Research progress on corrosion detection technology for reinforced concrete in marine environment

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Abstract: The corrosion of reinforced concrete structures in marine environment is serious, and the corrosion monitoring and detection of reinforced concrete is an effective means to control the risk of corrosion damage.In this paper, the common research methods of corrosion monitoring and detection of reinforced concrete are summarized respectively. Because these methods have different working principles, different measurements and different advantages and limitations, it is necessary to know how to use each technology to maximize the value of corrosion monitoring and detection.Therefore, it can effectively support the reasonable decision-making process of the maintenance and repair of existing reinforced concrete structures.

At present, the testing technology for reinforced concrete can be mainly divided into analytical methods, physical methods, electrochemical methods, etc. The analysis method first involves on-site testing of parameters such as steel bar diameter, protective layer thickness, concrete strength, infiltration depth and content of harmful ions, longitudinal crack width, etc., and then analyzing the degree of steel bar corrosion in combination with the corrosive environment. The physical methods mainly characterize the corrosion of steel bars by measuring the changes in physical properties such as resistance, electromagnetic, thermal conductivity, and sound wave propagation caused by steel bars, including resistance bar method, eddy current detection method, X-ray method, infrared thermal imaging method, and acoustic emission detection method.

Due to the fact that concrete corrosion in marine environments is an electrochemical process, electrochemical methods can better reflect the essence of its corrosion process. In addition, electrochemical methods also have advantages such as fast testing speed, high sensitivity, continuous tracking, and in-situ measurement, making electrochemical detection methods significantly advantageous in concrete corrosion detection. Common electrochemical methods include half cell potential method, electrochemical noise, cyclic voltammetry, polarization resistance, constant current

polarization, pulse current, electrochemical impedance spectroscopy, etc. Among them, the AC impedance method has outstanding advantages such as high accuracy, not being affected by structural geometric factors, and being able to comprehensively reflect the electrochemical process of corrosion, making it an ideal means of corrosion detection for reinforced concrete. However, there are still some urgent problems to be solved in the application of electrochemical impedance spectroscopy (EIS) methods for testing on engineering sites, including the engineering application of complex EIS measurement equipment, extraction of surface corrosion signals of high impedance steel bars, and analysis of corrosion kinetics parameters of steel bars in complex concrete corrosion systems. Finally, this article focuses on the application prospects and research priorities of electrochemical impedance spectroscopy in corrosion detection of reinforced concrete.

Keywords*:* corrosion detection; reinforced concrete; marine environment