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Concrete electrical resistivity as a simple and rapid method to assess concrete resistance to chloride penetration

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Abstract – Concrete electrical resistivity was determined by conductivimetry and compared with results obtained by electrochemical impedance spectroscopy. Chloride penetration was tested by ponding test and migration test. Concrete with high electrical resistivity can be associated with high durability of reinforced concrete structures, and rapid tests are been the main goal of several researchers. This paper presents results obtained from different concrete mixtures, with and without admixtures, submitted to tests of chloride penetration and electrical resistivity and their correlation. Good correlations lead to conclude that the conductivimetry test can be used as a rapid method to achieve concrete durability properties.

Chloride penetration in concrete is a big issue that engineers need to solve to achieve the durability of reinforced concrete structures. The major deterioration cause of these structures is the rebar corrosion, which can begin in consequence of the concrete carbonation or the attack of chloride ions. A high quality concrete and an adequate rebar covering is necessary to prevent it [1].

There are many different methods to evaluate concrete performance under chloride laden environment: migration tests, rapid chloride permeability test, bulk diffusion test, and ponding test. They are expensive and time consuming. Andrade [2] proposed a model to predict a service life of a concrete reinforced structure based on the fundamental Einstein law, relating electrical resistance, or electrical conductance, to the chloride diffusion coefficient in concrete.

In this work, concrete with different compositions and admixtures were tested by conductivimetry, and their results were compared with those obtained by Electrochemical Impedance Spectroscopy (EIS), chloride penetration by ponding test [3], and migration test[4]. Conductivimetry tests were performed using an Analiser conductivimeter adapted to solid materials, and the results were used to calculate electrical resistivity. Good correlations were found with electrical resistivity tested by EIS (r^2=0,869) and chloride penetration by migration test (r^2=0,7050). Correlation with the penetration depth to achieve 0,1% chloride was not so good, as expected [5]. Correlations indicate that using conductivimetry method to measure concrete resistivity can be a good way to estimate concrete performance under chloride exposure.

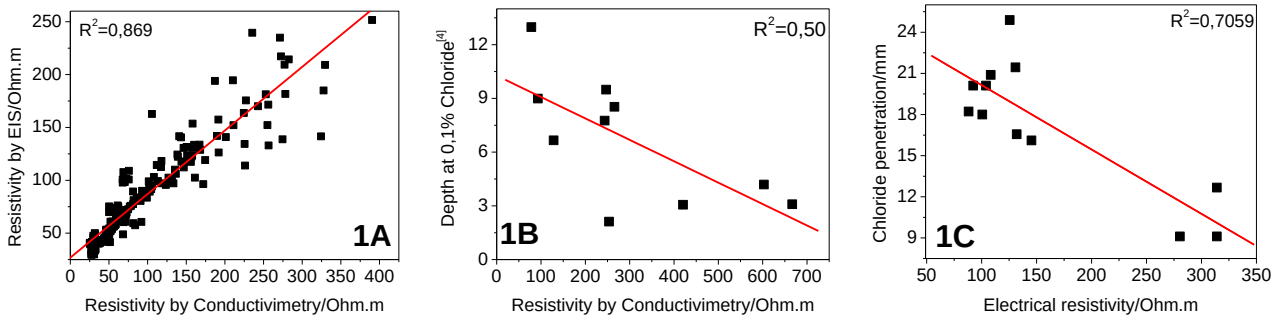

Figure1: Correlations between electrical resistivity by conductivimety and electrical resistivity by EIS (A), and Depth of 0,1% chloride[3] (B) and Chloride penetration[4](C).

References

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