International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 03 | Mar 2024 www.irjet.net p-ISSN: 2395-0072

A COMPREHENSIVE REVIEW OF THE EFFECTIVENESS OF CORROSION INHIBITOR

Mrs. Shubhra Dhamande[1], Khan Ammar haider[2], Khan Siraj Ahmed[3], Shah Nikhat Jahan[4]

[1]*Asst. Professor, Department of civil engineering, New Horizon institute of technology and management, Maharashtra, India*
[2]*B.E student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India*
[3]*B.E student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India*
[4]*B.E student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India*

Abstract - *Reinforced Concrete Cement Structures (RCC) are structures where concrete is reinforced with steel bars to increase its strength and durability, therefore corrosion inhibitors are used to promote the cost-effective utilization of steel as a structural material. Migrating Corrosion inhibitors play a critical role in reducing corrosion rates by forming a protective barrier on the surface of rebar to prevent steel corrosion. The experimental investigation of corrosion Inhibitors in RCC Structures carried out by Migrating Corrosion Inhibitors includes method techniques such as Electrochemical Impedance spectroscopy (EIS), Potentiodynamic, polarization, weight loss measurements, and scanning electron microscopy utilized to access the inhibitory efficiency and mechanism of corrosion inhibitors. This process is carried out to study various forms of corrosion processes, such as the chemical and physical properties of corrosion inhibitors, evaluating their inhibiting capabilities, and investigating their impact on the longevity of RCC structures. Different types of corrosion inhibitors are analyzed for their effectiveness in preventing corrosion in RCC. The results showcase the promising inhibitory effects of corrosion inhibitors, with some demonstrating high efficiency in reducing corrosion rates and improving the durability of RCC structures. It is also concluded that for the durability of the RCC, it is recommended to optimize the compositions and application methods of inhibitors for practical implementation in construction and maintenance practices*

Key Words: Corrosion inhibitors, Reinforced Concrete, Corrosion protection, Experimental study, RCC structures

1. INTRODUCTION

Corrosion Inhibitors are Chemicals that are applied to the RCC Structures due to their anti-corrosive property and the same is used as a resistance for the metals in the RCC Structures to avoid them from getting damaged. Since there are several chemical reactions in the environment and whenever there are structures made with metals such as steel which are used in the RCC, due to there are high risks of those metals getting eroded over a while and to protect those structures and to increase its durability the Corrosion Inhibitors are used. Corrosion inhibitors play a prominent role in protecting metal surfaces from degradation in corrosive environments. When introduced to a corrosive setting, these substances reduce the rate of corrosion by creating a protective layer on the metal surface.

There are several types of Corrosion Inhibitors but the Inhibitors which gives better results are the Migrating Corrosion Inhibitors. Migrating corrosion inhibitors are chemicals that move from a metal surface to potential corrosion sites, forming a protective layer to halt the corrosion process. These inhibitors are utilized in diverse applications to safeguard metal structures from degradation.

The Migrating inhibitors either block corrosive agents' access to the metal or adjust the chemical environment to make it less conducive to corrosion. Corrosion inhibitors function through various mechanisms, such as passivation, adsorption, and chemical reactions. These processes delay the corrosion effects and prevent the deterioration of metal surfaces over time. The traditional corrosive inhibitors may stay in the place where it is applied but the migrating corrosion inhibitors have the properties of traveling further and spreading to the metal to which it is applied and protect it from getting corroded over some time.

The experimental evaluation of chemical corrosion inhibitors in Reinforced Concrete (RCC) structures is a critical aspect of modern construction practices. As concrete deterioration due to embedded reinforcement corrosion poses significant challenges globally, developing effective corrosion inhibitors is crucial.

Surface coatings, concrete mix integration, and electrochemical migration are some methods employed to facilitate inhibitor movement within the concrete matrix.

Through experimental investigations and the exploration of various techniques, researchers strive to develop robust

strategies for enhancing the durability and longevity of RCC structures in corrosive environments. The importance of corrosion inhibitors in modern construction cannot be overstated, as they play a crucial role in safeguarding metal surfaces against degradation

1.1 TYPES OF CORROSION INHIBITORS

I. Type of corrosion

1. Carbonation-induced corrosion:

Carbon dioxide from the atmosphere penetrates concrete and reacts with calcium hydroxide to form calcium carbonate, reducing the alkalinity of concrete and exposing reinforcement to corrosion. This type of corrosion can significantly impact the structural integrity of the concrete.

2. Chloride-induced Corrosion:

Chloride ions, often from de-icing salts or seawater, penetrate concrete and oxidize the reinforcing steel, leading to corrosion. The presence of chlorides can break down the protective oxide layer on the steel, making it susceptible to corrosion. Preventive measures such as the use of protective coatings can help mitigate chloride-induced corrosion.

3. Sulfate-induced Corrosion:

Sulfate ions from soil or groundwater can react with the calcium hydroxide in concrete, forming gypsum. This chemical reaction can lead to concrete expansion and cracking, ultimately causing steel reinforcement corrosion. Proper drainage systems and waterproofing can help prevent Sulfate-induced corrosion.

4. Galvanic Corrosion:

When dissimilar metals are in contact with the presence of moisture in concrete, galvanic corrosion can occur. In reinforced concrete structures, this can happen when steel reinforcement comes into contact with other metals or materials. Isolating different metals from each other can help prevent galvanic corrosion.

5. Microbiologically induced corrosion:

Microorganisms in sewage or other environments can produce byproducts that accelerate the corrosion of reinforcement in concrete structures. Proper sanitation and maintenance of sewage systems can mitigate microbiologically induced corrosion.

6. Pitting corrosion:

Localized corrosion that creates small pits in the surface of concrete or steel reinforcement. Pitting corrosion can weaken the structural integrity of the concrete and compromise its durability.

7. Crevice corrosion:

Crevice corrosion occurs in confined spaces or crevices with low oxygen levels, leading to accelerated corrosion. Proper design and construction practices can help minimize the risk of crevice corrosion in reinforced concrete structures.

8. Stress corrosion cracking:

Cracking is caused by the combined influence of tensile stress and a corrosive environment. Proper design considerations and stress-relieving techniques can help prevent stress corrosion cracking in concrete structures.

9. Galvanic corrosion:

Electrochemical interaction between different metals or alloys embedded in concrete can lead to galvanic corrosion. Using compatible materials and coatings can help prevent galvanic corrosion in reinforced concrete structures.

10. Alkali silica reaction (ASR):

The chemical reaction between alkalis in cement and reactive silica in aggregates can lead to the expansion and cracking of concrete. Proper selection of materials and quality control measures can help mitigate the effects of ASR in concrete structures.

II. Types of inhibitors

1. Calcium Nitrite-Based Inhibitors

Act as anodic inhibitors, forming a protective layer on the steel surface that prevents the ingress of chlorides and other corrosive agents. Commonly used in new construction and added to the concrete mix.

2. Organic Inhibitors

Amines, esters, and phosphonates. Form a protective film on the steel surface that reduces the rate of corrosive reactions. Suitable for both new constructions and as treatments for existing structures.

3. Migrating Corrosion Inhibitors (MCI)

Amine carboxylates and other organic compounds. Vaporize and then condense on the metal surface, forming a protective film. They can penetrate through concrete to reach the reinforcement. Applied to existing structures; it can be used as a surface treatment or injected into concrete.

4. Inorganic Inhibitors

Sodium monofluorophosphate, zinc oxide, and silicates. React with the steel surface to form a protective layer, and can also work by passivating the steel. Often used in new

concrete mixes; some can be applied as treatments to existing structures.

5. Mixed Inhibitors

Provide both anodic and cathodic protection, forming a protective film and passivating the steel surface. Suitable for various concrete applications.

6. Surface Coatings

Epoxy coatings, chlorinated rubber paints. Although not inhibitors in the traditional sense, these coatings prevent the ingress of water, oxygen, and chlorides, thus reducing corrosion risk. Applied to exposed surfaces of concrete structures.

7. Cathodic Protection

While technically not an inhibitor, cathodic protection systems protect steel in concrete by making it the cathode of an electrochemical cell. Used in severe corrosion environments, such as marine structures.

8. Electrochemical Treatments

Re-alkalization and chloride extraction. Techniques that alter the chemical environment in the concrete to reduce corrosion risk. Applied to existing structures suffering from chloride-induced corrosion or carbonation.

2. LITERATURE REVIEW

2.1 General

When corrosion inhibitor is used on the surface of RCC structure it has various advantages including the integrity and longevity of metal structures. This review provides an outline of related works of literature in which researchers used different types of corrosion inhibitors on several types of corrosion surfaces and procedures of corrosion inhibitors to stop the deterioration of RCC structure due to chemical reactions with the environment. Depending on their types of corrosion different chemical inhibitors were used to reduce the corrosion on the surface of the RCC to increase its lifespan.

2.2 Basics of Inhibitor

1. C. Montecilli, A. Frignani, G. Trabanelli (2000)

The study assessed the inhibiting properties of different substances against steel corrosion in an alkaline chloride solution and chloride-polluted mortars. It identified sodium nitrite, 5-hexyl-benzotriazole, sodium b-glycerophosphate, and dicyclohexylammonium nitrite as effective inhibitors in preventing pitting corrosion in an alkaline chloride solution. Additionally, the research explored the effectiveness of commercial corrosion inhibitive filming product DINITROL AV 30 1, and admixed tungstosilicic acid, glycerophosphate, and dicyclohexylammonium nitrite in chloride-polluted mortars, demonstrating their potential in corrosion inhibition. GPH-impregnated mortars exhibited an inhibiting efficiency of 88, while DCHAMN-impregnated mortars indicates an inhibiting efficiency of 90 after 6 months of exhibition to chloride-polluted mortars. Electrochemical Impedance Spectroscopy (EIS) is utilized to evaluate the inhibiting ability of the substances.

2. H. Ashassi-Sorkhabia, B. Shaabanib, D. Seifzadeh (2005)

The research paper explores the inhibition of mild steel corrosion in hydrochloric acid using three Schiff base compounds: benzylidene-pyridine-2-yl-amine (referred to as A), (4-benzylidene)-pyridine-2-ylamine (referred to as B), and (4-chloro-benzylidene)-pyridine-2-yl-amine (referred to as C). The study was conducted at 25°C using both electrochemical and weight loss measurements. Polarization curves indicate that the compounds act as mixed-type inhibitors. The results demonstrate that the inhibition efficiency increases with higher inhibitor concentrations and varies depending on the functional groups substituted on the benzene ring. The experimentally derived adsorption isotherms conform to the Langmuir equation. Additionally, the impact of temperature on the corrosion behaviour in the presence of 10^(-2) M of inhibitors was investigated in the temperature scale of 25– 43 8C. The related actuation power of corrosion and other thermodynamic frameworks have been concluded. Through this study it is analysed that all those Schiff Base compounds are outstanding inhibitors .An apparent connection was set up between erosion inhibition effectiveness and amount chemical parameters, using the direct and non-linear QSAR models. The experiment results that is obtained after testing is compared with theoretical results showed corelation indicating the effectiveness.

3. Daoming Shen (2017)

This paper study explains, the “corrosion of reinforced concrete” by studying the methods and issues to protect the steel in concrete. They emphasize on two methods for protection i.e. by creating an exterior protection of structure to avoid the penetration of CO2 so that the water and salts present does give evasion to the external factors through which it gets affected. It also states that at the initially it is difficult to calculate the level of corrosion in the structures since its not discovered and uncertain. They have adopted electrochemical impedance spectroscopy (EIS) for studying the stages and behaviour of the steel in the concrete structures from time to time. Due to this method it becomes convenient to evaluate the procedure of corrosion. They have conducted experiment by adding different ratios of calcium nitrate to study the detailed results. They found that the concrete in which inhibitors were applied has greater strength as compared to the concrete without any inhibitor. During the several experiments carried out on several concrete structures it was evident that the tests that were conducted for pH control it was found that the behaviour of

steel corrosion were relying over the carbonation of the alkaline solutions and the decreament of the pH. This study also concluded that if the Calcium nitrate is applied as a corrosion inhibitor improves its durability and has efficient strength to fight the environmental causing chemical reactions which lead to corrosion. In result it was found that, if the steel is covered with the calcium nitrite as a corrosion inhibitor then it may hinder the growth of the of concrete's durability and strength.

3.3 MCI (Migrating corrosion inhibitor)

1. Ling Shen, Hui Jiang, Jindong Cao, Mengjiao Zhang, Hui Zhang (2020)

This paper study shows that for treating the corroded RCC Structures with the injection of corrosion inhibitors such as Electro-migration (EM) remedy is considered as the crucial and high resulting method to restore the RCC which are corroded due to the external agents such as water, Climatic Conditions, Chemical reaction in the environment. During te procedure of analyzing the inhibiting dominance of the corrosion inhibitors three proclaimed nitrogenous electro-migrating inhibitors were introduced such as: guanidine, 1,6-hexamethylenediamine (HMDA), and 3 aminopropyltriethoxysilane (APS). When these corrosion inhibitors were applied on the concrete structures their ability for protection was compared. Among these corrosion inhibitiors HDMA showed high proficiency for creating resistance of the aggressive factors from the environment to enter into the RCC Structures. The present study shows that different corrosion inhibitors are having different quality for protecting and rejuvenating the affected and corroded RCC structures. The guanidine had less effect on the cement structure but it had the quality of improvising the alkalinity of the cement. But HDMA has shown its higher efficiency in removing the corrosion causing chloride ions and increase the durability of the mortar wheras it has lowest re-alkalization property.

2. R. Vedalakshmi, K. RajaGopaland and N. Palaniswamy (2007).

This case paper studies the determination of migration efficiency of amino alcohol based migration corrosion inhibitor through concrete. While carrying out this experiment two types of Migrating Corrosion Inhibitor (MCI) such as Organic and Inorganic MCI were applied to the Mortar in order to check its efficiency. Inorganic inhibitors like nitrate and sodium monofluoro phosphate transform the oxidised steel on the steel in the RCC which increased the efficiency and durability. Whereas the organic inhibitors are made of alkanolamines and amines of amino carboxylate. They are applied to the metal surface which created monomolecular bridge which reduces the anodic and cathodic reactions. It was also found that when the concrete was already erected then MCI technique is applied by measuring corrosion using Tafel extrapolation technique.

3. M. Ormellese, F. Bolzoni, S. Goidanich, MP Pedeferri and A. Brenna (2011)

This present study refers to corrosion inhibitors in reinforced concrete structures. It shows that to prevent corrosion of the rebar, corrosion inhibitors are used at the initial stage of the construction for strengthening and if the construction is already done then the RCC structures are injected through migrating concrete inhibitors for rehabilitation. Two tests were carried out namely Diffusion Test and Capillary absorption Test in the previous six years on the concrete by both mixed and migrating inhibitors. Through these experiments the ability of the concrete to absorb the migrating corrosion inhibitor were determined. And in result it was found that Capillary absorption test showed higher concentration of inhibitor when the concrete specimen were immersed in the inhibitor from time to time. In these experiments when the mixed inhibitors were introduced to the concrete it resisted both chloride based corrosion and carbonated concrete.

4. Congtao Sun, Ming Sun, Junde Liu, Zhenping Dong, Liang Fan and Jizhou Duan (2022)

The anticorrosion performance on RC was exposed to different degrees of chloride of MCI such as Commercial Amino alcohol. Tests were performed in order to analyse the effect of MCI on the rebar affected by chloride, under several methods such as Electrochemical impedance spectroscopy (EIS), potentiodynamic polarization (PD), scanning electron microscopy, and energy dispersive spectroscopy (SEM-EDS). While carrying out the process of calculating the resistance of the corrosion steel bars it was evidently shown that the MCIs that were applied at the earlier stage to the concrete prior to chloride erosion showed higher anti- corrosion efficiency of 55.35% than that to the concrete which it was applied after ninth drying wetting cycle and found that the efficiency decreased by 3.40%.

5. Behzad Bavarian, Akinbosede Oluwaseye, Lisa Reiner (2018).

This research paper studies about Migrating Corrosion inhibitors to protect steel reinforced concrete structures. The concrete structures which are made for roads, high ways, over bridge and bridges for heavy vehicles to commute on daily basis are made steel and concrete structures. The structures of the steel are in the form of girders, piles, rails or embedded in concrete to form reinforced structures. Ordinary Portland Cement is alkaline in nature which provides great protection to the concrete for embedded steel. The harsh chemical ions pass through the concrete since the concrete is permeable even if the concrete be of very good quality. Migrating corrosion inhibitor, a mixture of amine carboxylates and amino alcohols, show adaptation as admixtures, surface treatments, and in restoration programs. After corrosion tests inspection of embedded rebar was done where sample of MCI treated concrete

showed no corrosion attack samples, whereas non-treated concrete showed localized corrosion. They examined that the inhibitor reached the surface of steel in about 150 days this was detected using X-ray photoelectron spectroscopy and depth profiling. The amine-rich compound after applied on the steel surface which is exposed to chloride effect, improved corrosion protection for the MCI-treated steel rebar prevented formation of red rust.

3.4 Chemicals in Corrosion Inhibitor

1. F. Benhiba, N.K. Sebbar , H. Bourazmi , M.E. Belghiti , R. Hsissou ,T. Hokulea , A. Bellaouchou , A. Guenbour , I. Warad , H. Oudda , A. Zarrouk , E.M. Essassi (2021)

The paper investigates the corrosion inhibition of 4-(prop-2-ynyl)-2H [1,4]-benzothiazin-3(4H)-one (PBO) was synthesized and evaluated on corrosion resistance for mild steel (MS) in1 M HCl environment. The molecular and crystal clear structure of PBO has been determined by single-demitasseX-ray crystallography, Hirshfeld face analysis was carried out by using Crystal Explorer17.5. To find corrosion rate, corrosion inhibition efficiency in the presence and absence of PBO where PBO has mixed type mechanism. Theoretical studies using DFT and molecular dynamics simulations supported the experimental results, showing the parallel adsorption of PBO molecules with the iron surface. The PBO monocrystal, which had 92% at a concentration of 0.001 M at 303 K, and Langmuir isotherm proved the highest compliance with experimental data, representing the generation of protective mono-layer inhibitors on the MS substrate.

2. Hwa-Sung Ryu, Jitendra Kumar Singh, Hyun-Min Yang, Han-Seung Lee, Mohamed A. Ismail (2016)

This paper evaluates the corrosion resistance properties of N, N 0 -Dimethyl ethanolamine (DMEA) corrosion inhibitor in saturated Ca(OH)2 solution with different concentrations of chloride ions is revealed through electrochemical experiments and pitting corrosion resistance with NaCl is explained through potentiodynamic experiment. There are different techniques that helps the steel rebar from protection that is embedded in concrete. In this, the Steel rebars attain passivity in a concrete environment. Commercially available N, N0-Dimethyl ethanol amine (DMEA) inhibitor is studied in different concentrations of NaCl in saturated Ca(OH)2 solution. The inhibiting efficiency was calculated by potential time, electrochemical impedance spectroscopy, and potentiodynamic by reducing the corrosion DMEA inhibitor showed 63–74% efficiency.

3. Arpit Goyal, Eshmaiel Ganjian, Homayoon Sadeghi Pouya, Mark Tyrer (2021)

The paper investigates the inhibiting efficiency of migration corrosion inhibitors for RC structures exposed to a high chloride present in the environment. The effective types of inhibitors such as organo-functional silanes which shows the best inhibitor efficiency, Amino-alcohol, and Surfactant & amine salts-based inhibitors was investigated using electrochemical study and permeability measurements to determine the most efficient inhibitor to protect RC structures which is effected by a high chloride effect that is present in the environment. organo-functional showed good results compared to potential-time behaviour of different MCI-treated concrete with control specimens over a period of 70 days. Organo-functional silanes MCI-1 and MCI-2 showed the less corrosion rate and potential values highest electrical resistivity and water absorption was also observed for MCI-1 and MCI-2 inhibitors, indicating enhanced barrier properties. These results indicate that all specimens treated with corrosion inhibitors showed a reduced corrosion rate compared to the control specimens but this inhibitor requires more time to attack the rebar to provide protection form chloride environments.

4. M. Sánchez, M.C. Alonso (2011)

In this paper, the simultaneous application of Electrochemical Chloride Extraction and electric field is used. Electrochemical Chloride Extraction is becoming a common methodology for repairing reinforced structures The migration of erosion impediments can be promoted by the operation of an electric field, enhancing in this way the transport of the asset.. The migration of nitrite to the rebar is promoted during the application of an ECE treatment by modifying the classical configuration through the connection of an external cathode to the rebar. The response of the rebar after the electrochemical treatment it is evaluated by corrosion potential and polarization resistance measurements. The efficiency of the treatment was confirmed by the visual inspection of the rebar and the analysis of chloride and nitrite at the level of the rebar. An efficient arrangement for penetrating nitrite as an anionic corrosion inhibitor during electrochemical treatment of repair with the connection of the rebar to an external cathode is proposed. The treatment in chloride removal obtained is 35% higher. The nitrite ion present on rebar after the electrochemical treatment has been confirmed it maintains the faster and efficient passivation with time.

5. L. Benzina Mechmeche, L. Dhouibi, M. Ben Ouezdou, E. Triki, F. Zucchi (2007)

This paper focuses on the investigation of the effectiveness of an amino-alcohol based corrosion inhibitor in simulated pore solutions and mortar specimens, considering both curative and preventive modes of use. The effectiveness of the corrosion inhibitor was investigated through corrosion potential measurements, polarization curves, and microscopic observations. In which Curative and Preventive modes of inhibitor was tested, preventive inhibitor showed good results before contamination with chlorides while curative inhibitor reduced the effect in presence of chloride in stimulated pore solution. The reinforcement

electrochemical behaviour was assessed through corrosion potential measurements and the study of current density evolution.

6. Tayfun Altug Söylev, Ciaran McNally , Mark Richardson (2007)

In this study the effectiveness of amino alcohol based applied on the surface of a Rebar was investigated for two generations high as well as low chloride effect, for higher chloride effect the inhibitor was not effective and for low chloride it was effective. Results was observed that the second generation of amino alcohol-based inhibitor applied showed low corrosion as compared to without inhibitor which is exposed to high chloride effect compared to control samples effectiveness increased with chloride concentration.

8. Xifeng Yang, Feng Li, corresponding author and Weiwei Zhang (2019)

In this paper author focused on eco-friendly corrosion inhibitor. They created 4-(pyridin-4-yl)thiazol-2-amine (PTA), and found inhibitor against corrosion for mild steel in 1 M HCl solution. Its effectiveness against mild steel was found out through weight loss test, electrochemical measurements and surface analyses. The experimental results showed that corrosion inhibitor was effective on mild steel when exposed to acid medium and the maximum efficiency was observed as 96.06% at 0.2 mm as concentration.

7. **I.A.Akpan, N.O.Offiong (2013**

This case paper studies about effects of ethanolamine and ethylamine on the Entrophy content of the corrosion of mild steel in 1mol/1HCL Solution. While carrying out the tests it was noticed that the adsorption of the inhibitors by the corroded metal surface decides their inhibitive quality. After the applications of these two acids it was found that ethylamine has higher efficiency as that of ethanolamine. Ethanolamine and ethylamine were seen to be reacting with different weight loss method at room temperature and it was found that the inhibition efficiency increased as the concentration of these chemicals while using it as inhibitors were raised. The molecular structure of the inhibitors such as mentioned above describes their molecular structures.

3.5 Experiment on Corrosion

1. Renato Altobelli Antunes, Rodrigo Uchida Ichikawa, Luis Gallego Martinez, and Isolda Costa (2014) et.al

The paper compares the corrosion products formed on carbon steel plates exposed to atmospheric corrosion in urban and industrial atmospheres which formed after accelerated corrosion tests. Specimen 'A' exposed to natural weathering for about nine months under the Raman spectroscopy, Lepidocrocite and goethite were formed as the main phases on carbon steel exposed to natural weathering and Specimen 'B' were in urban polluted atmosphere for about nine months under the Mossbauer spectroscopy, showed the presence of lepidocrocite for most samples which effected the resolution issue of results. Using scanning electron microscopy corrosion inhibitor structure was found out. Major oxide phase on the specimen 'A' was magnetite, goethite and smaller amount of lepidocrocite and in specimen 'B' typical iron oxide component Akageneite was identified which is present in marine environment. The results showed that an alternated fog/dry cycle combined with UV radiation exposure provided better correlation as compared to the results of ASTM B117, Raman spectroscopy and Mössbauer spectroscopy was capable of showing the different oxide phases formed on carbon steel.

2. Haibing Zheng, Weihua Li Fubin Ma, Qinglin Kong (2013)

In the present work, the working of an amino alcohol-based surface applied inhibitor which shows action of quick adsorption of on rebar in which the inhibitor protect the steel bar after the chloride effect happens and with increase of this chemical concentrations the inhibition of the corrosion inhibitor improves. To find the performance of corrosion inhibitor applied on the surface in saturated Ca(OH)2 solutions Electrochemical measurements is used to eliminate the pore blocking effect on concrete by influencing it. As the increasing concentration in the inhibitor the effect on RCC increased which is contaminated to different chloride concentrations is found out through tests like electrochemical techniques, scanning electron microscopy, and energy diffraction spectrum analysis.

3. Ebrahim Afsar Dizaj, Rahmat Madandoust & Mohammad M. Kashani (2017)

The paper proposes a non-linear finite element framework which found out impaction on rectangular reinforced concrete columns caused corrosion damage which reduces the ductility of RCC by changing failure mode and suggests that the damage limit should be considered of time changing of seismic fragility analysis on corrosion structures.

4. Yunze Xu, Mike Yongjun Tan (2019)

The paper explores the initiation and propagation processes of flow-accelerated corrosion in which the flow-generated interfacial anolyte transportation and small-scale turbulences around initial pits appear in a flow mark corrosion. Erosion corrosion is caused by the impingement of sand particles under simulated turbulent flow conditions on the side of initial anodes which leads to crater-appearance corrosion. To find out interactions between flow accelerate corrosion and erosion corrosion they use electrochemically integrated multi-electrode arrangement and electrochemical impedance spectroscopy in propagation and initiation. They also mention the use of a wire beam electrode method in with gravimetric and electrochemical

measurements to understand in detail processes associated with flow accelerated corrosion and Erosion corrosion.

3. CONCLUSIONS

1. According to the Literature Review it can be concluded corrosion inhibitors are modern and effective for Rebars in harsh environments.

2. Electrochemical studies are Reliable techniques to find ingression of corrosion in the RCC Structures.

3. Electrochemical Studies are more reliable as they give accelerated corrosion state of steel in the laboratory investigation which is matching to field conditions.

4. The impact of corrosion inhibitors on the durability and longevity of RCC structures has been assessed.

REFERENCES

1. Arpit Goyal a, *. E. (2021). Inhibitor efficiency of migratory corrosion inhibitors to reduce corrosion in reinforced concrete exposed to high chloride environment. *www.elsevier.com/locate/conbuildmat*, 303.

2. Behzad Bavarian, A. O. (2018). Migrating Corrosion Inhibitors to Protect Reinforced Concrete Structures. *NACE International*, 63-72.

3. BEHZAD BAVARIAN, A. O. (2018). Migrating Corrosion Inhibitors to Protect Steel Reinforced Concrete Structures. *VCI*, 23.

4. C. Monticelli*, A. F. (2000). A study on corrosion inhibitors for concrete application. *Cement and Concrete Research*, 63-67.

5. Congtao Sun 1, 2. M. (2022). Anti-Corrosion Performance of Migratory Corrosion Inhibitors on Reinforced Concrete Exposed to Varying Degrees of Chloride Erosion . *MDPI*, 20.

6. Ebrahim Afsar Dizaj, R. M. (2017). Exploring the impact of chloride-induced corrosion on seismic damage limit states and residual capacity of reinforced concrete structures. *http://www.tandfonline.com/loi/nsie20*, 125.

7. F. Benhiba a, c. N. (2019). Corrosion inhibition performance of 4-(prop-2-only)- [1,4]-benzothiazin-3-one against mild steelin 1 M HCl solution: Experimental and theoretical. *i n t e r n a t i o n a l journal o f hydrogen energy*, 291.

8. Haibing Zheng a, W. L. (2014). The performance of a surface-applied corrosion inhibitor for the carbon steel in saturated Ca(OH)2 solutions. *Cement and Concrete Research*, 55.

9. Hwa-Sung Ryu a, J. K.-M.-S. (2016). Evaluation of corrosion resistance properties of N, N0-Dimethyl ethanolamine corrosion inhibitor in saturated Ca(OH)2 solution with different concentrations of chloride ions by electrochemical experiments. *www.elsevier.com/locate/conbuildmat*, 114.

10. I.A.Akpan*. (2011). Effects of ethanolamine and ethylamine on the entropy content of the corrosion of mild steel in 1mol/l HCl solution. *PCAIJ*, 44-51.

11. L. Benzina Mechmeche a, L. D. (2008). Investigation of the early effectiveness of an amino-alcohol-based corrosion inhibitor using simulated pore solutions and mortar specimens. *Cement & Concrete Composites*, 30.

12. Ling Shen a, H. J. (2020). A comparison study of the performance of three electro-migrating corrosion inhibitors in improving concrete durability and rehabilitating decayed reinforced concrete. *www.elsevier.com/locate/conbuildmat*, 18.

13. M. Ormellese*, F. B. (2011). Corrosion inhibitors in reinforced concrete structures. *Corrosion Engineering, Science and Technology*, 44-76.

14. R. Vedalakshmi*1, K. R. (2009). Determination of migration efficiency of amino alcohol-based migrating corrosion inhibitor through concrete. *Corrosion Engineering, Science and Technology*, 50-62.

15. Renato Altobelli Antunes, 1. R. (2014). Characterization of Corrosion Products on Carbon Steel Exposed to Natural Weathering and to Accelerated Corrosion Tests. *Hindawi Publishing Corporation International Journal of Corrosion*, 9.

16. Renato Altobelli Antunes, 1. R. (2014). Characterization of Corrosion Products on Carbon Steel Exposed to Natural Weathering and to Accelerated Corrosion Tests. *Hindawi Publishing Corporation International Journal of Corrosion*, 91.

17. Shen, D. (2017). Electrochemical Impedance Spectroscopy Study on Corrosion Inhibitor for Reinforced Concrete. *International Journal of*, 54-81.

18. Tayfun Altug Söylev a, ∗. C. (2007). Effectiveness of amino alcohol-based surface-applied corrosion inhibitors in chloride-contaminated concrete. *Cement and Concrete Research*, 31.

19. Yunze Xua, b. M. (2019). Probing the initiation and propagation processes of flow accelerated corrosion

and erosion-corrosion under simulated turbulent flow conditions. *Corrosion Science*, 151.

20. BIOGRAPHIES

Shubhra Dhamande
(*Asst. Professor, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)*

Khan Ammar Haider
(*B.E student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)*

Khan Siraj Ahmed
(*B.E student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)*

Shah Nikhat Jahan
(*B.E student, Department of Civil Engineering, New Horizon Institute of Technology and management, Maharashtra, India)*