International Journal of Engineering, Management and Humanities (IJEMH)
Volume 4, Issue 2, Mar.-Apr. 2023 pp: 65-68 www.ijemh.com

Prevention of steel rebar from corrosion by using corrosion inhibitors

Tejal Patil[1], Dishank Raut[2], Vaibhav phatangare[3], Dipesh Dhadave[4], Shubhra Dhamande[5]

[1,2,3,4] *Student, Department of Civil Engineering, NHITM, Thane, India*
[5]*Asst. Professor, Department of Civil Engineering, NHITM, Thane, India*

Date of Submission: 20-03-2023 Date of Acceptance: 04-04-2023

ABSTRACT: Corrosion of reinforced concrete steel is one of the main reasons for the deterioration of reinforced concrete structure all around the world and the biggest problem that civil engineers are facing today. Various methods have been developed to protect the steel corrosion by using corrosion resistance coatings. Approximately, more than 18 billion dollars per year is incurred on the repair and rehabilitation of corroded structure throughout the world. This paper focuses on corrosion resistance coating chemicals which are used to protect steel rebars. We used Hipoxyphinolic, Zincrichipoxy, Cpcc chemicals on steel rebars. In that chemicals we perform Polarization test, Potentiostatic Impedance test and Tafel Plot test. We found Hipoxyphinolic is better than other chemicals.

KEYWORDS: .
Hipoxyphinolic , zincrichipoxy , Cpcc , Rebar, Corrosion.

I. INTRODUCTION

Corrosion of steel embedded in concrete is one of the major causes of degradation of concrete structure. In the marine environment, the steel bars protected by passive layer is easily attack by chlorides which can penetrate through the concrete cover. (Haibing zheng et al. 2014). Studied casting specimen of concrete with include accelerated carbonation in a control situation and corrosion rate and resistivity was monitored by half-cell potential method.(Heiyantuduwa et al. 2006). Cement polymer composite coated rebar (CPCC) and FBEC in major infrastructure facility including metro rail projects. The sodium and calcium nitrate based / bipolar type / diffusion type corrosion inhibitor also find its use in limited infrastructure project. (M.S. Haji sheik mohammed et al. 2020). Electrochemical impedance spectroscopy (EIS) in the 100kHz - 1 MHz frequency range was employed as main electrochemical technique to study the corrosion protection behaviour of a zincrichipoxy paint in 3% Na-cl solution. (C.M Abreu et al. 1996). corrosion may be defined as deterioration of metal and its alloys due to chemical or electrochemical reaction with its environment. (tan-kang-wei et al.2012) their have been increased of researches devoted to use plant extract as corrosion inhibitor for sustainable development (Abdel-Gaber et al .,2006 ; raja seturaman,2008; abdullah,2011.) polyphenols containing multipal phenolic functionality with diverse chemical structures and properties . letelt polyphinols especially tannin in plants extract have been reported to account for inhabitation of acidic corrosion metals , (rahim et al .,2007;samartha and minakshi , 2008 ;tan and kassim , 2011;hussin and kassin , 2011). The hypothesis that the corrosion Mg alloys can be adequately estimated Tafel extrapolation of polarization curve is termed herein the electrochemical measurement hypothesis for Mg. In principle, such a hypothesis can be disapproved by single valid counter example. The critical review of Mg corrosion by song and atrens in 2003 indicated that, for Mg alloys, Tafel extrapolation had not estimated the corrosion rate reliably. (Zhiming shi et al. 2010). The literature data shows that process of electfochemical polishing is the basic stage in developing functional properties of metal bio materials used for vessel stents due to their miniaturisation. The process of chemical passivation is the basic stage in developing functional properties of Cr-Ni-Mo steel (316LVM type) intended for production of implants.(M.Basiaga et al. 2016). The corrosion damage industrialize countries is known to be significant, 4-6% of the national income. The corrosion -

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 4, Issue 2, Mar.-Apr. 2023 pp: 65-68 www.ijemh.com

include metal losses can be substantially decrease when varies corrosion protection methods are used. The successful application of this methods needs reliable fast methods for controlling the corrosion activity of a medium and determining the corrosion rate of metals and other corrosion parameters. The linear polarization resistance (LPR) method proposed by Geary and stern in 1957 is in wide use among the device methods of corrosion control in liquid con-dusting area. This electrochemical method is based on measuring the polarization resistance of the metal-media interface ear a steady corrosion potential. Here, the corrosion rate express in terms of the metal dissolution current density is inversely proportional to the polarization resistance. (A.T. Fritov et al. 2015)

II. MATERIALS AND METHODS

chemicals

1. Zincrichipoxy
2. Hipoxyphinolic
3. Cpcc

Name	Temperature	Skin infection	colors
Zincrichipoxy	5°C to 40°C	yes	yellow
Hipoxyphinolic	200 °C	no	black
Cpcc	20–60 °C	no	Olive green

physical property

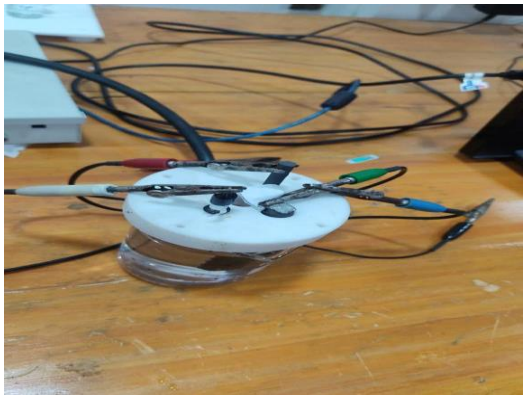
Methods

All the steel rebars samples were cleaned and dried. Length of every rebars is 1.5cm and width 0.7cm. Area of every rebars is 1.05cm^2. We take four samples for testing with same dimension and coloured all samples.

3.5% Sodium chloride solution put into the beaker

.

Reference electrode (AgAgcl) White colour, Counter electrode (graphite rod) Red colour and Working electrode (rebar TMT 500) Green colour.



Chloride permeation

Salt spray chamber Weight the metal keen in salt spray chamber after certain time weight the sample again calculate how much sample is lost corrosion rate in mili inch / year.

WE = Working Electrode made of the sample of which measure's corrosion.

Reference Electrode = Potential applied with respect to reference electrode.

Counter Electrode = Counter measures between counter and working.

When an electrode is immersed in solution potential developed on the electrode

EOC = Open Circuit Potential. Corrosion occurs at this potential .

Potential scan applied - 20ml - EOC - + 20ml

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 4, Issue 2, Mar.-Apr. 2023 pp: 65-68 www.ijemh.com

Zincrichipoxy (Yellow), Hipoxyphinolic (Black) and CPCC (Olive green)

III. RESULT AND DISCUSSION

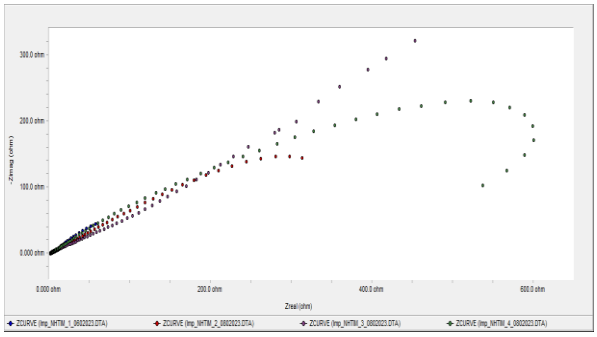
Potentiostatic Impedance :

EIS Experimental Parameters
Initial Frequency : 1 MHz

Final Frequency : 100 MHz
Points per decade : 10
DC Bias 0 mV vs Eoc
AC Amplitude : 10 mV

Impedance at 100 MHz

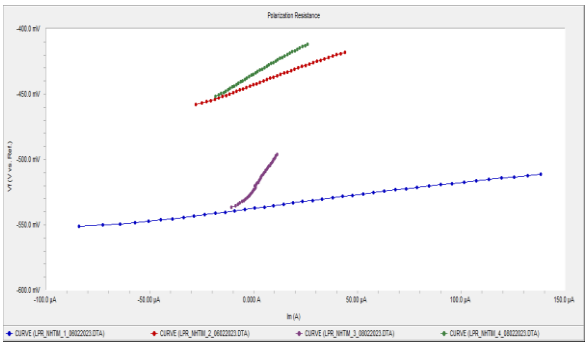
Bare metal : 7 Ohm
Coating 1 : 345 Ohm
Coating 2 : 550 Ohm
Coating 3 : 580 Ohm
Coating 3 has highest impedance of 580 Ohm. This indicates probably the film is dissolving at lower frequencies.



Polarization Resistance Plot

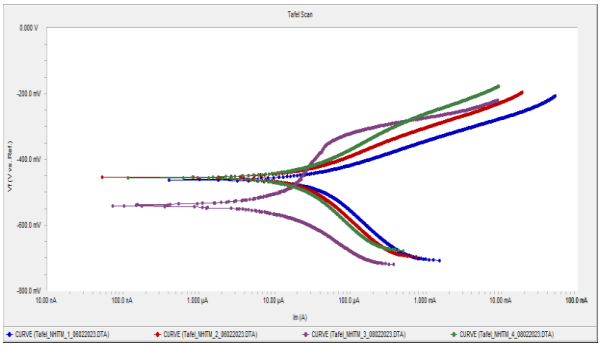
Polarization Resistance
Bare metal : 208.3 Ohm
Coating 1 : 605.8 Ohm
Coating 2 : 2579 Ohm
Coating 3 : 935.5 Ohm
Coating 2 has highest RP value
This is consistent with EIS experiment

Corrosion Rate from RP
Bare metal : 15.91 mpy
Coating 1 : 20.90 mpy
Coating 2 : 4.32 mpy
Coating 3 : 18.66 mpy
Coating 2 has lowest corrosion rate



Tafel Plot

Corrosion Rate from Tafel Plot
Bare metal : 15.91 mpy
Coating 1 : 11.06 mpy
Coating 2 : 2.107 mpy
Coating 3 : 12.40 mpy
Coating 2 has lowest corrosion rate



IV. CONCLUSION

The evaluation and testing of corrosion inhibitors is a crucial step in determining their effectiveness in mitigating the effects of corrosion

on various materials. The testing methods used can range from simple laboratory experiments to more complex field trials.

The effectiveness of corrosion inhibitors can be evaluated by measuring various parameters such as corrosion rate, mass loss, and electrochemical behavior.In addition, other factors such as cost, toxicity, and environmental impact also need to be taken into consideration when selecting a suitable inhibitor.On steel rebar we perform three test. In first test we observed that the 3rd sample means CPCC has high corrosion resistivity.In second test we observed that the 2nd sample means hipoxyphinolic has high corrosion resistivity. In three test we observed that 2nd sample means hipoxyphinolic has high corrosion resistivity. According to three test results the 2nd sample means hipoxyphinolic has high corrosion resistivity than other two inhibitors.

REFERENCES

[1]. M. Basiaga, Z. Paszenda, W. Walke, P. Karasiński, j. Marciniak
j. Information Technologies in Biomedicine, Advances in Intelligent Systems and Computing. Springer **284**, 411-420 (2014).

[2]. M. Kiel, j. Marciniak, j. Szewczenko. Information Technologies in Biomedicine, Advances in Inteliligent Systems and Computing **69**, 447- 456 (2010).

[3]. M. Basiaga, W. Walke, Z. Paszenda, A. Kajzer, Materiali in Tehnologije **50**, 1, 153-158 (2016).

[4]. W. Walke, Z. Paszenda, M. Basiaga, P. Karasiński, M. Kaczmarek, Information Technologies in Biomedicine, Advances in Intelligent Systems and Computing Springer **284**, 403-410 (2014).

[5]. M. R. Saleem, P. Silfsten, S. Honkanen, j. Turunen. Thin Solid Films **520**, 5442–5446 (2012).

[6]. L. Aarik, T. Arroval, R. Rammula, H. Mändar, V. Sammelselg,
j. Aarik. Thin Solid Films **542**, 100–107 (2013)

[7]. H. Kumagai, Y. Masuda, T. Shinagawa. journal of Crystal Growth. **314**, 146-150 (2011).

[8]. L. Wang, X. Zhao, M. H. Ding, H. Zheng et all Applied Surface Science **340**, 113-119 (2015).

[9]. B.S. Lim, A. Rahtu, R.G. Gordon. Nature Materials **2**, 749-754 (2003)

[10]. W. Walke, M. Staszuk. International Conference on Advanced Computational Engineering and Experimenting - ACE-X 2015, Munich, Germany.

[11]. M. Staszuk, W. Walke, Z. Opilski. Materialwissenschaft & Werkstofftechnik **47**, 5, 1-9 (2016).

[12]. C.X. Shan, X. Hou, K.-L. Choy Surface & Coatings Technology **202**, 2399-2402 (2008).

[13]. A. Kajzer, W. Kajzer, j. Dzielicki, D. Matejczyk. Acta of Bioengineering and Biomechanics **2**, 35-44 (2015).

[14]. ASTM F2129-08 Standard Test Method for Conducting Cyclic Potentiodynamic Polarization Measurements to Determine the Corrosion Susceptibility of Small Implant Devices.

[15]. E. Marin, L. Guzman, A. Lanzutti, W. Ensinger, L. Fedrizzi. Thin Solid Films **522**, 283-288 (2012).

[16]. E. Martin, A. Lanzutti, L. Paussa, L. Guzman, L. Fedrizzi. Materials and Corrosion **66**, 909-914 (2015).

[17]. Lee, H. S., Saraswathy, V., Kwon, S. J., Karthick, S. (2018). Corrosion inhibitors for reinforced concrete: A review. In Corrosion inhibitors, principles and recent applications. https://doi.org/10.5772/intechopen.72572.

[18]. Rivetti, M. L. S., da Silva Andrade Neto, J. de Amorim Junior, N. S., Ribeiro, D. V. (2018). Corrosion inhibitors for reinforced concrete. In Corrosion inhibitors, principles and recent applications. https://doi.org/10.5772/intechopen.72772.

[19]. 1.Ormellese,M.,Berra,M.,Bolzoni,F.,&Pastore,T.(2006).Corrosioninhibitorsforchlorides induced corrosion in reinforced concrete structures. Cement and Concrete Research, 36(3), 536–547. https://doi.org/10.1016/j.cemconres.2005.11.007.