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Performance And Study Of Corrosion Inhibitor By Using Aloe Perfoliata Gel

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Abstract - *Corrosion is a phenomenon which results in the rust formation in steel reinforcement in RCC Concrete structure when they are exposed to different environmental condition. The steel corrosion in reinforced concrete reduces its durability and can even result in failure of the structure. This issue cannot be avoided but can be minimized by the use of corrosion inhibitors. The selection of the inhibitor is important for environmental protection. Because of using some corrosion inhibitor create toxic exposure whereas green inhibitors are eco-friendly, no toxic compound are present and affordable cost. They are available and renewable. In this paper various experimental study were made with aloe perfoliata gel was added as chemical admixture with various percentage (10%,20%,30%) of water reduction for preparation. Following examination were conducted in compressive strength, split tensile, flexure strength. The paper discuss about the effect of aloe perfoliata as a green inhibitor and their harden properties of concrete. This project is planned and designed according to Indian Standard Method.*

Key Words: **Aloe perfoliata, Corrosion inhibitor, Green inhibitor, Eco-friendly, Toxic Exposure.**

1.INTRODUCTION

The chemical or electro-chemical reaction between a material usually a metal and its environment that produces a deterioration of the material and its properties. "For steel embedded in concrete, corrosion result in the formation of rust which has two to four times the volume of the original steel and none of the good mechanical properties corrosion also produces pits or holes in the surface of reinforcing steel, reducing strength capacity as a result of the reduced cross sectional area. After the construction the concrete is exposed to many environments during its service life. When we focus on the environment which has chlorine in it, doesn't affect concrete but it corrodes the steel reinforcement. To affect the steel reinforcement, it must be transported through concrete. Once the threshold of chlorine ions has reached the surfaces of steel, corrosion starts to occur when the steel bars start to corrode, the reinforced concrete member gradually begins deteriorating going through the following stages.

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Formation of white patches atmospheric carbon dioxide reacts with calcium hydroxide present in the cement paste forming calcium carbonate. This calcium carbonate is carried by moisture and deposited onto the concrete surface forming white patches.

Brown patches along reinforcement when the steel bars start corroding, a layer of iron oxide is formed on it. This iron oxide also gets carried to the surface of the concrete by moisture.

Formation of cracks – The products of corrosion occupy a greater volume than the original material. Hence they exert pressure on the concrete and crack it with more corrosion occurring, more and wider cracks are formed. Here are some possible ways to prevent corrosion of metals, such as

1) Pilling corrosion,
2) Crevice corrosion,
3) Inter granular corrosion,
4) Coating to reinforcement,
5) Galvanized reinforcement,
6) Improving metallurgical by addition of certain elements,
7) Using corrosion inhibitors,
8) Coating to concrete,
9) Cathodic Protection,
10) Electrochemical chloride removal,

There is a growing trend to use plant extracts as a corrosion inhibitors. The inhibitors which are made from the naturally occurring plant extracts are commonly known as green corrosion inhibitors. Where most of their extracts containing the necessary elements such as O,C,N and S which are active in organic compounds, assist in adsorption of these compounds on metal or alloys to form a film that protects the surface and hinders corrosion. In this study Aleo perfoliata is used as green inhibitor. The green corrosion

inhibitor is added in various percentage like 10%, 20%, 30% replacement of Weight of water. It is directly added to the concrete while mixing.

2. MATERIAL USED

2.1 Cement

Ordinary Portland cement 53 grade, commercially available in the market was used for the precast study and it is having a specific gravity of 3.18 and normal consistency 30% conforming to the requirements of IS: 12269-1987 specifications.

2.2 Fine Aggregate

If the aggregate is less than 4.75mm. Then it is called as fine aggregate. In this study locally available river sand is used which having the specific gravity of 2.37 and water absorption of 1%.

2.3 Coarse Aggregate

The coarse aggregate of 20mm size was used for this present study and its having the specific gravity of 2.64. The aggregate were tested as per IS 2386 – 1963.

2.4 Normal Water

The water which if suitable for drinking have to be used for making concrete. The water should be clean and free from harmful, impurities such as alkali, acids and oil etc.

2.5 Aloe Perfoliata

It originates from the Arabian peninsula but grows wild in tropical climates. Aloe vera is a stemless or very short-stemmed plant growing to 60-100cm (24-39 inch) tall, spreading by offsets the leaves are thick, and fleshy, green to grey green.

3. EXPERIMENTAL PROGRAMME

3.1 Preparation Of Plant Extract

The leaves were obtained from the plant in the neighbour hood and thoroughly washed with water to remove dust and green layer of aloe Perfoliata.

The white flesh is collected from aloe Perfoliata, and grained it is a gel.

3.2 Casting

M30 Grade of concrete is used. Ordinary Portland cement of 53 grade is used and river sand passing through 4.75mm sieve. 20mm size of coarse aggregate is used. Portland water was used for both mixing and curing. The 0.4 water cement ratio used.

And cement content was 420Kg/m3 sand used was 529.81Kg/m3 and coarse aggregate content used was 1144.76Kg/m3 with 20mm maximum nominal size.

3.3 Compression Strength

Compressive testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. Compressive strength or compression strength is a capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstand loads tending to elongate. compressive strength resists compression, whereas tensile strength resists tension.

The compressive strength of concrete is given in terms of the characteristic compressive strength of 150mm size cubes tested at 28 days.

The compressive strength is calculated from failure loaded divided by cross section area resisting the load and reported in units of pound-force per square inch.

Compressive strength of concrete = P/A

Where,

P = Compressive Load

A = Cross Sectional Area

3.4 Split Tensile Strength

The tensional strength is an indirect method. A measure of the ability of material to resists a force that tends to pull it apart each value was taken as the average of these samples. Test results were obtained for specimens cured for 28 days. The concrete develops cracks when subjected tensile forces, the splitting tensile strength of the strength as follows,

$$T = 2P/\pi LD$$

3.5 Flexural Strength

Flexural strength is one measure of the tensile strength of concrete. It is measured (100mm x 100mm) concrete beams with a span length at least three times the depth. Flexural strength represents the highest stress experienced within the material at its moment of yield, the flexural strength is expressed as modules of rupture. A simply supported concrete prism is loaded by two loads placed at third points along the span. The load is monotonically increased until flexural failure occurs.

$$F_b = Pl/bd^2$$

3.6 Accelerated Corrosion Test

An accelerated corrosion test by the impressed current technique is confirmed to be a valid method to study the corrosion process of steel in concrete, To evaluate the initiation time of corrosion under accelerated test conditions, concrete cylinders of size 150mm diameter and 300mm length were cast with HYSD steel bar of 12mm diameter fixed centrally into it. After 28 days of curing, all the specimens are dried for 24 hours and immersed in saline media (5% sodium chloride solution). The positive terminal (anode) of the DC source connected to the steel bar and the stainless steel plate is connected to the negative terminal (cathode). The specimens were subjected to a constant voltage. The response of current is monitored with respect to time.

4. RESULTS AND DISCUSSIONS

4.1 Compressive Strength

The compressive strength tested on cube for different percentage of aloe perfoliata in M30 concrete for 7 days and 28days. The strength of concrete is gradually increased with respect to increasing the percentage of aloe perfoliata. When adding the aloe perfoliata gel the strength of concrete is increased compared to conventional concrete.

Table -1: compressive strength comparison between 7 days and 28 days

S.NO	% OF ALOE PERFOLIATA GEL ADDED	AVERAGE COMPRESSIVE STRENGTH @ 7 DAYS (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH @ 28 DAYS (N/mm^2)
1	0%	25.52	39.41
2	10%	27.93	42.96
3	20%	30.79	47.71
4	30%	36.01	55.43

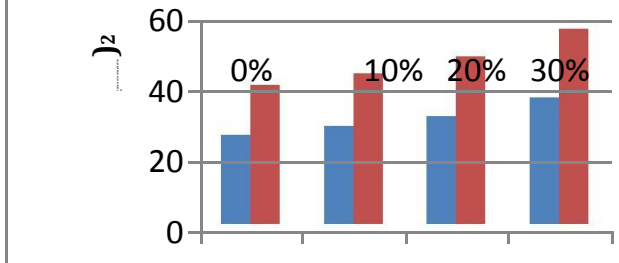

Chart 1: Compressive Strength Analysis

% of Aloe perfoliata

4.2 Split Tensile Strength

The split tensile strength tested on cylinders for different percentage of aloe perfoliata in M_{30} concrete for 7days and 28days having more or less equal strength compare to conventional concrete.

Table -2: split tensile strength comparison between 7 days and 28 days

S.NO	%OF ALOE PERFOLIATA ADDED	AVERAGE SPLIT TENSILE STRENGTH@ 7 DAYS (N/mm^2)	AVERAGE SPLIT TENSILE STRENGTH @ 28 DAYS(N/mm^2)
1	0%	2.1	3.37
2	10%	2.2	3.38
3	20%	2.25	3.4
4	30%	2.4	3.44

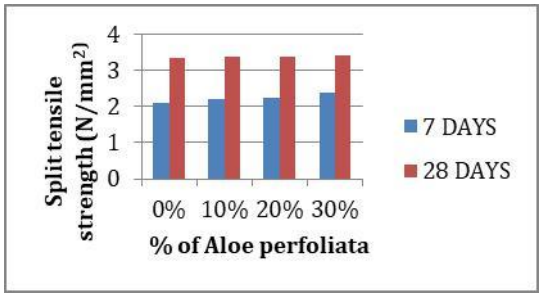

Chart -2: Split Tensile Strength Analysis

4.3 Flexural Strength

The flexural strength tested on prism for different percentage of aloe perfoliata have better results compared to conventional concrete.

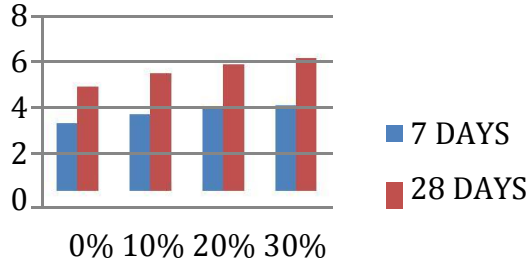

Chart -3: Flexural **%ofAloe** Strength **perfoliata** Analysis

Table -3: Flexural strength comparison between 7 days and 28 days

S.NO	%OF ALOE PERFOLIATA ADDED	AVERAGE FLEXURAL STRENGTH @ 7 DAYS(N/mm^2)	AVERAGE FLEXURAL STRENGTH @28 DAYS (N/mm^2)
1	0%	2.94	4.52
2	10%	3.32	5.11
3	20%	3.59	5.52
4	30%	3.75	5.77

4.4 Accelerated Corrosion Test

The sudden rise in current (mA) can be identified as initiation time of corrosion. The aloe Perfoliata has high corrosion initiation time compared to the conventional concrete.

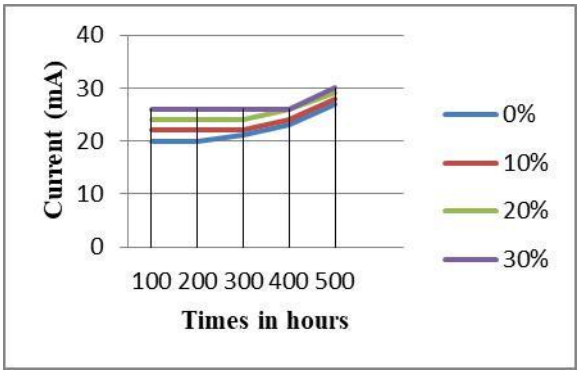

Chart -4: Comparison of Initiation time of corrosion

5. CONCLUSIONS

The green inhibitors are economical, eco-friendly and locally available. While adding the aloe Perfoliata gel to the concrete the hardened properties of concrete greatly increased compare to the conventional concrete.

- The compressive strength and flexural strength is increase upto 30% compare to the conventional concrete.
- The increasing percentage of strength with respect to the increasing percentage of aloe Perfoliata added to the concrete.
- The split tensile strength is more or less equal to the conventional concrete.

The green inhibitor such as aloe Perfoliata has high corrosion initiation time compared to the conventional concrete.

The result of inhibitor showed that aloe Perfoliata has good corrosion inhibition efficiency compared to the conventional concrete.

The further study to be needed to found the optimum percentage of aloe Perfoliata added to the concrete.

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