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Corrosion study rebars in reinforced concrete structure by open circuit potential method

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Abstract

In present investigation an attempt has been made to investigate corrosion rate of mild steel, Tor steel and CRS steel in reinforced concrete structure by open circuit potential difference method obtained reliable results in OCP method. The four concrete block from sites have been selected. The factor causing corrosion and conditions of the environment has been studied. Attempt has been made to consider conditions which will help to get greater protection against corrosion problem for industries as well as household articles.

Key words: Reinforced concrete; OCP method.

Introduction

Corrosion of rebars is one of the major durability problems for reinforced concrete structure. The effect of inadequate workmanship like proper cover, placing, compaction and curing of concrete on carbonation are the factors responsible for the corrosion of reinforcement in concrete structures. Corrosion is the destructive attack on a metal or a metal alloy by chemical or electrochemical reaction with its environment [1-4]. There are different factors influencing corrosion such as acids, oxidizing agents and temperature. The numbers of methods are available for study of the corrosion viz. surface potential test method, open circuit potential test method and method of weight loss. The present work deals with the study of the effect of water cement ratio, grade of concrete and type of steel on corrosion of steel in concrete using open circuit potential test method. This the most suitable method for the detecting the percentage of corrosion of the rebars, because in this method the bars are directly connected to the electrode it gives

direct readings of the corrosion current in mv and based on standards fixed we can detect the condition of rebars.

Materials and Methods

Experimental Section

Open circuit potential of steel (OCP)

In this technique the corrosion potential of the rebar is measured with respect to standard reference electrode such as saturated calomel electrode, copper-copper sulphate electrode, silver-silver chloride electrode. In view of reinforced concrete structure. The steel bars should be accessible in few locations for getting electrical connection. A high impedance voltmeter with accuracy of ± 10 mv is normally used. Results are reported in Table 1. For the test standards are fixed by applying $Cu/CuSO_4$ electrodes. Potential more than 350 mv or 0.35 V CSE, very high (about 95%) probability of presence of active corrosion. Potential more than 200 mv or 0.20 V CSE, very high probability of no corrosion. Potential in the range of 0.20 V to 0.35 V or 200 MV to 350 MV approximately 50% probability of corrosion

Results and Discussion

It was observed from readings in Table 1. That the flow of corrosion current is more at less cover depths and less at more cover depths also mild steel and tor steel both are get affected due to the corrosive environment. Though the open circuit potential method data useful is ascertaining the condition of rebar embedded in concrete in a NDT way it is only qualitative OCP values are influenced by moisture content in the concrete.

Table 1. Corrosion Rate by Open circuit Potential Method

Time for exposure = 7 days; Density of Steel (D) = 7.78 gms/cm^3;

Sr. No	Symbol	Grade of concrete	Water cement ratio	Type of steel	Cover in mm	OCP Readings in mV
1	A-1	M15	0.40	Mild Steel	10 30 45	-272 mV -108 mV -103 mV
2	A-2	M15	0.40	Mild Steel	10 30 45	-260 mV -121 mV -081 mV
3	A-3	M15	0.40	Tor Steel	10 30 45	-352 mV -130 mV -127 mV
4	A-4	M15	0.40	Tor Steel	10 30 45	-378 mV -144 mV -114 mV
5	A-5	M15	0.40	CRS Steel	10 30 45	-091 mV -039 mV -035 mV
6	A-6	M15	0.40	CRS Steel	10 30 45	-097 mV -042 mV -041 mV
7	B-1	M15	0.45	Mild Steel	10	-178 mV

					30 45	-169 mV -041 mV
8	B-2	M15	0.45	Mild Steel	10 30 45	-172 mV -100 mV -041 mV
9	B-3	M15	0.45	Tor Steel	10 30 45	-209 mV -175 mV -067 mV
10	B-4	M15	0.45	Tor Steel	10 30 45	-275 mV -160 mV -077 mV
11	B-5	M15	0.45	CRS Steel	10 30 45	-059 mV -041 mV -032 mV
12	B-6	M15	0.45	CRS Steel	10 30 45	-056 mV -042 mV -030 mV
13	C-1	M15	0.5	Mild Steel	10 30 45	-077 mV -060 mV -054 mV
14	C-2	M15	0.5	Mild Steel	10 30 45	-071 mV -068 mV -041 mV
15	C-3	M15	0.5	Tor Steel	10 30 45	-0146 mV -0122 mV -082 mV
16	C-4	M15	0.5	Tor Steel	10 30 45	-0150 mV -0124 mV -077 mV
17	C-5	M15	0.5	CRS Steel	10 30 45	-047 mV -042 mV -028 mV
18	C-6	M15	0.5	CRS Steel	10 30 45	-068 mV -065 mV -035 mV
19	D-1	M15	0.55	Mild Steel	10 30 45	-085 mV -081 mV -067 mV
20	D-2	M15	0.55	Mild Steel	10 30 45	-072 mV -068 mV -060 mV
21	D-3	M15	0.55	Tor Steel	10 30 45	-109 mV -087 mV -070 mV
22	D-4	M15	0.55	Tor Steel	10 30 45	-135 mV -078 mV -072 mV
23	D-5	M15	0.55	CRS Steel	10 30 45	-010 mV -011 mV -008 mV
24	D-6	M15	0.55	CRS Steel	10 30 45	-030 mV -020 mV -015 mV

Conclusion

- Open circuit potential method is more suitable than other method because less instrumentation is required in this method and which gives quick result for further repairs and rehabilitation.
- Open circuit potential method suitable on the field where the spalling or cracking of concrete has taken place due to increase in volume of concrete due to rust formation.
- The bars at cover depth of 10 mm are severally affected by the corrosion. The potential difference in OCP method is maximum at 10 mm.
- Corrosion knowledge is very important for planning to reduce corrosion.
- As bars are more susceptible to corrosion if cover is in between 10 to 15 mm. Therefore in recent revision of I.S. 456-2000, the code has recommended minimum cover to concrete as 20 mm and minimum grade of concrete used is M20 in R.C.C. works.

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References

[1] H. H. Uligh, Corrosion and corrosion control – An Introduction to Corrosion Science and Engineering, John Wiley and Sons, New York, **1971**.
[2] V. Kumpawat; V. Garg; R. K. Tak, *J. Ind. Council. Chem.*, **2009**, 26, 82.
[3] W. Z. Friend, *Corrosion*, **1957**, **13** 81.
[4] F. F. Booth; K. G. Latimer, *corrosion Technique*, **1962**, 315.