An Experimental Investigation for the Permeableness of Chloride in Self-Compacting Geopolymer Concrete by using Rapid Chloride Permeability Test Apparatus

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Abstract— In the present investigation a trial is created to seek out electrical phenomenon of the geopolymer concrete towards the penetration of chloride ions by replacing the fine aggregate with vermiculite and copper slag. The methodology concerned during this study follows the codal specifications of C1202-05.This is most significant and advantageous technique for the rehabilitation of structures and for various studies.

Index Terms—Geopolymer concrete, Vermiculite, Copperslag, RCPT

I. INTRODUCTION

The transport of chloride ions into concrete is also a troublesome and mechanistic development. This check methodology covers the laboratory analysis of the physical phenomenon of concrete samples to provide a quick indication of their resistance to chloride particle penetration. In the most cases the physical phenomenon results have shown good correlation with chloride ponding tests. The permeableness of concrete depends on the pore structure of the concrete, whereas electrical conduction or electrical phenomenon of concrete is determined by every pore structure.

II. EXPERIMENTAL PROCEDURE

First of all cylinders of 1:3 mix is prepared with the dimensions of 10.2cm in diameter and 20cm height.

The casted cylinders ought to be set for proper curing.

- After completion of curing the sample should be cut into 5.1cm thickness.
- The prepared samples should be kept in mould of RCPT apparatus.
- Silicone sealant should be applied to the walls of the sample to avoid leakage.
- The moulds ought to be filled with the NAOH solution (+ve) and NACL solution (-ve).
- A Potential difference of 60V should be maintained.
- Readings ought to be noted for every 30min up to 6hrs.
- The obtained readings should be substituted in the formula below:
- *I cumulative* $=I_0+((I_{30}+I_{60}+I_{90}+I_{120}+I_{150}+I_{180}+I_{210}+I_{240}+I_{270}+I_{300}+I_{330})x2)+I_{360}$ $I_{AVERAGE}=900$ X $I_{CUMULATIVE}$

Where I=Current Reading In mille amperes

The obtained values ought to be compared with the table below and the result is determined.

Table: I Comparison of values from the Results

CHARGE PASSED IN COLOUMBS	CHLORIDE ION PENETRABILITY
>4000	HIGH
2000-4000	MODERATE
1000-2000	LOW
100-1000	VERY LOW
<100	NEGLIGIBLE

III. SELF COMPACTING GEOPOLYMER CONCRETE MIX DESIGN PROCEDURE

8 Molarity:

Step 1: The wet density of geopolymer concrete=2400 kg/m^3

Step 2: Mass of combined aggregate = 72.8% of the mass of concrete

= (72.8*2400/100) = 1747.2 kg/m^3

Step 3: Mass of Binders and the alkaline liquid = 2400-1747.2 = 652.8 kg/m^3

Step 4: Alkaline liquid to Binders ratio by mass = 0.45

Step 5: Assuming flyash content = 450 kg/m^3

GGBS content = 450 kg/m^3

Step 6: Mass of alkaline liquid = 0.45*450 = 202.6 kg/ m^3

Step 7: Ratio of sodium silicate to sodium hydroxide solution = 2.5

Step 8: Mass of sodium hydroxide solution = 202.6/ (1+2.5) = 57.9 kg/ m^3

For 1 molar sodium hydroxide solution, 40g of sodium hydroxide pellets are dissolved in 1 liter of water.

i.e., for 1 molar: 40g pellets →1000g or 1000ml of water.

For 8 molar: 8x40g of pellets→1000g or 1000ml of water.

% of sodium hydroxide solids(pellets) in NaOH Solution = 32 %

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In sodium hydroxide solution, solids = 0.32x57.9 = 18.528 kg/m^3

Weight of water in NaOH solution = 68% of 57.9

= 0.68×57.9 = 39.372 kg/m^3.

Step 10: Water content in sodium silicate solution=55.9%

Mass of sodium silicate solution =2.5 ×57.9 = 144.75 kg/m^3

Step 11: Coarse aggregate=0.45 X 1747.2 = 786.24 kg/ m^3

Step 12 : Fine aggregate= 0.55 X1747.2 = 960.96 kg/ m^3

IV. RESULTS AND DISCUSSIONS

Table: II Determination of Penetrability of Chloride for replacement of fine aggregate with vermiculite

SL.NO	PERCENTAGE REPLACEMENT OF VERMICULITE FOR FINE AGGREGATE	PENETRABILITY OF CHLORIDE
1	0 % Vermiculite	MODERATE
2	10% Vermiculite	MODERATE
3	20% Vermiculite	MODERATE
4	30% Vermiculite	LOW

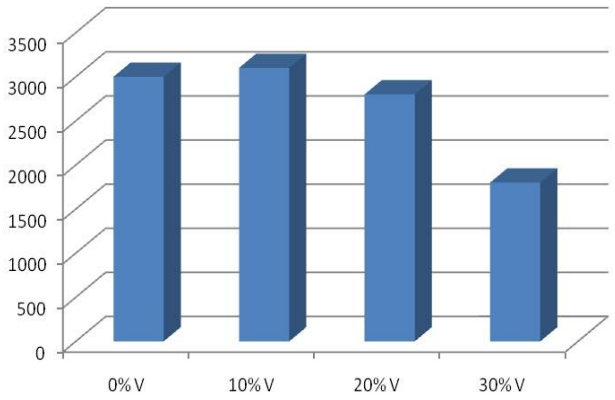

Figure:1 Value of current vs percentage replacement of vermiculite

Table: III Determination of Penetrability of Chloride for replacement of fine aggregate with copper slag

SL.NO	PERCENTAGE REPLACEMENT OF COPPER SLAG FOR FINE AGGREGATE	PENETRABILITY OF CHLORIDE
1	0 % Copper slag	MODERATE
2	10% Copper slag	MODERATE
3	20% Copper slag	HIGH
4	30% Copper slag	HIGH

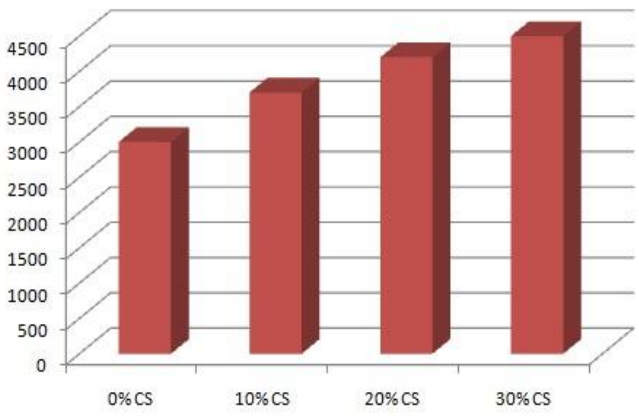

Figure:2 Value of current vs percentage replacement of copper slag

Figure:3 RCPT apparatus

Figure:4 Experimental setup for RCPT test

Figure:5 Cylindrical specimens for RCPT test

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V. CONCLUSION

From the above discussions it is noticed that resistance offered to the penetration of chloride ions is more in case of geopolymer concrete with copper slag when compared to that of geopolymer concrete with vermiculite. The numerical results (total charge passed, in coulombs) from this technique should be used with caution, particularly in applications like internal control and acceptance testing. Care ought to be taken in deciphering results of this test when it is used on surface treated concretes, for instance concretes treated with penetrating sealers.

This check technique will turnout deceptive results once metallic element radical has been admixed into a concrete. The results from this check on some such concretes indicate higher coulomb values, that is, lower resistance to chloride particle penetration, than from tests on identical concrete mixtures.

The presence of reinforcing steelor different embedded electrically semiconductive materials might have a big result. The check isn't valid for specimens containing reinforcing steel positioned length ways that's, providing endless electrical path between the ends of the specimen.

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