I may leave some questions unanswered.

I should point out that performance of crack opening dramatically improved when Calcium acetate was used. This was done because we were only working with 50mm test slab which restricts the amount of ongoing free Calcium available to Radcon in accelerated laboratory conditions.

The key to this test was to seal a 1.3mm crack then cyclically open and close between 0.9mm and 1.3mm. That is a 0.4mm opening and closing without failure. Then obviously this test demonstrates elasticity tolerance and crack size performance vis. 1.3mm. See pages hand marked 8 to 14.

5. Outgassing.

A simple test, refer to 5.3 pages 15 & 16 referred to as moisture vapour permeability.

6. Penetration.

Penetration can be measured as per page 17 of Warnock Hersey vis 15 to 16mm.

Penetration can also be determined by SEM study, refer to CSIRO testing marked page 18, 19 and 20.

Remember Radcon # 7 produces Calcium silicate hydrates just like Portland Cement, so it takes a well-trained eye to spot the difference.
If difficulties in gauging product penetration are encountered, independent assistance may be sourced through the Australian Government testing authority, CSIRO.

We hope this overview will assist in not making testing errors based on generic tests for generic products..

We are happy to liase further on any areas which may need further explanation.

Kind regards,

Ed Byrne
Managing Director
Radcrete Pacific Pty Ltd

- **Our e-mail address is sales@radcrete.com.au**
- **Please visit our website www.radcrete.com.au**

PAGE 1 TEST OVERVIEW

WARNOCK HERSEY PROFESSIONAL SERVICES LTD.
3210 AMERICAN DRIVE, MISSISSAUGA, ONTARIO, CANADA L4V 1B3
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TELECOPIER (416) 673-0282

January 20, 1989

50244-C7-416600

Concretech Inc.

Attention: Ms. Lisa K. Cvet
Technical Sales Manager

SUBJECT: Laboratory Testing and Evaluation of Concrete Sealer, Radcon Formula #7

Dear Ms. Cvet:

1.0 INTRODUCTION

On July 16, 1988 Warnock Hersey Professional Services Ltd. was commissioned by Concretech Inc. to conduct a complete series of tests as outlined in the subsequent parts of this report. This report is intended to convey testing and evaluation results of Radcon Formula #7 conducted in our Mississauga laboratory since July 1988.

2.0 TESTING PROGRAM

The testing program included the following individual tests:

2.1 Depth of Penetration
2.2 Water Absorption
2.3 Moisture Vapour Permeability
2.4 Chloride Ion Penetration
2.5 Freeze-Thaw Test in the Presence of Deicing Salt
2.6 Chemical Resistance (2 acidic, 2 alkalis, 1 solvent) Resistance to Oil, Gasoline and Grease
2.7 Slip Resistance
2.8 Viscosity
2.9 Non-volatile Contents
2.10 Relative Density
2.11 Ph Value
2.12 Hardness Test

Cont'd.....

3.0 REFERENCE STANDARD Standard References

This report refers to the following International and Canadian Standards for Material Testing:

- MTC-M1-79 April 1985, Used as a general guideline
- CSA CAN3-A23.1 and CAN3-A23.2
- AASHTO T259-78, Resistance of Concrete to Chloride Ion Penetration
- MTC LS-411, Method of Determination of Water Soluble Chloride Ion in Concrete
- MTC Form 1351, Salt Scaling Test
- ASTM C192, Making & Curing Concrete Samples in the Laboratory
- ASTM C672, Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
- ASTM D1644, Test for Non-Volatile Contents

4.0 PREPARATION OF TEST SPECIMENS

4.1 Concrete Mix Suitable Mix Design

Two concrete mixes were designed and batched in accordance with MTC-M1-79 test procedures. One mix was made without an Air Entraining Agent, and designated as Normal Concrete. The other mix was made by adding an Air Entraining Agent, and designated as Air Entrained Concrete. The mix proportions and values for the slump and air content are presented in Table 1 below.

TABLE 1

MIX PROPORTIONS (BASED ON DRY MASS)

Materials	Normal Concrete (Mix #1)	Air Entrained Concrete (Mix #2)
Coarse Aggregate (kg) max. size 20 mm	171.0	168.0
Sand (kg)	116.5	121.0
Cement Type 10 (kg)	56.2	52.2
Water (kg)	28.8	28.3
Water Reducing (ml) Admixture (WR DA)	247.0	243.0
Air Entraining (ml) Admixture (DAREX AEA)	nil	11.0
Fresh Concrete Test Results		
Slump (mm)	75.0	82.0
Air Content (%)	2.5	5.8

All the materials complied with the MTC requirements.

Cont'd.....

5.2 Water Absorption PERMEABILITY TEST

Eight of the 150 x 150 x 50 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. All of the eight samples were lightly sandblasted to remove the laitance and other residual materials. The samples were then oven dried at 110 ± 5°C to a constant mass, after removal of the samples from the oven they were cooled to a normal room temperature under laboratory conditions. Radcon Formula #7 was applied to all sides of each slab, under the supervision of Concretech Inc. with strict manufacturer's directions. The slabs were further cured for 14 days under normal laboratory conditions and then each slab was weighed and recorded. Then all the slabs were immersed in water, after 48 hours they were removed and surface dried by a water absorbant cloth, each slab was weighed and recorded. All the slabs weight were recorded to the nearest 0.1 g. Test results are presented in Table 3 below

TABLE 3

WATER ABSORPTION

Concrete Type	No. of Sealant Coats Applied	Average Water Absorption (%)
Normal	1 coat	2.42
Air Entrained	1 coat	2.33
Normal	2 coats	2.11
Air Entrained	2 coats	2.25
Control Sample (Normal)	-	4.07
Control Sample (Air Entrained	-	3.18

5.3 Moisture Vapour Permeability

Eight of the 150 x 150 x 50 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. All of the eight samples were lightly sandblasted to remove the laitance and other residual materials. The samples were then oven dried at 110 ± 5°C to a constant mass, after removal of the samples from the oven they were cooled to a normal room temperature under laboratory conditions. Then the samples were placed in distilled water for 48 hours,

Cont'd.....

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6.0 DISCUSSION (Cont'd)

Depth of Penetration: The average depth of penetration was greater than 15 mm, although this is an average value it is important to note that across the sections in some areas the depth of penetration was about 20 mm. Therefore, Radcon Formula #7 can be classified as a penetrating sealer. This depth is sufficient to prevent migration of chloride ion to the surface of the reinforcement with a minimum cover of 15 mm. This fact is clearly supported by the results of the chloride ion test.

Permeability *

Water Absorption: Test results presented in Table 3 clearly indicate that the samples treated with the Radcon Formula #7 absorb about 50% less water than those samples untreated. Part of the water absorbed by the treated sample is used to reactivate the sealer. Our subsequent tests of the treated samples showed much lower values of water absorption.

Vapour transmission

Moisture Vapour Permeability: The moisture loss varied between 81 to 91%, again this is mainly due to the fact that part of the moisture absorbed is used by the sealer to reactivate it.

Salt *

Chloride Ion Penetration: Radcon Formula #7 shows excellent performance in preventing chloride ion penetration. This is clearly indicated by test results presented in Table 5, specifically on samples treated with two coats.

Chemical Resistance: Test results are presented in section 5.5 and it is seen from the results that Radcon Formula #7 provides a better protection to the concrete.

Freeze-Thaw Test: All of the treated samples after 50 cycles of freeze-thaw test showed very good performance. The maximum mass loss on the treated samples ranged from 0.160 to 0.254 kg/m^2 which are far below the 0.80 kg/m^2 threshold by MTC Form 1351 and 1352. For comparison, the values for control (untreated) samples for normal and air entrained concrete were 1.290 and 1.033 kg/m^2 respectively.

Hardness Test: Our test results show that Radcon Formula #7 improves the surface hardness of the concrete. Also, our supplemental tests indicate that the compressive strength of the concrete is improved by application of Radcon Formula #7. Therefore, Radcon Formula #7 acts as a consolidant.

Slip Resistance: Radcon Formula #7 improved the slip resistance of concrete surface, except in the dry condition under leather.

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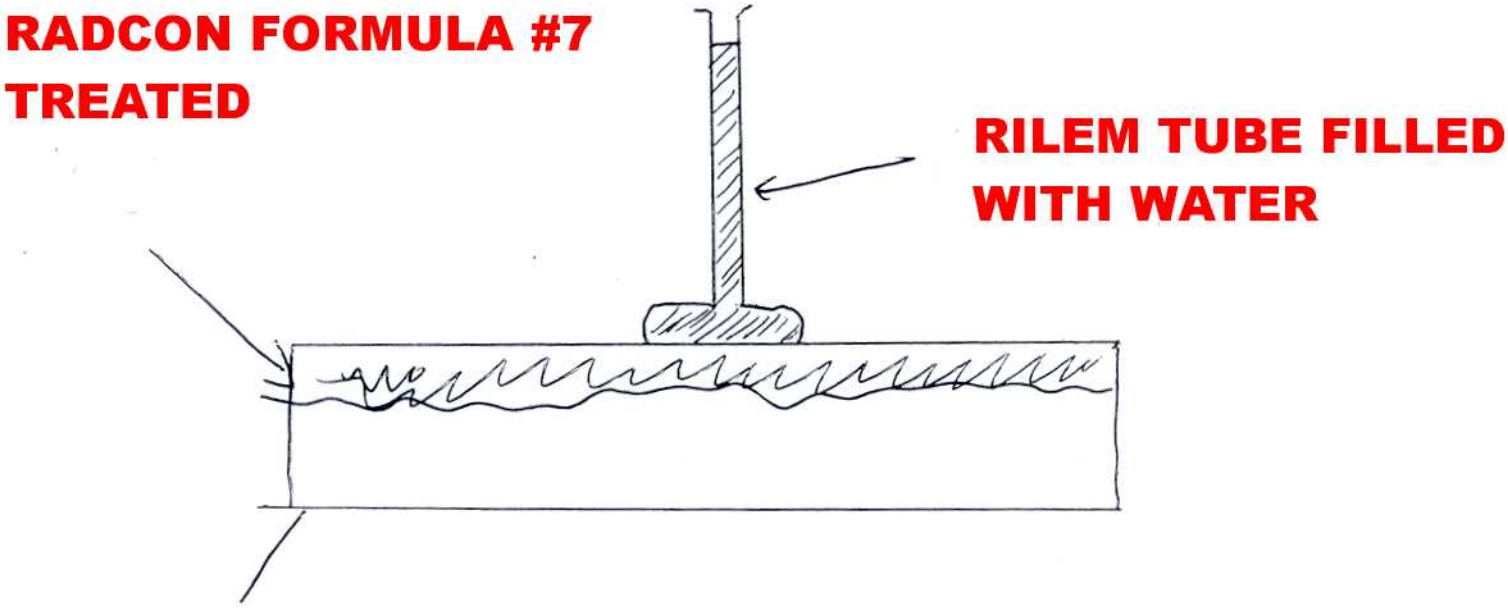

CONCRETE BLOCK

Suitable blends - Ordinary Portland cement, slag blends, Type C Flyash only (no Type F).

5.3 Moisture Vapour Permeability (Cont'd)

after removal from the distilled water, they were surface dried with an absorbant cloth. The mass of each slab was measured and recorded to the nearest 0.1 g. Radcon Formula #7 was applied to all sides of each slab, under the direct supervision of Concretech Inc., following strict manufacturer's directions. Upon drying of the sealant the mass of each slab was determined to the nearest 0.1 g and recorded. The treated slabs were stored for 14 days under laboratory conditions. Then they were placed in an oven at 110 ± 5°C until they reached a constant mass. Each slab was weighed and the mass was recorded. Tests results are presented in Table 4 below.

TABLE 4

MOISTURE VAPOUR PERMEABILITY

Concrete Type	No. of Sealant Coats Applied	Average Vapour Permeability (%)
Normal	1 coat	84.1
Air Entrained	1 coat	91.4
Normal	2 coats	81.2
Air Entrained	2 coats	83.1
Control Sample (Normal)	-	98.0
Control Sample (Air Entrained)	-	96.0

5.4 Chloride Ion Penetration

Eight of the 300 x 300 x 75 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. Four of the slabs were of normal concrete and the other four samples were concrete slabs with entrained air. Two slabs of normal concrete were treated with one and two coats of Radcon Formula #7, and two slabs of air entrained concrete were also treated in the same fashion. Two of the samples, one of each type were used as control and the last two samples were used to determine background chloride ion content of each type of concrete.

Cont'd.....

5.4 **Chloride Ion Penetration** (Cont'd)

After 14 days of storage at normal laboratory conditions six of the slabs were ponded with a 3% sodium chloride solution. Testing was conducted in accordance with AASHTO Designation T259-78. The water soluble chloride ion contents were determined in accordance with MTC Method LS-411. An additional band was also taken and tested at the 25 mm to 38 mm depth. Test results after deduction of the background chloride ion content (as determined from the unponded samples) are presented in Table 5 below.

TABLE 5

AVERAGE WATER SOLUBLE CHLORIDE ION CONTENT

Concrete Type	Layer Depth (mm)	% cl^- Contents by mass of Concrete	Comments
Normal with one coat of Radcon Formula #7	2 - 13 13 - 25 25 - 38	0.199 0.026 0.000	3% Sodium Chloride Solution Ponding
Air entrained with one coat of Radcon Formula #7	2 - 13 13 - 25 25 - 38	0.397 0.032 0.000	3% Sodium Chloride Solution Ponding
Normal with two coats of Radcon Formula #7	2 - 13 13 - 25 25 - 38	0.048 0.001 0.000	3% Sodium Chloride Solution Ponding
Air entrained with two coats of Radcon Formula #7	2 - 13 13 - 25 25 - 38	0.127 0.002 0.000	3% Sodium Chloride Solution Ponding
Normal (untreated)	2 - 13 13 - 25 23 - 38	0.459 0.048 0.003	3% Sodium Chloride Solution Ponding
Air entrained (untreated)	2 - 13 13 - 25 23 - 38	0.697 0.065 0.001	3% Sodium Chloride Solution Ponding

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UNIVERSITÀ DEGLI STUDI DI BOLOGNA (ITALY)
DIPARTIMENTO DI CHIMICA APPLICATA
E SCIENZA DEI MATERIALI

Codice Fiscale 80007010376
Partita IVA 01131710376

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Bologna, li .....23/12/95.....

To RADCON Italia
Via Fonte d'Abisso, 14
41100 Modena

CERTIFICATE N. 905

Rif.: Your request of 10.10.95

OGGETTO: Evaluation of the effects of the treatment of damaged and cracked concrete surfaces by a liquid product supplied from you.

SAMPLES

A sample of about 2 l of a transparent and clear liquid product, named RADCON FORMULA #7, has been supplied. A printed technical note describing the product and its application technique on damaged and cracked concrete surfaces has been supplied at the same time. The note states that the product gives waterproofing and hardening properties to the concrete surface treated with the named product even in the presence of cracks, with product penetration up to about 20 mm depth.

PROCEDURES

Concrete substrates preparation.

To the above mentioned purpose, some accelerated testing procedures have been designed and planned on the customer agreement to evaluate the effectiveness of the treatment of damaged and cracked concrete by the supplied product, applied on the concrete surfaces according to technical instructions delivered with the product. The following parameters were agreed to be tested:

- water permeability before and after the treatment
- Mohs hardness before and after the treatment
- product penetration after its application on the concrete surface.

Due to the long time required for the tests, priority was given to water permeability tests.

Concrete samples with variable water/cement ratio were prepared with components and amounts reported in table 1. The samples had the shape and sizes reported in Figure 1 according to prelimina-

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LABORATORI : V.le Risorgimento, 2 / Via Terracini, 34 - 40100 BOLOGNA - Tel. (051) 6443209 / 6387554
POSTA ELETTRONICA : dichiasm1@ingbo1.cineca.it

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ry investigation, which allow to obtain cracks of variable and controlled width on the median line of the samples.

Tabella 1

W/c ratio	0.4	0.5	0.6	0.7
Components, Kg:				
Portland cement 52.5 R	450	360	300	287
Water	180	180	180	200
Sand 0÷3 mm	981	1026	1049	1038
Gravel 3÷8 mm	700	733	767	733
Superplasticizer	12	10	8	/

Samples were prepared in laboratory according to UNI Standard 6128 in moulds cured at least 28 days according to UNI Standard 6127 before any treatment.

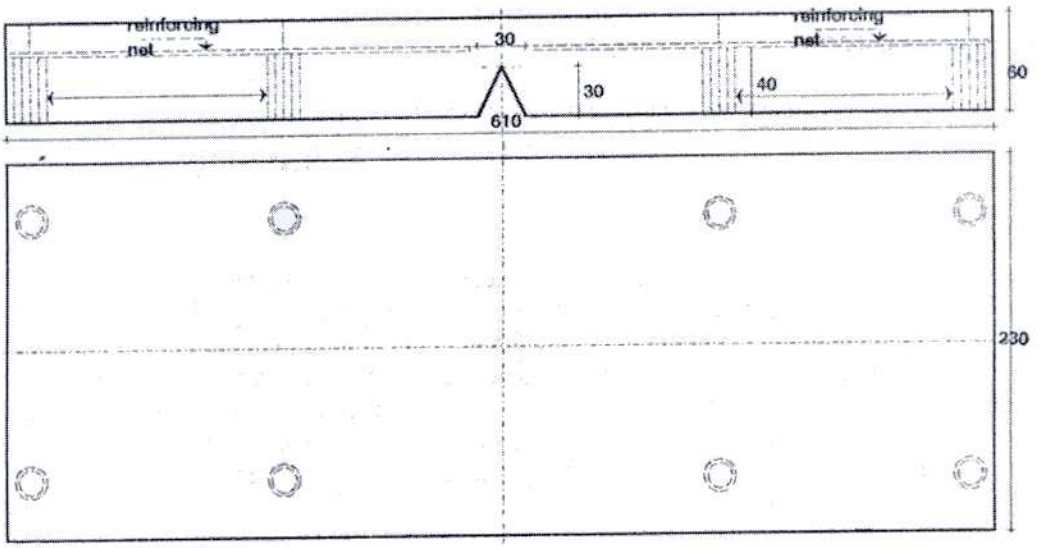

Figure 1

After curing the samples were coated on the upper surface by brushing with RADCON FORMULA #7 liquid product at the rate of 0.25 l/m^2, some of them on the whole surface (1403 cm^2) and other ones only on the half surface (701.5 cm^2).
After 6, 24, 48 hours since the treatment, surfaces have been plentifully soaked with water according to RADCON instructions. Tests on at least two treated samples started after 2 days since the last water soaking.
Water permeability of treated surface without cracks.
The test has been made by the so-called "pipette" method, which is as a rule used to determine the amount of water permeating building components exposed to wind and rain [1].
A cilindric plastic box with internal cross-section of 10 cm^2 is tightly fastened to the component surface by a silicone adhesi-

ve. After hardening of the adhesive, the box is filled with water by a small upper pipe connected to a graduated pipette. The liquid level in the pipette lowers as a function of time due to the water absortion of the component surface under the pressure of the small liquid column (Figure 2). The water volume absorbed by the surface is measured as a function of time.

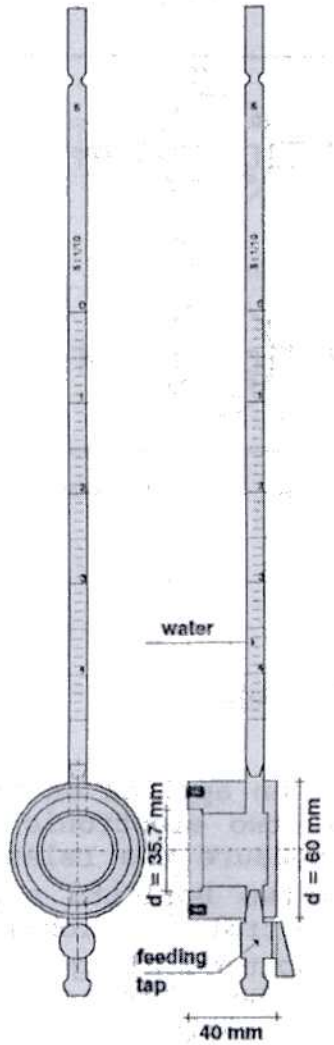

Figure 2

The test has been performed on the samples treated only on half upper surface applying pipettes on both treated and not-treated parts of the surface of samples put in vertical position.

Water permeability of treated surface with cracks.

A steel frame has been constructed and welded to a steel plate about 20 mm thick, which ensures stiffness to the system. The frame is composed of two parts, one securely fastened and the other sliding by rotation of a threaded bar MA-16 within the corresponding nut screw. Sliding may be controlled within 5 μm accuracy. A sample, previously treated on the upper surface by the RADCON FORMULA #7 liquid according to the instructions and

still free from evident cracks, is fastened to four bars of the frame by 8 bolt, 4 for fastened and 4 for sliding part.

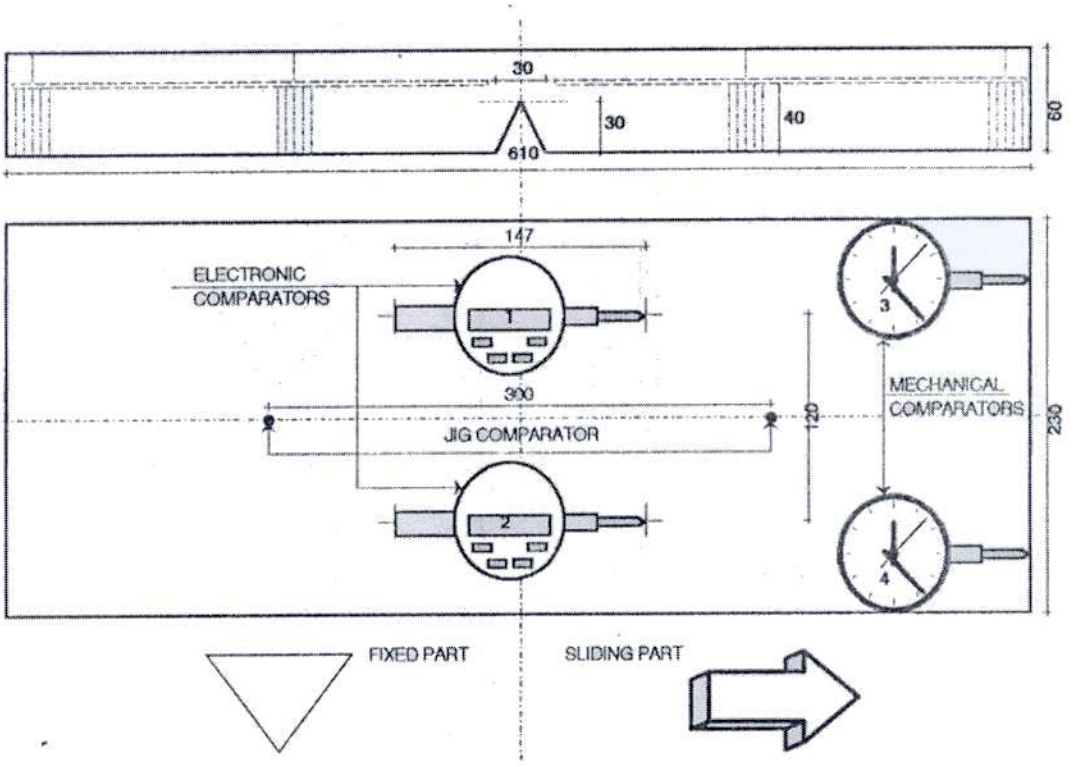

Figure 3

Measuring instruments are then applied on the surface according to the scheme of Figure 3: two electronic Mitutoyo comparators with 1 μm accuracy (1-2) measure the relative shifting between the two sample parts, and two Borletti mechanical comparators with 10 μm accuracy (3-4) control any global shifting.
The sample is initially fractured along the median line corresponding to the grooving on the bottom surface (see Figures 1 e 3) by direct tensile stress applied by rotation of the MA-16 threaded bar. The two parts are then tightly approached for zero-ing the measuring instruments. Since this moment the two parts of the sample are progressively separated by hand rotation of the MA-16 threaded bar, so that a crack is created of width increasing with time at an average rate of about 50 μm/d (about 8 h/d, with night stop of about 16 h). The crack is continuously kept covered by water contained within silicone relieves created all-around the crack. Progressive enlargement of the crack is also controlled by a jig comparator Rambold (RMU) with 1 μm accuracy, which allows also sample handling and last crack width restoration. The test consists in the observation of water percolation below the sample as a function of time.

RESULTS

The results up to now obtained concern samples with w/c = 0.6.

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DIPARTIMENTO DI CHIMICA APPLICATA E SCIENZA DEI MATERIALI

Water permeability of treated surface without cracks (average of two determinations): see Table 1.

Table 1

w/c=0,6	Not treated surface (◆)	Treated surface (■)
Time, s	Absorption, cc	Absorption, cc
0	0.00	0.00
200	0.45	0.18
400	0.58	0.20
600	0.78	0.25
1,200	0.91	0.35
1,800	1.14	0.44
2,700	1.36	0.60
3,600	1.62	0.69
5,400	2.02	0.83
7,200	2.34	0.98
9,000	2.68	1.05
10,800	2.84	1.19
12,000	3.03	1.26

The results are also plotted in the Figure 4.

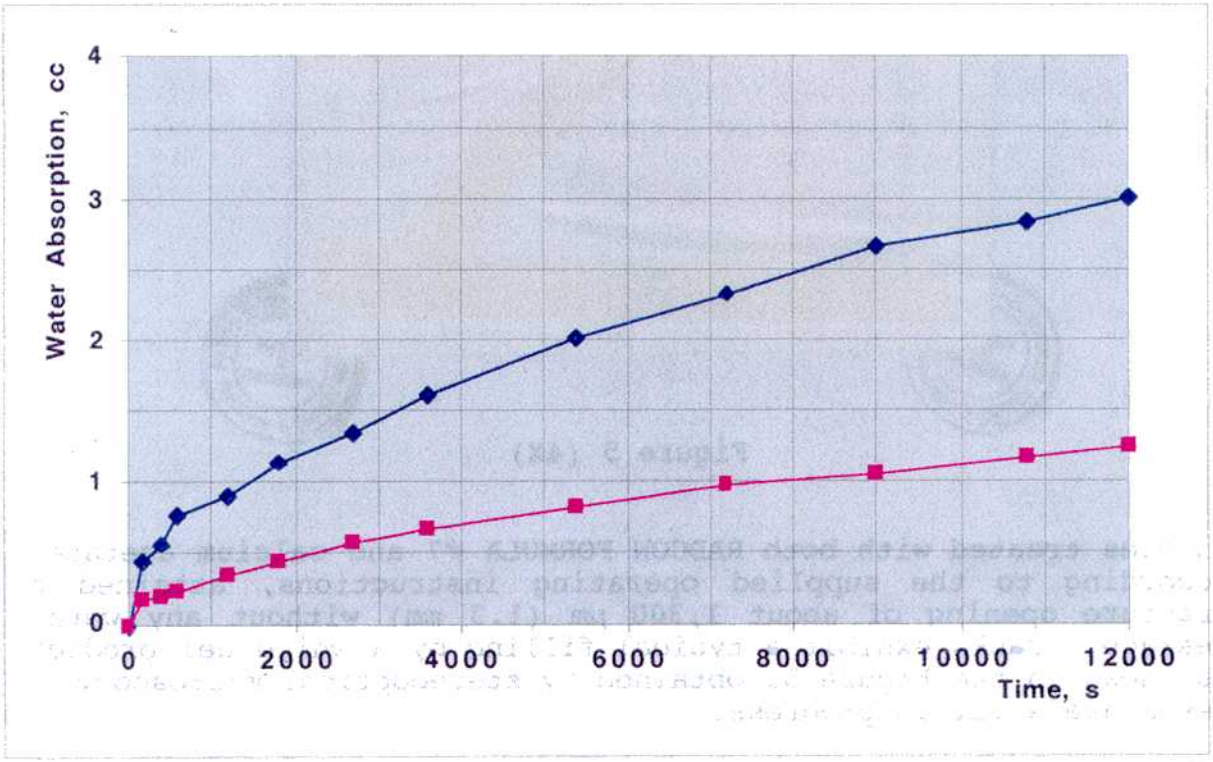

Figure 4

Water permeability of treated surface with cracks.
Not-treated samples exhibit continuous water percolations through the induced crack, which never stopped during all the time of the test (ab. 20 d), although the two parts of the samples were kept in strong, tight and continuous contact after the creation of the fracture.
The two fractured parts of treated samples (w/c = 0.6) were progressively moved away from each other by about 15÷20 μm steps, at an average rate of about 50 μm/d for the whole test duration (about 20 d). Samples exhibited only slight water infiltrations and percolations through the induced fracture, which always stopped ab. 1÷2 h after the induced fracture opening during the whole test time.
Samples treated only with RADCON FORMULA #7 attained a fracture opening of ab. 300 μm (0.3 mm) without any leakage.

Figure 5 (4X)

Samples treated with both RADCON FORMULA #7 and calcium acetate, according to the supplied operating instructions, attained a fracture opening of about 1,300 μm (1.3 mm) without any water leakage. Cracks exhibit a typical filling by a white gel product as shown in the Figure 5, obtained by stereooptical microscopy. Tests are still in progress.

COMMENTS
On the basis of the so far carried out tests, the supplied liquid product named RADCON FORMULA #7 considerably reduce the

DIPARTIMENTO DI CHIMICA APPLICATA E SCIENZA DEI MATERIALI

surface permeability of damaged concrete when treated by the cited product according to the manufacturer recommendations.

REFERENCES

[1] P. Tiano "Metodi obiettivi di valutazione". Cons. del Patrimonio Monumentale, 1991 De Lettera Editore, p. 17.

The Experimenter
Prof. ing. Franco Sandrolini

The Director
Prof. Piero Manaresi

5.2 Water Absorption

Eight of the 150 x 150 x 50 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. All of the eight samples were lightly sandblasted to remove the laitance and other residual materials. The samples were then oven dried at 110 ± 5°C to a constant mass, after removal of the samples from the oven they were cooled to a normal room temperature under laboratory conditions. Radcon Formula #7 was applied to all sides of each slab, under the supervision of Concretech Inc. with strict manufacturer's directions. The slabs were further cured for 14 days under normal laboratory conditions and then each slab was weighed and recorded. Then all the slabs were immersed in water, after 48 hours they were removed and surface dried by a water absorbant cloth, each slab was weighed and recorded. All the slabs weight were recorded to the nearest 0.1 g. Test results are presented in Table 3 below

TABLE 3

WATER ABSORPTION

Concrete Type	No. of Sealant Coats Applied	Average Water Absorption (%)
Normal	1 coat	2.42
Air Entrained	1 coat	2.33
Normal	2 coats	2.11
Air Entrained	2 coats	2.25
Control Sample (Normal)	-	4.07
Control Sample (Air Entrained	-	3.18

5.3 Moisture Vapour Permeability

Eight of the 150 x 150 x 50 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. All of the eight samples were lightly sandblasted to remove the laitance and other residual materials. The samples were then oven dried at 110 ± 5°C to a constant mass, after removal of the samples from the oven they were cooled to a normal room temperature under laboratory conditions. Then the samples were placed in distilled water for 48 hours,

Cont'd.....

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5.3 Moisture Vapour Permeability (Cont'd)

after removal from the distilled water, they were surface dried with an absorbant cloth. The mass of each slab was measured and recorded to the nearest 0.1 g. Radcon Formula #7 was applied to all sides of each slab, under the direct supervision of Concretech Inc., following strict manufacturer's directions. Upon drying of the sealant the mass of each slab was determined to the nearest 0.1 g and recorded. The treated slabs were stored for 14 days under laboratory conditions. Then they were placed in an oven at 110 ± 5°C until they reached a constant mass. Each slab was weighed and the mass was recorded. Tests results are presented in Table 4 below.

TABLE 4

MOISTURE VAPOUR PERMEABILITY

Concrete Type	No. of Sealant Coats Applied	Average Vapour Permeability (%)
Normal	1 coat	84.1
Air Entrained	1 coat	91.4
Normal	2 coats	81.2
Air Entrained	2 coats	83.1
Control Sample (Normal)	-	98.0
Control Sample (Air Entrained)	-	96.0

5.4 Chloride Ion Penetration

Eight of the 300 x 300 x 75 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. Four of the slabs were of normal concrete and the other four samples were concrete slabs with entrained air. Two slabs of normal concrete were treated with one and two coats of Radcon Formula #7, and two slabs of air entrained concrete were also treated in the same fashion. Two of the samples, one of each type were used as control and the last two samples were used to determine background chloride ion content of each type of concrete.

Cont'd.....

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4.2 Test Specimen

Two different sizes of slabs as test specimens were cast. Fifteen small slabs (150 x 150 x 50 mm) and nine larger slabs (300 x 300 x 75 mm) were cast from each mix. Samples cast were compacted by rodding in accordance with ASTM C192-81. All the samples were moist cured for 14 days followed by 14 days laboratory curing.

4.3 Application of the Sealant

Radcon Formula #7 was applied by brushing it on to the concrete surface under strict supervision of Concretech Inc. (manufacturer).

5.0 TEST RESULTS

5.1 Depth of Penetration

Four of the 150 x 150 x 50 mm slabs after being moist cured for 14 days, were surface dried under normal laboratory conditions. Samples were lightly sandblasted to remove the surface laitance and other residual materials. Radcon Formula #7 was applied onto the surface of the samples under the supervision of Concretech Inc. The surface treated slabs were allowed to cure for 14 days at normal laboratory air conditions before they were cut into four 75 x 75 x 50 mm blocks. The blocks were then immersed in water for approximately one minute to delineate the depth of penetration to the nearest 0.1 mm on each saw cut side of each block. Four readings were taken from each cut block, therefore a total of 16 measurements were made for each slab sample and their average was recorded as the depth of penetration. The test results are presented in Table 2 below.

TABLE 2

DEPTH OF PENETRATION

Concrete Type	No. of Sealant Coats Applied	Average Depth of Penetration (mm)
Normal	1 coat	15.80
Air Entrained	1 coat	15.50
Normal	2 coats	16.10
Air Entrained	2 coats	15.60

Cont'd.....

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REPORT BIN 151

INVESTIGATION OF CONCRETE CORES
(Hong Kong Highways Department)
FOR RADCRETE PACIFIC

Report

by

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IN CONFIDENCE TO

RADCRETE PACIFIC PTY LTD

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Improving the Built Environment

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Investigation of Concrete Cores (Hong Kong Highways Department) for Radcrete Pacific

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Executive Summary

This report present the findings obtained from an investigation of concrete cores as supplied by Radcrete Pacific Pty Ltd. The objectives of this investigation were a) determination of the penetration depth of Radcon Formula #7 in the cores; b) determination of water penetration characteristics of Radcon Formula #7 treated cores; c) determination of chloride profiles in the cores; and d) detection of evidence of alkali-aggregate reaction (AAR).

Three sets of three samples were provided for this investigation. Scanning Electron Microscopy (SEM) and Optical Microscopy (OM) were used in for determining depth of penetration of Radcon Formula #7 and AAR evidence. Water penetration characteristics were determined using water sorptivity test. Chloride profiles were determined by analysis of drilled powder obtained at different depths.

The important findings are:

1. The depth of Radcon Formula #7 is in the range of 14 – 17 mm;
2. Water soluble chloride level in the cores at depth of 25 mm is about 0.05% by weight of dry concrete or less;
3. The 24 hour water penetration into treated cores is about 5 mm or less. This is equal to or better than most 60 MPa untreated concrete cut surface;
4. No evidence of alkali-aggregate reaction found in the supplied cores.

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4. General discussion and conclusions

The results obtained in this investigation denote that the Radcon Formula #7 treatment is an effective method of improving concrete surface in situ. The most striking result is the very low water sorptivity characteristic of the treated concrete core samples. The treated cores show water sorptivity characteristics similar to or better than those shown by 60 MPa grade concretes. This can be translated to better resistance to the ingress of chloride ions.

There were some chloride contamination found in these cores. This would mostly be the "left-over" chloride contamination prior to application of Radcon Formula #7. With the relatively shallow existing chloride profile and particularly with low water penetration characteristics, further chloride contamination is expected to be very slow.

The depth of penetration of Radcon Formula #7 is about 14 –17 mm. In these regions, calcium silicates with varying calcium content forms resulting in dense microstructures of pastes and paste/aggregate interface. No evidence of alkali-aggregate reaction was observed in these cores.