An Experimental Study on Corrosion Prevention of Reinforcement in RCC using Admixture and Anodes

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Abstract; This paper provides a experimental research work and the results of experimental work of some of the progress in the area of corrosion prevention of reinforcement in RCC works using optimum quantity of Admixture and Anodes with experiments.Existing studies have shown that the rate of corrosion in concrete beams in which anticorrosive admixtures used is reduced at greater extent.This paper presents the results of an experimental study on the performance of Corro guard Admix Admixture and Anodes on corrosion prevention of reinforcement in RCC beams.

Index Terms; Admixture,Anode,Fiber reinforced polymer

1.INTRODUCTION :-

Concrete is a versatile composite material which has been used over century in the construction area due to its economical ecological and technical advantages. But the corrosion of steel reinforcement bars in the concrete is a longstanding global problem being faced by many technical Engineers which causes damage to concrete structures.In case of adverse environments, numerous structures have life experienced unacceptable loss in safety or serviceability far earlier than expected due to corrosion of reinforcing steel bars and therefore there is need for corrosion prevention.Corrosion is mainly caused by the chloride intrusion (Passage of aggressive chloride ions form marine environments, deicing salts, and use of chloride contaminated aggregates) and carbonation. When chloride ions react with steel, corrosion products such as rust is formed which involves a substantial increase in volume which results in expansion of the concrete and thus spalling and delamination of concrete takes place, so it is necessary to stop the corrosion at the initial stage itself, so that the life of the structure is improved which indirectly reduces the maintenance cost using Admixture and anodes.

2.EXPERIMENTAL WORK AND DISCUSSION;

A)Corro-Guard Admix Admixture; The details of test specimens were divided into three main categories depending upon the percentage of admixture ranging from 0.1%,0.2%,1.0% are described in following table

Sr.no	Group	Number of M20 RCC beam specimens
1.	Normal water (Without admixture)	3
2.	0.1% Admixture	3
3.	0.2% Admixture	3
4.	0.3% Admixture	3
5.	0.4% Admixture	3
6.	0.5% Admixture	3
7.	0.6% Admixture	3
8.	0.7% Admixture	3
9.	0.8% Admixture	3
10.	0.9% Admixture	3
11.	1% Admixture	3
	Total	33

Table 1 – Beams Specification

11 samples of RC beams were cast (each sample contains 3 RC beams) taking dosage of anticorrosive admixture ranging from0,0.1%,0.2%,0.3%….1%.The potential difference is observed for all these samples observed after 84 days of curing,average potential as follows:

Table 2 : Potential difference observed for different dosage of Admixture

Dosage of Admixture %	Average Potential Difference (mV)
0	800
0.1	440
0.2	350
0.3	250
0.4	210
0.5	160
0.6	165
0.7	170
0.8	175
0.9	180
1	180

Based on observations made in table 2 the potential difference is reducing with a faster rate upto 0.5% dosage further the rate of corrosion reduction is less hence we can conclude that the optimum dosage of admixture is 0.5%.

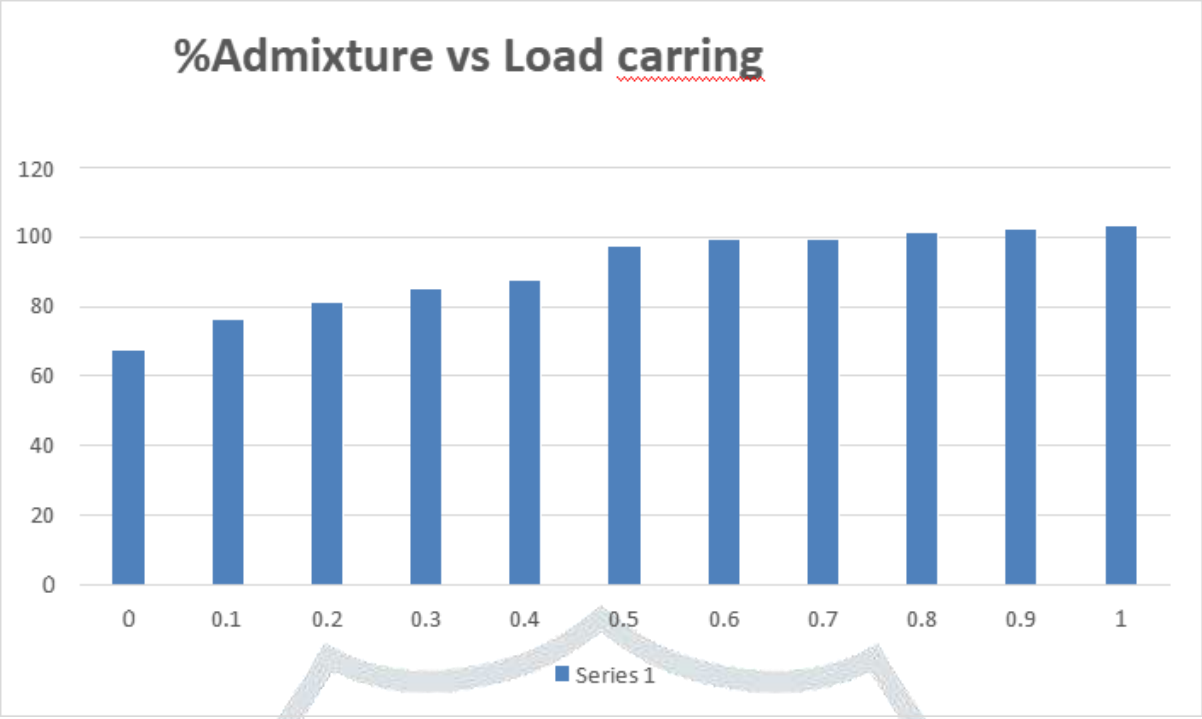
►We have cast the RC beam using different conditions,11 samples (each sample contains 3 beams) were cast and observed the corrosion potential after 84 days,Flexural strength of RC beams,the results of corrosion potential and flexural strength observed were compared,The RC beams cast using varying % of Admixture

ranging from 0,0.1%,0.2%…1% and observed the load carrying capacity of RC beam with varying % of Admixture.

►After loading starts beams resists the initial load , but due to gradual increase in load cracks starts developing on the beams. We observe that cracks starts developing at load greater than 30KN.Cracks are formed at point of contact of load and continues till supports.

Table 3: Average load at different stages of crack for different % of Admixture dosage

Percentage of Admixture(%)	Total load take by			Average (KN)
	Beam1 (KN)	Beam2 (KN)	Beam3 (KN)	
0	65	69	67	67
0.1	70	80	78	76
0.2	74	87	82	81
0.3	78	91	86	85
0.4	83	91	89	87
0.5	88	104	99	97
0.6	91	105	101	99
0.7	93	104	102	99
0.8	95	106	102	101
0.9	97	105	104	102
1	98	107	105	103



Load in KN ↑

Admixture Dosage in % →

Graph 1 ;% of Admixture dosage used vs Load carrying capacity

From above graph we can observe that by adding Admixture load carrying capacity of RCC beam increases upto 0.5% of admixture dosage. Therefore 0.5% Dosage of Admixture is optimum percentage.

B) ANODES;

The details of test specimens were divided into following categories ►RCC Beam cast using normal water RCC beam cast using normal water having Anode for corrosion control ,RCC beam cast with saline water having anode for corrosion control,RCC beam cast using saline water without use of anode ,RC beam cast using saline water,Acitic Acid ,Hydrogen peroxide with and without use of anode and with use of saline water and normal water.RCC beams cast using Red oxide admixture with normal water,saline water,with and without use of anode.Test results after 28 days of casting are given below:Beams cast with M20 grade of concrete and Fe500 Grade of steel using different conditions are given below in table 4

Table 4 Average Corrosion Potential of reinforcement in RCC beam

GROUPS based on type of water used for mixing,with and without anodes	NUMBER OFM20 BEAM SAMPLES	CORROSION POTENTIAL	AVERAGE CORROSION POTENTIAL
RCC beam cast using normal water	3	-117 -154 -152	-141
RCC beams cast using normal water having Anode for corrosion control	3	-115 -154 -152	-140
RCC beam cast with salt(5Kg)saline water having anode for corrosion control	3	-280 -197 -205	-227.5
RCC beam cast using saline water without use of anode	3	-342 -238 -245	-275
RCC beam cast using salt(5Kg)saline water+Acitic Acid(4.2%)+Hydrogen Peroxide Solution(400ml) having anode for corrosion control	3	-219 -230 -225	-224.5
RCC beam cast with normal water with Acitic acid Hydrogen Peroxide solution without use of anode	3	-240 -244 -238	-240.6

The rate of corrosion in RC beams in which anodes are used with saline water is reduced by 20% as compared to the rate of corrosion in RC beam cast with saline water without anodes.

Fig;Flexural Test on Beam

Fig; Beams cast using Admixture and Anodes

Experimental Work

3.CONCLUSIONS;

A)Corro-Guard Admix Admixture for Corrosion Control;

►Test were conducted by taking dosages of admixture ranging from 0.1%,0.2%….1%.As per the results shown in table 2 and graph1we can observe that 0.5% of anticorrosive admixture is optimum dosage at which the rate of corrosion is reduced at greater extent. The rate of corrosion is reduced gradually with increase in percentage of anticorrosive admixture upto 0.5%, after this the rate of corrosion decreases but at a slower rate with further increase in dosage of anticorrosive admixture.From graph 6.5 b we can observe that by adding the quantity of Admixture dosage Corrosion is reducing in the bars gradually, and it is reduced by very less quantity from 0.5% to 1%.Therefore 0.5% Dosage of Admixture is optimum percentage it is thus recommended that the anticorrosive admixture of optimum dosage 0.5% should be used in reinforced concrete construction.

Effect of Admixture on Flexural Strength of RCC beam;

►The research revealed that the flexural strengths of concrete beams reinforced with steel bars with anticorrosive admixture is greater than the flexural strength of concrete beam without admixture.Hence, the use of this anticorrosive admixture helps in not only decreasing the rate of corrosion of reinforcing steel in RCC structure but also it helps in maintaining the strength of RCC structure.

►The research revealed that the flexural strength of concrete beams reinforced with steel bars with anticorrosive admixture is greater than the flexural strength of concrete beam without admixture than 54% .

B) Use of Anodes for Corrosion Control

Comparison of experimental results of RCC beam cast using normal water;

►The corrosion rate of reinforcement is reduced by 1% when anode is used for corrosion control tested after 28 days of curing in case of RCC beam cast using normal water.

►The corrosion rate of reinforcement is increased by 38% in case of RCC beam cast using saline water having anodes for corrosion control as compared to the rate of corrosion in RCC beams cast using normal water without anode.

►The corrosion rate of reinforcement is increased by 48% in case of RCC beam cast using saline water without anode as compared to the RCC beam cast using normal water.

►The corrosion rate is increased by 38% in case of RCC beams cast using saline water,Acitic acid,Hydrogen Peroxide having anode for corrosion control as compared to the rate of corrosion of RCC beam cast with normal water.

Comparison of experimental results of RCC beams cast using saline water having anode for corrosion control;

►The corrosion rate of reinforcement is reduced by 18% in case of RCC beams cast using saline water having anodes for corrosion control as compared to the RCC beams cast using saline water without anode.

Comparison of experimental results of RCC beams cast using saline water,Acitic acid,Hydrogen peroxide having anode for corrosion control;

►The corrosion rate of reinforcement is increased by 6% in case of RCC beams cast using saline water,Acitic acid ,hydrogen peroxide with anode as compared to the RCC beams cast using saline water,Acitic acid,Hydrogen Peroxide without anode.

IMPORTANT NOTES;

►The rate of corrosion increased by 35% to 37% when RC beams cast using saline water having Anodes for corrosion control as compared to the rate of corrosion of RC beam cast using normal water having Anode for corrosion control.

►Saline Water (salt 5Kg per mix) corrodes the RC beam @ 45% faster than the rate of corrosion in RC beam cast using normal water at the time of casting tested after 28 days of curing.

Effect of saline water on flexural strength of RCC beam

► The RC beam cast using saline water reduces the Flexural strength of RC beam by 20% as compared to the Flexural strength of RC beam cast using normal water.

►The RC beam cast using Acitic acid,saline water,Hydrogen Peroxide reduces the flexural strength of RCC beam by 15% as compared to the flexural strength of RCC beam cast using normal water with anode.

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