Non-destructive corrosion diagnosis methods of reinforced concrete structures

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Safety of reinforced concrete structures involves monitoring of re-bars corrosion state. Destructive methods of corrosion diagnosis, still very common, are realized by removing of outer concrete layer or cutting samples from the construction for further analysis in laboratory. Thus, nondestructive methods of corrosion investigation, such as electrochemical methods, acoustic emission, electromagnetic methods, optical sensing methods and infrared thermography are extensively developed. Visual inspection, open circuit potential (OCP), polarization resistance, and other electrochemical methods are more commonly used for corrosion monitoring in reinforced concrete structures.

A new nondestructive method of rebar corrosion diagnosis of concrete structures in the field is presented. It is based on the complementary analysis of results obtained from four electrochemical techniques: electrochemical impedance spectroscopy (EIS), open circuit potential, concrete resistivity and galvanostatic pulse method. Based on developed electrodes the measurements are performed for places critical for the construction and particularly exposed to depassivation factors like chlorides. Complex analysis based on put forward electrochemical techniques enables determination of corrosion state in reinforced structures in a nondestructive way. Two variants of an application of the method are presented. In the first variant (for existing structures) the risk of corrosion is determined. In the second variant (new constructions) measuring electrodes are placed in the construction during the building process, allowing monitoring of corrosion and quantitatively determine the speed of corrosion.

Mathematical models used for interpretation of measured signals are presented. The long term corrosion of re-bars in concrete structures enabling the calculation of service life is shown. It takes into account such factors as: diffusion of chlorides, oxygen, CO_2, concrete pore structure, and variations of humidity. The anodic and cathodic zone are not set but results from the local conditions.