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EVALUTION OF CHLORIDE ION PENETRATION ON CALCINED BENTONITE MODIFIED CONCRETE

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Abstract.

This study deals with the evaluation of chloride ion penetration on calcined bentonite modified concrete. The variables in this work were taken as bentonite replacement and calcination temperature. 0, 5, 10, 15 percentage of bentonite was replaced in concrete at calcination temperature of 700^0C and 800^0C. 64 specimens were cast as per the mix design was prepared by using the standard procedure IS 10262. Specimens were tested after 7 days and 28 days of curing. Concrete modified with 5% of bentonite at 800^0C performed better results among all mixes. This may be attributed to the better fineness of calcined bentonite.

Keywords: Maximum 4 keywords.

1. Introduction

The present study on the feasibility of incorporating bentonite, primarily composed of montmorillonite, into cement mortar and concrete at varying percentages (5%, 10%, 15% of cement). The bentonite's activity index was evaluated under different conditions, including 'as accepted' (20ºC) and 'burned' (treated at 500ºC and 900ºC). The results demonstrated compliance with ASTM Standard C618 specifications, except for the bentonite labeled '80000º-700º Cheated.'

The study delves into the Rapid Chloride Permeability (RCPT) test, a widely used method to assess concrete strength and resistance to chloride ion penetration, especially with cementitious additives. Concerns about the applicability of RCPT in Normal Cement Concrete are raised, given the need for costly repairs before achieving the intended service life. Environmental

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conditions affecting concrete, such as alkali-aggregate reactions, freeze-thaw cycles, reinforcement corrosion, and sulphate attacks, are discussed. High-performance concrete (HPC) is introduced as a solution to enhance strength and durability, resisting aggressive solutions.

Sulphate attacks, characterized by chemical reactions involving sulfate ions, lead to concrete cracking and reduced structural lifespan. The impact of exposure conditions, such as continuous immersion, circulating water, drying, and partial immersion by evaporation, on sulfate attack is explored. The study investigates the properties and effective use of clay and nutrients in concrete cement, emphasizing the use of metakaoline and bentonite as substitutes for cement. Research findings highlight the increased resistance to sulphate in metakaoline concrete, particularly at higher substitution levels. Additionally, the study reveals the potential of bentonite clay as a substitute for cement, as demonstrated in previous works by Hassan et al. (2003) and Badshah (2003) using Jehangira bentonite.

2. Methodology:

Physical properties of Bentonite:

Physical properties of bentonite

Color	Light Yellow
Size	Pass from sieve200
Free swell	60% by volume
Nature	Pozzolanic

The UTC-1200 Rapid Chloride Permeability Test Equipment (RCPT) serves as a critical tool for assessing a concrete sample's resistance to chloride ion penetration. This evaluation involves placing a 100 mm diameter concrete cylinder into sample cells containing a 3.0% salt solution and 0.3 N sodium hydroxide solution. Throughout the test, a voltage of 60 V DC is maintained across the sample ends, and the recorded charge passing through the sample provides a basis for qualitatively rating the concrete's permeability.

Equipped with four standard cells, four PT-100 sensors for temperature monitoring, and a 190x64 resolution LCD screen, the Rapid Chloride Permeability Test Equipment by Utest offers a comprehensive testing solution. Two types of sample cells are provided: the UTC-1210, which is the standard cell for chloride resistance tests, and the UTC-1220, featuring

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additional cooling fins for situations requiring constant temperature. The Utest equipment also includes Usoft-1200, the dedicated software for RCPT tests.

The Usoft-1200 software facilitates the display of temperature and current measurements for each of the four cells, allowing for a thorough analysis of the testing conditions. The final charge passed (Q) can be conveniently reported using this software. The entire RCPT process involves the placement of a 100 mm diameter concrete cylinder into the specified sample cells, immersed in the salt and sodium hydroxide solutions. illustrates the RCPT test specimens, while depicts the setup for the RCPT test. In essence, the UTC-1200 RCPT Equipment provides a reliable and comprehensive means of evaluating concrete resistance to chloride ion penetration, supported by user-friendly software for efficient data analysis and reporting.

3. Results and Discussion

To explore the Rapid Chloride Permeability Test (RCPT), two different temperatures, 700 degrees and 800 degrees, were applied to bentonite, casting variations of 5%, 10%, and 15%. Subsequently, the specimens underwent curing for 7 days and 28 days. Following the curing process, the ASTM C1202, known as the Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration, was employed for the Rapid Chloride Ion Permeability Test (RCPT). This test, also referred to as a short-term corrosion performance test, requires approximately six hours for completion. For the RCPT, exposed and internally cored specimens, measuring 100mm in diameter and 50mm in height, were examined for their electrical resistance to chloride ions. The specimens underwent thorough drying in a desiccator after epoxy coating around the circumference. Subsequently, the cored specimens were saturated with water for 18 hours before being placed in the RCPT apparatus. The RCPT cell's left side was filled with a 3% NaCl solution, while the right side contained a 0.1N sodium hydroxide (NaOH) solution. Observations were recorded at 30-minute intervals throughout the six-hour testing period.

Mix design details of all specimens.

S. No	Materials	S-1	S-2	S-3	S-4	S-5	S-6
1	Water (ml)	577	577	577	577	577	577
2	Cement (kg)	1.12	1.12	1.12	1.12	1.12	1.12
3	Bentonite (gm)	60	120	180	60	120	180
4	Fine Aggregate (kg)	3	3	3	3	3	3

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5	Course Aggregate (kg)	3.52	3.52	3.52	3.52	3.52	3.52

Charge passes in Columbus for Set-1 specimens.

SAMPLES	0%		5%		10%		15%	
Bentonite (700^{0}C)	7 days	28 days	7 days	28 days	7 days	28 days	7 days	28 days
30	280	200	249.3	208.8	147	130	140	134
60	289	210	240.3	263.3	187.1	170	143	138.6
90	300	211	252.3	249.3	210.3	190	138	132.4
120	320	222	257.5	240.3	210.2	200	146	143.5
150	400	265	262	252.3	210.3	220.3	150	146.1
180	410	280	262.5	257.5	233.3	235.6	149	145.5
210	473	299	268.5	127.4	250.2	250.5	150.1	144.8
240	499	333	258	267.1	265.4	260.2	148.2	145.4
270	507	350	257.7	268.5	273.0	270.3	148	146.9
300	522	356	258.2	258.8	283.3	290	150	145.9
330	566	400	254.7	257.6	305.3	300	155	150.9
360	580	412	265	5469	5796	300	160	157

Charge passes in Columbus for Set-2 specimens

SAMPLES	0%		5%		10%		15%	
Bentonite (800^{0}C)	7 days	28 days	7 days	28 days	7 days	28 days	7 days	28 days
30	340	249	185	180	206	202.5	135	114.3
60	345	248	186.1	180.4	207	202.9	160	132.6
90	400	247	187	182.1	207.5	205.2	162.3	136.8
120	444	245	189	184.1	208	205.9	165	142.8
150	455	240	189.5	184.6	209	206.7	190	136.1
180	467	230	190	186.2	210	207	230	145.7
210	488	255	191	186.9	211	207.2	250	153
240	489	220	200	195.2	215	207.6	270	155.3

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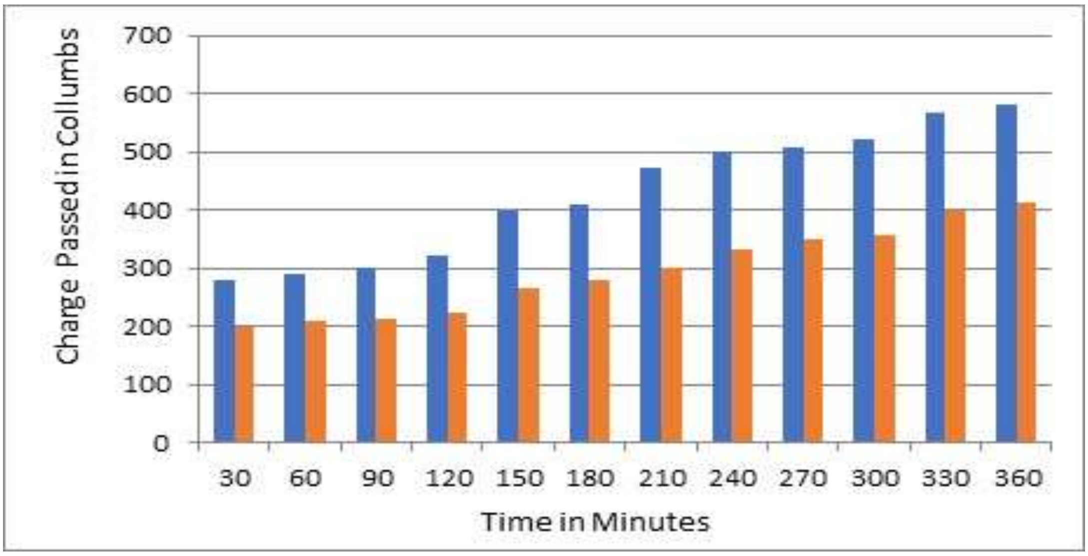
270	500	217	204	199.1	216	208	500	156.2
300	540	215	204	199.6	216.3	208.3	530	158.4
330	555	213	206	200.5	217	208.6	532	157.7
360	567	211	208	5449	218	5356	560	160.1

Rating of chloride permeability of concrete according to the ASTM: C1202

Chloride permeability	Charge passing coulombs	Typical concrete types
High	>4000	High wc ratio (> 0.6) conventional pc concrete
Moderate	2000 to 4000	Moderate wc ratio (0.40 to 0.50) conventional pc concrete
Low	1000 to 2000	Low wc ratio (< 0.40) conventional pc concrete
Very low	100 to 1000	Latex modified concrete internally seated concrete
Negaligible	< 100	Polymer impregnated concrete, polymer concrete



Bentonite(800^{0}c) 5%

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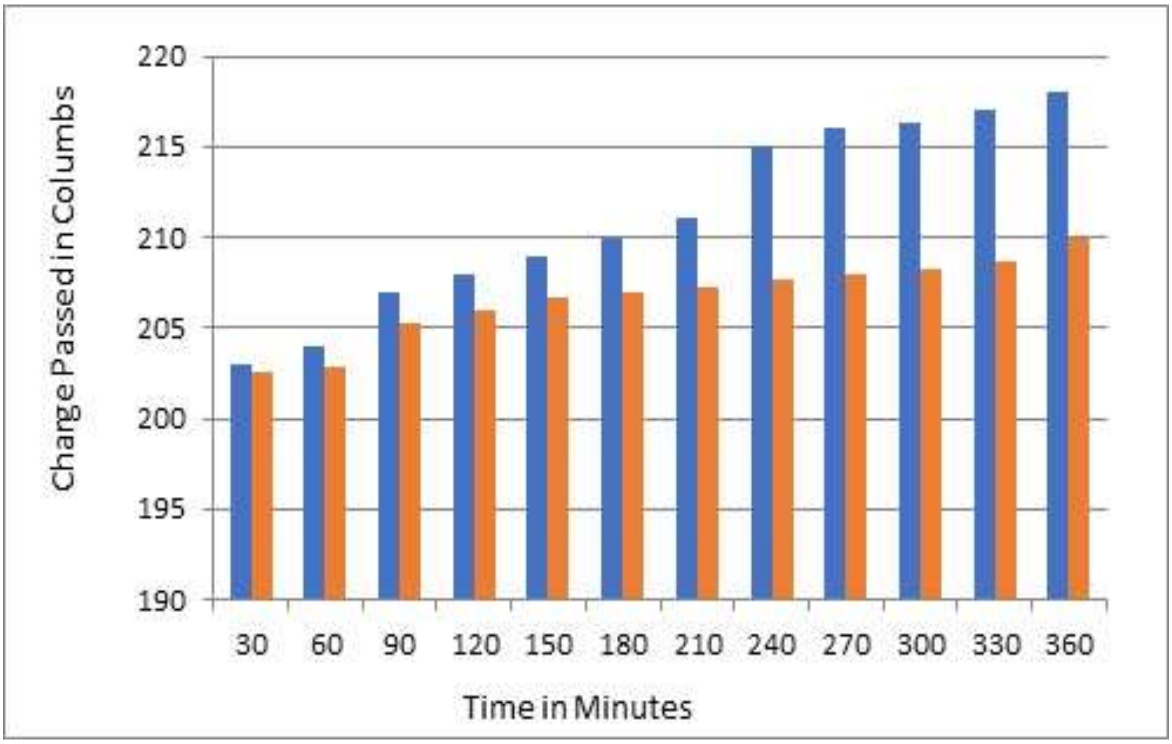
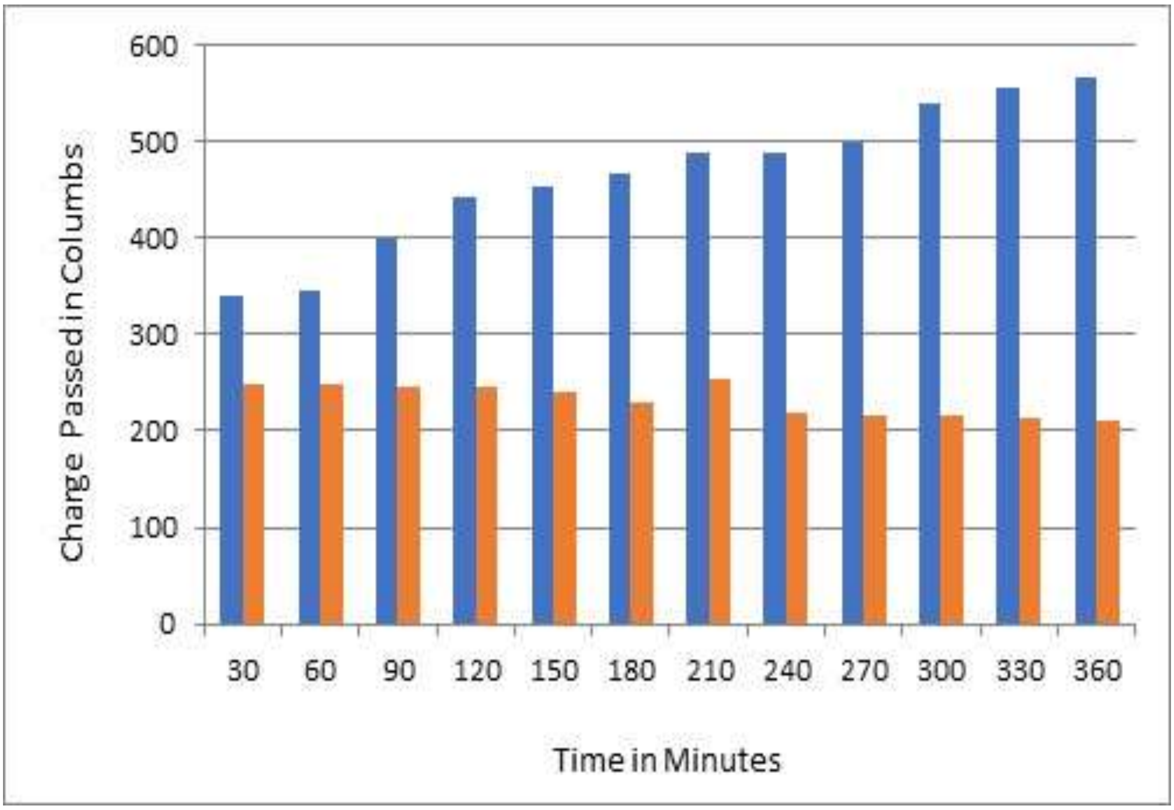


Bentonite(800^{0}c) 10%



Bentonite(800^{0}c) 15%

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Conclusions

Based on the experimental findings, we determined the values for bentonite at 700 degrees in percentages of 0%, 5%, 10%, and 15% for both 7 days and 28 days. The results were as follows: 0% values were 580 and 412, 5% values were 265 and 5469, 10% values were 5796 and 300, and 15% values were 160 and 157. For bentonite at 800 degrees, the values at 0%, 5%, 10%, and 15% were measured for both 7 days and 28 days. The results were: 0% values of 567 and 211, 5% values of 208 and 5449, 10% values of 218 and 5356, and 15% values of 560 and 160.1.Analysis of the results indicates that the use of 15% bentonite at 800 degrees Celsius yields superior outcomes compared to other percentages. Specifically, the addition of 15% bentonite at 800 degrees Celsius demonstrates significantly reduced permeability. This lower chloride ion penetration suggests a decrease in corrosion when using 15% calcined bentonite as a replacement.

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References

[1] D. Whiting, "Rapid Determination of the Chloride Permeability of Concrete," Report No. FHWA / RD81 / 119, August 1981, Federal Highway Administration, Office of Research & Development, Washington, D.C.

[2] "Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration," ASTM C 1202-97, ASTM Standards Manual, Vol. 04.02, pages 639-644.

[3] K.D. Spanish, RD Hooton, and MD.A. Thomas, "Predicting the Entry of Cement in Concrete," Testing the Congestion of Cold Clocking in Concrete: A Literature Review, FHWA Contract DTFH61-97-R-00022.

[4] C. Shi, 4. J. Stegemann, and R. Caldwell, "Effect of Threatening Stimulants on the Effective Efficiency of Pore Solution and Its Effects on Rapid Chloride Permeability Test Results," (AASHTO T277 and ASTM C 1202) July - August 1998, pages 389–394.

[5] R. Feldman, G. Chan, R. Brousseau, and P. Tumidajski, "Investigation of the Rapid Chloride Permeability Test," ACI Materials Journal, May - June 1994, pages 246-255.

[6] "Parking Buildings-Building Buildings," CSA S413-94, Canadian Standards Association, December 1994.

ISSN PRINT 2319 1775 Online 2320 7876

  UGC CARE Listed (Group -I) Journal Volume 8, Issue 1, 2019

[7] P. Plante and A. Bilodeau, "Rapid Chloride Ion Permeability Test Data on Concrete Incorporating Supplementary Cementing Materials, Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete," S-114, Proceedings, Third International Conference, Trondheim, Norway, 1989, i -American Concrete Institute