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Expert report
on the corrosion risk for the reinforcement in contact with Dryflex I and Dryflex II in the area of concrete cracks

B 5640-1

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This expert report includes 7 pages.

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1. CONTRACT

On February 14th 2012 Drytech S.A. placed an order with Consulting Engineers Raupach Bruns Wolff GmbH & Co.KG (in the following: RBW) via Email to write an expert report regarding the corrosion risk of the reinforcement in concrete cracks which had been injected with the acrylic gels Dryflex I and Dryflex II.

Basis for the expert report is a material testing carried out at the Institute of Building Materials Research (ibac) at RWTH Aachen University. The test procedure and the test results are described in the Test Report M 1281/3 /1/.

2. MATERIAL TESTING

When cracks in reinforced concrete are injected by use of acrylic gels, the gel gets in direct contact to the steel surface of the reinforcement which is crossing the cracks. To be sure that in such cases significant macro cell corrosion of the reinforcement does not occur, it has to be ascertained that the use of the gel does lead to unacceptable corrosion enhancing effects at the steel surface in the cracked area.

In order to examine if the acrylic gels Dryflex I and Dryflex II can be used as injection material for cracked concrete structures without the risk of inducing unacceptable reinforcement corrosion in the area of the cracks the tests described in the test report M 1281/3 /1/ were carried out at ibac.

For the tests a test procedure was used, which was developed during the research project F 947 “Anwendungsbedingungen für den Einsatz von Acrylatgelen in Arbeitsfugen und in Rissen von Stahlbetonbauteilen” at ibac. The test setup is schematically shown in figure 1. For the test a steel bar is embedded in a borehole within a concrete cube. The space between the borehole wall and the steel surface is injected by the acrylic gel that is to be tested. During the test the steel is polarised to a potential of +500 mV versus the initial free corrosion potential of the steel by use of a potentiostat and a counter electrode. During the test the resulting element current is measured.

This test simulates the corrosion situation in cracks, where the steel surface in the crack is in contact to a thin layer of the acrylic gel and can be anodically polarised by the surrounding reinforcement which acts as cathode of the corrosion element.

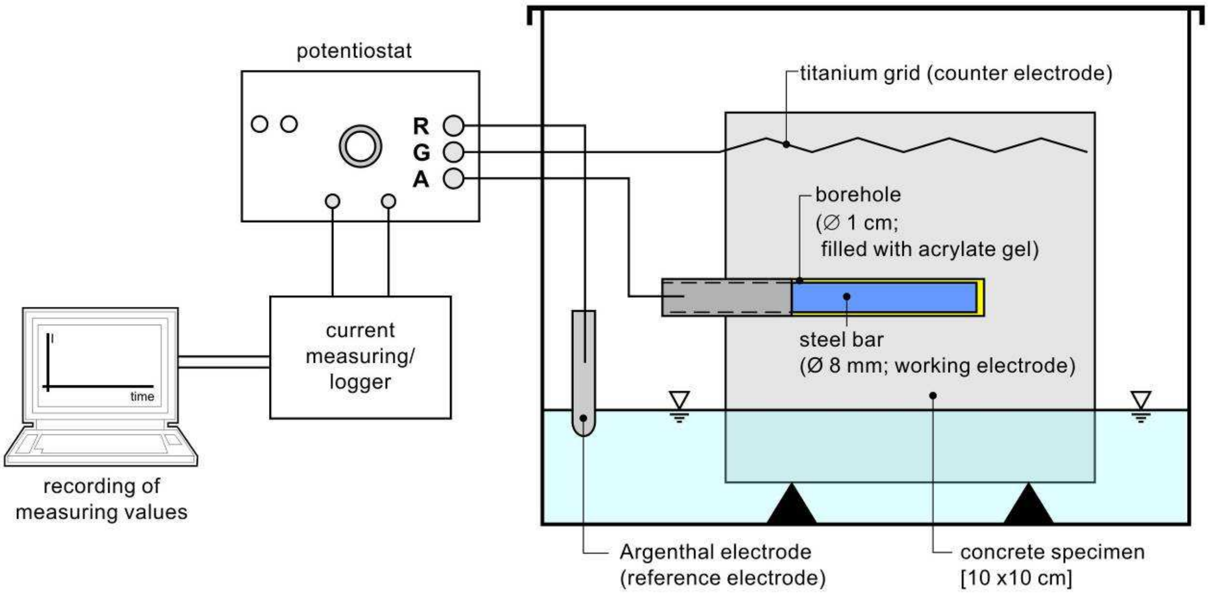

Figure 1: Schematic test set-up of the tests described in M 1281/3 /1/

According to the report M 1281/3 /1/ for both acrylic gels (Dryflex I and Dryflex II) two identical specimens were tested as described. As result of the tests the measured element currents are given in Figure 2 and 3, as mean surface current densities related to the Steel surface.

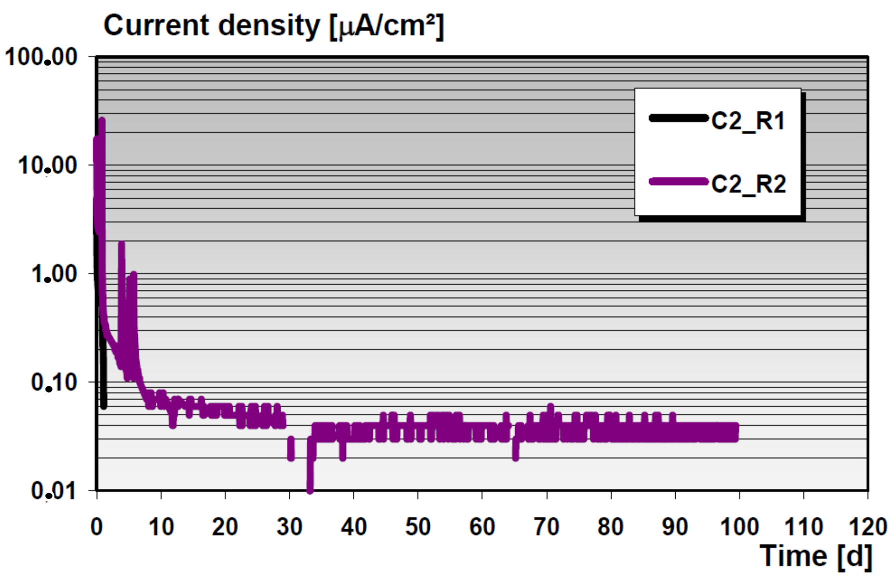

Figure 2: Measured mean element current density of the specimens prepared with Dryflex I (taken from M 1281/3 /1/)

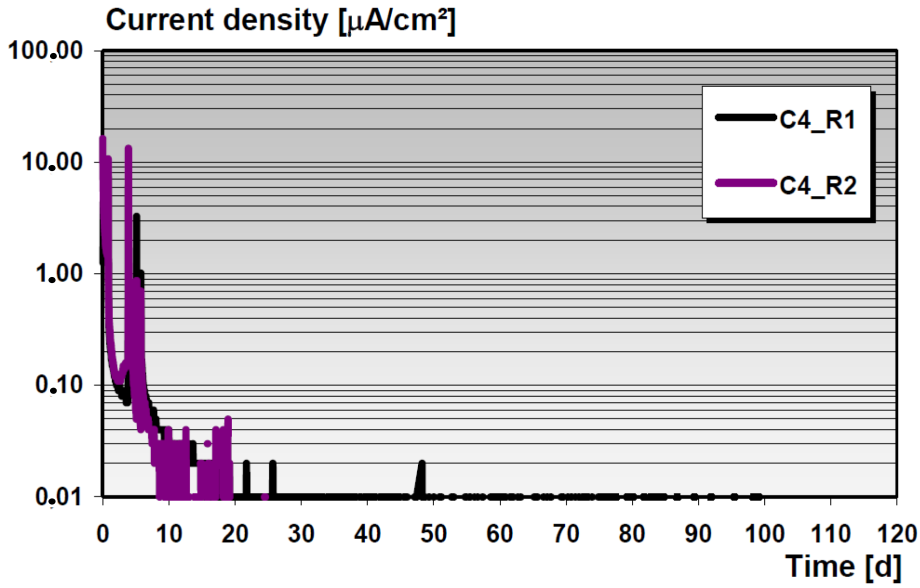

Figure 3: Measured mean element current density of the specimens prepared with Dryflex II (taken from M 1281/3 /1/)

3. INTERPRETATION OF THE TEST RESULTS

In the first days of testing in case of both gels active corrosion of the steel occurs with relevant corrosion rates. But after this short period of active corrosion the element current densities rapidly decrease to maximum values of about 0.05 µA/cm^2 (Dryflex I). According to Faraday´s Law this equals to a negligible uniform corrosion loss of about 0.55 µm/a. For both gels in one of the two tests even a change of the direction of the element current to cathodic currents at the steel surface was observed after the initial corrosion period. This is only possible if the free corrosion potential of the steel raised by more than 500 mV in positive direction during the test which could be an indicator for passivation of the steel surface. One explanation for this behaviour is an increase of the alkalinity of the gel e.g. due to diffusion of hydroxide or alkaline ions from the surrounding concrete into the thin gel layer.

4. CONCLUSIONS

From the results of the test report M 1281/3 /1/ the following conclusions can be drawn on the corrosiveness of the acrylic gels Dryflex I and Dryflex II:

If the acrylic gels Dryflex I or Dryflex II are used for the injection in the area of cracked concrete no relevant corrosion damage has to be expected if:

- the crack width at the reinforcement surface is smaller than 1 mm.
- the concrete in the crack at the depth of the reinforcement is not carbonated
- the concrete, especially in the crack or near the crack is not contaminated by chlorides (e.g. from seawater or de-icing salts)
- the cracks and the gel system are not exposed to any chloride source (e.g. from seawater or de-icing salts).

The tests carried out in M 1281/3 /1/ only simulate the situation in static cracks without any crack movement. Also the influence of frequent wetting and drying of the cracks was not evaluated. Therefore an assessment of the corrosion risk for these conditions (moving cracks and wet/dry changes) is not possible on basis of the test results.

For static cracks without significant changes in crack width and without frequent wet/dry changes relevant corrosion of the reinforcement in the area of cracks has not to be expected under compliance with the requirements given above when the acrylic gels Dryflex I or Dryflex II are used.

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LITERATURE

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/2/ Raupach, M. ; Harnisch, J. ; Wolff, L.: Anwendungsbedingungen für den Einsatz von Acrylatgelen in Arbeitsfugen und in Rissen von Stahlbetonbauteilen. Aachen : Institut für Bauforschung der RWTH Aachen, 2007. - Forschungsbericht Nr. F 947