Cathodic Protection or Cathodic Prevention: Can we Optimize Efficiency and/or Reduce Side Effects?

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Cathodic Protection (CP) and Cathodic Prevention (CPre) are electrochemical techniques, applied to reinforced concrete structures with the aim to stop, minimize or prevent corrosion of the embedded reinforcing steel. The former (CP) has a widespread use since the 70's and is the only technique able to solve corrosion problems in highly aggressive, chloride-containing environment. The latter (CPre) has a restricted application so far, its main purpose being to prevent corrosion initiation in or (depending on chloride content) to minimize it in way, such that localized corrosion can initiate but does not propagate.

As far as the assessment of the effective performance of CP is concerned, electrochemical methods and generally applied monitoring techniques (e.g. potential mapping, decay measurements) provide sufficient information. However, CP is known to be accompanied by side effects (e.g. alkali-silica reaction, bond strength degradation) and more recently confirmed, is the influence of electrical current flow (as within CP) on the bulk matrix properties. Therefore, concrete material science should play a role in the assessment and efficiency evaluation of CP. To this end, finding alternatives of the conventional CP is an important aspect for the engineering practice, main objective being sufficient protection and minimized negative side effects.

On the other hand, CPre could be a perfect alternative for new reinforced concrete structures, and since it uses significantly lower current densities, compared to CP (1- 2 mA/m² vs 10 – 20 mA/m² for CP), it is also expected that the negative side effects with CPre will be none or largely reduced.

The paper will discuss a new alternative for both CP and CPre, based on pulse technology. The summarized outcomes (electrochemical and microstructural parameters) provide reliable evidence that electrochemical protection techniques can be optimized and side effects largely reduced.