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STUDY OF CORROSION PREVENTION OF STEEL IN R.C.ELEMENTS WITH REPLACEMENT OF FINE AGGREGATE BY WASTE MATERIALS

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Abstract The main objective of this project is to describe some of the important topics related to corrosion prevention in R.C. Elements by Nitro Zinc, Rust remover and polyester resin. Phosphate coatings have a wide field of applications in industry. The aim of the present work is to control the corrosion *i.e* ion concentration in the phosphate bath in order to improve the quality and adhesive properties of Nitro zinc coatings in steel. Rust remover soak quickly dissolves rust from metal and restores surfaces to bare metal without scraping, chipping or scrubbing. It removes light rust, leave the parts in 1-3 hours. The term polyester is typically reserved for acidic and hydroxyl functional polyester resin. The family of polyester comprises all polymers with ester functional groups in the polymer backbone. Therefore the chemistry of the structural units connecting the ester groups can be varied over an immense broad. The application of Nitro -Zinc helps the formation of thin inert layer on the metal surface to be protected. Material for anti–corrosion paint is used in reinforcements. Nitro zinc has a large crystalline structure. The large crystalline is an excellent medium for holding oil and adhering to paint. The phosphate also improves lubricity. Appearance is gray. The coating shows satisfactory corrosion resistance for high durability in concrete structure.

Index Terms* – Corrosion, *Nitro -Zinc, polyester resin, strength parameters.

I. INTRODUCTION

Steel reinforcement is widely used in the concrete. The residual life of the concrete structures exposed to varied and aggressive environment depends on the depth of carbonation and de-alkalization of the cast-concrete is a well known phenomenon, yet focus on this aspect is very limited. Also, methods of de-carbonization and delayed alkalization have not been paid systematic research approach. When steel embedded in concrete corrodes, the increase in volume from metallic steel to corrosion product produces an expansive force, which can rupture the concrete. After a crack has been formed in this way, the steel corrodes even more rapidly, leading ultimately to complete failure of the structural member involved. The reinforced concrete is used throughout the world to build infrastructure and building. Today, the large numbers of civil infrastructures around the world in a state of serious deterioration due to carbonation, chloride attack, etc. The term polyester is typically reserved for acidic and hydroxyl functional polyester resin. Nitro -Zinc has a large crystalline structure. The large crystalline is an excellent medium for holding oil and adhering to paint. The coating shows satisfactory corrosion resistance for high durability in concrete structure.

II. LITERATURE REVIEW

T Charng and F.Lansing et al[1].(1982) this report summarize a general review of causes of corrosion of metals and their alloys. The corrosion mechanism is explained using the concept of electro chemical reaction theory. The causes and methods of controlling of both physicochemical corrosion and biological corrosion are presented in detail. Factors which influence the rate of corrosion are also discussed.

Thangavel .K, et al[2]., conducted experiments to study the influence of rebar coatings on the steel-concrete bond. Their conclusions are:

1. Coated steel rebar improved the bond strength when compared with plain mild steel rebar.
2. Galvanizing and epoxy coatings reduce the bond strength at higher thickness of coatings. On the other hand, the bon strength improves further at higher thickness of coating in the case of inhibited cement slurry coatings is for the increase in bond

strength is that the inhibited cement slurry coating is cement based and hence compatible with the surrounding concrete.

.**Gonzalez, J.A et al[3].** have studied the corrosion mechanism of rebars and also the role of oxygen in the mechanism. They conducted that the beginning of corrosion, oxygen required and for this the oxygen in the pores of the concrete is consumed. The process continues due to cyclic catalytic mechanism similar to that in the atmospheric corrosion of steel in the presence of sulphur-di- oxide or chlorides.

The effect of chloride ions on the corrosion of rebars and have concluded that the presence of chloride ions in concrete reduces the life of RC structures to less than 10 years. Chloride ions increase the rate of corrosion and hence induce cracking of cover concrete due to corrosion.

Sugumar P[4] has compared the weight loss of steel due to corrosion of Tiscon CRS, ordinary Fe 415 and coated Fe 415.He conducted that the loss in weight for coated rebar is about 30% less than that for uncoated rods and about 20% less than for CRS. The time enquired for CRS and coated Fe415 is 30 to 40% more than that for uncoated Fe415 rods.

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III. PROPERTIES OF MATERIALS

(OPC 43 grade)

Cement

A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete.

TABLE 1. PROPERTIES OF CEMENT

SI.NO	Properties	Result
1.	Initial setting time	30min
2.	Final setting time	300min
3.	Specific gravity	3.16
4.	Consistency	35%

Fine aggregate

Fine Aggregate is the granular material used to produce concrete or mortar and when the particles of the granular materials are so fine that they pass through a 4.7mm sieve

TABLE 2. PROPERTIES OF FINE AGGREGATE

SI.NO	Properties	Result
1.	Specific gravity	2.65
2.	Water absorption	0.65%
3.	Fineness modulus	2.85
4.	Bulk density	1799kg/m^3

Coarse aggregate

Coarse aggregate is the portion of the concrete which is made up of the larger stones embedded in the mix. Concrete contains three ingredients; water, cement, and aggregate. That aggregate is made of fine sand and coarse gravel.

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TABLE 3. PROPERTIES OF COARSE AGGREGATE

S.NO	Properties	Result
1.	Specific gravity	2.65
2.	Water absorption	0.55
3.	Fineness modules	4.20
4.	Bulk density	1700kg/m^3

IV. MIX DESIGN

Mix ratio as per IS method is adopted for the design mix. M30 grade of concrete is chosen and the design mix is adopted for the test specimen is 1:1.36:2.3.

V. PREPARATION OF SPECIMEN

Preparation of concrete specimens aggregate, cement was added. After thorough mixing, water was added and the mixing was continued until a uniform mix was obtained. specimen thus prepared were de-molded-after 24 hours of casting and were kept in a curing tank for curing.

VI .TESTS ON SPECIMENS

Compressive strength

Slab specimen are used of size 50×50×5cm to determine the compressive strength of mix design concrete number of slab casted for compressive strength in specimen for 7 days and 28 days

TABLE 4.COMPRESSIVE STRENGTH TEST

S.No	Type of casting	7 days compressive strength (N/mm^2)	28 days compressive strength (N/mm^2)
1.	Without coating	19.27	30.0
2.	With coating	18.9	29.7

Tensile strength

Slab specimen are used of size 50×50×5cm to determine the compressive strength of mix design concrete number of slab casted for tensile strength in specimen for 7 days and 28 days

TABLE 5.TENSILE STRENGTH TEST

S.No	Type of casting	7 days Tensile strength (N/mm^2)	28 days Tensile strength (N/mm^2)
1.	Without coating	3.6	2.7
2.	With coating	3.1	2.56

Flexural strength

Slab specimen are used of size 50×50×5cm to determine the compressive strength of mix design concrete number of slab casted for flexural strength in specimen for 7 days and 28 days

TABLE 6. FLEXURAL STRENGTH

S.No	Type of casting	7 days Flexural strength (N/mm^2)	28 days Flexural strength (N/mm^2)
1.	Without coating	3.9	2.0
2.	With coating	3.3	1.8

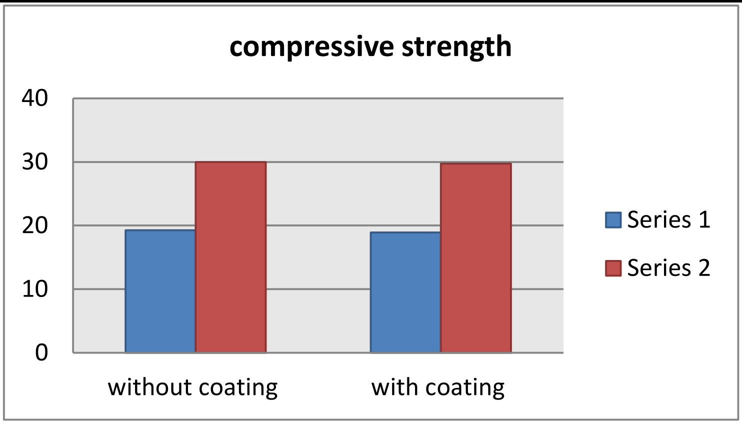


Fig 1. Compressive strength

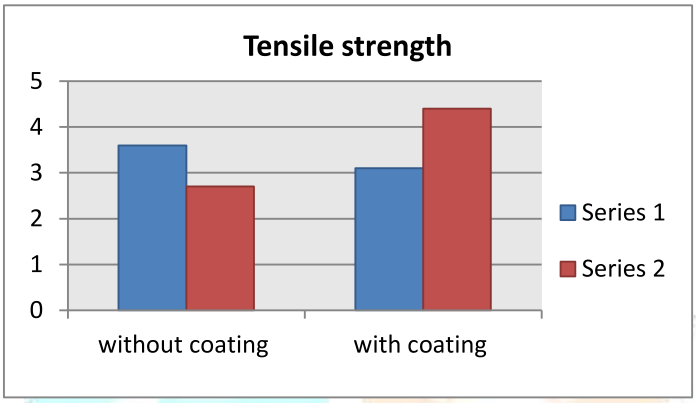


Fig 2. Tensile strength

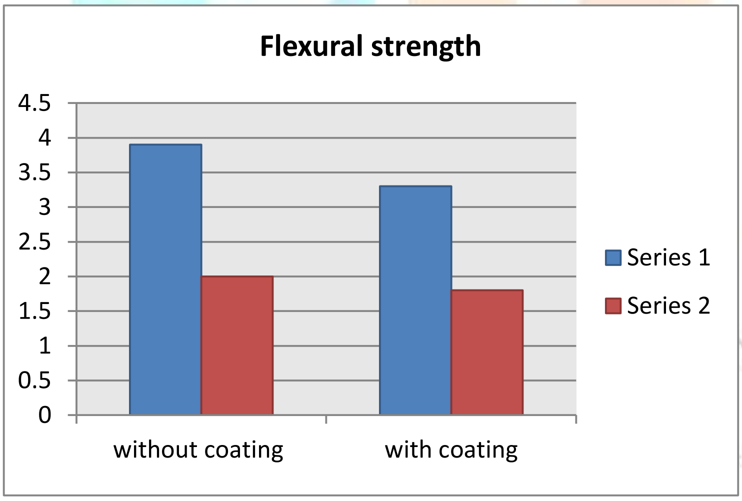


Fig 3. Flexural strength

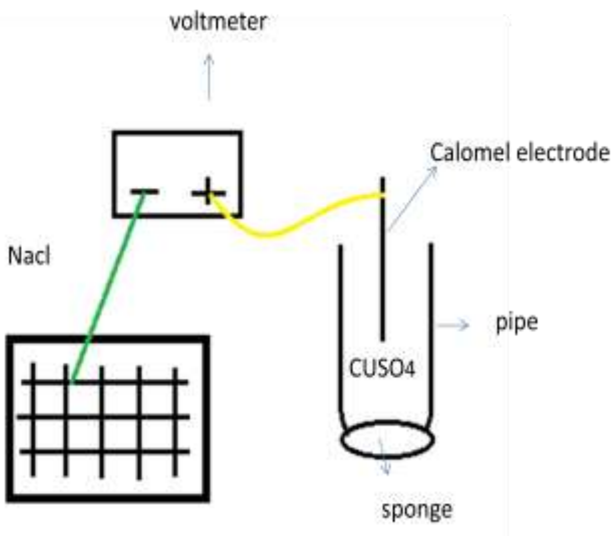


Fig 4. Half cell measurement

PREPARATION OF HALF- CELL

- Check the electrical continuity of the cell between copper rod and terminal of the wire, which is connected at the copper rod.
- Clean the copper rod using emery sheet to obtain the red colour surface of the copper rod free from sulphate coating.
- Prepare saturated copper sulphate solution using copper sulphate crystals with glass beakers and glass stick.
- Remove the half-cell cover and fill with copper sulphate solution in the half-cell tube and close cover tightly.
- Keep the cell unit vertically for about 5 to 10 minutes so that the copper sulphate solution should permeate through sponge bottom of the cell.

PREPARATION OF SPECIMEN FOR POTENTIAL

Some millivolts of current exist in the reinforcement in the normal state. The negative potential is increased when corrosion occurs. This instrument gives the potential head. From the various potential heads we can infer that higher negative potential head indicate higher probability of corrosion.

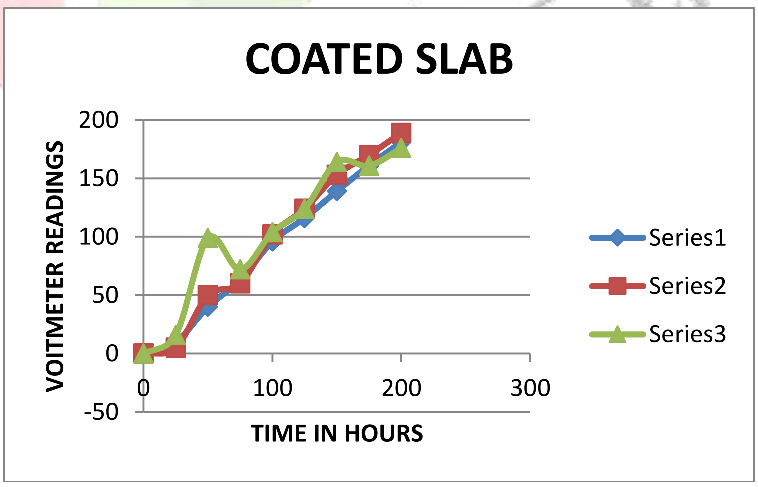
ASTM limits prescribes that below 350mV corrosion do not occur.From the 350mV to 600mV there is a probability of occurrence of corrosion. When the potential head exceeds 600mV there is a probability of 90% of the corrosion can occur.

POTENTIAL VALUES (ASTM STANDARD)

Corrosion	Potential (C – CSE)
>95%	More negative than -350mV
50%	-200 to 350mV
<5%	More positive than -200mV

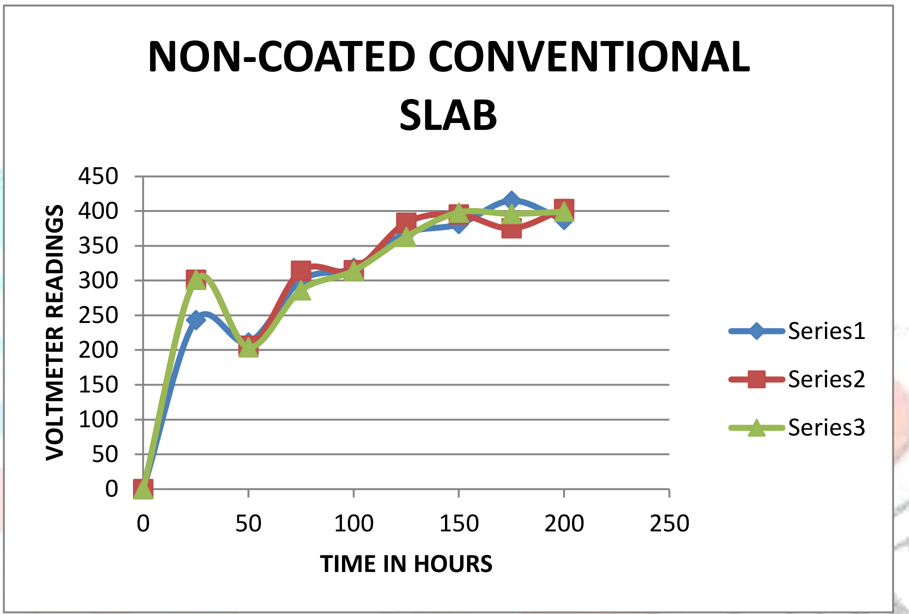
VOLTMETER READINGS FOR COATED CONVENTIONAL REINFORCEMENT

TIME IN HOURS	M 30		
	TRIAL I	TRIAL II	TRIAL III
0	-	-	-
25	10	5	16
50	40	50	99
75	63	60	72
100	96	102	104
125	116	124	124
150	139	153	164
175	161	170	161
200	181	189	176



VOLTMETER READINGS FOR NON-COATED CONVENTIONAL REINFORCEMENT

TIME IN HOURS	M 30		
	TRIAL I	TRIAL II	TRIAL III
0	-	-	-
25	243	301	301
50	211	206	204
75	300	314	286
100	318	315	314
125	368	383	363
150	381	395	398
175	415	375	396
200	387	403	399



VII. CONCLUSION

From the above results, the conventional and replacement concrete gives high compressive strength, tensile strength and flexural strength.Nitro -Zinc and polyester resin reduce the corrosion in the reinforcement and gives strength of the building when compare to conventional elements with uncoated and finally Nitro Zinc resin produce better results than Polyester resin and prevent corrosion in Reinforced elementsand improves the Structural strength.

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