

CorroWatch- Embedded Corrosion Sensor



Figure 1 – Photo of CorroWatch Probe Installed

Introduction

The CorroWatch acts as an early warning system to predict the initial stages of corrosion in concrete structures. It is cast into the cover concrete, normally in newly cast concrete structures. The sensor can measure most of the relevant corrosion parameters.

The CorroWatch is a multi-sensor, which in the standard version consists of four black steel anodes and one noble metal cathode. The anodes are placed in varying, but defined distances from the exposed concrete surface. The height of the anodes is flexible and can be adjusted according to the concrete cover thickness.

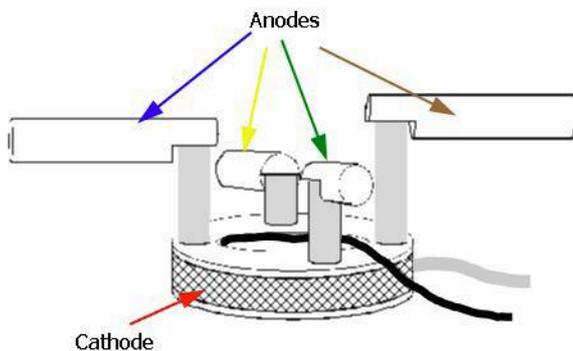


Figure 2 – CorroWatch Probe with 4 anodes shown

The CorroWatch sensor is acting as a macrocell measuring the corrosion activity between the corroding (anodic) and not corroding (cathodic) on the metal surface.

By measuring the corrosion current and also electrochemical potential in different depths in the concrete cover it is possible to predict when the corrosion should reach the reinforcement and thus prepare the necessary maintenance measures in time before the damage occurs.

Attack of aggressive ions to first anode

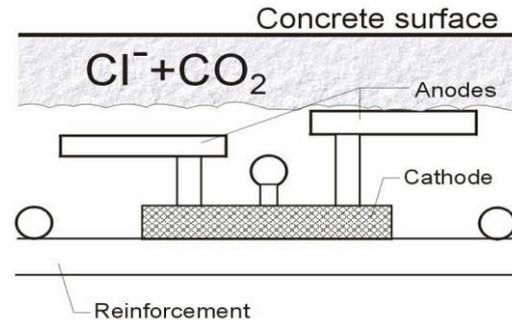


Figure 3 – Chlorides and Carbonation approaching the Anodes

To predict when the reinforcement corrosion will start corroding different measurements techniques could be chosen. First and foremost it could be done by means of electrochemical potential measurements against a stable reference electrode. The current is measured, either with a volt-meter or a specially designed data logger. When corrosion starts, the current will increase significantly.

Another option is to measure the corrosion current, between the single anodes and the cathode. This is also open for use of different measurements techniques. One of them is to measure the macro-cell current through a shunt. Another option is to use zero resistance Ammeter.

The CorroWatch sensors allow use of both options for measurements of corrosion current. However the use of zero resistance Ammeter technique is to be preferred. In the beginning before corrosion occurs on the anode the measured corrosion current is very small. When the passive layer is broken and corrosion is initiated the measured corrosion current increase rapidly.

Structure

The CorroWatch multi-probe is composed of: 4 anodes, 1 cathode, 1 reinforcement connection and an internal temperature sensor. The 4 anodes are placed in a joint ring in varying but well known distance to the ring's bottom. The cathode is placed in the ring's periphery.

To obtain optimum evaluation possibilities, we recommend the CorroWatch probe to be mounted in combination with an ERE-20 reference-electrode.

The cables from the CorroWatch probe and the ERE-20 reference-electrode are joined and conducted to the concrete surface. To protect against casting damage, it might be advantageous to conduct the cables in conduits.

Areas of use

- Areas difficult to access, e.g. tunnels.
- Bridges in marine environments.
- Splash zones, e.g. pillars in sea water.
- Desalination Plants and Sea Ports

Position

It is recommended to install the CorroWatch probe in the concrete cover between the concrete surface and the outer reinforcement layer. To ensure correct function it is extremely important that great care is taken when mounting the CorroWatch probe. It is important that the position of the probe does not change during casting. This is ensured in the best way by e.g. mounting the probe on at least two reinforcement bars.

Example

The adjacent picture shows a CorroWatch multi-sensor which has been installed for monitoring of time to corrosion initiation in the immersed elements of Øresund tunnel connecting Denmark and Sweden.

In each of the chosen tunnel elements 21 CorroWatch were installed together with 27 ERE 20 reference electrodes. In total 189 CorroWatch were installed in 9 tunnel elements. The CorroWatch were installed in such a way that the concrete cover on the highest electrode (anode) is approximately 25 mm from the concrete surface.

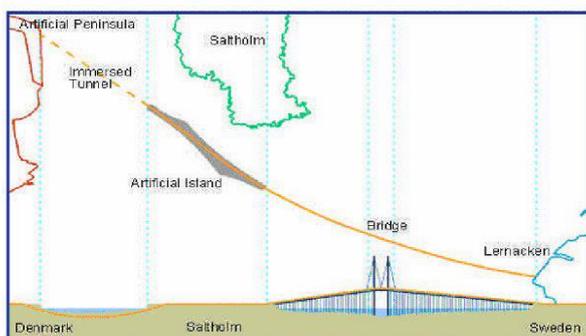


Figure 4 - Image showing the Location of the Øresund Tunnel

In figure 5 an example from a laboratory test is shown indicating when the corrosion initiates at each of the 4 anodes.

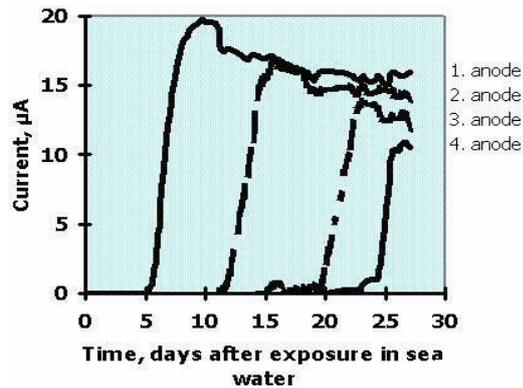


Figure 5 – Data from 4 anodes over 30days exposure

Specifications

The standard CorroWatch probe is supplied with specifications as follows:

Body	Diameter	Ø75 mm
	Height	48 mm
	Width	160 mm
Anodes	Length	60 mm
	Diameter	Ø12 mm
Overall	Weight	0.5 kg
Cable	Type	Screened 8-conductor
	Length	5 m (extendable)
Anode Heights	Anode 1	48 mm high
	Anode 2	43 mm high
	Anode 3	38 mm high
	Anode 4	33 mm high

About PCTE

PCTE have over 30years experience in the measurement and testing of concrete. With experience in research, consulting and construction they are able to assist you in reviewing the issues and developing solutions. PCTE can provide more than just the equipment. They can provide leading technical support for your business.

Other Equipment

The full Proceq range of equipment is available for insitu non destructive concrete measurement, including Schmidt Hammers, Covermeters, Half Potentials, Resistivity, Ultrasonics and Permeability. The Olson Instrument range also includes the CTG, Freedom Data PC and DAS as well as the resonance tester. We also supply Intelli-Rock maturity, temp and humidity logging systems, corrosion rate monitoring equipment.