

Corrosion Effect over the Flexural Strength of Ferro-cement

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Abstract - Ferro-cement can be define as a composite material, which consist of cement mortar reinforced with multi-layer of steel mesh. Ferro-cement laminate are very thin cross-section and the cover which is provided to reinforcing element are quite small, which can make them not only susceptible to corrosion. So experiment have be conducted to monitor the corrosion rate in Ferro-cement panel subjected to severe condition which involve alternate wetting and drying accelerated corrosion technique. For experimental work Ferro-cement panels had been casted with different types cement i.e. OPC 53 grade Birla cement and PSC Jsw HD Concreel while keep all other parameters constant. After casting of panels, demolding was done with gap of 24 hours and two day normal curing was done after on panels were subjected to acceleration corrosion technique which involve 4 days wetting in different percentage of NaCL solution (0%, 3% & 5%) and 3 days drying in air for 63 days. After assessment of corrosion the Ferro-cement panel were test in flexural on U.T.M Corrosion monitoring of steel mesh have be carried out with help of half-cell potential meter. Aim of experiment was to compare the corrosion performance and corrosion rate of steel mesh in OPC and PSC cements based Ferro-cement panel. Results obtain from experimental work shows high corrosion rate in Ferro-cement panel casted with OPC while comparing it with PSC panels in NaCL content 5 %and the result obtain from half-cell potential test are supported by result obtain through flexural testing of specimen. Experiment shows specimen casted with PSC showed good performance in both corrosion and flexural strength as compared to Specimen casted with OPC.

Key Words: Ferro-cement, panel, acceleration corrosion, steel mesh, Monitoring

1. INTRODUCTION

The laminate composites like Ferro-cement are composite material made from cement, sand, water, admixture, steel mesh and skeletal steel. The use of such laminate are increasing day by day because of having various advantages like toughness, fire resistances, economy, and soundness etc. (1 & 3). The minimum outer cover which is provided to the reinforcing element in such laminate are as small as 3mm. which make more and more closer to get affected by corrosion. From the experimental studies the results show that despite using traditional galvanized steel mesh in Ferro-

cement an considerable amount of corrosion damage can occur within few years if no additional measures have been taken. The information available on this topic are not sufficient so as to give general guidance to prevent or control corrosion. This have created area of region in which huge amount of research work is need to be done.

If we compare the Ferro-cement element to conventional concrete elements, thickness of Ferro-cement laminate rarely crosses 25mm (1, 2 & 4). In means of material Crouse aggregate are completely replaced by fine sand , while the steel reinforcement is evenly and uniformly spread in cement mortar mix. So, Present aim of the experiment is to find suitable cement for Ferro-cement laminate which can provide safety against corrosion and enhance service life period of Ferro-cement laminate.

The possible way to reduce/delayed the potential corrosion problem can be achieve by either coating the reinforcing steel, use of corrosion resisting cement or coating complete laminate by paint. For the experiment program use of corrosion resisting cement have been used for delaying the corrosion process and to make comparison with normal cement corrosion rate of steel mesh. As natural corrosion of steel embedded in cement mortar mix require few decade to show corrosion an acceleration corrosion technique have been implemented which involves wetting the specimen in sodium chloride solution for 4 days and drying specimen for 3 days in different percent of sodium chloride solution. The corrosion Monitoring is conducted with help of half-cell potential meter. The half-cell potential meter consist of micro-volt meter and reference electrode is confining to ASTM 876 standards. The data obtain with help of half-cell potential meter is compared. The result obtain from experiment work shows that specimen cased with PSC JSW Hd Concreel shows very reduce rate of corrosion and have better protection from corrosion in comparison to OPC Panels of Ferro-cement.

2. EXPERIMENTAL WORK

For experimental work 18 numbers of Ferro-cement panels were casted with size of 330mm X 100mm X 20mm. They were divided into two groups which consist 9 panels in each group. Cement sand ration used for panel was 1:2.5 and water cement ration was kept as 0.45. Each of the panel were reinforced with 2 layers of galvanize square steel mesh having 1mm dia. and no skeleton steel were used. 5 mm

cover was provided to steel mesh. For monitoring purpose copper wire are jointed to each layer steel mesh brought out of specimen that can be seen Fig 1.



Fig-1: Connection for corrosion monitoring in Ferro-cement panels

2.1 Different Condition of Curing

The specimen were given 2 days normal curing in portable water in order to gain sufficient strength. After normal curing the specimen subjected to acceleration curing processes which involves 4 days wetting in NaCL solution (0%, 3% & 5%) and followed by 3 days of drying in air for 63 days as shown below.



Fig-2: Wetting and drying of specimen in different percentage of NaCL Solution

2.2 Corrosion Monitoring

For corrosion monitoring purpose half-cell potential meter was used. Cu/Cuso₄ electrode was used as reference electrode. Corrosion was monitored at end of each cycle of acceleration corrosion for 63 days. For monitoring of corrosion the reference electrode is placed on the pre wetted surface of specimen and the copper wire from the specimen is connected to micro-voltmeter. The reading obtain are in m-volts which shows the chances of corrosion.

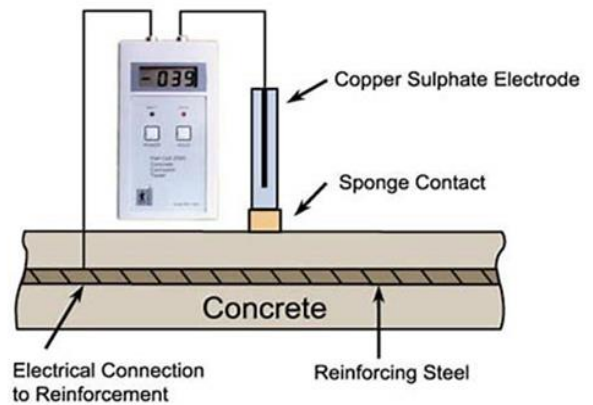


Fig-3: Half-cell potential meter with Cu/Cuso₄

2.3 Flexural Test

After assessing corrosion of Ferro-cement panels they were subject to 3 point loading with help of U.T.M as shown in figure below. All specimen tested under universal testing machine and result of the testing is discussed



Fig-4: Specimen subject to 3 point loading.

3. RESULT

The spontaneous reading obtain from half-cell meter from 1 day and 63 days have been given below. Specimen are designated as RP-0-01 relates to Roof Panel curing in 0% of NaCL solution and 01 indicate as specimen casted with Ordinary Portland cement while P1 indicate specimen casted with PSC Jsw Hd concreel.

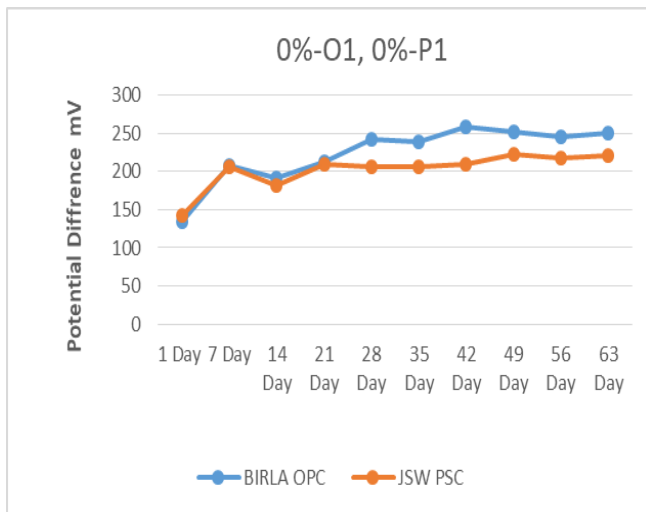


Chart-1: Results of 0-O1 and 0-P1

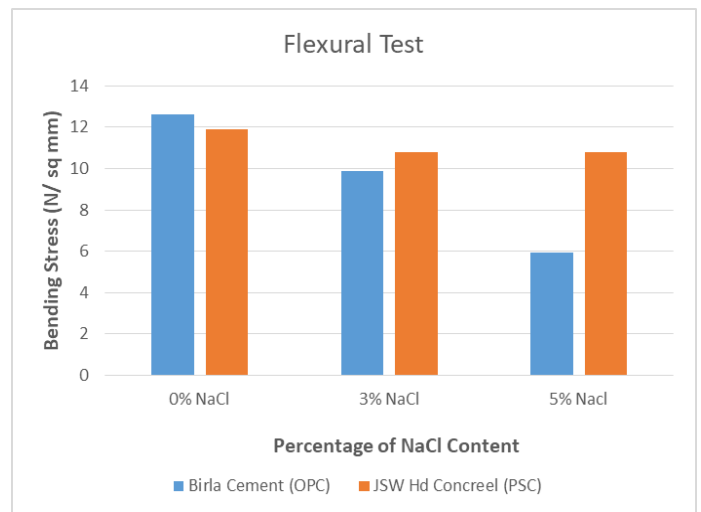


Chart-4: Results of Flexural Strength Test

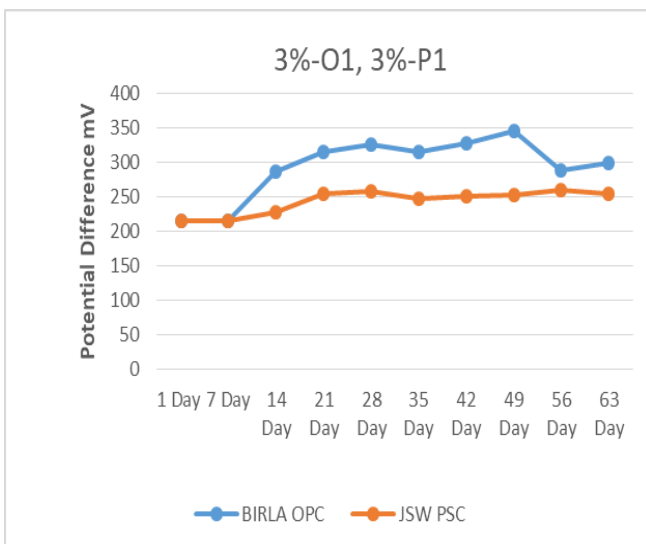


Chart-2: Results of 3%-O2 and 3%-P2

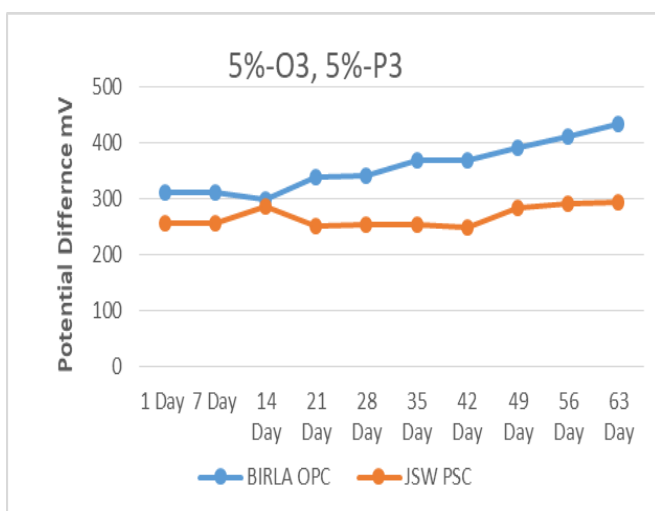


Chart-3: Results of 5%-O3 and 5%-P3

4. CONCLUSION

Spontaneous Monitoring of corrosion in Ferro-cement laminate can be possible with help of half-cell potential meter. Corrosion of the steel mesh lead to reduction of the flexural strenght of panels. The specimen casted with help of PSC show good performance against corrosion while comparing it with corrosion performance steel mesh in OPC based specimen. OPC Panels subject to 5% showed corrosion and its flexural strenght get reduced by 51% due to corrosion. While the flexural strenght of PSC panel was not affected as there was no corrosion in any of its panel. Panels of OPC subjected to 0% NaCL content showed no. from experiment it can be concluded that under normal environmental exposure condition OPC is enough to take care of corrosion while in sever exposure environmental condition PSC cement should be used in Ferro-cement.

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