3.5 wt.% NaCl로 오염된 SCP 용액의 부식 개시 완화에 대한 하이브리드 억제제의 효과

Effect of Hybrid Inhibitor on the Mitigation of Corrosion Initiation in SCP Solution Contaminated 3.5 wt.% NaCl

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Abstract

In this study, the optimum amount of hybrid inhibitors i.e. L-Arginine (LA) and sodium phosphate tribasic dodecahydrate (SP), applied for carbon steel rebar in simulated pore concrete (SCP) solution contaminated with 3.5 wt.% NaCl, was discovered. The corrosion inhibition performance of hybrid inhibitors was investigated by open circuit potential (OCP), electrochemical impedance spectroscopy (EIS), and potentiodynamic polarization. The highest corrosion inhibition efficiency was found as 99.52% corresponding to 2% LA and 0.25% SP after 210 h exposure. Anodic type inhibition action was confirmed by potentiodynamic polarization study. Surface studies including scanning electron microscopy (SEM), and atomic force microscopy (AFM) were used to figure out the surface morphology of the steel rebar treated with hybrid inhibitors in order to collaborate with electrochemical studies.

키 워 드 : 친환경억제제, 철근부식, SCP
Keywords: Green inhibitor, steel rebar corrosion, SCP

1. Introduction

As a save-economically and environmentally friendly technique to protect metal substrates by reducing the corrosion rate and/or delaying the corrosion initiation, the inhibitors employment has been the most applied, simplest, as well as most effective solution1). Our purpose in this study is to research the corrosion inhibition effect of a novel hybrid inhibitors based on L-Arginine and Sodium phosphate tribasic dodecahydrate on the steel rebar in SCP solution contaminated 3.5 wt.% NaCl. The corrosion kinetics and passive film formation mechanism are explained by Open Circuit Potential (OCP), and Electrochemical Impedance Spectroscopy (EIS). Alternatively, the chemistry and morphology of precipitated protective film on the steel surface after exposing 210 h are pointed out by X-Ray Photoelectron Spectroscopy (XPS), Field-emission Scanning Electron Microscope (FE-SEM), and Atomic Force Microscopy (AFM).

2. Materials and methods

Table 1. The mix of SCP solution containing 3.5 wt.% NaCl with inhibitor and without inhibitor

Sample ID	L-Arginine	Trisodium phosphate
Blank	-	-
L2P0	2%	-
L2P1		0.1%
L2P2		0.25%
L2P3		0.5%

SCP solution was synthesized by dissolving analytical reagent grade of 2 g/L CaO, 3.36 g/L KOH, and 8.33 g/L

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NaOH in distilled water following some literatures. Four different amounts of inhibitors were measured at room temperature (20±2 oC). The carbon steel samples with the dimension of 22 mm diameter and 10 mm thickness were investigated to the resistance impact of without inhibitor as well as with inhibitor in SCP + 3.5 wt.% NaCl solution. Studies on EIS were performed by imposing 10 mV amplitude sinusoidal voltage with frequency from 105 Hz to 10-2 Hz at the open circuit potential of the WE. The cloth polished steel samples were subjected to SCP + 3.5wt.% NaCl without and with inhibitors i.e. L2P025 for 210 h. The surface morphology of the protective film was investigated by using FE-SEM, and AFM images.

3. Results and Discussion

Figure 1 indicated that the total impedance results of all samples exposed SCP + 3.5 wt.% NaCl solution. It can be seen that the impedance value of blank sample reduced over time attributed to the degradation of corrosive resistance. Once the addition of SP dosage reached lower or higher than 0.25%, the total impedance values were lower than blank samples ascribed to the poor corrosive resistance compared to that of blank sample. The total impedance of L2P0 increased after 93 h, however, it decreased after 210h due to the corrosive attack of chloride ion to the passive film leading to the deterioration of passive film. Once 0.25 % SP was used, the total impedance obtained the highest value and even slightly increased after 210 h resulting in the noble synergistic effect of two inhibitors and the cooperation of these two inhibitors were obviously essential.

Figure 2(a) demonstrated that the surface of steel rebar was volume expanded attributed to the corrosion rust. The chloride ion caused the severe corrosion on the steel surface of blank sample. Once inhibitor was applied i.e. L2P025, as can be seen in Figure 2(b) the surface of steel rebar was invariably protected by the strong passive film. The steel surface of L2P025 was almost fully protected.

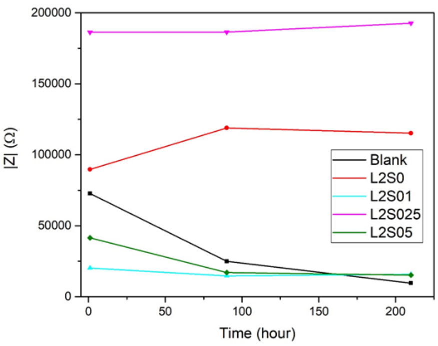

Figure 1. Total impedance plot of steel samples in SCP solution + 3.5 wt.% NaCl with and without inhibitor after 210 h exposure

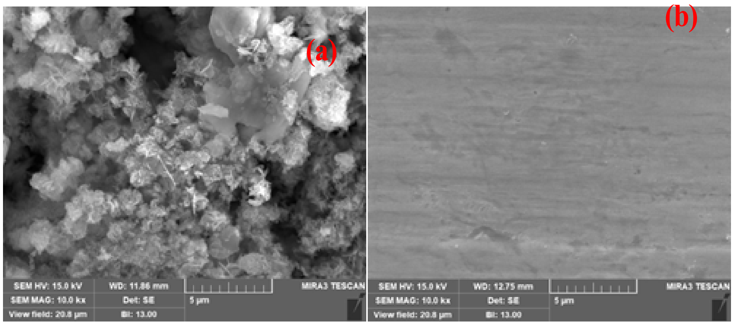

Figure 2. SEM images of the film formed on the surface after 210 h exposed SC + 3.5wt.% NaCl solution (a) Blank and (b) L2P025

4. Conclusion

L2P025 performs the noble corrosion resistance, known as the optimum inhibitor dosage with 2% L-Arginine and 0.25% TSP. The hybrid inhibitor considers as anodic inhibitor. This passive film is outstandingly protective, homogeneous, thin, and uniform.

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