염화물에 노출된 콘크리트 기공 내에 솔방울 추출물의 부식 방청 특성

Corrosion Inhibition Properties of Conifer Cone (*Pinus resinosa*) Extract in Chloride Contaminated Concrete Pore Solutions

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Abstract

The corrosion inhibition properties of conifer cone (Pinus resinosa) extract were studied in synthetic concrete pore solutions (SCPS) with and without chloride environments by electrochemical methods. The electrochemical impedance spectroscopy (EIS) revealed that the conifer cone (CC) extract showed promising inhibition behavior by diminishing the corrosion rate of steel rebar both solutions i.e. with and without chloride. The extract of conifer cone hinders the corrosion reaction between steel rebar and aggressive ions. Further, it can be verified that the up to 1000mg.L-1 of CC extract can able to reduce the corrosion rate of steel rebar in chloride contaminated concrete.

키 워 드 : 친환경 부식 방청제, 철근, 부식
Keywords : eco-friendly corrosion inhibitor, steel rebar, corrosion

1. Introductions

Owing to increase in the durability and sustainability of reinforced steel in concrete structures, the researchers have devised several techniques to increase corrosion protection. The inhibitors are material which hinders the corrosion reaction rate and enhancing the durability as well as lifetime of the steel in concrete structures. In this case, the inhibitor should be inexpensive, reliable and remarkable for corrosion protection. Therefore, by considering the above factors, researchers are developing non-toxic, and eco-friendly inhibitors to protect the steel in concrete structures. Hence, In the present studies, we have reported the corrosion inhibition properties of CC extract as eco-friendly inhibitor to protect the steel rebar in chloride contaminated SCPS.

2. Materials and Methods

12mm dia and 120mm length of the steel rebar was used to access the corrosion resistance properties of inhibitor. The SCPS was prepared by dissolving 8.33g NaOH, 3.36g KOH and 2g CaO in one liter distilled water. The collected CCs were washed with distilled water to remove impurities and dried at room temperatures. The dried CCs was mechanically crushed then approximately 10g of crushed CCs was soaked in 200 ml of ethanol for 7 days thereafter it was filtered. The obtained filtrates were heated at 80 °C then dried powder of CC was collected as inhibitor.

3. Results and Discussion

The EIS results of sample without and with 30000ppm of Cl- ions after 1 h of exposure are shown in Figure 1a and 1b, respectively. It can be seen from the Nyquist plots of samples that as the concentration of inhibitor is increased with and without chloride, the dimension of semi-circle arc is increased up to 1000 mg.L-1 of CC. The corrosion kinetics parameters of steel rebar from potentiodynamic polarization is shown in Table 1.

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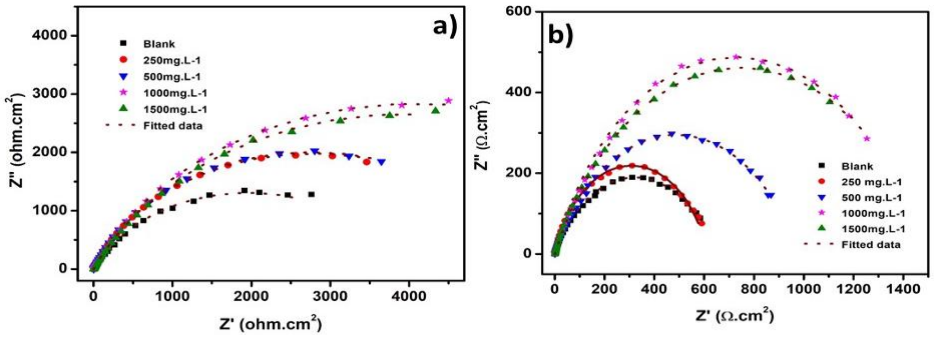

Figure 1. Nyquist plots for steel rebar in (a) various concentrations of inhibitor (without NaCl) and (b) 30000 mg.L-1 NaCl containing solution

Table 1. The potentiodynamic polarization parameters

System	Dosage of inhibitors mg.L-1	Ecorr (V)	Icorr (μA.cm2)	Corrosion rate ×10-2 (mmpy)	Efficiency (%)	pH
SCPS without chloride	0	-0.480	1.323	0.907	-	13.39
	250	-0.382	0.709	0.486	46.45	13.42
	500	-0.392	0.643	0.435	52.07	13.41
	1,000	-0.403	0.509	0.349	61.46	13.41
	1,500	-0.408	0.545	0.373	58.82	13.40
SCPS with 30000 mg.L-1 of chloride	0	-0.529	5.88	6.91	-	12.98
	250	-0.533	3.156	3.71	46.31	12.97
	500	-0.502	3.081	3.55	48.68	12.98
	1,000	-0.486	1.2549	1.47	78.67	12.99
	1,500	-0.503	2.6705	3.14	54.59	12.98

From Table 1, it can be seen that the corrosion rate of steel rebar immersed in 0, 250, 500, 1000, and 1500mg.L-1 inhibitor containing SCPS is found to be 0.907, 0.486, 0.435, 0.349 & 0.373 ×10-2 mmpy whereas in 30000 mg.L-1 of chloride added solutions is 6.91, 3.71, 3.55, 1.47 & 3.14 ×10-2 mmpy, respectively. The corrosion resistance efficiency (%) of 1000mg.L-1 inhibitor containing solution is the best even with and without chloride medium. Higher and lower than this concentration of inhibitor is less than 60% efficiency. There is not significant difference in pH of solution once added the inhibitor.

4. Conclusion

The conifer cone extracts act as an excellent inhibitor for steel rebar in SCPS with and without chloride ions. The non-toxicity and low cast of conifer cone has major advantages over the other toxic chemicals. The extract of CC hinders the corrosion reaction between steel rebar and aggressive ions. Further, it can be verified that the up to 1000mg.L-1 of CC extract can able to reduce the corrosion rate of steel rebar in chloride contaminated SCPS.

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