GALVANIC CATHODIC PROTECTION OF STEEL IN CONCRETE

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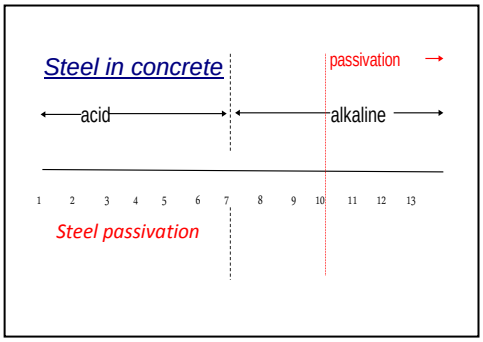
Corrosion is recognized as one of the major contributors to the deterioration of reinforced and pre-stressed concrete structures worldwide. The amount of reinforced concrete structures world-wide is growing rapidly and therefore so is the increasing necessity of easily applied low-cost maintenance programs.

Over the last 30 years, cathodic protection (CP) has been shown to be a highly effective technique in preventing concrete deterioration from chloride induced and carbonated concrete corrosion.

The presence of chloride based salts within the concrete can be a threat to the passivation layer (protective oxide-layer) on the carbon steel reinforcement of the concrete. Also variations in the concrete cover on top of the reinforcement, the quality of the concrete cover and the content of the chlorides around the reinforcement will cause similar corrosive circumstances. These circumstances will cause local corrosion cells. These locations are anodic. Other locations of the reinforcement, where the circumstances are relatively less corrosive and aggressive, remain passivated (passive oxide-layer). These locations are cathodic.

The combination of anodic and cathodic locations result in electrochemical reactions (redox-reactions) if the distance between the anode and cathode is relatively small. These electrochemical reactions will convert the steel of the reinforcement into iron-oxides (rust) at the anodic locations. The corrosion products formed, can be 5 to 10 times the volume of the original steel reinforcement and this will lead to pressure within the concrete which will eventually lead to cracking and spalling of the concrete cover. The loss of steel and concrete will eventually weaken the structure and be a threat to safety.



European standard ISO 12696:"*Cathodic Protection of steel in concrete*" details the principles of CP and its application to steel in concrete. The purpose of cathodic protection of steel reinforced concrete is to suppress the corrosion process of steel in concrete by use of an applied current.

CP of steel reinforced concrete structures can be achieved by polarising the steel reinforcement with an external direct current (DC). For this purpose anodes are either surface mounted, painted on to or embedded in the concrete and connected to the positive pole of a DC power supply in the case of impressed current (ICCP), or directly connected to the steel reinforcement in the case of galvanic anodes.

For galvanic cathodic protection (GACP) the anode (typically zinc) provides the external current for CP. The liquids within the concrete pores (pore solution) function as an electrolyte and will permit ions to flow within the electric field created by the CP system. Sufficient corrosion protection is given if specific criteria for protection are met at representative points within the structure.

GACP systems, using galvanic anodes, have recognised advantages of simplicity and reliability, and have recently become available as a viable alternative to ICCP. Unlike ICCP, GACP systems require no extensive wiring or conduit, and no power supplies. Their inherent simplicity greatly reduces the need for ongoing monitoring and maintenance.

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