알칼리성 환경에서 부동태 피막 개선에 대한 양쪽성 이온 및 인산염 그룹을 갖는 염화물 이온의 역할

Role of chloride ions with Zwitterions and phosphate groups on the improvement of the passive film in alkaline environment

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Abstract

In this study, the optimum amount of chloride ions is used to collaborate with hybrid corrosion inhibitor for carbon steel rebar treatment in simulated pore concrete (SCP) solution is discovered. The corrosion inhibition performance of hybrid inhibitors is carried on by open circuit potential (OCP), electrochemical impedance spectroscopy (EIS), and potentiodynamic polarization (PP). The highest corrosion inhibition resistance is found in case of LP-C2 after 240 h exposure. 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 well with electrochemical studies. Anodic type inhibition action was confirmed by potentiodynamic polarization study.

키 워 드 : 철근 부식, SCP, 친환경 억제제.
Keywords : steel rebar corrosion, SCP, green corrosion inhibitor

1. Introduction

In order to save economically in steel maintenance works, researchers have studied in a variety of corrosion postponement methods for steel rebar in reinforced concrete (RC) structure in marine environment. Besides, human-being and eco-friendly problem is also essential, thus, corrosion inhibitor-based green inhibitor for steel rebar is widely studied at the present time [1]. The optimum amount of inhibitor mix is necessarily determined to obtain the noble performance to prevent the corrosion initiation by increasing the chloride threshold value. it is widely known that chloride ions in sea water is the main factor inducing the active corrosion in steel. However, our research group recently found that the chloride ions are also able to contribute structure in the formation of passive film along with Zwitterions and phosphate groups onto the steel rebar surface. Thus, our purpose in this study is to study the optimum amount of chloride ions with hybrid corrosion inhibitor on the improvement of protective film in SCP solution. The mechanism of passive film formation and corrosion kinetics are explained by Open Circuit Potential (OCP), Electrochemical Impedance Spectroscopy (EIS), and Potentiodynamic Polarization (PP). Alternatively, the chemical composition and morphology of protective film formation on the steel surface after 240 h exposure are figured out by , Field-emission Scanning Electron Microscope (FE-SEM), and Atomic Force Microscopy (AFM), and X-Ray Photoelectron Spectroscopy (XPS).

2. Materials and methods

The hybrid corrosion inhibitors including L-Arginine and Trisodium phosphate is researched in this study. SCP solution was synthesized via dissolving analytical reagent grade of 3.36 g/L KOH, 2 g/L CaO, and 8.33 g/L NaOH in distilled water following some literatures. Five different amounts of inhibitors were measured at room

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temperature (23±2 oC). The 22 mm diameter carbon steel samples were investigated to the role of different chloride concentration along with hybrid inhibitor in SCP solution. Studies on EIS were performed by imposing 10 mV amplitude sinusoidal voltage with frequency from 100 kHz to 0.01 Hz at the open circuit potential of the working electrode. The surface morphology of the protective film was investigated by using FE-SEM, and AFM images. The cloth polished steel rebar samples is prepared for AFM and Raman investigation.

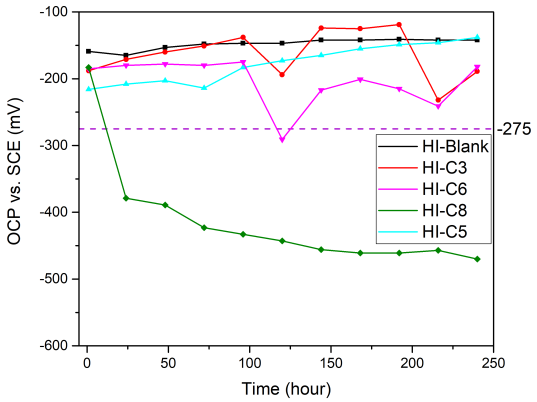

Figure 1. OCP plot of steel samples treated with hybrid inhibitor in SCP solution after 240 h exposure

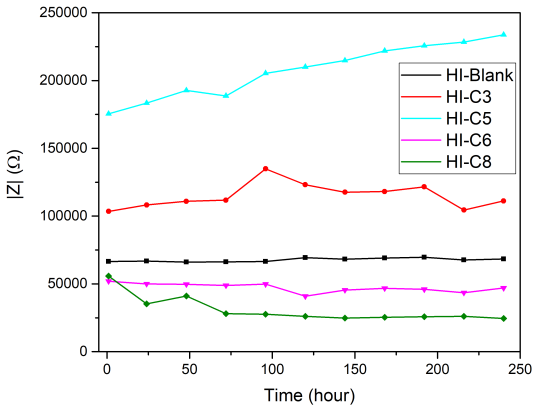

Figure 2. Impedance modulus plot of the steel rebar samples treated with hybrid inhibitor in SCP solution after 240 h exposure

3. Results and Discussion

Figure 1 indicated that the sample treated with hybrid inhibitor without chloride exposure exhibits a passive state, which its OCP value is approximately −150 mV, means that the steel rebar is protected stably with the passive film onto the steel rebar surface. Once the chloride content is added to 5 wt.% NaCl i.e. LP-C1 and LP-C2, the OCP tend to shift toward passive direction as well as obtain higher than −150 mV, showing that despite the presence of chloride ions, the steel rebar is still guaranteed under the great protection. However, the passive film is deteriorated due to the OCP shifting toward active direction, once the chloride concentration addition is higher 5 wt.%. Impedance modulus values also perform the same trend with those of OCP results.

4. Conclusions

Chloride ions also play an essential role in enhancement of passive film. LP-C2 sample containing 5 wt.% NaCl addition performs the noblest properties of corrosion resistance. Once the chloride concentration extends over 5 wt.% NaCl, the corrosion resistance property of samples exhibit a deteriorated state.

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