양쪽성 이온 및 인산염 기반 하이브리드 방청제의 전기화학적 특성에 관한 실험적 연구

Experimental study on the electrochemical properties of zwitterion and phosphate-based hybrid inhibitors in reinforced concrete

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Abstract : During the past decades, the corrosion of the steel rebar embedded in concrete structure surrounding marine environment is actually problematic and required the suitable preventive method. An eco-friendly corrosion inhibitor mix is investigated to stifle the active corrosion in comparison with other commercial corrosion inhibitors. The hybrid inhibitor enhances the corrosion resistance and the workability of concrete. However, it reduces the compressive strength slightly after 28-day-age. The electrochemical studies and mechanical studies are pointed out the corrosion resistance property, corrosion kinetics, and the mechanical properties of all concrete samples. H-3 is the optimum dose of hybrid inhbitor that meets the demand of both electrochemical property and mechanical property. It performs the noble features due to the formation of optimum amount of P-Zwitterions-(Cl)-Fe complex onto the steel rebar surface.

키워드 : 철근부식, 내식성, 콘크리트 , 친환경 억제제
Keywords : steel rebar, corrosion resistance, concrete, eco-friendly inhibitor

1. Introduction

Researchers have investigated several corrosion delay techniques for steel rebar in reinforced concrete (RC) structures in maritime environments in order to cut costs on RC maintenance work. A corrosion inhibitor-based green inhibitor for steel rebar is now being extensively researched since environmental and human health issues are equally important. The primary cause of active corrosion in steel is known to be chloride ions in sea water. Therefore, the goal of this study is to determine the ideal concentration of chloride ions in combination with a hybrid corrosion inhibitor to enhance the protective film in concrete.

2. Materials and methods

The hybrid corrosion inhibitor was constituted by L-Arginine (LA) and trisodium phosphate dodecahydrate (TSP). Table 1 tabulated the amount of concrete mix of all samples. Moreover, the ratio between LA and TSP was always constant at 2 : 0.25 owing to its optimum dose to form the high performance of the passive film onto the steel rebar surface 1). The 13 mm diameter steel rebar was employed to be embedded in the concrete sample with the cylinder dimension of 50x100 mm3. T The wet-dry cycle (W-D) was applied in this work, in particular, 3 days wet and 4 days dry, that is to say, one cycle equals a week. 10 wt.% NaCl is used in wetting cycle and measuring EIS.

Table 1. The concrete mix containing hybrid inhibitor (kg/m3)

Sample ID	W/C	Cement	Water	Sand	Coarse aggregate	LA : TSP	Inhibitor : Cement
H-0	0.5	400	200	778	956	2 : 0.25	0
H-1							0.25 wt.%
H-2							0.5 wt.%
H-3							1 wt.%
H-4							2 wt.%

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3. Results and Discussion

3.1. Impedance modulus

It can be observed from Fig. 1 that the impedance values tend to reduce gradually in light of all samples owing to the penetration of high content of chloride ions from the medium outside (10 wt.% NaCl). AThe amount of hybrid inhibitor contained H-3 sample currently is optimum with the content of chloride penetrating from the medium to form the stable passive complex (i.e., P-Zwitterions-(Cl)-Fe) onto the steel rebar surface for protection against active corrosion.

3.1. Compressive strength

H-0 sample obtains the highest compressive strength value while the lowest one goes to H-4. It may be due to the hybrid inhibitor causes the increment of the air content leading to the less dense of the concrete matrix. The reduction of compressive strength in light of H-3 is still in the allowance range of inhibitor contained concrete sample according to Korean Standard.

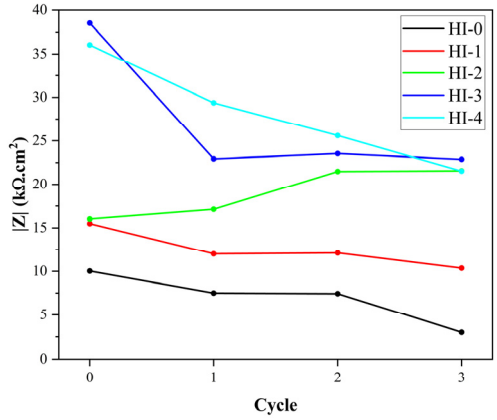

Figure 1. Impedance modulus plot of reinforced concrete

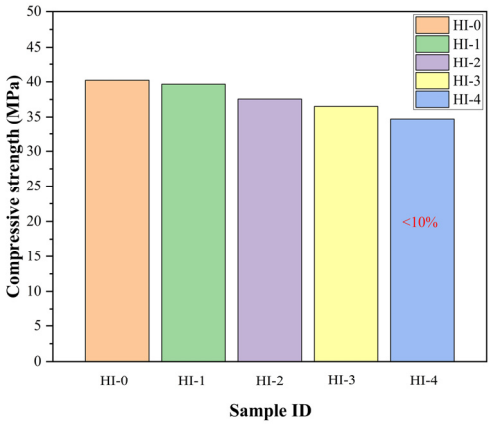

Figure 2. Compressive strength of reinforced concrete

4. Conclusion

Although the compressive strength exhibits a decrement trend, the corrosion resistance property is enhanced significantly once the hybrid inhibitor concentration is increased. It is found that HI-3 is the optimum amount that is able to balance the merit of compressive strength and corrosion resistance property.

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References

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