Resistivity measurement and corrosion initiation detection in reinforced concrete structure using the monitoring DIAMOND probe

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The corrosion of steel rebars is a major issue with respect to the durability of reinforced concrete structure. Several corrosion detection methods exist: concrete resistivity, half-cell potential or linear polarization resistance (LPR) measurement. However these techniques are employed at a given moment and are not suitable for constant concrete resistivity measurement and corrosion initiation monitoring. Most of the time, corrosion initiation begin at on a single area of the steel / concrete interface (macro-cell corrosion).

This works belongs to the DIAMOND project which aims to produce a new corrosion rate measurement device. In particular, this paper focus on the monitoring both resistivity and corrosion initiation. The monitoring probe consists on a cylindrical probe. A ring shape counter-electrode is plated on the probe side. At the centre of the counter-electrode, a reference electrode is placed for potential measurement. The device is embedded in concrete in order to limit the influence of environmental factors (rain, sun…) that can heavily modify concrete resistivity on a thin layer of the concrete surface.

The metal-concrete interface can be modelled by the Randles model that associates the polarization resistance and an electrical capacity in parallel. The instantaneous ohmic drop observed at the beginning of the polarization measurement is only linked with the concrete resistance which depends on concrete thickness and resistivity. A numerical model was developed on Comsol® to create abacuses that link concrete resistivity and concrete resistance. Thus, the ohmic drop measure at the beginning of the polarization can now be used to determine regularly concrete average resistivity between the monitoring probe and steel rebar. Knowing the resistivity, corrosion initiation detection is now possible as it will modified the measured potential. Indeed, an active area has a lower potential than an active area. The area of possible detection will depend on the measured concrete resistivity.

Keywords: Resistivity, corrosion initiation, ohmic drop, macro-cell corrosion

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