

Electrochemical Impedance Spectroscopy Study of the Effects of High Voltage AC Stray Current on Concrete

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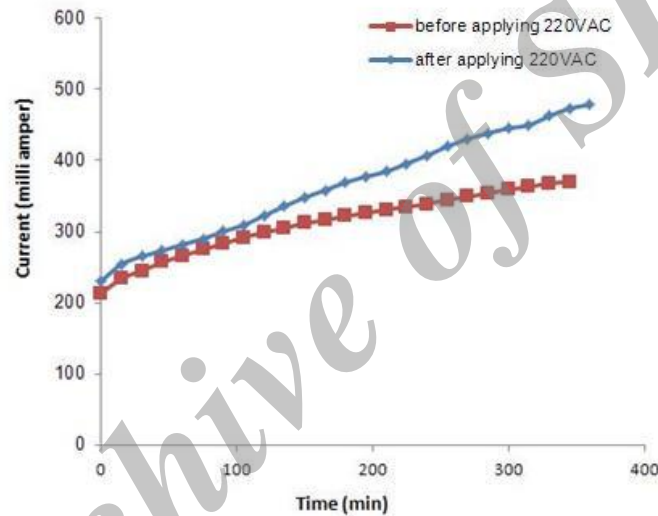
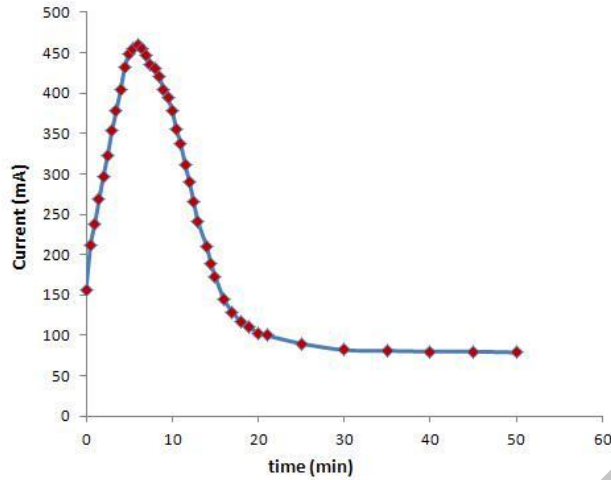
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ABSTRACT

The purpose of this study is to apply Electrochemical Impedance Spectroscopy (EIS) in order to investigate the structure and properties of concrete and the effects of 220 VAC on Ordinary Portland Concrete (OPC). At first, valid scientific sources about application of EIS to cementation materials were reviewed. Then, by using laboratorial tests, the effects of 220 VAC on OPC were investigated. Before and after the application of 220 VAC, concrete samples were studied through EIS. In order to prove the correctness of the EIS results, the concrete samples were tested by other methods such as resistivity, current-time and Rapid Chloride Penetration tests. They all confirmed the results of EIS. Concrete power poles and concrete tunnels of urban railway networks are examples of concrete structures which are exposed to alternative and dynamic stray current respectively. Study the effects of 220 VAC stray current on concrete and application of EIS in study of concrete microstructures are new field of research projects. Based on the test results, applying AC stray current under 220 VAC for 50 minutes on the concrete samples made of ordinary Portland cement is cause for decreasing 33% in their resistivity. Also, in the first step of applying AC current, flow of AC current through the sample increased from 157 mA to 459 mA. Results of Randles plot confirmed that applying AC stray current increased chloride diffusion in the sample. In addition, EIS results approved that applying AC current increased capillary pore size of the sample.



Therefore, according to the results of researches, concrete is an active cellular cementation material which its structure and its permeability to corrosive agents are changed by AC stray current. In other words, AC stray current develops premature ageing in concrete, thereby causes the reduction of concrete durability.

Key words: Electrochemical Impedance, Concrete, Stray current