Indian J.Sci.Res. 20(2): 79-82, 2018

ISSN: 0976-2876 (Print)
ISSN: 2250-0138(Online)

EXPERIMENTAL STUDY ON ANTI-CORROSION TECHNIQUE BY USING NANO MATERIALS IN REBAR

M. SELVAPRIYA[a1], T. RAMASAMY[b], E. APNA[c], S. GOKILA[d] AND K. ASHWINI[e]

[abcde]Department of Civil Engineering, Mahendra Engineering College, Namakkal, Tamilnadu, India

ABSTRACT

Corrosion of embedded reinforcement is the most prevalent form of degradation of reinforced concrete structures, and may impair structural capacity through loss of bar section, loss of bond between reinforcement and concrete as a result of longitudinal cracking, or loss of concrete cross section. The effect of corrosion attacked reinforcement is investigated through physical tests on bars with simulated corrosion damage. The test was performed with three different diameters like 12 mm, 16 mm and 20 mm. The rod was corroded with accelerated corrosion test setup with duration of 0 to 200 hours with interval of 25 hours. The rod was coated with epoxy, epoxy with cement coating, epoxy along with cement and nano silica coating. The weight losses of Rebar's were found 0 to 200 hours. This investigation reveals that the Nano silica coated bar performed well compared to all other coating with respect to weight losses of rebar. Also, the acceleration corrosion was induced with help of AC to DC power pack. It indicates that Nano silica coating significantly reduced the corrosion of steel reinforcement.

KEYWORDS: Nano Silica, Steel Reinforcement, Structural Capacity, Epoxy

Concrete is the most common used material for construction and their design consumes almost the total cement production in the world. The use of large quantities of cement produces increasing CO2 emissions, and as a consequence the green-house effect. A method to reduce the cement content in concrete mixes is the use of Nano particles.

Corrosion

Corrosion is the slow and continuous (or) gradual destruction of material (metal or alloy) by the chemical (or) electro chemical reaction with its Environment. Because of Corrosion, the material is converted into its compounds. Hence, the weight of the metal is decreased. And also strength is reduced. The corroded material becomes un-suitable for any work.

Nanotechnology

Nanotechnology is the design, characterization, production and application structures, devices and systems by controlling shape and size at nano meter scale Nanotechnology is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. Application of many of the developments in the nanotechnology field in the area of construction engineering is growing**.**

Application of Nanotechnology

- Lighter and stronger structural composites.
- Low maintenance coating.
- Improving pipe joining materials and techniques.
- Better properties of corrosion protection materials.
- Reducing the thermal transfer rate of fire resistance.
- Increasing the sound absorption of acoustic absorber.
- Increasing the reflectivity of glass.

Nanotechnology in Anti-Corrosion Coating

A large number of large steel structure is an important part of the infrastructure. The use of carbon steel and some low alloy steel has good mechanical properties, but there are serious electrochemical corrosion. In a variety of corrosion control methods, the main use of different surface treatments and applied anti-corrosion coating method for protection of large steel structures.

Currently, a nanotechnology product in the steel heavy-duty applications is still in its infancy. A reasonable selection: According to the medium and conditions of use, select the appropriate material.

Scope of the Work

- To determine the coating effect of TMT bars with Nano silica
- To determine better coating method to prevent the corrosion of steel reinforcement
- To determine percentage of loss of steel reinforcement with respect to corrosion
- To determine percentage of loss of different duration of steel reinforcement with different dia of rods with corrosion environment

[1]Corresponding Author

- To determine the rate of corrosion with respect to different coating and rods

Properties of Thermo Mechanically Treated (TMT) Bar

Table 1: Properties of Thermo Mechanically Treated (TMT) Bar

Sl. No.	Diameter	Yield stress (MPa)	Ultimate load (MPa)
1	12 mm	0.698	79
2	16 mm	0.586	118
3	20 mm	0.654	205

Specimen Images

Figure 1: TMT Rod Specimens for Testing

Experimental Setup

Experimental setup was developed with aggressive environment with help of accelerated corrosion test. In This Investigation Deals with Effect of Steel Reinforcement in Corrosion Environment

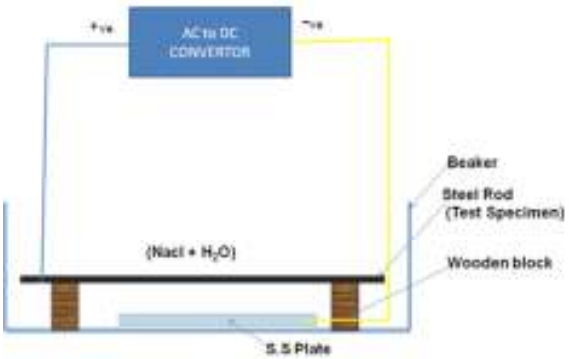

Figure 2: Experimental setup

MATERIALS AND METHODS

TMT rods of sizes 12mm, 16mm and20mm are taken. The rods are then undergone corrosion placing in a horizontal position inside a barrel mixed with water containing 3 % of salt (Nacl). From Ac to Dc convertor the current is passed in such a way that positive end is connected to stainless steel plate immersed inside the water and Negative end to the rods. After passing 12 volt current for about 200 hours the rods are disconnected. Again the rods were weighted with weight balance.

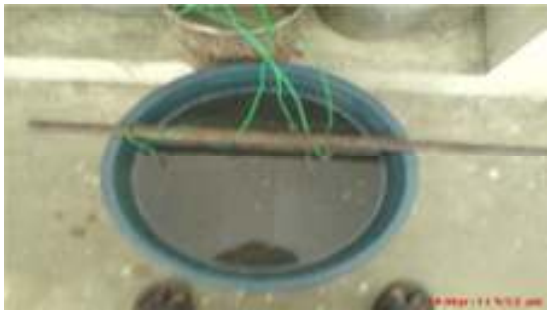

Figure 3: Corrosion rod with Nacl

Figure 4: Passing Current to rod

Figure 5: Balancing rod

Applied Voltage Test

The effect of electrical and electrochemical stresses on the bond of coating to steel and no film integrity of the coating shall be assessed. A non-conductive plastic material shall be used for the vessel or a lining in a metallic vessel. A potential of 12V shall be applied. No film failure as evidenced by evolution of hydrogen gas at the cathode or appearance of corrosion products of iron at the anode, shall take place during first

hour of testing. The test shall be continued for 9 days and the elapsed time for development of the first holiday shall be recorded.

Figure 6: Ac to Dc Produced For Impressed Current

Nano-silica & epoxy coating for TMT rod

Figure 7: Solution of Nano silica and rod

Figure 8: Coated rod

Figure 9: Corroded rod

Xrd Properties of Nano – Silica

Table 2: Xrd Properties of Nano silica

Sl. No.	Test	Test Results
1	Raw Data Origin	XRD measurement (*.XRDML)
2	Scan Axis	Gonio
3	Start Position [^{0}2 Th.]	10.0881
4	End Position [^{0}2 Th.]	79.9381
5	Step Size [^{0}2 Th.]	0.0500
6	Scan Step Time [s]	10.1382
7	Scan Type	Continuous
8	PSD Mode	Scanning
9	PSD Length [^{0}2 Th.]	2.12
10	Offset [^{0}2 Th.]	0.0000
11	Divergence Slit Type	Fixed
12	Divergence Slit Size [^{0}]	0.4785
13	Specimen Length [mm]	10.00
14	Measurement Temperature [^{0}]	25.00
15	Anode Material	Cu
16	K-Alpha 1 [Å]	1.54060
17	K-Alpha 2 [Å]	1.54443
18	K-Beta [Å]	1.39225
19	K-A2/K-A1 Ratio	0.50000
20	Generator Settings	30 mA, 40 kV
21	Diffractometer Type	00000000110246 44
22	Diffractometer Number	0
23	Goniometer Radius [mm]	240.00
24	Dist. Focus-Diverg. Slit [mm]	91.00
25	Incident Beam Monochromator	No

SUMMARY AND CONCLUSION

Concluded in this experimental study the effect of Nano coating with respect to corrosion of rebar. Nano Silica Coating is the best coating material and it helps to prevent the corrosion in steel reinforcement when compare to all other coating materials like Epoxy, Cement coating. Nano materials plays vital role in the field of Science & Technology by using various applications.

This helps to improve the values and properties of the materials. This work nano-silica with cement and epoxy on the building steels acts as the corrosive resistances on that materials. This improves the reduction of the corrosion and reduces the loss of materials by corrosion. When compared to Epoxy + Cement Coating

(EC+CC) the percentage of Weight loses is reduced 5.03% than Epoxy Coating (EC).

REFERENCES

Akio Hikasa, Tohru Sekino, Yamato Hayashi and Ramaseshan Rajagopalan, 2003. Preparation and Corrosion Studies of Self-Healing Multi-Layered Nano Coatings of Silica and Swelling Clay.

Raiess Ghasemi A.M, Parhizkar T. and Ramezanianpour A.A., 2010. Influence of Colloidal Nano-Sio2 Addition as Silica Fume Replacement Material in Properties of Concrete.

Castro Y., Ferrari B., Moreno R. and Duran A., 2004. Coatings Produced by Electrophoretic Deposition from Nano-Particulate Silica Sol– Gel Suspensions. Surf. Coat. Technol., **182**: 199–203.

Ayres C.F., En Nett M.J., Gohi D.D., The Behaviour of Amorphous Silica Coatings at High Temperatures in Aggressive Environments.

Daniel Cristea, Cristian Ionescu, Alexandru Munteanu and Daniel Munteanu, The Corrosion Characterization of Ti-Si-C Thin Films Obtained by Magnetron Sputtering Deposition.

Stojanovic D., Orlovic A. and Markovic S., 2009. Springer Science+Business Media Nanosilica/Pmma Composites Obtained by the Modification of Silica Nanoparticles in A Supercritical Carbon Dioxide–Ethanol Mixture.

Quercia G. and Brouwers H.J.H., 2010. Application of Nano-Silica (Ns) in Concrete Mixtures pensions (July 2003).

Quercia G. and Brouwers H.J.H., Application of Nano-Silica (Ns) in Concrete Mixtures.

Laurent Akessoa, Michala E. Pettittb and James A. Callow, 2009. The Potential of Nano-Structured Silicon Oxide type Coatings Deposited by Pacvd for control of Aquatic Biofouling.

Pang X. and Zhitomirsky I., 2005. Electro deposition of Nano composite Organic–Inorganic Coatings for Biomedical Applications. Int. J. Nanosci., **4**: 409–418.

Chen Q., 2009. Silica Coating of Nanoparticles by Sonogel Process.

Voevodin N., Balbyshev V.N., Khobaib M. and Donley M.S., 2003. Nano structured Coatings Approach for Corrosion Protection. Prog.Org. Coat., **47**:416–423.

Wang Y., Limb S., Luob J.L. and Xub Z.H., 2006. Tribological and Corrosion Behaviors of Al2o3/Polymer Nano composite coatings. wear, **260**: 976–983.

Sol–Gel Susa. Jumahat C. and Soutis F.R. Jones, 2010. Effect of Silica Nanoparticles on Compressive Properties of an Epoxy Polymer.

Zhenyu Wang, Enhou Hany, Fuchun Liu and Wei Ke 2009. Fire and Corrosion Resistances of Intumescent Nano-Coating Containing Nano-Sio2 in Salt Spray Condition.