International Journal of Scientific Research & Engineering Trends
Volume 5, Issue 2, Mar-Apr-2019, ISSN (Online): 2395-566X

Cathodic Protection to Reinforcements

Chirag Patidar Sajjan Singh Gujjar Shubham Mishra Vivek Dubey Asst. Prof. Pankaj Jadhav
Department of Civil Engineering
Shree L.R. Tiwari College of Engineering
Thane, MH, India

Abstract - Corrosion in the reinforcement is one of the major cause for cracks in structure. Usually beams are provided with slab at the top, so top of the beam is not exposed to environment. Bottom of the beam are exposed to atmospheric conditions and if the cover to reinforcement is insufficient, then corrosion of reinforcement takes place. These cracks generally appear near the side face of the beam near the bottom reinforcement along its length. Corrosion in reinforcement can cause expansion of reinforcement bars due to which cracks are formed. In severe cases it can be prevented by good quality control during its construction by providing Cathodic Protection. Cathodic Protection has been widely used in ship building and underground pipeline.

Keywords **- Corrosion, Reinforcement, Magnesium, Cracks, Cathodic Protection-CP.**

I. INTRODUCTION

Cathodic protection is one of the method of preventing corrosion. Widely applied in naval and Underground piping system. This method can be applied on steel reinforcement in concrete to contain corrosion within the limit. By means of an externally applied electric current, corrosion is reduced virtually to zero, and a metal surface can be maintained in a corrosive environment without deterioration for an indefinite time. Cathodic protection can be applied to any metallic structure in contact with electrolyte. In practice its main use is to protect steel structures buried in soil or immersed in water.

When reinforced concrete is located in alkaline conditions, anions (for example chloride ions, Cl-) can penetrate and diffuse through the body of the concrete and ultimately reach the steel bars and cause corrosion. Once the reinforcement bars in concrete members are corroded, the volume expansion of rust generates radial tension around those bars. With the continuous development corrosion, the tensile stress in the concrete increases and the concrete cover will crack in a longitudinal direction. This is called corrosive cracking in reinforced concrete.

II. EXPERIMENTAL

1. Methodology

Initially a concrete block of M20 Grade was casted. Inserting two new 8mm diameter bars in concrete simultaneously while casting the block. One bar is kept as reference for checking the level of corrosion in the bars and the other bar is subjected bar which is connected to magnesium anode electrically by copper wire. Electrical connectivity was checked by millimetre for proper connection between subjected bar and magnesium anode. This setup is then left under observation period of 3 months under which following results and conclusion were obtained as mentioned below.

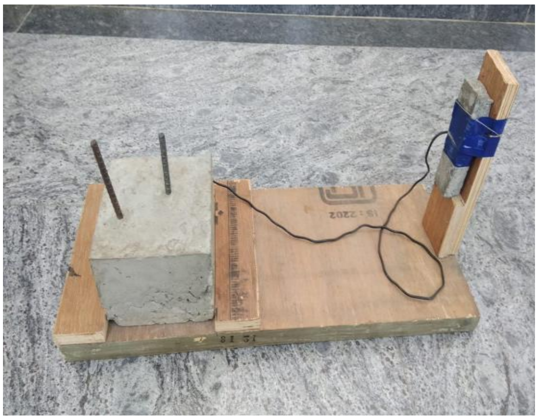

Fig. 1 Setup for Cathodic Protection.

III.CONCEPT SACRIFICIAL ANODE METHOD

Sacrificial Anode method is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. In this method, the metal to be protected is connected to a more easily corroded “sacrificial metal” to act as the anode. The sacrificial metal then corrodes itself instead of the protected metal.

In order for sacrificial anode method to work, the anode must possess a lower (that is, more negative) electrode potential than that of the cathode (the target structure to be protected). The table below shows a simplified galvanic series. This table is used select anode for a given metal to be protected. The anode is chosen from a material that is lower on the table than the material to be protected.

Table 1 Potential of Metals.

Metal	Potential w.r.t a Cu:CuSO4 reference electrode in neutral pH environment (volts)
Carbon, Graphite, Coke	+0.3
Platinum	0 to -0.1
Mill Scale on Steel	-0.2
High Silicon Cast Iron	-0.2
Copper, Brass, Bronze	-0.2
Mild Steel	-0.2
Lead	-0.5
Cast iron (not graphitized)	-0.5
Mild Steel (Rusted)	-0.2 to-0.5
Mild Steel (Clean)	-0.5 to -0.8
Commercially pure Aluminium	-0.8
Zinc	-1.1
Magnesium Alloy (6% Al, 3% Zn, 0.15% Mn)	-1.6
Commercially Pure Magnesium	-1.75

IV. RESULTS AND DISCUSSIONS

During 3 months of experimentation period it was observed that reference reinforcement bar started to corrode while subjected reinforcement bar which was connected to anode was protected against corrosion.

V. CONCLUSION

As it can be seen that steel reinforcement connected electrically to magnesium anode via copper wire is less corroded than reference steel reinforcement. It is safe to presume that sacrificial cathodic protection method is intact. We can conclude that satisfactory results were obtained. Corrosion in the subjected steel reinforcement is reliably limited.

ACKNOWLEDGEMENT

We are very much thankful to our Prof. Pankaj Jadhav and Department of Civil, Shree L.R. Tiwari College of Engineering for providing laboratory.

REFERENCES

1. A. S. Yaro et al.(2011), “Study for Prevention of Steel Corrosion by Sacrificial Anode Cathodic Protection”
2. A. Mathiazhagan,(2010), “Design and Programming of Cathodic Protection for SHIPS”
3. Gopala krishnan et al,(2014), “Cathodic Protection of Pipeline Using Distributed Control System”
4. Jha(2017), “Cathodic protection system for internal surfaces of piping/pipeline”
5. Luz M. Calle and Paul E. Hintze, (2010), “Launch Pad Coatings for Smart Corrosion Control”
6. Yong-Sang et al,(2017), “Optimizing the sacrificial anode cathodic protection of the rail canal structure in seawater using the boundary element method”

Authors

First Author- Chirag Patidar, Undergraduate, Shree L.R. Tiwari college of Engineering.

Second Author- Sajjan Singh Gujjar, Undergraduate, Shree L.R. Tiwari college of Engineering.

Third Author- Shubham Mishra, Undergraduate, Shree L.R. Tiwari college of Engineering.

Fourth Author- Vivek Dubey, Undergraduate, Shree L.R. Tiwari college of Engineering.

Five Author- Asst. Prof. Pankaj Jadhav Shree L.R. Tiwari college of Engineering