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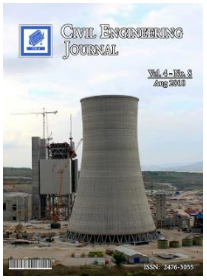

Comparative Study of Pure Mg and AZ91D as Sacrificial Anodes for Reinforced Cement Concrete Structures in Chloride Atmosphere

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Abstract

Comparative study of the corrosion behavior of pure Magnesium and AZ91D anodes in reinforced cement concrete was undertaken in the present work. The steel reinforcements were kept in contact with these anodes electrochemically in chloride atmosphere and the half-cell potential drop was observed. Bare steel reinforcements were tied to the anodes and were also kept in high chloride atmosphere to test the mechanical properties. The yield stress and ultimate tensile stress were found to decrease by approximately 50MPa while the reduction in percentage elongation is approximately 25% for reinforcements tied to AZ91D and pure Mg at the end of 80 days compared to fresh steel reinforcement. The rate of corrosion of pure Mg was reportedly slightly higher compared to AZ91D due to the presence of inter-metallics as inferred through micro-graphs.

Keywords: Cathodic Protection; AZ91D; Mechanical Properties; Micro-Characterization; Inter-Metallics.

1. Introduction

The corrosion of steel reinforcement is one of the underlying factors which affect the durability of structure (Page CL). There are several factors which initiate corrosion, such as, ingress of free chloride ions, carbon dioxide, fluoride ions or sulphate ions. The concrete pore network, permeability, rate of ingress by diffusion or capillary suction are some factors (Ožbolt) which enhance the corrosion rate (Koleva) due to the above-mentioned ions. Amongst the agents of corrosion mentioned, chloride ions are the most important sources for the degradation of concrete (Escalante). (V.Kumar) (Song), especially in coastal regions. The ingress of chlorine causes the formation of HCl, which being a strong acid, reduces the pH of concrete. When the reduction in pH reaches a threshold value (typically < 8) (Broomfield), corrosion of steel reinforcements occur due to localized breakdown of the passivating film (Montemor).

Cathodic protection (CP) of reinforced cement concrete (RCC) structures has been in practice since decades (C.L. Page). This technique is widely used for structural integrity against corrosion in regions exposed to chloride atmosphere or extreme marine environment (Fuyong Cao). The underlying principle of CP technique is based on electro-chemical reaction involving the anodic dissolution of metal by providing electrons to the metal structure to be protected. The process of CP can be accomplished in two ways, viz. impressed current cathodic protection (ICCP) and galvanic coupling or sacrificial anoding of suitable material. The most commonly used anodes amongst the latter technique are pure Magnesium (Mg) (Fontana) . Its low efficiency (~50%) is surpassed by the very high negative potential, which in turn provides high current output. The corrosion rate of Mg is high and hence, alloying is pursued. Amongst the alloys

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