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The Study of Rapid Chloride Penetration Test on Durability Properties of High Performance Concrete Containing Rice Husk Ash

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***Abstract*: Our aim is to develop concrete which does not only concern on the strength of concrete but it also satisfies the durability aspect. So for this we need to go for the addition of pozzolanic materials along with super plasticizer with having low water cement ratio. The use of Rice Husk Ash is many, which is having good pozzolanic activity and is a good material for the production high performance concrete. The rapid chloride-ion test also reveals that the connectivity of the pore system decreases drastically as the w/c ratio decreases, making the migration of aggressive ions or gas more difficult in HPC than in its plain counterpart. This indicates that the service life of HPC should exceed that of ordinary concrete in the same environment. It is difficult to determine the number of years by which the service life would be extended because the predictive models developed for ordinary concrete cannot be readily extrapolated to include HPC. However, it can be said that some HPC structures will outlast the average life span of a human being. Durability and strength are two essential factors that define performance of concrete. Chloride induced corrosion is considered to be one of the main causes of deterioration in concrete structures. It is caused by the penetration of chloride ions into concrete eventually reaching the steel reinforcement. Chloride permeation is a complex phenomenon involving various transmission mechanisms: such as diffusion of chloride ions and movement of chlorides through permeation of water into concrete. It is found that in the case of saturated concrete, at normal pressure, the predominant transport process is likely to be molecular or ionic diffusion measuring concrete durability related to chloride induced corrosion is more difficult and complicated than measuring compressive strength.**

***Keywords*: high performance concrete, rice husk ash, rapid chloride penetration test, concrete electrical resistivity.**

1. Introduction

Concrete is the most widely used man-made construction material in the world. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock-like mass known as concrete. The utility and elegance as well as the durability of concrete structures, built during the first half of the last century with Ordinary Portland Cement (OPC) and plain round bars of mild steel, the easy availability of the constituent materials (whatever may be their qualities) of concrete and the knowledge that virtually any combination of the constituents leads to a mass of concrete have bred contempt. Strength was emphasized without a thought on the durability of structures. As a consequence of the liberties taken, the durability of concrete and concrete structures is on a southward journey; a journey that seems to have gained momentum on its path to self–destruction. This is particularly true of concrete structures which were constructed since 1970 or thereabout by which time (a) the use of high strength rebar with surface deformations (HSD) started becoming common, (b) significant changes in the constituents and properties of cement were initiated, and (c) engineers started using supplementary cementitious materials and admixtures in concrete, often without adequate consideration.

To improve the quality of transition zone, use of mineral admixtures is also found to be necessary ingredient for high strength and durable concrete. In the present project work Rice Husk Ash is used as mineral admixture.

The RCPT is a standard test and is a commonly used technique for rapid characterization of concrete in terms of penetrability of chloride ions.

2. Objectives

- To study the durability properties concrete
- To design mix proportions of M60, M80 and M100 Grade Concrete.
- To cast cube and cylinder specimens of 0,5,10 and15% of rice husk ash by replacement method.
- To perform test on compressive strength of cube and cylinder specimens.
- To study durability of RHA concrete by Rapid Chloride Ion Penetration Test as per ASTM 1202 C- 2007.

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3. Methodology

A. Problem Statement

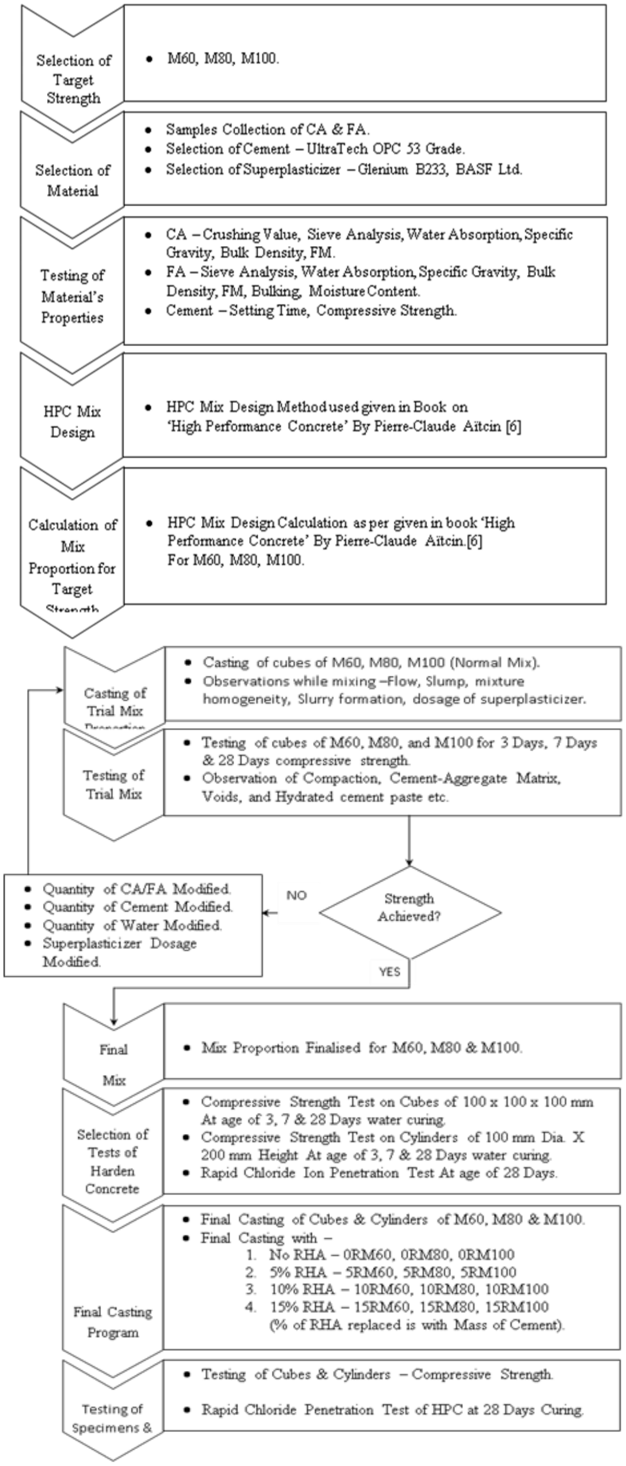

Fig. 1. Experimental steps

Table 1
Mix Proportion obtained by trials

S. No.	Particulars	M60	M80	M100
1	W/C	0.35	0.30	0.25
2	Cement (kg/m^3)	457	517	552
3	Coarse Aggregates (kg/m^3)	1158	1302	1325
	20 mm Down (%)	60	60	0
	12.5 mm Down (%)	40	40	100
4	Fine Aggregates (kg/m^3)	695	550	539.84
5	Super plasticizer Dosage (%)	0.4	0.4	0.8
6	Super plasticizer Dosage (lit/m^3)	4.81	5.44	11.62
7	Water (lit/m^3)	160	155	138
8	Density (kg/m^3)	2471.95	2525.91	2559.26
9	Slump (mm)	210	190	180
10	No. of Trials	3	4	7

B. Results

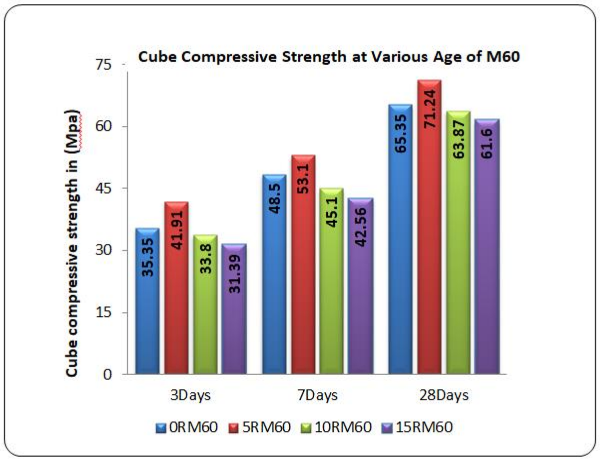

Fig. 2. Variation in Cube Compressive Strength at Various Ages of M60 mixes

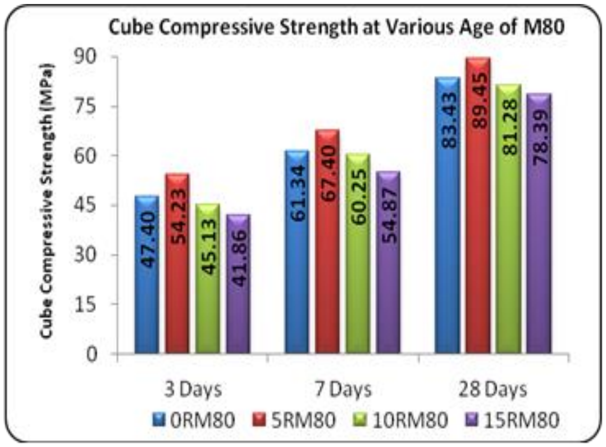

Fig. 3. Variation in Cube Compressive Strength at Various Ages of M80 mixes

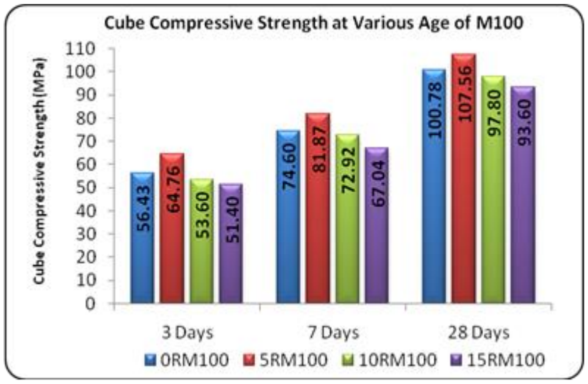

Fig. 4. Variation in Cube Compressive Strength at Various Ages of M100 mixes

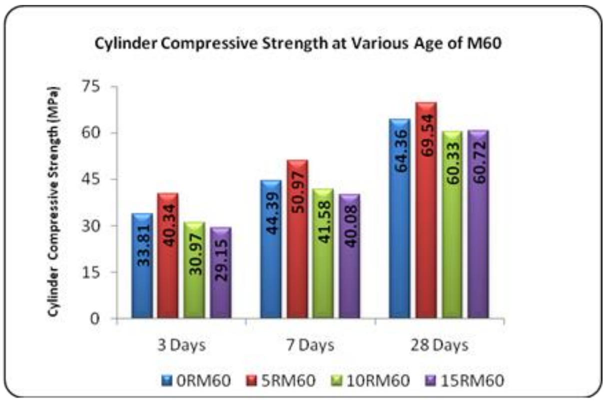

Fig. 5. Variation in Cylinder Compressive Strength in Various ages of M60 mixes

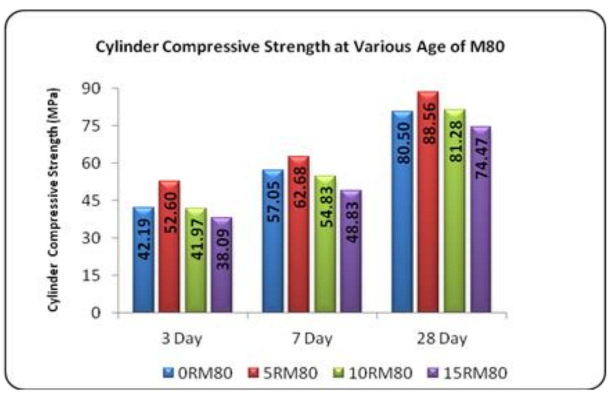

Fig. 6. Variation in Cylinder Compressive Strength in Various ages of M80 mixes

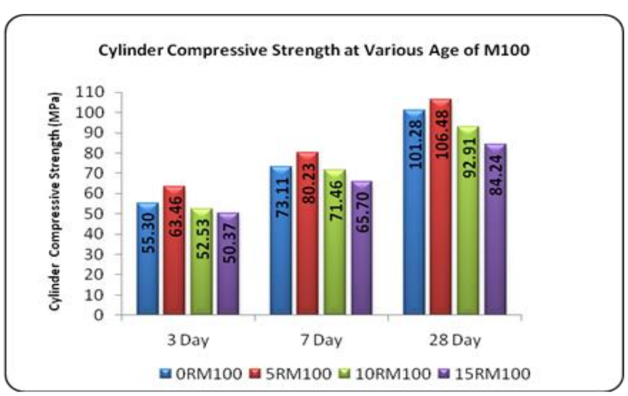

Fig. 7. Variation in Cylinder Compressive Strength in Various ages of M100 mixes

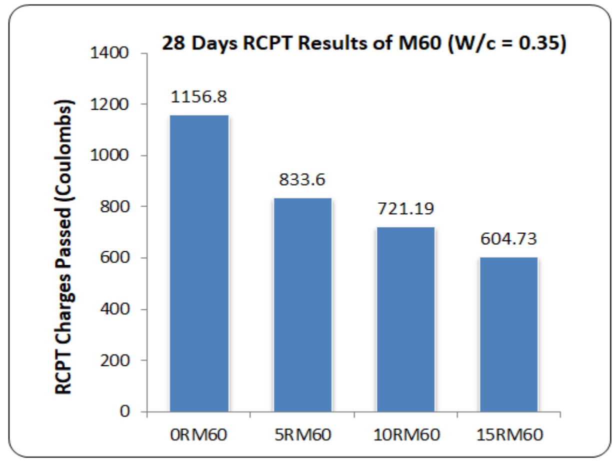

Fig. 8. RCPT Results at 28 Days of M60

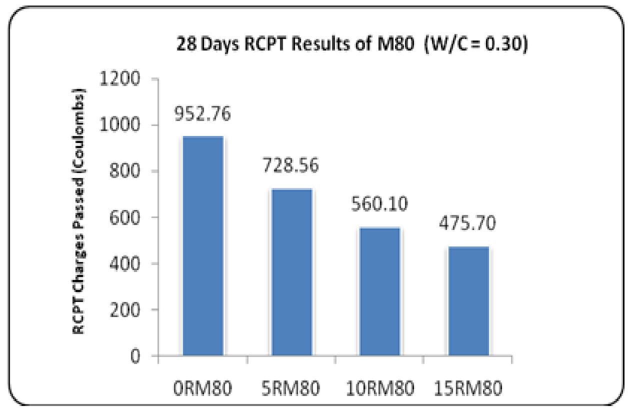

Fig. 9. RCPT results at 28 Days of M80

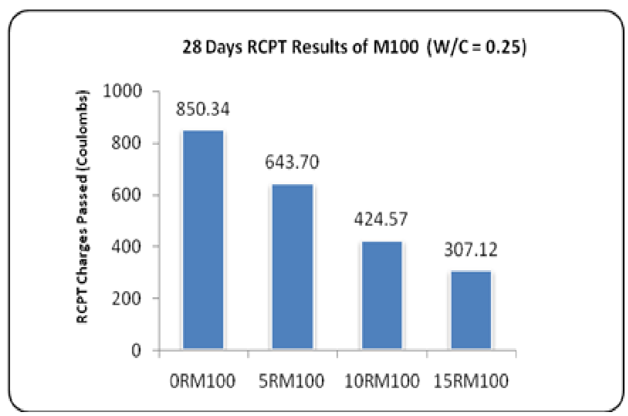

Fig. 10. RCPT Results at 28 Days of M100

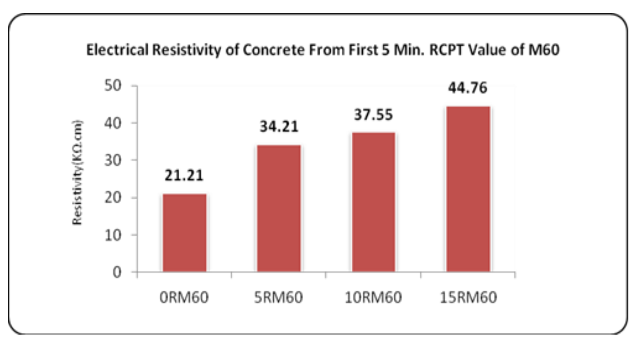

Fig. 11. Electrical Resistivity from first 5 minutes RCPT Value of M60 Mix

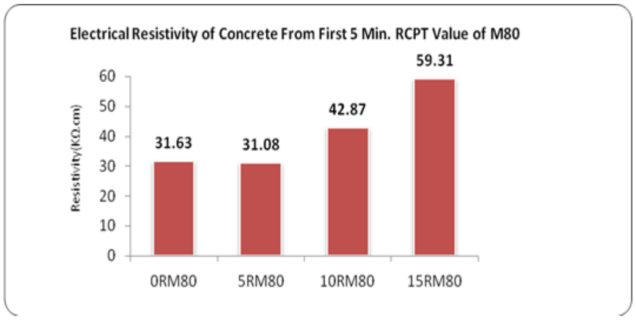

Fig. 12. Electrical Resistivity from first 5 minutes RCPT Value of M80 Mix

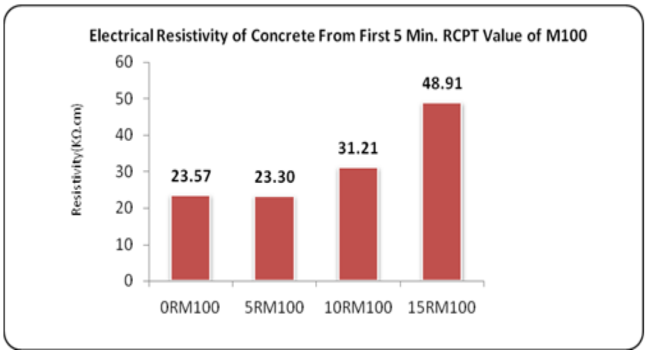

Fig. 13. Electrical Resistivity from first 5 minutes RCPT Value of M100 Mix

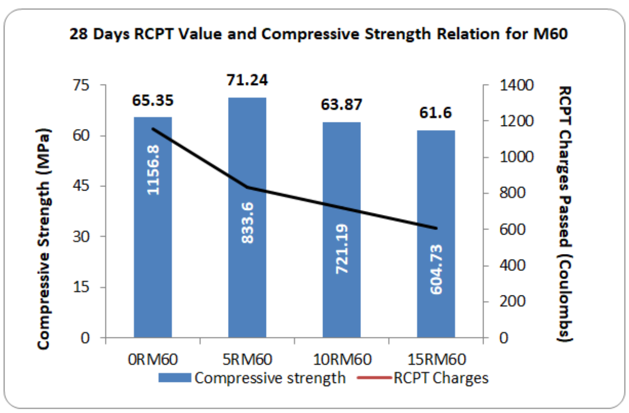

Fig. 14. Relation between Compressive Strength and RCPT Value of M60

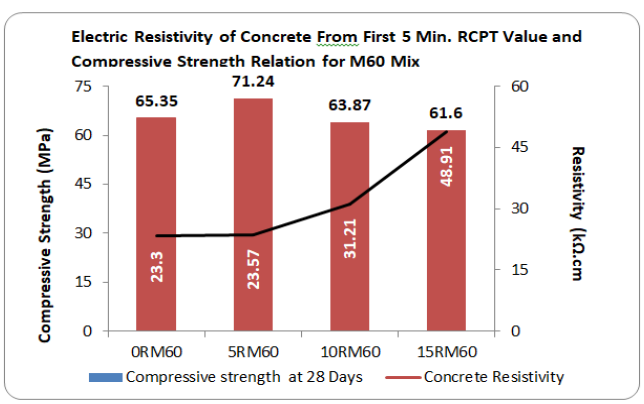

Fig. 15. Relation between Compressive Strength and RCPT Electrical Resistivity of M60

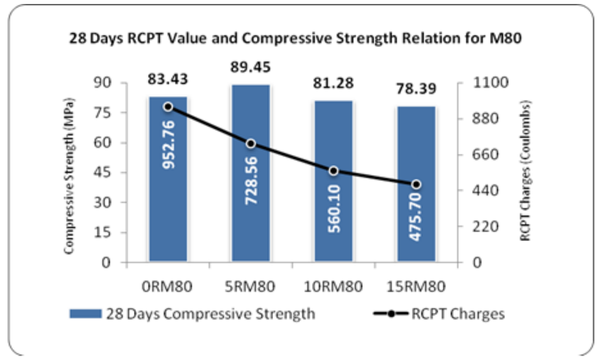

Fig. 16. Relation between Compressive Strength and RCPT Value of M80

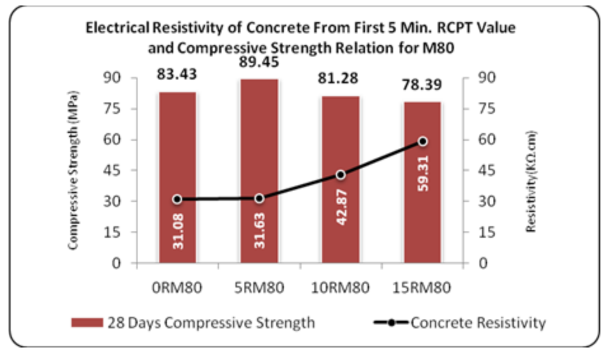

Fig. 17. Relation between Compressive Strength and RCPT Electrical Resistivity of M80

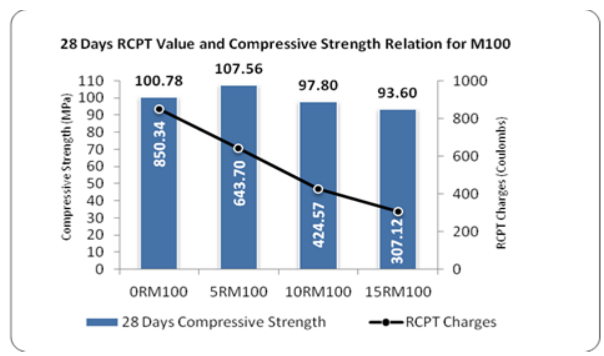

Fig. 18. Relation between Compressive Strength and RCPT Value of M100

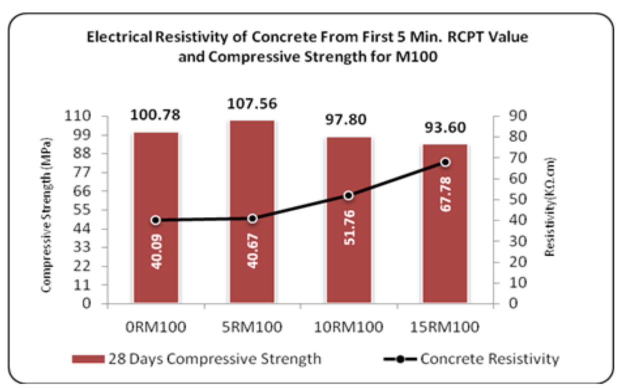

Fig. 19. Relation between Compressive Strength and RCPT Electrical Resistivity of M100

4. Conclusion

Based on the work presented, following point-wise conclusions can be drawn:

- With the use of super plasticizer it possible to get a mix with low water to cement ratios in the range of 0.35, 0.30, 0.25 to get the desired strength.
- The compressive strength of RHA concrete is increasing as compared to reference concrete. It is higher at 5% replacement among all replacement for M60, M80 and M100. At 28 days maximum strengths achieved are 70.24 MPa, 89.45 MPa and 107.56 MPa for M60, M80 and M100 in 5% RHA replacement which is higher than 0%, 10%, 15% RHA replacements.
- The gain of strength is slow in 10% and 15% RHA replacements than reference and 5% RHA replacements in M60, M80 and M100.
- The rapid chloride penetration test indicates decrease in the charges passed as the replacement of RHA percentage increases. The rapid chloride penetrability is 'low' for mix without RHA while for mix with RHA is 'very low' for M60. In M80 and M100 mixes the chloride ion penetrability is 'very low' but charges passed are higher in mix without RHA than mix with RHA. This is indicating the pore structure refinement of because of filler action of RHA particles and increase in impermeability of HPC.
- The RCPT concrete resistivity value gives 'low rate' of corrosion risk level for all mixes which indicate that HPC protects the steel reinforcement from corrosion and this protection increase due to the pore filling action of RHA.
- At 5% RHA replacement the compressive strength is higher than other mixes, RCPT value interprets it as 'low' penetrability of chloride ions and RCPT electrical resistivity gives 'low rate' of rebar corrosion risk level. So it can be concluded that the 5% RHA replacement gives more durable HPC as compared to 0%, 10% and 15% of M60, M80 and M100 mixes.

References

[1] ACI 222.R-01, "Protection of metal in concrete Against Corrosion", American Concrete Institute, Detroit, 2001.
[2] Ahmed M. S., Kayali O., and Anderson W., Evaluation of Binary and Ternary Blends of Pozzolanic Materials Using the Rapid Chloride Permeability Test, Journal of Materials in Civil Engineering, vol. 21, no. 9, 2009, pp. 446-453
[3] Aïtcin, Pierre-Claude "The durability characteristics of high performance concrete", Cement and Concrete Composite, vol. 25, 2003, 409-420.
[4] Aïtcin Pierre-Claude Durable concrete—current practice and future trends. In: Mehta PK, editor. Concrete technology: past, present, and future. ACI SP-144; 1994. pp. 83–104
[5] ASTM C1202 – 07, "Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration" American Society of Testing and Materials, Pennsylvania, 2007.