CORROSION RESISTANCE POTENTIALITY OF RESIN MIXED CEMENT CONCRETE

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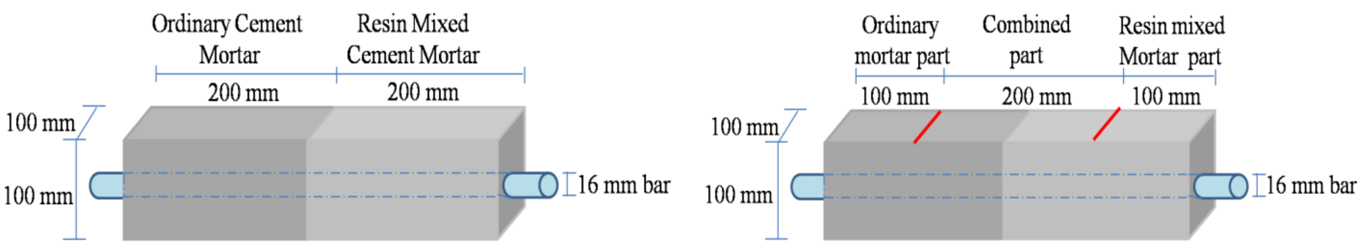
1. INTRODUCTION

The corrosion of steel reinforcement in an aging concrete structure is major problem now a day, and in particular, chloride induced corrosion is a major concern. Eliminating or slowing the chloride induced deterioration of Reinforced Concrete (RC) structures, with the uses of innovative technique is highly warranted to enhance the service life of structures (Schiessl. P,1998). The objective of this study is to examine the corrosion resistance potentiality of resin mixed cement concrete, by Macrocell corrosion test, against chloride attack.

2. OUTLINE OF EXPERIMENT



(a) Specimens for Macrocell Testing (b) Macrocell Testing Areas

Fig.1 Geometry and dimensions in (a) Specimens for Macrocell Testing & (b) Macrocell Testing Areas

Table 1: Material Composition and Exposure Condition of Specimens

Material Composition				Exposure Condition	
Specimen Type	Cement Type	Resin Percentage	Chloride Content	Temp.& Humidity	Exposure/Cycle
HESPC-IER (0%)	HESPC	0%	13.5 (kg/m^3)	Temp. 40°C & Humidity 60% for drying & 95% for wetting	4 Days for drying & 3 Days for wetting
HESPC-IER (3%)		3%			
HESPC-IER (5%)		5%			
PC-IER (0%)	PC	0%			
PC-IER (3%)		3%			

Five types of mortar specimens were prepared using different ion exchange resin percentage for High Early Strength Portland Cement (HESPC) and Polymer Cement (PC) and tested for Macrocell corrosion resistance. All specimen having the same size and dimensions as shown in Fig.1(a) & Fig.1(b) and material compositions & exposure conditions (JCI Diagnostic Technology of Concrete, JCI 2010) as shown in Table1.

3. RESULTS AND DISCUSSION

3.1 Natural Electric Potential

Results of Macrocell Natural Electric Potential, obtained by using Sensor for Detecting Corrosion speed of Reinforcement in Concrete Materials (SRI-CM-III) are shown in Fig.2 & Fig.3.

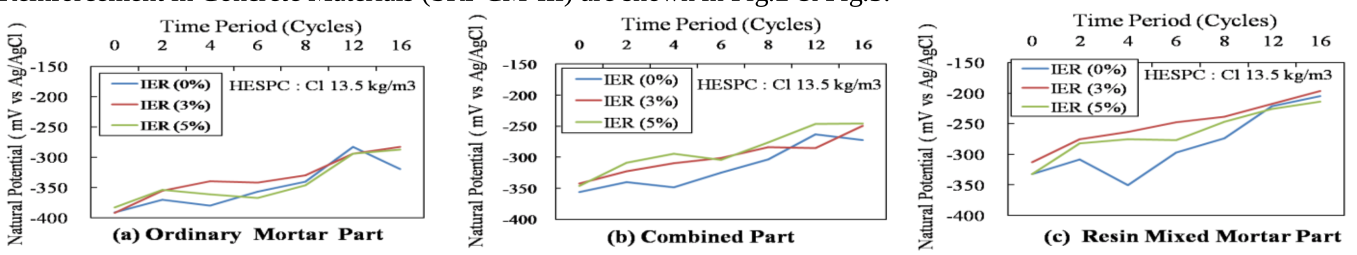


Fig. 2 Changing of HESPC Natural Potentials in (a) Ordinary Mortar Part, (b) Combined Part & (c) Resin Mixed Part.

Keywords: Corrosion, Potentiality, Chloride attack, Deterioration, Macrocell
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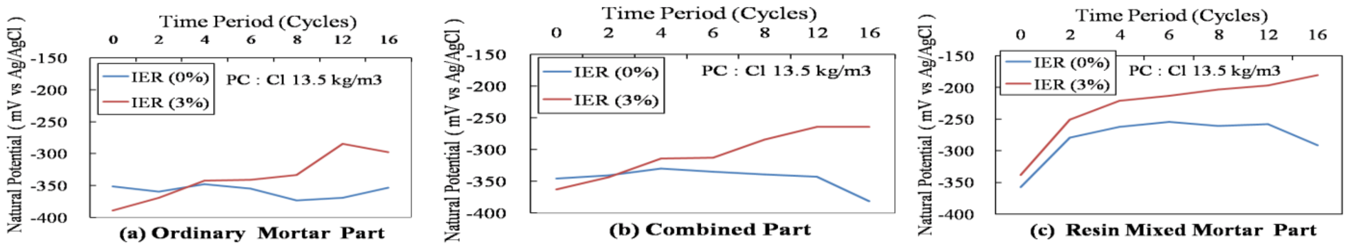

Fig. 3 Changing of PC Natural Potentials in (a) Ordinary Mortar Part, (b) Combined Part & (c) Resin Mixed Part.

Results indicate that resin mixed mortar showed relatively better resistance against reinforcement corrosion than control specimen both in HESPC and PC, as per Comite Euro-International du Beton (CEB) standards (CEB Design Guide, CEB 1992), shown in Table 2. However in HESPC, 5% resin mixed specimen performed worst than 3% resin mixed specimen.

Table 2: Comite Euro-International du Beton (CEB) Standards for rebar Corrosion.

Natural Electric Potential [E (mV vs Ag/AgCl)]		Corrosion Current Density (μA/cm2)	
-80<E	No corrosion Probability ≥90%	0.1~0.2	No Corrosion
-230<E≤-80	Indefinite	0.2~0.5	Low Degree of Corrosion
E≤-230	Corrosion Probability ≥90%	0.5~1.0	Medium Degree of Corrosion
		Larger than 1.0	Intense Corrosion

3.2 Corrosion Current Density

Results of Corrosion Current Density, obtained by SRI-CM-III are shown in Fig.4 & Fig.5. It revealed that, in resin mixed mortar part, corrosion current density goes down, which indicates a quite better resistance against reinforcement corrosion as per CEB standards, and observed in both HESPC and PC. In case of HESPC, 3% resin mixed mortar showed a bit better performance than control specimen, although 5% resin mixed mortar performed worst. In case of PC, 3% resin mixed mortar specimen also performed worst than control specimen. Ambiguity in these results might be due to improper curing, moisture condition, w/c ratio, delay of cement hydration and slight variations in exposure conditions.

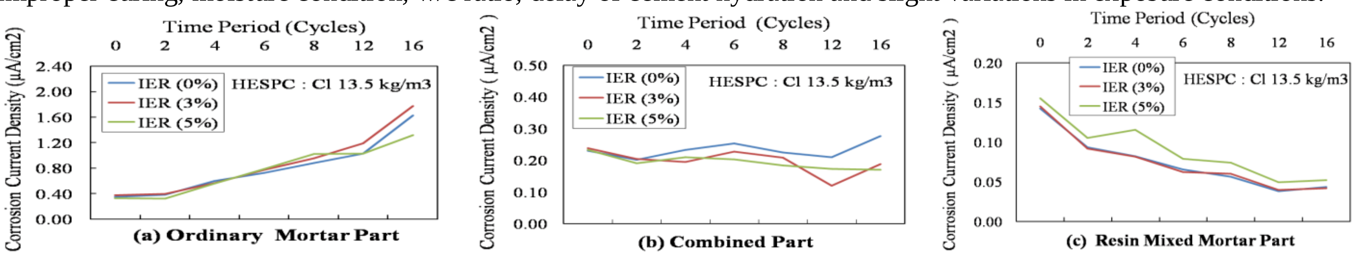

Fig. 4 Changing of HESPC Corrosion Current in (a) Ordinary Mortar Part, (b) Combined Part & (c) Resin Mixed Part.

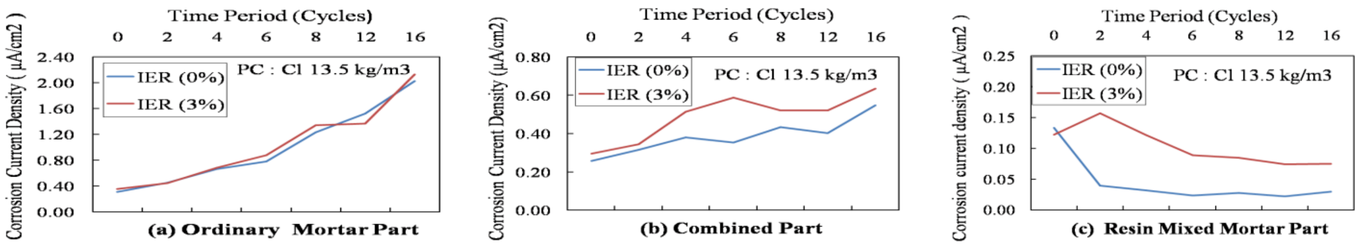

Fig. 5 Changing of PC Corrosion Current in (a) Ordinary Mortar Part, (b) Combined Part & (c) Resin Mixed Part.

4. CONCLUSIONS

This paper examined the potentiality of using ion exchange resin with cement mortar against bar corrosion of RC structures due to chloride attack. Test results showed a tendency of declining corrosion probability, although there exists some ambiguity. Results were interpreted only for 16 cycles and it's not so much time to understand the phenomena at all. Further investigations are required to justify the matter by using optimum percentage of resin with more time trend.

REFERENCES

Schiessl, P.: Corrosion of steel in concrete, Report of the Technical Committee, 60-CSC, RILEM, 1988.
Japan Concrete Institute.: Diagnostic Technology of Concrete 2010(JCI).
CEB - Comite Euro-International du Beton (1992) .: Durable Concrete Structures, Design Guide.