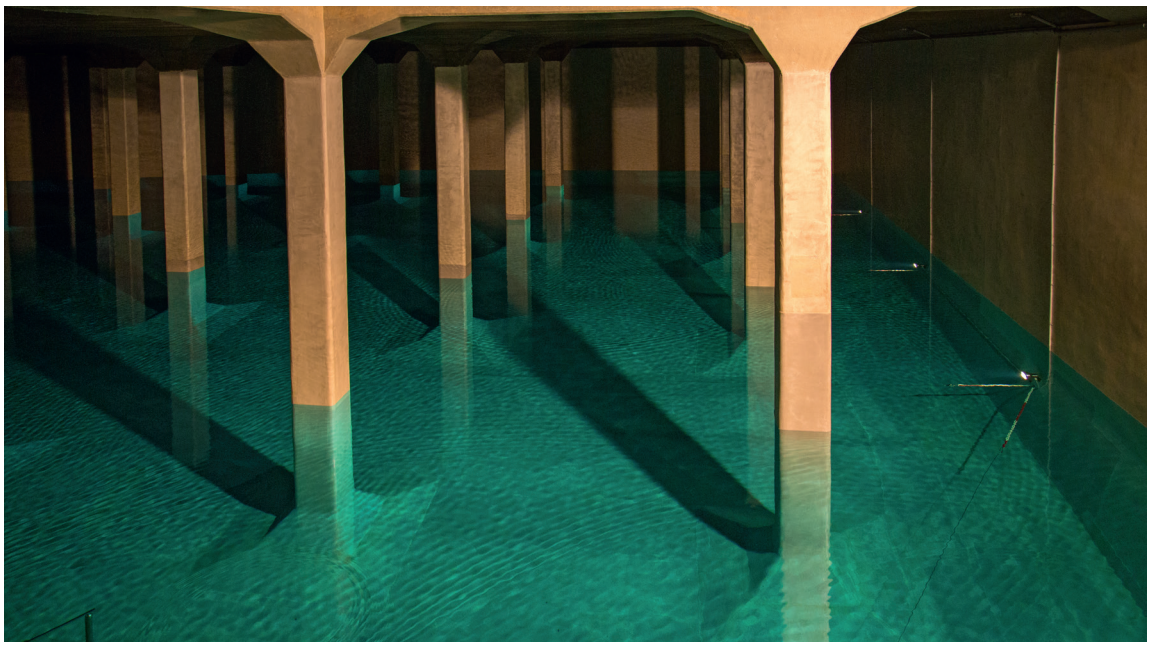

A filled reservoir with integrated cathodic protection system

Drinking water reservoirs with cathodic protection system

Reservoirs are important infrastructural facilities that supply drinking water to the public. The majority are made of concrete as this material is exceptionally well suited to receiving and storing drinking water and has no negative effect on its taste or composition.

These concrete tanks usually have a lifespan of 50 –100 years. This is necessary to make sure that the cost of drinking water is not too heavily inflated by spending on infrastructure. However, experience shows that brown patches can occur on the clean surfaces of white-cement tank linings after only a few years of use. These are caused by so-called ion currents. Cathodic protection systems offer a cost-efficient and sustainable way of dealing with this problem.

Damage to concrete in drinking water reservoirs

A survey conducted in 1996 by the Swiss Association of Water Treatment Engineers showed that around 45 % of drinking water reservoirs in Switzerland have soft patches in their cement-mortar linings. A range of reasons for this have been debated in the past. In addition to microbiological influences, experts have also discussed hydrolysis and differences in water pressure. Yet none of the reasons mentioned can explain the intensity of the attack and its unique appearance. The most plausible process to explain the attacks on coatings (mortar and concrete) is ion currents. These occur when local anodes (e.g. corroding metal surfaces, galvanised earthing strips) and cathodes (e.g. chromium-nickel steel wirings, reinforcements in back-ventilated reservoir walls) develop, causing a current to flow similar that of a battery. This ion current passes out of the cement mortar or concrete so that calcium ions enter the water and bicarbonate ions the mortar surface. This results in a soft mortar surface and a corroding anode beneath, both of which slowly disintegrate.

Faraday's law enables us to calculate the relationship between current density and the resulting calcium output. According to Faraday's law, current densities from 1 to 2 mA/m² correspond to an erosion of 8 to 16 µm/a of calcium carbonate. A corresponding amount of cement stone also disappears along with it. If erosion does

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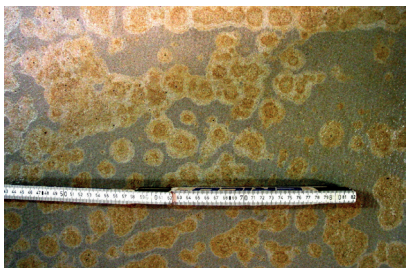
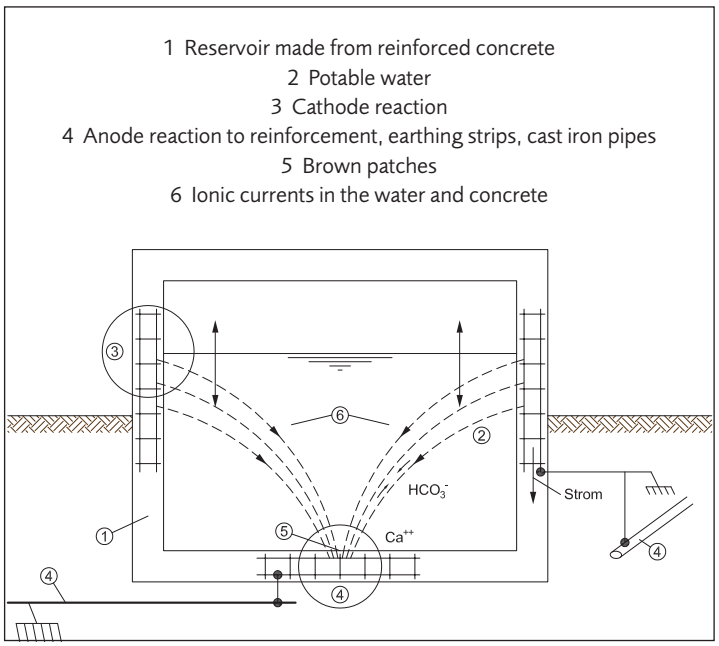


Brown patches

Horizontal anode following installation



How ionic currents cause damage in reservoirs

not occur uniformly, for example, only ⅟₂₀ of the surface is attacked, the result will be correspondingly deeper incursions of 0.15 to 0.3 mm per year. Strong attacks such as these are often encountered in practice.

Alternative overhaul

The principle of cathodic protection systems relies on preventing the anodic partial reaction, in other words iron disintegration, by using a direct current moving in the opposite direction. This is achieved by installing a permanent anode in the water chamber. A point on the reinforcement is exposed and is connected to the negative pole of the rectifier that is serving as a source, while the anode is connected to the positive pole. Once the source is activated, the flow of electrons causes cathodic polarisation of the reinforcement. This prevents anodic disintegration of the metal. The reinforcement is also re-rendered passive through the cathodic partial reaction and the associated increase in pH value.

Experience

Our team has over 40 years of combined first-hand experience. So whatever the application, we can draw on an enormous amount of expertise.

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