8.1 PRODUCT DISCUSSION

Professor Harold Roper

On October 16, 1987 a product discussion was conducted with Professor Harold Roper, Associate Professor in Civil Engineering at Sydney University.

Interviewer: Professor Roper, when was the first time you became acquainted with **Radcon Formula** #7?

Harold Roper: It was approximately two years ago when I was approached to conduct a test of the crack sealing potential of **Radcon Formula** #7. The purpose was to add to the data already available from several test programs at overseas universities.

Interviewer: What was it about **Radcon Formula** #7 that interested you in particular?

Harold Roper: The purpose of using the product is to seal cracks and to reduce water and other undesirable elements penetrating the concrete thus causing serviceability and durability problems.

It achieves this by precipitating the same types of compounds, within the pores or cracks, as are produced by the hydration reactions of the Portland cement in the concrete viz:calcium silicate hydrates .

Interviewer: Are there other materials which can be used for pore blocking?

Harold Roper: Yes - several have been tried, for example monomers such a methyl methacrylates. They have the disadvantage of low penetration and difficulties in polymerisation.

Interviewer: Does **Radcon Formula** #7 suffer from the same problem?

Harold Roper: No - because it has a low viscosity it penetrates readily, up to 20 mm, and the polymerisation of the silicate hydrate compound is triggered by the presence of the calcium ions already present in solution within the concrete.

Interviewer: Surely coatings such as acrylics and membranes achieve the blockage of water and other undesirable elements permeating the concrete?

Harold Roper: Yes - but only if their sealing capacity is perfect. If any holes or holidays are present or develop in the coating, their efficiency in keeping out water vapour is considerably reduced. Furthermore there are problems of long term reapplications which may not be necessary if the pores are blocked by a single treatment of a penetrating sealant. Another point for consideration is that coatings tend to be rather more expensive than penetrating sealants to apply.

Interviewer: A lot of sealants have a relatively short life span. In your opinion what would be the life of a **Radcon Formula** #7 treatment?

Harold Roper: Once the pores are effectively blocked, the compounds become part of the structure of the concrete and, therefore, they should have the same life as the concrete itself.

Interviewer: Do you see any difference in the effectiveness of **Radcon Formula** #7 in the treatment of new and old concrete?

Harold Roper: Yes - the effect of pore blocking will occur closer to the surface in new concrete because of the greater availability of calcium ions. In older concrete, pore blocking will still occur providing that some available calcium ions are present.

Interviewer: Do all concretes have the capacity to trigger the polymerisation of the silicate hydrates?

Harold Roper: Yes - unless they are completely carbonated; you see even if they contained admixtures or additives, such as fly ash, enough calcium hydroxide should be available for polymerisation. The use of admixtures and additives have allowed, in the past, very low cement content concretes to be used.

Interviewer: What was the result of using such lean concrete mixtures?

Harold Roper: Many building facades in Australian cities have concretes which are rather porous and hence vulnerable with respect to the durability problems. The strengths of these concretes passed code requirements. In certain members, cracking has nevertheless resulted.

Interviewer: Has **Radcon Formula** #7 a role to play in such cracked concrete?

Harold Roper: Yes - it has the capacity to block leaking cracks provided that they are not active.

Interviewer: What is the mechanism of such crack sealing?

Harold Roper: In leaking cracks, water movement may leach calcium hydroxides from the cement hydrates, thus widening the crack. The formulation, on entering the crack, polymerises within the crack and thus reduces any water movement. Retreatment now may fully seal the crack or slow the water movement to such an extent that autogenous healing will occur.

Interviewer: If **Radcon Formula** #7 is used in a new structure will it serve to reduce micro-cracking in the first place?

Harold Roper: Yes - but one may find that under such circumstances the depth of penetration may be reduced if the polymerisation takes place just within the surface layer.

Interviewer: Does the presence of such a silicate layer have any adverse effects on subsequentcoverings such as floor tiles or paint?

Harold Roper: There should be no bond decrease provided any excess of calcium silicate is removed, and the concrete dried, prior to the application of other materials.

Interviewer: Will **Radcon Formula** #7 assist in situations where the concrete surface is subject to acid attack?

Harold Roper: The rate of attack may be somewhat reduced. It should be noted that no Portland cement concrete is immune from acid attack. If the acids are weak organic acids then this rate may be sufficiently low to permit concrete use.

Interviewer: As **Radcon Formula** #7 is basically alkaline, what will be the effect if used where an alkali-aggregate reaction is taking place?

Harold Roper: It should not be used in this situation as it will more than likely exacerbate the problem. This would apply to any substance with an alkali metal base.

Interviewer: Can **Radcon Formula** #7 be used in non-cementitious materials such as bricks and products which have a very low cement content?

Harold Roper: Yes - but under these circumstances calcium ions must be made available to trigger the polymerisation of the silicate hydrates.

Interviewer: What do you see as **Radcon Formula** #7's biggest drawback?

Harold Roper: Its possible misuse. Because of its simplicity of application by persons who have not appreciated the problems presented by the structure, e.g. it will not permanently seal working cracks, nor is it a solution to a structural problem.

Since it has such a wide spectrum of use, there is always a possibility that some people will try to use it in circumstances beyond its capability to perform.

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Mr Adam C Everett
Director, Operations
Radcrete Pacific Pty Ltd

Dear Mr Everett

Further to our recent discussions in relation to the impregnating sealer Radcon #7, the procedures and analysis used by the RTA to assess new products for improving the long term durability of concrete have been reviewed. The results and analysis of tests on Radcon #7 carried out by other recognised agencies and additional literature provided by Radcrete have also been reviewed.

According to this independent Australian and overseas data provided to RTA by you, Radcon #7 is effective in reducing the water and chloride permeability of 25-40 MPa concretes, creating a continuous, effective barrier against the ingress of water and chloride ions , provided that sufficient free calcium is available for reaction, and provided that large cracks and construction joints are sealed by ancillary products as prescribed in the Radcrete Waterproofing System Datasheet.

In one of the test programs carried out on behalf of the RTA several years ago, the results from an accelerated test led to certain conclusions about Radcon #7's effectiveness in preventing chloride ion attack on embedded steel reinforcement within the concrete. It is now agreed that the test in question was not appropriate to determine the performance of Radcon #7 under actual in-service conditions.

As discussed, the improvement of concrete resistance to water and chloride ion penetration, as part of the RTA's overall strategy to improve concrete durability, is based on the use of blended cements to:

(i) improve the resistance of concretes to chloride ion and sulphate attack;
(ii) improve the resistance of concretes to alkali aggregate reaction;
(iii) improve environmental energy reduction performance by utilising industrial by-products;

Whilst the RTA recognises that Radcon #7 does provide a protective sub-surface barrier for concrete bridge decks against the ingress of water and chloride salts provided it is used in accordance with the manufacturer's instructions, for bridge decks under the RTA blended cements strategy, a prescribed polymer modified bitumen is used to seal large cracks and construction joints.

By following this approach to durability improvement, Radcon #7 or other impregnating sealers are not prescribed.

I trust that this clarification of the RTA's position with regard to the use of Radcon #7 and the Radcrete Waterproofing System will resolve the concerns raised

I wish your company every success in its future endeavours.

Yours sincerely

R J L Wedgwood
General Manager
Technical Services
RTA

ORIGINAL

13 June 2000

Jernbaneverket
Hovedkontoret

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Date: 11.05.2001
Our ref.:
Your ref.:
Enclosure: 1

Dear Mr. Adam C Everett,

Thank you for your letter of 11 April 2001. Enclosed please find my confirmation statement that we are satisfied with Radcon Formula #7.

Sincerely yours

Ivar Ness

Ivar Ness
chief engineer bridges

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Date: 11.05.2001
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TO WHOM IT MAY CONCERN

USE OF RADCON FORMULA #7 BY JBV

Since 1993 the Norwegian National Rail Administration (JBV) has been using Radcon Formula #7 as protection against water penetration into concrete decks of some 40 railway bridges. The largest bridge deck on which Radcon has been applied is about 5000 m^2.

Our experience so far is that Radcon Formula #7 gives a sufficient protection against moisture. The concrete we are using is of good quality, e.g. cube crushing strength of 45 MPa or higher, and it is in it self waterproof. However, cracks can never be avoided, not even when adequate measures are taken during the curing period. By applying Radcon Formula # 7 over the whole deck surface, we have experienced that the cracks get tightened and thus prevent moisture to find it´s way to the reinforcement.

It should be mentioned that we design our bridges for an expected life time of 100 years. The bridge decks are not directly exposed to rain and snow as they are covered with a layer of 0.55 m ballast. The decks have a downward gradient of not less than 1.4 % towards drains, thus preventing any great accumolation of water.

Ivar Ness
chief engineer bridges