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Original Research Article

Corrosion Measurement of Reinforcement Mechanical Properties Embedded in Concrete Slab using Electrochemical Corrosion Potential Probability

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Abstract

This research work investigated the application of Chrysophyllum albidum exudates/resin extracts as potential inhibitors in the control and prevention of corrosion attacks to reinforcing steel embedded in concrete slabs and are completely immersed in 5% sodium chloride (NaCl) solution in water and accelerated for a rapid corrosion process for 360 days with interval checks and routine tests of 90 days, 180 days, 270 days, and 360 days for examination and record documentations for comparison of tested sample performances. The maximum yields of controlled and coated samples were -112.42 mV and -118.97 mV, which showed the relationship between corrosion potential and opportunity in the reference range as $E\text{corr} > -200\text{mV}$ and the uncoated samples, the calculated maximum value is -338.49 mV, the result is within the reference value of the dependence between corrosion potential and probability of $-350\text{mV} \leq E\text{corr} \leq -200\text{mV}$ indicating a high-value range of 10% or an uncertain corrosion probability. The comparative results from the referencing range (controlled), showed that corroded samples exhibited corrosion presence resulting from the induced corrosion acceleration against coated samples that exhibited absence of corrosion. The results of the controlled concrete and armored resistance samples obtained at the maximum average value of 15.06kΩcm and 16.12kΩcm with a data value of $10 < \rho < 20$ (low) compared to a corrosion value of 9.82 k cm with a specification of $5 < \rho < 10$ (high). The calculated maximum percentage value of the controlled yield point is 7.05% relative to corrosion and coverage value -6.54% and 7.12% and the possible differential values of 0.02% controlled, 0.02% corroded, and 0 .15% covered. The percentage of maximum tensile strength calculated in the control is 2.39% relative to the corrosion and coating value -3.35% and 3.51% and the potential differential value is 0.04% controlled, 0.01% corroded and 0.04% coated. The yield strength, tensile strength, and deformation ratio of the mean, percentile, and controlled differential potential values, uncoated (corroded) and layered concrete slab samples were determined. , coated samples had higher breaking loads compared to corroded samples with reduced breakdown load and low load-bearing capacity and with mean and percentile values in relation to the reference range, whereas uncoated (corroded) samples, had a load-bearing capacity which is low and a reduced value compared to the reference range. For comparison, the results of corroded samples showed a decrease in value compared to the diameter of the reinforcement before and after the induction accelerated corrosion test with a percentage decrease in value from 0.428% to -1.48% and an average value in the range from 11.93 mm to 11. 88 mm. The differentials in mean values and relative percentiles between coated and corroded samples ranged from 69.57% to -41.03%. The decrease in mean and percentage values indicates that the corrosion effect causes a decrease in diameter and cross-sectional area, fiber degradation, rib reduction, and surface modification, while the exudate/resin-coated elements are validated in the work due to differential s in coating thickness. For comparison, the results obtained show a reduction/reduction and reduction of mean and percentile values for coatings with 0.070kg to 0.06kg and corrosion 7.81% to -5.8%. The summary results show that the corrosive effect had an impact on the rebar embedded in the concrete slab samples exposed to induced corrosion.

Keywords: Corrosion, Corrosion inhibitors, corrosion potential, concrete resistivity and Steel Reinforcement.

1.0. INTRODUCTION

Steel reinforcement corrosion embedded in concrete can lead to premature collapse and failure of many structures that are exposed to harsh marine and coastal environments. Generally, corrosion is caused by chloride contamination or carbonation of reinforced concrete structure. Major factors such as concrete pH, chloride ions, oxygen and water need to be considered in the control of corrosion resistance of reinforcement. The formation of surface films that cover the metal, although usually protective, can lead to localized corrosion and pitting ([1-4]) conclude that steel has an instantaneous film structure in the air-oxidized atmosphere, and that the metal "inactivates" and the rate of oxidation or "corrosion" of the metal decreases by more than 0.04mils per year (mpy). The methods to control these factors include the use of epoxy coatings, inhibitors, buffers, electrochemical protection procedures and scavengers.

Nelson et al. (2019) assessed the utilization of naturally inorganic exudates/resins extracted from trees bark of invingia gabonensis, inhibited to steel reinforcement with varying thicknesses, immersed in sodium chloride for corrosion assessments and examination with non-coated and control samples for 150 days of quickened process with applied current of -200 mV through 1200mV and with an output rate of 1mV/s. Full results of the exudates / resin coated specimens indicated the absence of corrosion, the results have been confirmed in invingia gabonensis exudates / resins as a good corrosion inhibitor. The results of cross-sectional reduction showed higher percentile reduction rates due to the disappearance of fiber loss in metallic materials resulting from the occurrence of corrosion from corroded samples [5]. Investigated the environmentally friendly inorganic content of olibanum exudate/resin coated with steel elements and uncoated embedded in a concrete slab and incubated in a corrosive environment for 150days at a test flow rate of 1200-200 mV compared to control samples. Due to the attack on the mechanical properties of steel reinforcement, high corrosion potential were achieved with uncoated (corroded) samples in contrast to coated samples. The steel weight reduction results represent a higher proportion of values compared to the control and coating models, leading to a reduction in the steel fiber/rib properties and thus the surface strength. The results of the expansion of the corrugated sample show a high percentage of reduction due to the effect of corrosion on the mechanical properties of the steel [6]. Studied the effect of Annegeria robusta extract as a corrosion inhibitor on aluminum in 2M HCl solution and the contribution of potassium iodide additives on the resistivity efficiency using The degree of inhibition efficiency with temperature was used to initiate the mechanism of inhibition. Resistance was found to increase with the extract concentration and temperature.

MacDonald [7] has conducted investigations into the solvents extracted from alkaline and cement. Substances extracted from the cement experiment revealed that corrosion was prevented by the use of sodium nitrate in the presence of chlorides, whereas sodium benzoate did not. Furthermore, corrosion with sodium nitrate is delayed, increasing with delayed resistance content.

Charles et al. [6] Investigated the electrochemical process leading to electron transfer in the corrosion process of steel reinforcement in a harsh marine environment with high levels of chloride. The corrosion test was carried out on a 12 mm steel bar, and the rough surface of the specimens was polished with symphonia globulifera lin resin extracts at varying thickness and covered with a concrete slab. The results of the half-cell potential test, of corrosion potential and concrete resistivity, the values of corroded samples ranges from $-350\text{mV} \leq E\text{corr} \leq -200\text{mV}$ indicating a high-value range of 10% or an uncertain corrosion probability and $5 < \rho < 10$ (high) and with a reference range of dependence between concrete resistance and corrosion probability for corroded concrete samples in the mapping areas and indicate a high or moderate likelihood of corrosion [7]. Investigated corrosion level probability assessment potential through half cell potential corrosion measurement, concrete resistivity test and tensile strength test mechanical properties of non-corroded, corroded and inhibited reinforcement with Moringa Oleifera lam resin paste of trees extract. When compared to corroded samples, corroded has 70.1% increased values potential Ecorr, mV and 35.5% decreased values of concrete resistivity. Average percentile results of potential Ecorr, mV, and concrete resistivity are 29.9% and 68.74% respectively. Results of computed percentile average values of yield stress against ultimate strength, when compared to corrode as 100% nominal yield stress decreased from 105.75 % to 96.12% and weight loss at 67.5% against 48.5% and 48.34% to 94.82%, cross-sectional diameter reduction, both showed decreased values of corroded compared to coated specimens [8].

Investigated the use of inorganic inhibitors and Greener approach inhibitors to evaluate the assessment of corrosion potential using Mangifera indica resins paste extracts layered to reinforcing steel with coated thicknesses of 150μm, 250μm and 350μm. When compared to corroded samples, corroded has 70.1% increased values potential Ecorr, mV and 38.8% decreased values of concrete resistivity, yield stress against ultimate strength at summary and average state of corroded slab with nominal values of 100% and decremented in ultimate strength from 105.36% to 96.12%, weight loss versus cross-section diameter reduction decreased due to attack from sodium chloride from 64.8% to 44.45% and 46.76% to 86.43% respectively. Average percentile results of potential Ecorr, mV, and concrete resistivity are 26.57% and 61.25% respectively [9].

Investigated corrosion probability level assessments of three different resins extracts of trees from dacryodes edulis, mangifera indica and moringa oleifera lam using half cell potential corrosion measurement, concrete resistivity measurement and tensile strength test to ascertain the surface condition of the mechanical properties of non-corroded, corroded and inhibited reinforcement coated specimen. Arbitrarily and computed percentile average values of yield stress against ultimate strength, when compared to corrode as 100% nominal yield stress decreased from100.95% to 96.12% dacryodes edulis inhibited, 105.36% to 96.12% mangifera indica inhibited, and 105.75 % to 96.12% moringa oleifera lam inhibited and weight loss of dacryodes edulis inhibited are 67.5%

against 48.5% and 98.7% to 94.82%, cross-sectional diameter reduction, mangifera indica inhibited specimen 64.8% to 44.45% and 46.76% to 86.43% cross-sectional diameter reduction and moringa oleifera lam inhibited specimen 67.5% against 48.5% and 48.34% to 94.82%, cross-sectional diameter reduction, all showed decreased values of corroded compared to coated specimens. When compared to corroded samples, corroded has 70.1% increased values potential Ecorr, mV and 35.5% decreased values of concrete resistivity [10].

Investigated the mechanical properties of the half-cell potential corrosion measurement, concrete resistivity test and tensile strength test control, and the corrosion level probability estimation by corroded and coated reinforcement of moringa oleifera lam resin paste of tree extract. Computed values on comparison of coated and corroded, the corroded specimens the decreased corrosion potential Ecorr,$_m$V, and concrete resistivity decreased. The results of the computed percentile average values of yield stress against ultimate strength, nominal yield stress decreased from and weight loss decreased cross-sectional diameter reduction, compared to both coated and controlled specimens. The half-cell potential test results, for the corrosion potential and resistance of concrete, the corroded sample value varies from -350mV corr -200mV, which is a high value range. indicates a corrosion probability of 10% or uncertain and 5 < < 10 (high) and with a reference range of dependence between concrete resistance and corrosion probability for corroded concrete samples in the mapping area and indicates a high or moderate probability of corrosion [11]. Evaluate the modifications and mechanical properties of steel-reinforced coated with exudates/resins and non-coated members, exposed to corrosive media embedded in concrete members. The results showed a higher yield of non-coated samples as compared to the coated samples due to the impact of corrosion on the mechanical properties of the steel reinforcement. Steel weight loss results showed higher percentage values against control and coated specimens due to the impact of corrosion on the mechanical properties of steel [12]. Investigated the corrosion rate of reinforcing steel embedded in concrete slab structures of exudates/resins coated and non-coated specimens submerged in a corrosive environment with the application of Wenner accelerated four-probe methods. The range of values of the depleted specimens indicates the probability of significant corrosion (<5, 5 <, <10, 10 <, <20, ρ> 20) for most, high, low to moderate and low, corrosion probabilities. Due to the effect of corrosion on the mechanical properties of steel reinforcement, the results showed a high ultimate yield of the specimens to control and the coating samples. The results of the weight loss of steel showed a high percentage of values against the control and coating models due to the effect of corrosion on the mechanical properties of the steel [13]. Evaluated the strength simulation of embedded steel reinforcement in corrosion structures for 150 days with non-coated and Khaiya Senegalensis exudates/resins coated samples. Concrete Resistivity, average km c percentile of 183.49% and percentage differential of 83.19% results from the corroded sample. The values, 71429% of the value of the control sample varies between "final strength" and 7. 13% of the variation of the clade red sample. Mechanical characteristics of the "steel weight loss" control percentage 53. 504%. Percentile differential of 50.4% and percentage differential of -46. 5055% average value and percentage differential of 18.50% [14].

Comparative evaluation of the application effectiveness of the celtis zenkeri coated paste reinforced steel of varying thickness and non-coated to access corrosion efficiency and mechanical properties. The results showed a high corrosion rate of non-coated member over and coated specimens and controlled members with corrosion impact on the mechanical properties of steel reinforcement. Corrugated steel weight loss results showed higher percentage values against control and coated members. Cross-sectional reduction results due to the impact of corrosion on the mechanical properties of steel showed a higher percentage reduction values.

Assessed the use of environmentally inorganic exudates/resins extracted from Invincia gabonensis, layered to reinforced steel with different thicknesses and non-layered members, immersed in sodium chloride for corrosion tests of 150 days fast process at a flow rate potential of 200 mV by 1200mV with a scan rate of 1mV / s. The aggregate results of the exudates/resins coated samples showed no indications of corrosion potential and the results demonstrated that Invincia gabonensis exudates/resins were good corrosion inhibitors while non-coated showed corrosion potential indications. Cross-sectional area reduction results showed higher percentage reduction values as fiber loss was negative on the mechanical properties of steel as a result of corrosion potential [15].

Investigated the passive loss of reinforcing steel with the use of natural inorganic exudates/resins paste of milicia excelsa with a coating thickness of 150μm, 300μm, and 450μm. The coated and uncoated members were embedded in the concrete slab and submerged in a partially fast-flowing media with rapid application currents ranging from 1200mV to 200200 mV, coated with a 1mV scan rate and half-scan rate for the non-coated. Half-cell corrosion potential, concrete resistance, and tensile strength. Cross-sectional area reduction results in a coating-free sample that results in higher corrosion values due to the effect of corrosion on the mechanical properties of steel reinforcement. Due to the influence of fiber / ribbed removal from the surface attack and the corrosion effect on the mechanical properties of the steel, the non-coated members showed higher percentage values against the control and coating samples. High-end yield and coating designs of non-coated samples with low load application to lead to corrosion on mechanical properties of steel reinforcement[16].

Introduced exudates/resins extracts from garcina cola as corrosion inhibitors, to reinforce the steel embedded in the concrete slab, and immersed in the corrosive medium for 150 days, assessing surface changes and mechanical properties. Due to the effect of corrosion on the mechanical properties of steel reinforcement, the results showed a high ultimate yield of the coated specimens to control and the coating samples. The results on the weight loss of steel- non-coated members showed a high percentage of values against the control and coating models due to the effect of corrosion on the mechanical properties of the reinforcing steel [17].

2.1. MATERIALS AND METHODS

2.1.1 Aggregates

Fine and coarse aggregates are purchased at the sand dumpsite. Both meet the requirements of [18].

2.1.2 Cement

Cement (limestone) 42.5 was used for all concrete mixtures. The cement meets the requirements of [19].

2.1.3 Water

Water samples were taken from the Department of Civil Engineering Laboratory at Kenule Beeson Polytechnic, Bori, and Rivers State. Water meets [20] requirements.

2.1.4 Structural Steel Reinforcement

Structural steel reinforcement purchased directly from the market at Port Harcourt. It conformed to [21] requirements

2.1.5 Corrosion Inhibitors (Resins / Exudates) Chrysophyllum albidum

The grayish-brown and whitish gummy exudates were obtained from the tree bark. They are abundantly seen in the bushes of Ekpeye land in Ahoada West / Ahoada East Local Government of Rivers State

2.2 EXPERIMENTAL PROCEDURE

2.2.1 Experimental method

2.2.2 Prepare Samples for Reinforcement with Coated

This research work investigated the application of Chrysophyllum albidum exudates/resin extracts as potential inhibitors in the control and prevention of corrosion attacks to reinforcing steel embedded in concrete structures exposed to acidic environments with high salinity. The extruded exudate/resin was tapped from the tree and coated to reinforcing steel with varying thickness, it is potentially of inorganic origin and eco-friendly, and non-hazardous to the environment.

It is of note that the process of corrosion manifestation is a long-term action and it spanned decades to fully surfaced, but the introduction of sodium chloride induces the rate of corrosion and quickens its rate of occurrence within a short period. The rate of corrosion rate value is measured by estimating the current density obtained from the polarization curve and the degree of quantification of the corrosion rate.

The concrete slab for the research was designed for mixes batched by material weight of the material using the manual mixing method using a standard concrete ratio of 1.2.4 and a water-cement ratio of 0.65. Concrete standards are obtained by gradually adding cement, gravel (fine and coarse), and water to achieve a consistent color. Concrete standards are obtained by gradually adding cement, aggregates (fine and coarse), and water to achieve a consistent color. Concrete slabs of 100 mm × 500 mm × 500 mm (thickness, width, and length) are cast into a metal mold, compacted to air and void-free, with a cover of 10 mm, and reinforced with 10 numbers of reinforcing steel of diameter 12 mm, spaced at 100 mm c / c (top and bottom) are placed and de-molded after 72 hours, cured for 28 days at standard room temperature to harden. The hardened concrete slabs are completely immersed in 5% sodium chloride (NaCl) solution in water and accelerated for a rapid corrosion process for 360 days with interval checks and routine tests of 90 days, 180 days, 270 days, and 360 days for examination and record documentations for comparison of tested sample performances.

2.3 Accelerated Corrosion Test

The corrosion process is a natural phenomenon that takes decades to materialize. This is a long-term process, but the fast and accelerated corrosion process using Sodium Chloride (NaCl) allows reinforcement embedded in concrete to undergo corrosion and can simulate the increase in corrosion that will occur over decades in a short time. To test the corrosion resistivity of concrete, experimental processes were developed that accelerated the corrosion process and maximize the corrosion resistivity of concrete. The accelerated corrosion test is an impress current technique, an effective technique for examining the corrosion process of steel in concrete and for assessing damage to the concrete cover protection to the steel bar. The laboratory acceleration process helps distinguish the role of individual factors that can influence chloride-induced corrosion. For the construction of structural elements and corrosion resistivity as well as for the selection of suitable materials and suitable protection systems, an accelerated corrosion test is carried out to obtain quantitative and qualitative information on corrosion.

2.4 Corrosion current measurement (Half-Cell Potential Measurement)

The classification of the severity of reinforcing steel corrosion is shown in Table 2.1. If the potential measurement results indicate a high probability of active corrosion, then the degree of corrosion can be assessed by measuring the resistivity of the concrete. However, care must be taken when using these data as it is assumed that the corrosion rate is constant over time. This has also been demonstrated through practical experience [Figg and Marsden [22], Gower and Millard [23]. Measurement of half potential is an indirect method of estimating the probability of corrosion. Recently, there has been much interest in developing tools for carrying out electrochemical measurements of disturbances on the steel itself to obtain a direct estimate of the corrosion rate (Stem and Geary [24]). Corrosion rate refers to electrochemical measurements, the first based on data.

Table-2.1: Dependence between potential and corrosion probability [25]

Potential E_{corr}	Probability of Corrosion
Ecorr < -350mV	Greater than 90% probability that reinforcing steel corrosion is occurring in that area at the time of measurement
$-350\text{mV} \leq Ec_{orr} \leq -200$mV	Corrosion activity of the reinforcing steel in that area is uncertain
$E_{corr} > -200$mV	90% probability that no reinforcing steel corrosion is occurring in that area at the time of measurement (10% risk of corrosion

2.5 Test for measuring the Resistivity of concrete

Different measured values are obtained at different points on the concrete surface. After the water has been applied to the slab surface, the resistivity of the concrete is measured daily at the reference point to determine its saturation state. This position was chosen on the side of the panel because special measurements of electrical resistivity can be made with water on top of the panel. A reading aid was recorded as the final resistivity measure in this study. The level of slab saturation is monitored by measuring the electrical resistivity of the concrete, which is directly related to the moisture content of the concrete. As soon as one plate reaches a saturated state, water can flow out while the other plate remains closed. The time limit is a major challenge for all experimental measurements because the saturation state of the concrete changes over time. This study used the Wenner method with four probes; for this purpose, the four probes touch the concrete of the reinforcing steel rail directly. From now on this measurement will be referred to as the "dry" measurement. Because each plate has a different W / C, the time required to saturate each plate is not the same. Before water is applied to the slab, the electrical resistivity of the concrete is measured at certain points in the dry state. The electrical Resistivity becomes constant as soon as the concrete reaches saturation.

Table-2.2: Dependence between concrete resistivity and corrosion probability [26]

Concrete resistivity ρ, kΩcm	Probability of corrosion
$\rho < 5$	Very high
$5 < \rho < 10$	High
$10 < \rho < 20$	Low to moderate
$\rho > 20$	Low

2.6 Tensile Strength of Reinforcement

To determine the yield strength and ultimate tensile strength peak point of the reinforcing steel bar, the concrete slabs are reinforced with 10 numbers of 12mm diameter (top and bottom direction) of uncoated and coated reinforcing steel and tested under stress in an Instron Universal testing machine (UTM) to failure. A digitalized and computerized system records the results of yield strength, ultimate tensile strength, and strain ratio. To ensure stability, the remaining cut portions are used for other parameters examinations of rebar diameter before the test, rebar diameter - after corrosion, cross-sectional area reduction/increase, rebar weights- before the test, rebar weights- after corrosion, weight loss /gain of steel.

3.0 TEST RESULTS AND DISCUSSION

The results of the half-cell potential measurements in Table 1 are plotted against the Resistivity in Table 3 for ease of interpretation. 2. It is used as an indication of the probability of significant corrosion (ρ <5, 5 <ρ <10, 10 <ρ <20, ρ> 20) for very high, high, low to a moderate and low probability of corrosion. At another measurement point, the potential for correction was high (–350 mV ≤ Ecorr ≤ –200 mV), indicating a corrosion probability of 10% or uncertain. The results of concrete resistivity measurements are shown in Table 2. It is proven that if the potential for corrosion is low (<-350 mV) within a certain range, there is a 95% chance of corrosion. Concrete resistivity is usually measured using the four-electrode method. Resistivity study data show whether certain states are conducive to lower ion movement, leading to greater corrosion.

Table-3.1: Potential Ecorr, after 28 days curing and 360days Accelerated Periods of Control Concrete slab Specimens

	Control Concrete slab Specimens											
Sample Numbers	CAS	CAS 1	CAS 2	CAS 3	CAS 4	CAS 5	CAS 6	CAS 7	CAS 8	CAS 9	CAS 10	CAS 11
	Time Intervals after 28 days curing											
Sampling and Durations	**Samples 1 (28 days)**			**Samples 2 (28 Days)**			**Samples 3 (28 Days)**			**Samples 4 (28 Days)**		
Potential Ecorr, mV	-114.7	-113.4	-109.1	-112.7	-110.1	-107.1	-115.5	-111.2	-106.7	-114.1	-113.9	-112.5
Concrete Resistivity ρ, kΩcm	15.03	15.02	15.01	15.01	15.00	15.17	15.16	15.15	15.15	15.14	15.08	15.00
Yield Strength, fy (MPa)	453.42	456.42	452.42	452.72	453.42	452.65	455.65	455.95	454.65	456.04	452.55	456.38
Ultimate Tensile Strength, fu (MPa)	624.89	622.84	624.52	620.30	623.83	624.25	624.05	624.85	623.45	625.00	624.50	624.36
Strain Ratio	1.38	1.37	1.38	1.37	1.38	1.38	1.37	1.37	1.37	1.37	1.38	1.37
Rebar Diameter Before Test (mm)	11.93	11.92	11.93	11.93	11.92	11.94	11.93	11.92	11.93	11.93	11.92	11.93
Rebar Diameter at 28 days(mm)	11.93	11.92	11.93	11.93	11.92	11.94	11.93	11.92	11.93	11.93	11.92	11.93
Cross- sectional Area Reduction/Increase (Diameter, mm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rebar Weights- Before Test	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Rebar Weights- After at 28 days (Kg)	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Weight Loss /Gain of Steel (Kg) at 28 days	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table-3.2: Potential Ecorr, after 28 days curing and 360days Accelerated Periods of Corroded Concrete slab Specimens

	Corroded Concrete slab Specimens											
Sampling and Durations	**Samples 1 (90 days)**			**Samples 2 (180 Days)**			**Samples 3 (270 Days)**			**Samples 4 (360 Days)**		
Potential Ecorr,mV	-323.4	-347.6	-344.4	-336.8	-346.6	-353.6	-387.5	-394.7	-398.8	-401.9	-406.1	-404.4
Concrete Resistivity ρ, kΩcm	**9.21**	**9.39**	**10.22**	**9.23**	**10.00**	**9.56**	**9.18**	**9.73**	**9.77**	**9.37**	**9.54**	**9.55**
Yield Strength, fy (MPa)	425.10	428.10	424.10	424.40	425.10	424.33	427.33	427.63	426.33	427.72	424.23	428.06
Ultimate Tensile Strength, fu (MPa)	610.58	608.53	610.21	605.99	609.52	609.94	609.74	610.54	609.14	610.69	610.19	610.05
Strain Ratio	1.44	1.42	1.44	1.43	1.43	1.44	1.43	1.43	1.43	1.43	1.44	1.43
Rebar Diameter Before Test (mm)	11.92	11.92	11.92	11.92	11.92	11.92	11.92	11.92	11.92	11.92	11.92	11.92
Rebar Diameter- After Corrosion(mm)	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88
Cross-sectional Area Reduction/Increase (Diameter, mm)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Rebar Weights- Before Test(Kg)	0.82	0.88	0.88	0.88	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.89
Rebar Weights- After Corrosion(Kg)	0.75	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Weight Loss /Gain of Steel (Kg)	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.06	0.07	0.07

Table-3.3: Potential Ecorr, after 28 days curing and 360days Accelerated Periods of Chrysophyllum albidum Exudate / Resin Coated Specimens

	CAS 1A1	CAS 1B2	CAS 1C3	CAS 1D4	CAS 1E5	CAS 1F6	CAS 1G7	CAS 1H8	CAS 1I9	CAS1 J10	CAS1 K11	CAS1 L12
Sampling and Durations	**Samples 1 (90 days)**			**Samples 2 (180 Days)**			**Samples 3 (270 Days)**			**Samples 4 (360 Days)**		
	150µm (Exudate/Resin) coated			300µm (Exudate/Resin) coated			450µm (Exudate/Resin) coated			600µm (Exudate/Resin) coated		
Potential Ecorr,mV	-120.3	-124.4	-119.7	-118.3	-120.7	-117.7	-126.2	-121.8	-117.4	-119.7	-123.7	-115.1
Concrete Resistivity ρ, kΩcm	15.67	15.82	16.10	16.23	15.92	16.21	16.16	16.31	16.34	15.81	15.70	15.55
Yield Strength, fy (MPa)	454.89	457.89	453.89	454.19	454.89	454.12	457.12	457.42	456.12	457.51	454.02	457.86
Ultimate Tensile Strength, fu (MPa)	631.73	629.68	631.36	627.14	630.67	631.09	630.89	631.69	630.29	631.84	631.34	631.20
Strain Ratio	1.39	1.38	1.39	1.38	1.39	1.39	1.38	1.38	1.38	1.38	1.39	1.38
Rebar Diameter Before Test (mm)	11.98	11.97	11.98	11.98	11.97	11.99	11.98	11.97	11.98	11.98	11.97	11.98
Rebar Diameter- After Corrosion(mm)	12.06	12.05	12.06	12.06	12.05	12.07	12.06	12.05	12.06	12.06	12.05	12.06
Cross- sectional Area Reduction/Increase (Diameter, mm)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Rebar Weights- Before Test(Kg)	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Rebar Weights- After Corrosion(Kg)	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Weight Loss /Gain of Steel (Kg)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Table-3.4: Average Potential Ecorr, after 28 days curing and 360days Accelerated Periods (Control, Corroded and Exudate/Resin Coated (specimens)

Sampling and Durations	**Control Concrete slab Specimens**				**Corroded Concrete slab Specimens**				**Chrysophyllum albidum Exudate / Resin Coated Specimens**			
	Average Potential Ecorr, Values of Control Concrete slab Specimens				Average Potential Ecorr, Values of Corroded Concrete slab Specimens				Average Potential Ecorr, Values of Chrysophyllum albidum Coated Specimens			
Potential Ecorr,mV	-112.4	-111.7	-110.6	-110.0	-338.4	-342.9	-342.6	-345.7	-121.3	-120.7	-119.6	-118.9
Concrete Resistivity ρ, kΩcm	15.02	15.01	15.01	15.06	9.60	9.61	9.82	9.60	15.86	16.05	16.08	16.12
Yield Strength, fy (MPa)	454.09	453.85	452.85	452.93	425.77	425.54	424.54	424.61	455.56	455.33	454.33	454.40
Ultimate Tensile Strength, fu (MPa)	624.09	622.56	622.89	622.80	609.78	608.25	608.58	608.49	630.92	629.39	629.72	629.63
Strain Ratio	1.37	1.37	1.38	1.38	1.43	1.43	1.43	1.43	1.39	1.38	1.39	1.39
Rebar Diameter Before Test (mm)	11.93	11.93	11.93	11.93	11.93	11.93	11.93	11.93	11.98	11.98	11.98	11.98
Rebar Diameter- After Corrosion(mm)	11.93	11.93	11.93	11.93	11.88	11.88	11.88	11.88	12.06	12.06	12.06	12.06
Cross- sectional Area Reduction/Increase (Diameter, mm)	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05	0.08	0.08	0.08	0.08
Rebar Weights- Before Test(Kg)	0.87	0.87	0.87	0.87	0.86	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Rebar Weights- After Corrosion(Kg)	0.87	0.87	0.87	0.87	0.80	0.82	0.82	0.82	0.95	0.95	0.95	0.95
Weight Loss /Gain of Steel (Kg)	0.00	0.00	0.00	0.00	0.07	0.06	0.06	0.06	0.07	0.07	0.07	0.07

Table-3.5: Average Percentile Potential Ecorr, after 28 days curing and 360days Accelerated Periods (Control, Corroded and Exudate/Resin Coated (specimens)

	Control Concrete slab Specimens				**Corroded Concrete slab Specimens**				**Chrysophyllum albidum Exudate / Resin Coated Specimens**			
	Percentile Average Potential Ecorr,				Percentile Average Potential Ecorr,				Percentile Average Potential Ecorr,			
Potential Ecorr,mV	-66.79	-67.41	-67.70	-68.18	178.84	184.08	186.40	190.60	-64.14	-64.80	-65.08	-65.59
Concrete Resistivity ρ, kΩcm	56.37	56.21	52.89	56.91	-39.46	-40.13	-38.97	-40.47	65.17	67.01	63.86	67.99
Yield Strength, fy (MPa)	6.99	7.05	6.97	6.87	-6.54	-6.54	-6.56	-6.56	6.97	7.08	7.02	7.12
Ultimate strength (N/mm2)	2.39	2.35	2.38	2.35	-3.35	-3.36	-3.36	-3.36	3.47	3.48	3.49	3.51
Strain Ratio	-4.05	-3.99	-4.11	-4.05	3.39	3.40	3.46	3.39	-3.28	-3.29	-3.35	-3.28
Rebar Diameter Before Test (mm)	0.425	0.427	0.428	0.425	0.428	0.429	0.428	0.426	0.427	0.429	0.427	0.250
Rebar Diameter- After Corrosion(mm)	0.425	0.427	0.428	0.425	-1.48	-1.48	-1.48	-1.51	1.51	1.51	1.51	1.53
Cross- sectional Area Reduction/Increase (Diameter, mm)	0.00	0.00	0.00	0.00	-41.03	-41.03	-41.03	-41.03	69.57	69.57	69.57	69.57
Rebar Weights- Before Test(Kg)	0.346	0.347	0.349	0.342	0.345	0.348	0.343	0.347	0.351	0.344	0.344	0.347
Rebar Weights- After Corrosion(Kg)	8.52	8.73	8.73	8.61	-16.00	-13.68	-13.68	-13.68	13.05	13.85	12.85	14.85
Weight Loss /Gain of Steel (Kg)	0.00	0.00	0.00	0.00	-5.80	-7.25	-7.25	-7.25	6.15	7.81	7.81	7.81

3.1 Results of Potential E_{corr}, mV, and Concrete Resistivity ρ, kΩcm on Concrete Slab Members

Homogeneous or generalized corrosion is characterized by an attack on the entire metal surface. It occurs when the anode and cathode reactions are directly adjacent, creating a microcell. The most common causes of uniform corrosion are large-scale carbonization of concrete or very high and uniform chloride content. The thickness loss is approximately the same on the exposed surface.

Local or local corrosion occurs when the anode and cathode processes are not evenly distributed, but a rather small concentrated anode appears next to a large cathode (sometimes quite separated from each other) known as a macro cell. This is related to the high moisture content which provides low electrical resistance to the concrete and easily transports ions so that the anode and cathode can be separated freely. The E_{corr}, mV potential results, and concrete resistance, kΩcm, are obtained from Tables 3.1 - 3.3 and summarized into mean and percentile values in Tables 3.4 and 3.5, plotted graphically in Figures 3.1-3.8b, are the results of controlled samples, not coated (corroded) and coated for 36 concrete slabs, divided into 3 parts of 12 controlled samples, which is the determinant reference range, 12 uncoated (corroded) samples, and 12 exudate/resin coated samples.

The mean and minimum, maximum, and differential percentiles of the calculated measurements of the half-cell corrosion potential of controlled samples were -112.42 mV and -110 mV (68.18% and -66.79%) with a potential differential of (2.42mV and 1.39%), corroded samples were -345.72mV and -338.49mV (178.84% and 190.6%) and the differential values were 7.23 mV and 11.76% while the coated samples were -121.39mV and -118.97mV (-65.59% and -64.14%) and the potential differentials are 2.42mV and 1.45%, respectively. The maximum calculated controlled percentile value is -66.79% compared to the corroded and coated values of 190.6% and -64.14% and the controlled potential differential value of 1.39%, corroded 11.76% and coated 1.45% . The maximum yields of controlled and coated samples were -112.42 mV and -118.97 mV, which showed the relationship between corrosion potential and opportunity in the reference range as $E\text{corr} > -200\text{mV}$. The results from these potential E_{corr} results indicate that the controlled sample values and exudate/resin coated are low with a 90% probability that no corrosion of the reinforcing steel is observed at the time of measurement (10% corrosion risk, which means a 10% corrosion probability or indicates a non-corrosion probability). For uncoated samples, the calculated maximum value is -338.49 mV, the result is within the reference value of the dependence between corrosion potential and probability of $-350\text{mV} \leq E\text{corr} \leq -200\text{mV}$ indicating a high-value range of 10% or an uncertain corrosion probability. The comparative results from the referencing range (controlled), showed that corroded samples exhibited corrosion presence resulting from the induced corrosion acceleration against coated samples that exhibited absence of corrosion. The exudates/resins exhibited inhibitory characteristics against corrosion attacks on reinforcing steel embedded in the concrete slab, exposed to corrosive media by the formation of the resistive coating.

The concrete resistivity minimum and maximum average and percentile values with potential differentials of controlled samples are 15.01kΩcm and 15.06kΩcm (52.89% and 56.91%) and differential values of **0.05**kΩcm and 4.02%., the corroded samples are 9.6kΩcm and 9.82kΩcm (-40.47% and -38.97%) and differential values of **0.22**kΩcm and **1.5**%, the coated sample vales are 15.86kΩcm and 16.12kΩcm (63.86% and 67.99%) and differential values of **0.26**kΩcm and **4.13**%.

The maximum value calculated from the controlled sample concrete resistance is 56.91% compared to the corroded and coated value of -38.97% and 67.99% and the maximum percentage differential in control is 4.02% compared to the corroded and coated value of 1.5% and 4.13%. The results of the controlled concrete and armored resistance samples obtained at the maximum average value of 15.06kΩcm and 16.12kΩcm with a data value of 10 < ρ < 20 (low) compared to a corrosion value of 9.82 k cm with a specification of 5 < ρ < 10 (high) and with a reference range of dependence between concrete resistance and corrosion probability at significant corrosion probability (ρ < 5, 5 < ρ < 10, 10 < ρ < 20, ρ > 20) for very high, high, low to moderate and low, for the possibility of corrosion. From the results of the comparison of the coated and corroded samples, the maximum values obtained for both samples clearly indicate the value of the coated samples in the range of 10 < ρ < 20 , which corresponds to the range of values as Classify as low to moderate, which indicates the possibility of corrosion significant. The maximum value of the corroded sample was in the range of 5 < ρ < 10 , indicating high, signs indicating the presence of possible corrosion, confirmed in the works ([14, 15, 16, 12, 10, 9]). From the results obtained it can be compared that the effect of corrosion attack was observed in the uncoated samples, while the samples with exudate/resin coating had corrosion protection properties with a highly resistant and water-resistant membrane that prevented corrosion of the reinforcing steel built into the concrete preventing slabs and induced accelerations from being exposed to corrosive media.

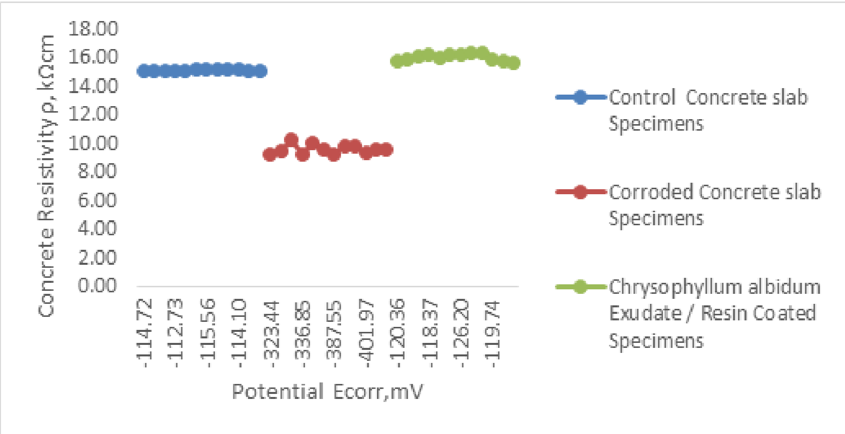

Fig-3.1: Concrete Resistivity ρ, kΩcm versus Potential Ecorr,mV Relationship

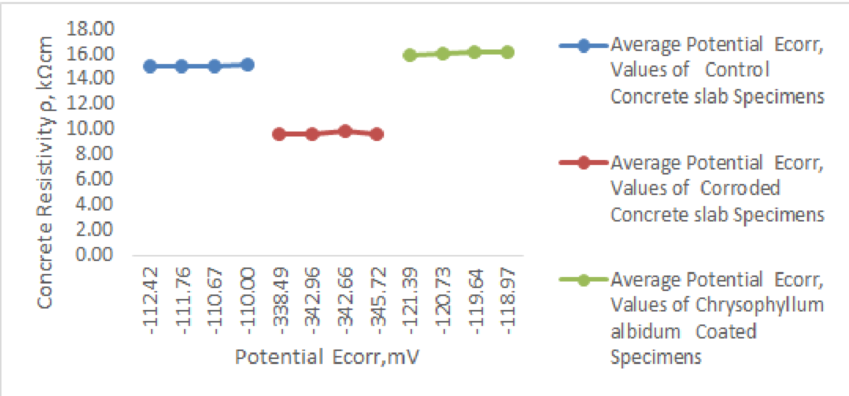

Fig-3.1A: Average Concrete Resistivity versus Potential Relationship

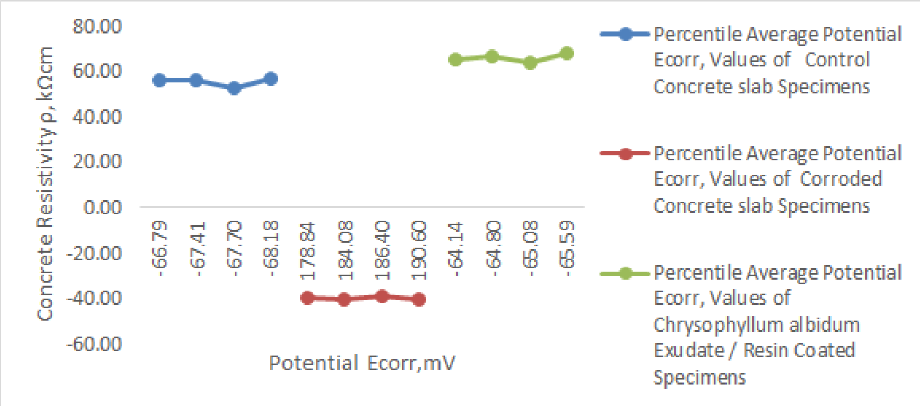

Fig-3.1B: Average Percentile Concrete Resistivity versus Potential Relationship

3.2 Results of Mechanical Properties of Yield Strength, Ultimate Strength and Strain Ratio of Embedded Reinforcing Steel in Concrete Slab

The corrosion effect of steel becomes more critical when assessing the mechanical properties of steel rusty steel rods. Changes in the behavior of corroded steel reinforcement, tested under monotonous stress. Stress is associated with various causes. At the material level, the name TEMPCORE is often an important factor for the heterogeneous distribution in the core cross-section of various material phases of modern production formation [27-32]. The results of the mean, percentile, and the value of the differential between the minimum and maximum yield limits, fy (MPa) of the controlled sample were 452.85MPa and 454.09MPa (6.87% and 7.05%) and the differential value was 1.24MPa and 0.18%, the corroded sample was 424.54MPa and 425.77MPa (-6.56% and -6.54%) and the differential value was 1.23 MPa and 0.02%, the coated sample value was 454.33MPa and 455.56MPa (6.97 % and 7.12%) and the differential value of 1.23MPa and 0.15%. The calculated maximum percentage value of the controlled yield point is 7.05% relative to corrosion and coverage value -6.54% and 7.12% and the possible differential values of 0.02% controlled, 0.02% corroded, and 0 .15% covered. The mean, percentile, and the differential between the minimum and maximum tensile strength, fu (MPa) of the controlled sample were 622.56MPa and 624.09MPa (2.35% and 2.39%) and the differential values were 1.53MPa and 0.04%, corrosive 608.25MPa and 609.78 MPa (-3.36MPa and -3.35%) and a differential of 1.53MPa and 0.01%, coverage of 629.39MPa and 630.92 MPa (3.47% and 3.51% and the differential in values is 1.53MPa and 0.04%. The percentage of maximum tensile strength calculated in the control is 2.39% relative to the corrosion and coating value -3.35% and 3.51% and the potential differential value is 0.04% controlled, 0.01% corroded and 0.04% coated.

The minimum and maximum mean values of the deformation ratio, percentile, and different values of the controlled samples were 1.37 and 1.38 (-4.11% and -3.99%) with a differential of 0.01 and 0.12%, respectively. the corrosion values of the samples were 1.43 and 1.43 (3.49% and 3.46%) and the differential values were 0.00 and 0.07%, the coated samples were 1.38 and 1.39 (-3.35%) and -3.28%) and the differential value of 0.01% and 0.07%. The maximum calculated percentage for the ratio of coated to -3.99% versus corroded 3.46% and 3.28%, and different peaks controlled to 0.12%, corroded 0.07% and covered 0.07%, as confirmed in the works ([14-16], [12, 10, 9]). From the calculation results obtained, summarized in Tables 3.4 and 3.5 and displayed graphically in Figures 3.1 - 3.7B, the yield strength, tensile strength, and deformation ratio of the mean, percentile, and controlled differential potential values, uncoated (corroded) and layered concrete slab samples were determined, coated samples had higher breaking loads compared to corroded samples with reduced breakdown load and low load-bearing capacity and with mean and percentile values in relation to the reference range, whereas uncoated (corroded) samples, had a load-bearing capacity which is low and a reduced value compared to the reference range. This attribute indicates the efficiency and effectiveness of the exudate/resin as an inhibitor against corrosive effects. of reinforced concrete structures exposed to the edges of strong, high salinity marine areas. The comparison results show that the low load carrying capacity is caused by the effect of corrosion attack on the uncoated (corroded) elements, which damage the reinforcing steel fibers, ribs, and passive formation and surface modification. The observed mean values for the coated samples were associated with the corrosion resistance potential to penetrate the reinforcing steel with the formation of a protective membrane.

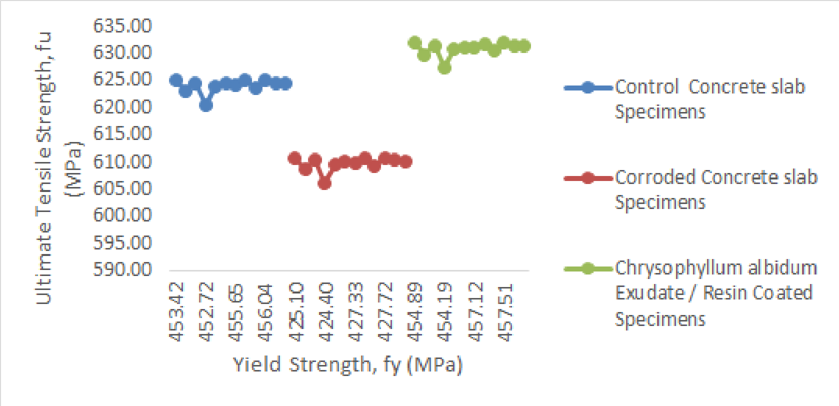

Fig-3.2: Yield Strength versus Ultimate strength

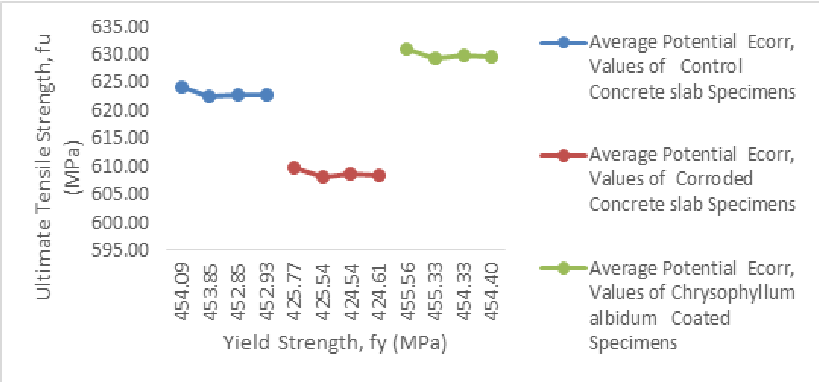

Fig-3.2A: Average Yield Strength versus Ultimate Tensile Strength

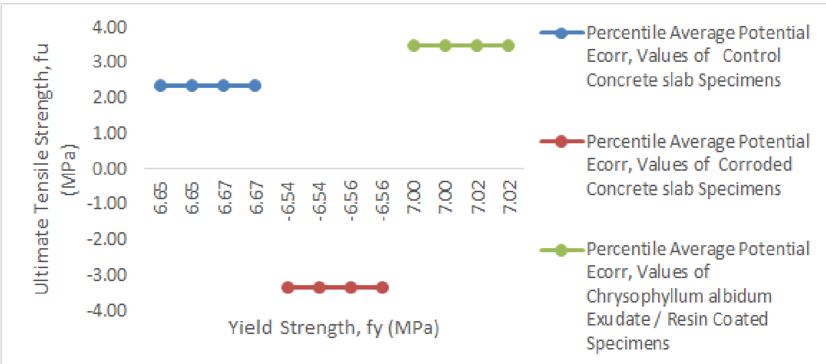

Fig-3.2B: Average Percentile Yield Strength versus Ultimate Tensile Strength

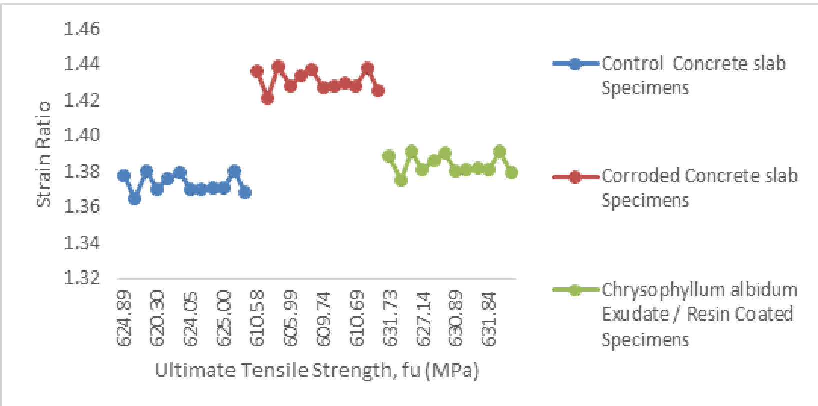

Fig-3.3: Ultimate Tensile Strength versus Strain Ratio

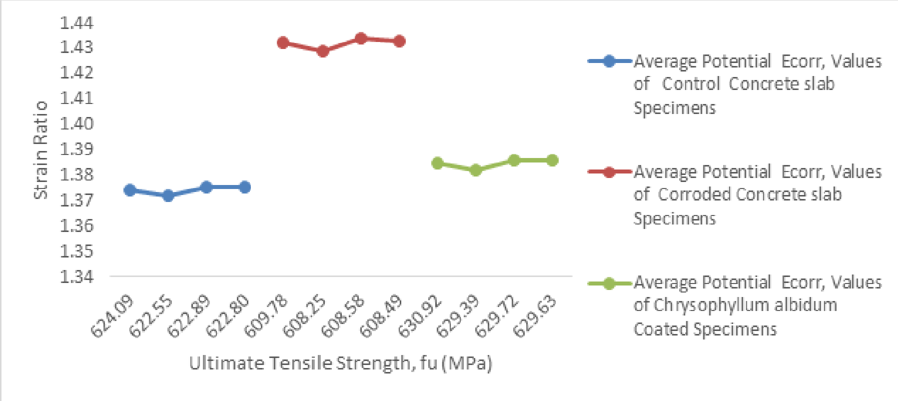

Fig-3.3A: Average Ultimate Tensile Strength versus Strain Ratio

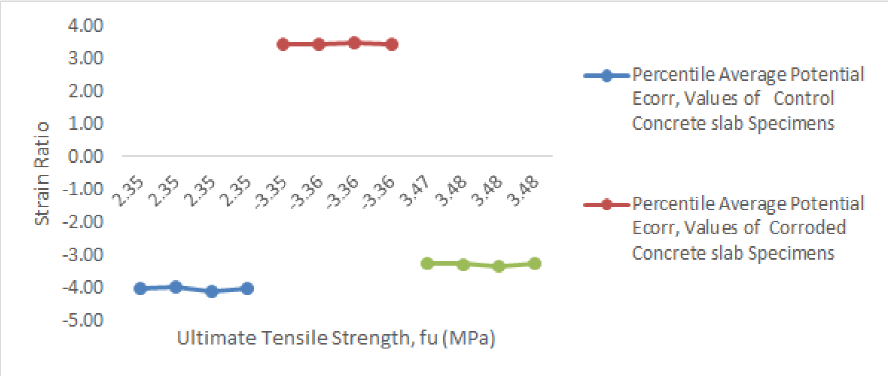

Fig-3.3B: Average percentile Ultimate Tensile Strength versus Strain Ratio

3.3. Results of Mechanical Properties of Rebar Diameter, Cross-Sectional Area and Weight Loss / Increase of Embedded Reinforcing Steel in Concrete Slab

An additional mechanism to explain the observed modification of the mechanical properties of corroded rods account for the geometric effect of uneven reduction from the cross-section of the rod. These effects include the occurrence of local bending moments due to displacement of the center of gravity relative to the original uncorroded cross-section and the stress concentration at the top of the hole due to a sudden change in cross-section, also known as the slot effect [30, 13, 33].

The rebar diameters before testing (mm), minimum and maximum mean and percentile values, 11.93 mm and 11.93mm (0.425% and 0.428%) were checked with a differential of 0.00mm and 0.003%, and corroded values were controlled from samples are 11.93mm and 11.93mm (0.426% and 0.429%) and the differential values of 0.00mm and 0.003% and the values of the coated samples were 11.98mm and 11.98mm (0.429% and 0.429% and the calculated values were differentially 0.00mm and 0.179%) Weight reinforcement units from corrosion. The test shows that the differential s are getting smaller based on the shape of the product and company, and the by-products used in the production process for the controlled sample are 11.93mm and 11.93mm (0.425% and 0.428%) with a differential of 0.00 mm and 0.003%, with a fixed reference value of 100%, the corroded sample values were 11.88 mm and 11.88 mm (-1.51% and -1.48%) and the differential 0.00mm and 0.03%, the values of the coated samples were 12.06 mm and 12.06mm and 1.53%) and the differentials were 0.00mm and 0.02%. The potential differential value is 0.00% corroded against 0.009% coated. The results obtained in Tables 3.4 and 3.5, which are summarized in Tables 3.1, 3.2, and 3.3 and shown graphically in Figures 3.3-3.6b, show the effect of corrosion attack on reinforcing steel embedded in concrete slabs, which are subjected to induced corrosion-accelerating activities. For comparison, the results of corroded samples showed a decrease in value compared to the diameter of the reinforcement before and after the induction accelerated corrosion test with a percentage decrease in value from 0.428% to -1.48% and an average value in the range from 11.93 mm to 11. 88 mm.

The nominal rebar decrease/increase (diameter) in cross-sectional area, minimum and maximum mean, and percentile values were controlled up to 100%, with no decrease or increase after 360 days of immersion in freshwater. Corroded sample values were 0.05 mm and 0.05 mm (-41.03% and -41.03%) and the differential of 0.0 mm and 0.00% for the corroded, coated sample value was 0.08 mm and 0.08 mm (69.57% and 69.57%) and the differential is 0.00 mm and 0.00%. The differential in mean values and relative percentiles between coated and corroded samples ranged from 69.57% to -41.03%. The decrease in mean and percentage values indicates that the corrosion effect causes a decrease in diameter and cross-sectional area, fiber degradation, rib reduction, and surface modification, while the exudate/resin-coated elements are validated in the work due to differential s in coating thickness [12, 16, 10, 8, 9].

In summary, it can be said that the exudate/resin has inhibitory properties against corrosive effects on reinforcing steel embedded in the concrete slab sample, which is induced in an environment with high salt content. The unit Weight - Before Test (kg), the mean and percentage results of the minimum, maximum and differential of the controlled samples were 0.87 kg and 0.87 kg (0.342% and 0.349%) and the differential was 0.00% and 0.007 %, corroded samples were 0.86 kg and 0.88 kg (0.343% and 0.348%) and the differential was 0.02% and 0.005%, coated samples were 0.88 kg and 0.88 kg (0.344% and 0.351%) , with a differential of 0.00% and 0.007%.

The average and percentage of reinforcement weight after corrosion (Kg) and the aggregate differential values of the minimum and maximum values of the controlled samples were 0.87kg and 0.87kg (0.342% and 0.349%), and the differential was 0.00% and 0.007%, the corroded samples were 0.8 kg and 0.82kg (-16% and -13.68%) and the differential was 0.02% and 2.32%, the coated sample values were 0.95kg and 0.95kg (12.85% and 14.85%) and the differential between 0.00% and 2.04%. The mean and percentage loss/gain of the minimum and maximum units of steel (Kg) and the percentage differential in comparisons were maintained at 100% values as a result of aggregation in freshwater tanks with no trace of corrosion potential relative to corrosion. Controlled sample values were 0.06kg and 0.06kg (-7.25% and -5.8%), and coverage was 0.07kg and 0.07kg (6.15% and 7.81%). Calculation results from Tables 3.1-3.3 and in 3.4 - 3.5 are summarized and plotted graphically in Figure 3.7-3.7B, listing the effects of corrosion on uncoated (corroded) and coated reinforcing steel and checking the weight of the pieces of reinforcement before and after corrosion tests Corroded samples lowers the weight compared to the layer with the percentage exposure and the average value increases, resulting in a minute volume increase in the layer thickness. For comparison, the results obtained show a reduction/reduction and reduction of mean and percentile values for coatings with 0.070kg to 0.06kg and corrosion 7.81% to -5.8%, as in the work [12, 16, 10, 8, 9]. The summary results show that the corrosive effect had an impact on the rebar embedded in the concrete slab samples exposed to induced corrosion.

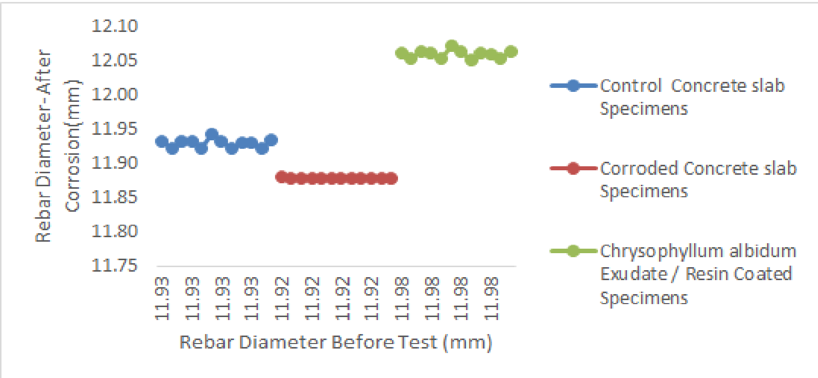

Fig-3.4: Rebar Diameter Before Test(mm) versus Rebar Diameter- After Corrosion(mm)

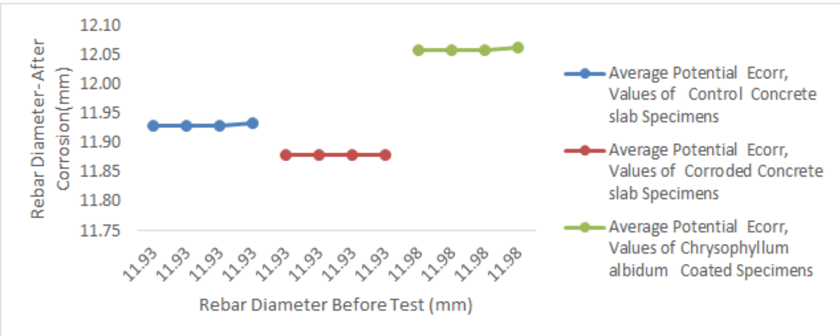

Fig-3.4A: Average Rebar Diameter Before Test(mm) versus Rebar Diameter- After Corrosion(mm)

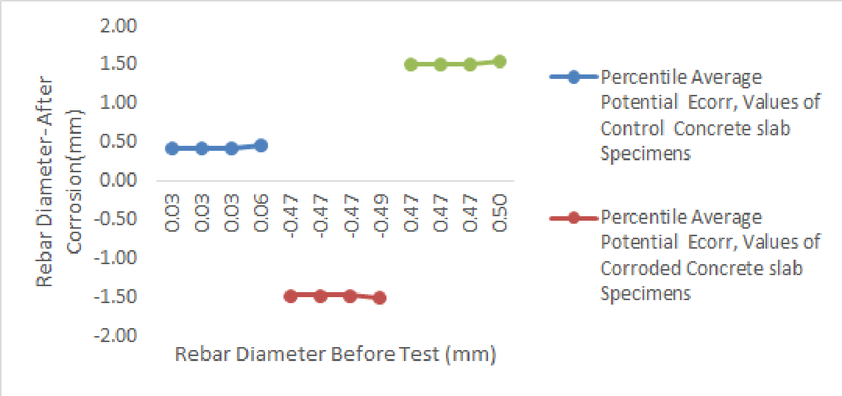

Fig-3.4B: Average Percentile Rebar Diameter Before Test(mm) versus Rebar Diameter- After Corrosion(mm)

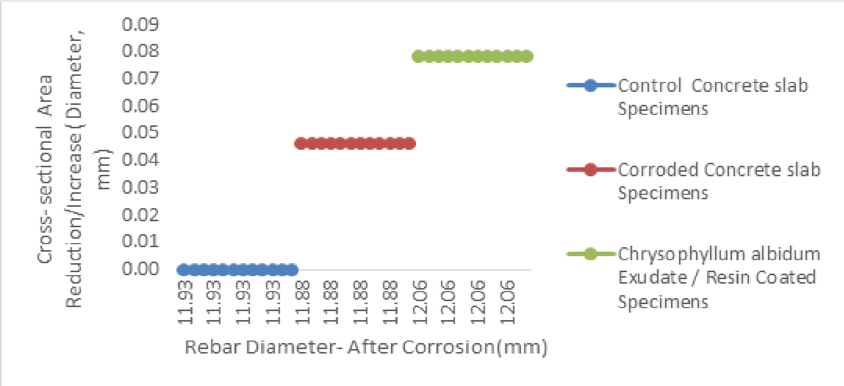

Fig-3.5: Rebar Diameter- After Corrosion(mm) versus Cross- section Area Reduction/Increase (Diameter, mm

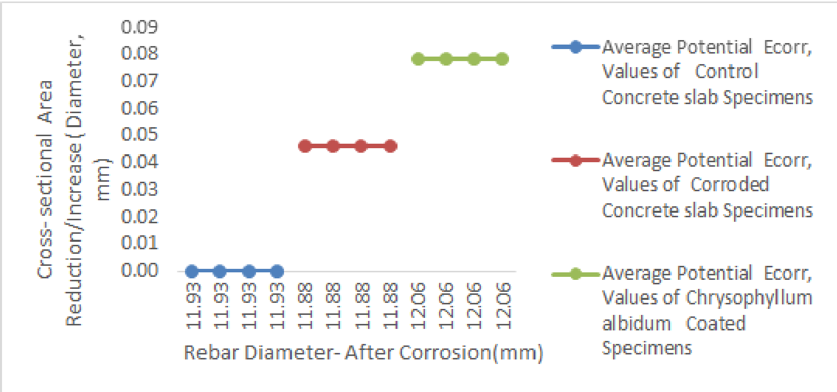

Fig-3.5A: Average Rebar Diameter- After Corrosion(mm) versus Cross- section Area Reduction/Increase (Diameter, mm)

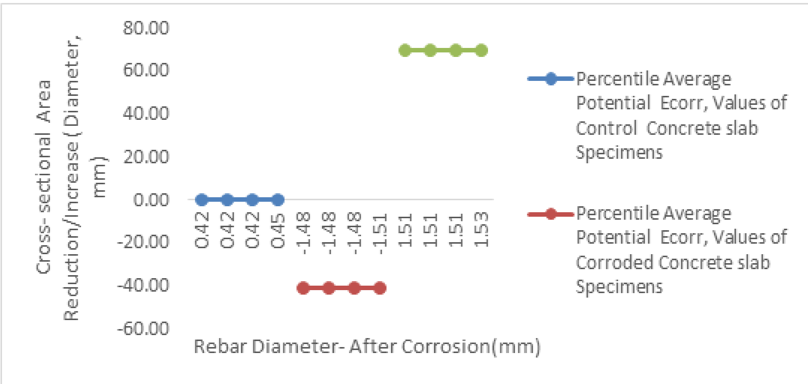

Fig-3.5B: Average Percentile Rebar Diameter- After Corrosion(mm) versus Cross- section Area Reduction/Increase (Diameter, mm)

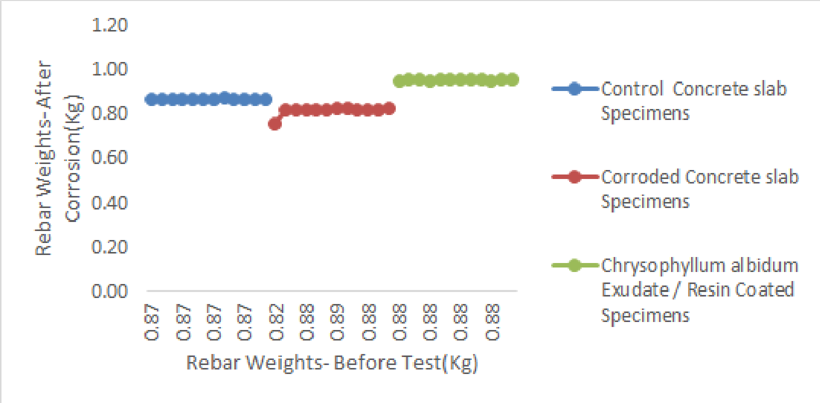

Fig-3.6: Rebar Weights- Before Test(Kg) versus Rebar Weights- After Corrosion(Kg)

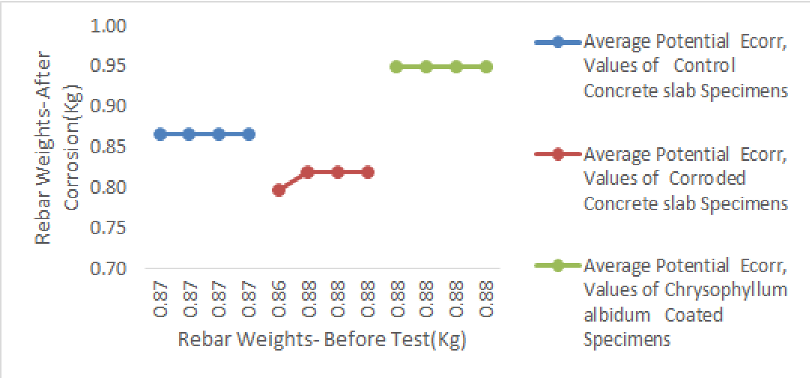

Fig-3.6A: Average Rebar Weights- Before Test(Kg) versus Rebar Weights- After Corrosion(Kg)

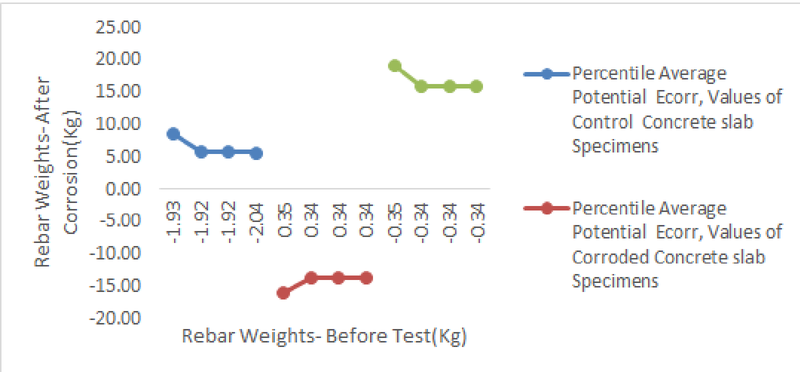

Fig-3.6B: Average Percentile Rebar Weights- Before Test(Kg) versus Rebar Weights- After Corrosion(Kg)

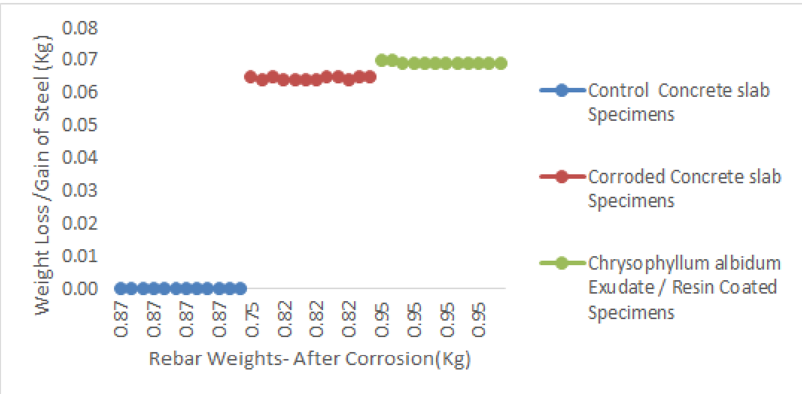

Fig-3.7: Rebar Weights- After Corrosion(Kg) versus Weight Loss /Gain of Steel (Kg)

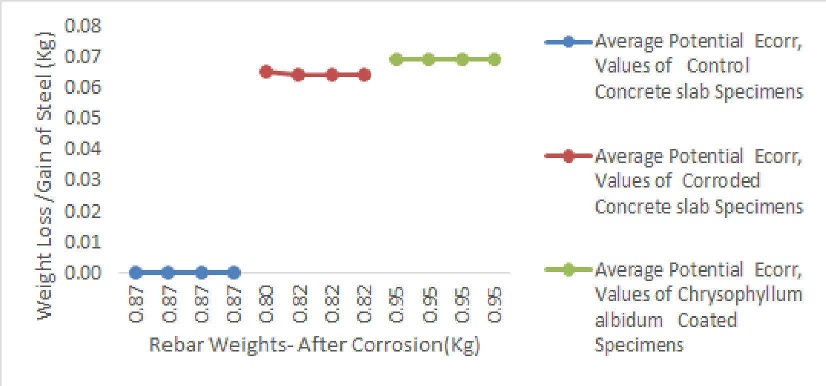

Fig-3.7A: Average Rebar Weights- After Corrosion(Kg) versus Weight Loss /Gain of Steel (Kg)

Fig-3.7B: Average Percentile Rebar Weights- After Corrosion(Kg) versus Weight Loss /Gain of Steel (Kg)

4.0. CONCLUSION

Experimental results showed the following conclusions:

i. Coated reinforcing steel showed no indications of corrosion presence
ii. Chrysophyllum albidum exudates / resins showed an inhibitory properties against corrosion attacks
iii. Reduction in diameter and cross-sectional areas were noticed in corroded samples
iv. Weight loss was witnessed in corroded samples while inhibited samples exhibited minute volumetric increase.
v. Yield strength and ultimate tensile strength reduction was noticed in corroded samples resulting from corrosion effect

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