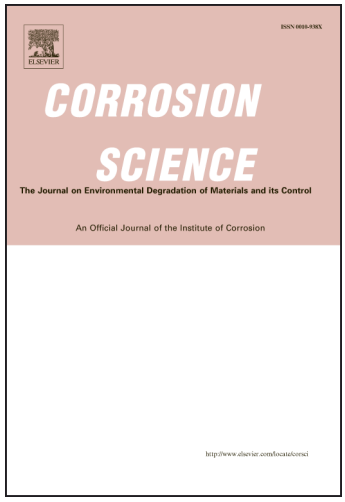

Characterization of Steel Corrosion in Mortar by Various Electrochemical and Physical Techniques

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Characterization of Steel Corrosion in Mortar by Various Electrochemical and Physical Techniques

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Abstract

In the study characterization of steel corrosion in concrete at the macro- and micro-level was performed. Physical (electrical-resistance probes) and electrochemical techniques (coupled multi-electrode arrays) were implemented in order to upgrade the general information that conventional electrochemical techniques can provide. Measurements were performed in mortar exposed to periodic wetting and drying. Steel corrosion damage was assessed by micro X-ray computer tomography (CT) and SEM. The results were compared and interpreted. By combined use of Micro-CT and electrochemical methods, new insights into the corrosion mechanisms of steel in concrete were obtained.

Keywords: A. steel reinforced concrete, A. concrete, B. electrical resistance probe, B. coupled multi-electrode array, B. X-ray computer tomography, C. corrosion

1. Introduction

It is well known that the corrosion of steel reinforcement in concrete is one of the main reasons for the reduced service life of concrete structures [1]. The economic importance of this topic has caused intensive development of new technologies and materials, whose aim is to increase the durability of concrete structures [2]. Simultaneously, deeper knowledge of the basic corrosion mechanisms of steel in concrete has been established. The importance of macro-cells has been known for some time [3], but their exact explanation and modelling were not realized until recently [4]. On the other hand, it has been confirmed that small non-uniformities in the transition zone between the concrete and the steel reinforcement can represent distinct corrosion initiation sites [5]. It was found that, under specific conditions, the corrosion processes of steel in concrete exhibit very high dynamics, and that corrosion initiation and repassivation might consist of a sequence of several events [6]. These observations have also provided an explanation as to why corrosion parameters and the evolution of corrosion processes in concrete cannot be exactly compared to those which occur in simulated pore water [7,8].

One of the main problems in measuring and explaining the corrosion of steel in concrete is the relatively large range of dimensions (a few tens of cm in the case of a structural element, up to a few tens of m in the case of a whole structure). On the other hand, at the same time the distribution of anodic and cathodic sites on the micro-scale could also be very important [9]. In this sense, as opposed to macro-cell corrosion, the

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