JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Rapid Chloride Permeability Test On Granite Powder Concrete

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Received: 14 Feb 2020 Revised and Accepted: 25 March 2020

ABSTRACT: This paper presents a definite exploratory investigation on penetrability qualities of granite powder (GP) concrete. The primary parameter researched in this investigation was M30 and M60 grades concrete with substitution of sand by GP of 0, 25,50 and 100 and concrete as fractional supplanting with super plasticiser, fly ash, slag and silica fume. The antacid arrangement utilized for present examination is the mix of sodium hydroxide and sodium silicate arrangement. The test example was 150x150mm solid shapes heat-relieved at 60°C in an oven. The variety was concentrated on the examples exposed to ambient air just as oven heat relieving. The rapid chloride permeability tests were led for a time of 28, 56, 90, 180 and 365 days. The test outcomes show that the substitution of rock and incomplete substitution of admixtures display better execution.

KEYWORDS: Granite powder, The rapid chloride permeability test, RCPT.

I. INTRODUCTION

Concrete is a versatile material of construction used globally. Unlike metals like steel, aluminium etc., which are produced in mills by employing skilled workers, concrete is prepared locally using granites, river sand, cement and water with the help of semi-skilled and unskilled workers. Sometimes in small quantities, it is obtained by mixing the ingredients described above at the site by hand. For the requirements of medium quantities and continuous supply the ingredients are mixed at the site using a machine called mixture machine. The concrete is then transported by trucks to the site. In whatever mode, the concrete is prepared it is laid in a formwork and allowed to set and harden. After a day of casting it is cured with water or by any other means to a required number of days as demanded by site condition. After 28 days the concrete hardens completely like a rock. It is then put to use. Compressive strength is a backbone of concrete. It is evaluated by testing representative samples cast in the form of control specimens like a cube, cylinder and prism at required number of days. Cement is an essential material in concrete. It binds all other ingredients. However, there is a drawback in it. Its production releases CO_2 to the environment at the rate of 1 ton of it per ton of cement produced. Therefore, to prevent degradation of the environment and to achieve sustainable construction the consumption of cement has to be curtailed. This can be obtained by harnessing the wastes in the production of concrete. These cement substitutes are called supplementary cementitious materials as well as pozzolans. Normally during the hydration of cement calcium hydroxide is released as a by-product. It is an unstable compound and tries to leave the body mass of concrete leaving pores in it through which atmospheric agent like oxygen and moisture ingress into it and attack steel reinforcement thus causing its corrosion by an electrochemical process. As a result of this concrete degrades and suffers a loss in its durability. This deterioration of concrete can be prevented by adding industrial wastes like fly ash, silica fume, marble powder, and ground granulated blast furnace slag (GGBFS), etc. These wastes react with calcium hydroxide and convert it into C-S-H gel which is beneficial to concrete adding strength to it. Another issue affecting the environment is river sand. Continuous use of this material as a fine aggregate in concrete causes strain in the environment due to its depletion, thus affecting the sustainability in construction. This problem could be solved by replacing the river sand partially with industrial waste such as granite powder.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

In RCPT directed by Prabakar et. al. [1] the estimation of PPC concrete was seen as 24% not as much as that of OPC concrete. The chloride diffusion esteem additionally improved. It was seen to be 1.60 occasions not as much as that of the OPC concrete. In like manner, the resistivity and quickened erosion commencement time were seen as expanded by 8.5% and 14.50%, individually. With the substitution of 18% of the concrete with fly debris in OPC concrete, the strength properties were equivalent to that of PPC concrete. Upgraded substitution levels of 25% and 35% improved the toughness properties further.

Torgal et. al. [2] the mechanical and sturdiness execution of ceramic waste based cement are surveyed by methods for mechanical tests water execution, porousness, chloride dispersion and furthermore quickened maturing tests. Results shows that solid with fractional concrete substitution by earthenware powder in spite of the fact that it has minor quality misfortune have increment toughness execution and solid blends with artistic total perform better than the control solid blends concerning compressive quality, capillarity water assimilation, oxygen penetrability and chloride dispersion. The substitution of concrete and total in concrete by earthenware squanders will have major ecological advantages.

Trial examination conducted by Srinivasa Rao et. al. [3,4] revealed the utilization of the salt opposition glass filaments to discover the usefulness obstruction of cement because of corrosive assault, sulfate assault and quick chloride porousness of M30 and M40 and M50 evaluation of glass fiber fortified concrete and customary cement at the 28 and 90 days with changing rates of glass strands.

II. Experimental details

2.1 Materials

The following materials are used in this experimental study.

Cement

In the present work, the cement was used is OPC of 53-grade. In Compliance with the fineness modulus of cement was measured as per IS code.

Fine aggregate

The ordinary river sand was used in preparing the concrete mixes and specific gravity of the sand was found to be 2.33. The sand used was confined to zone 3.

Coarse aggregate

Granite stone with the size of 10 -20 mm was the coarse aggregate used in the present study. As per sieve analysis,size of 19 mm sieve found successful with 99percent.

Water

Drinking water was used for mixing concrete since normal water may have impurities which may impact the strength and other properties of concrete.

Granite powder

Granite belongs to igneous rock family. Granite powder obtained from the polishing units and the properties were found. Since the granite powder was fine, hydrometer analysis was carried out on the powder to determine the particle size distribution.

Admixture

The partial replacement of cement using mineral and chemical admixtures like Silica fume, fly ash, slag (GGBFS) and Superplastciser.

Mixing, demoulding and curing

Thorough mixing and adequate curing are most essential for achieving a good concrete. In the laboratory, the concretewas handmixed. The mixing time was kept to about 3–4 min for normal concrete. Generally, the demoulding was done 24 hours of casting. Potable water was used for curing all the concretes and was kept in moist environment immediately after the initial set and before thedemoulding.

III. Experimental procedure

Rapid Chloride Permeability Test (RCPT) is essentially a measure of electrical conductivity of concrete. This conductivity depends on the pore structure of concrete as well as pore solution chemistry (Caijun Shi, 2004). Chloride diffusion is one of the major reasons for causing corrosion of steel reinforcement inside concrete. Because of this reason, it is imperative to comprehend the behaviour of concrete concerning chloride ion permeability. In geopolymer concrete (GPC) alumino-silicate is the binder. However, in the conventional concrete calcium silicate hydrate (C-S-H) gel is the primary binding system.

Water saturated, 50 mm thick, and 100 mm diameter concrete specimen was subjected to a DC voltage of 60 V applied across terminals according to ASTM C1202 [5], for 6 hours using the apparatus shown in Figure.1. In one reservoir a 3.0% NaC1 solution was kept and in the other reservoir a 0.3 M NaOH solution. The total charge passed was recorded. This charge was used to reckon the rate of which the concrete was classified by the criteria included in Table 1.

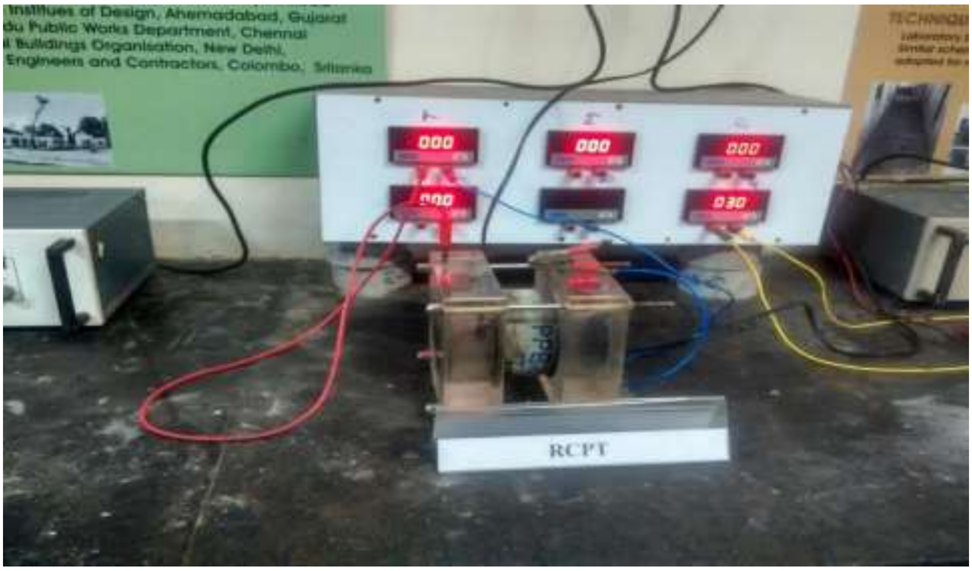

Figure1.RCPT Setup Apparatus

Table 1. Coulomb Charges Rating of Concrete as per ASTM C1202

Range of Coulombs Charges (× 1000)	**Concrete classification**
>4	High
2-4	Medium
1-2	Low
0.1-1	Very Low
<0.1	Negligible

IV. Results and discussion

The recommended range of RCPT values regarding Coulomb charges is presented in Table 4. The measured RCPT values of different grades of concrete with various percentages of granite powder are summarized in Table 5and Table 6. Variation of charges passed in respect of M30 concrete is shown in Figure.2 and for M60 concrete in Figure.3. At ages of 28 days and 56 days in respect of M30 grade concrete, the charges passed were lower than 1000 Coulomb. Therefore, as for M30 grade, all concretes observed to possess good resistance to chloride penetration. In respect of M60 grade concrete, the Coulomb charges passed through all concrete were above 1000 for 28 days. For GP75 and GP100 the charges were 1500 Coulomb and above for 28 days.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

However, in the case of 56days charges passed for GP0 and GP25 were less than 1000 Coulomb and that for GP25 it was less than 750 Coulomb. For GP50 and GP100 the charges were more than 2000 Coulomb. On the whole, the resistance of GP25 concrete of M60 grade against chloride penetrability was better than other concretes.

Table 2. Measured Values of Chloride Permeability for M30 grade Concrete at Different Ages

Replacement Level	Total No. of Specimens	28 Days	56 Days	90 Days	180 Days	365 Days
GP0	30	812	707	658	500	446
GP25	30	539	418	245	175	--
GP50	30	909	738	502	344	179
GP75	30	749	617	527	412	334
GP100	30	941	735	609	467	277
NA100	30	822	743	514	356	112
CC	30	1757	1543	1058	923	759

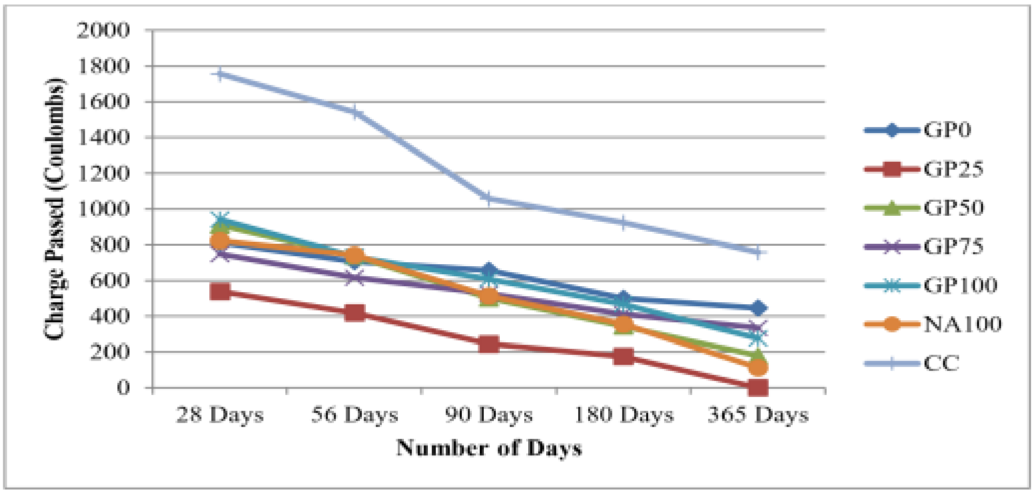

Figure 2. RCPT Value for M30 grade Concrete

The values of charges in Coulomb passed through all types of concrete of M30 grade were presented in Table 2. All values excepting that of CC concrete were lower than 1000 Coulomb. They were categorized as very low.

The charges passed in respect of CC concrete were 1757 Coulomb. It fell under the category of low. The Coulomb charge in respect of CC at 28 days was almost double that of the other mixes. Therefore, the percentage variation of chloride permeability of GP25 is 28% to 69.32% at 28 days; Corresponding values for 56,90 and 180 days are 32.3% to 70%, 51.2% to76.8% and 49.12% to81% respectively. The chloride permeability of GP25 concrete is negligible for 365 days as per ASTM C 1202.

It was obvious that mixes containing granite powder/admixtures had registered a lower value of charges indicating better resistance to chloride permeability. The charges keep decreasing with ages. At 28 days the charges were relatively higher for all concretes and decreased to as low as 112 Coulomb at 365 days. The RCPT test proved that M30 grade concrete was able to prevent the chloride penetration very well.

The RCPT values for all concrete in respect of M60 grade has been given in Table 6. The values of charges for all concrete were more than 1000 Coulomb at 28 days. However, they are categorized as low. The value of CC at 28 days was 1956 Coulomb. At 28 days the charges were lowered with the addition of granite powder and cementitious materials. However, the charges increase with the increase in percentage addition of granite powder. The NA100 concrete contains 100% granite powder, but it does not have cementitious materials. Therefore, its chloride permeability has increased and registered a value of 1943 Coulomb, slightly lower that of CC by 0.66%. Among all concretes at 28 days the charge of GP0 concrete which contains cementitious materials and 100% sand registered the lowest value of 1116 Coulomb which is lower by 42.94% when compared to CC concrete. The charges decrease with the ages. In some cases, the values were more than 1000 Coulombs for 56 days, 90 days, and 180 days. For 365 days all the values for all concrete were less than 1000 Coulomb and in some cases as low as 110 Coulomb. Therefore, higher the ages the chloride permeability of all concretes is low indicating better resistance to chloride penetration which is beneficial to structures in the long run. Therefore, the percentage variation of chloride permeability of GP25 is 5.8% to 46.3% at 28 days and corresponding values for 56, 90 and 180 days are 41.7% to 68.4%, 13.63% to 73% and 27.3% to 85% respectively. The chloride permeability of GP25 concrete is negligible for 365 days as per ASTM C 1202.

Table 3. Rapid Chloride Permeability Values of M60 grade Concrete

Replacement Level	**Total No. of Specimens**	**28 Days**	**56 Days**	**90 Days**	**180 Days**	**365 Days**
GP0	30	1116	885	440	220	110
GP25	30	1051	516	380	160	-
GP50	30	1441	1239	867	443	224
GP75	30	1634	1397	1178	654	333
GP100	30	1847	1547	1287	523	312
NA100	30	1943	1632	1411	1057	546
CC	30	1956	1523	1134	945	480

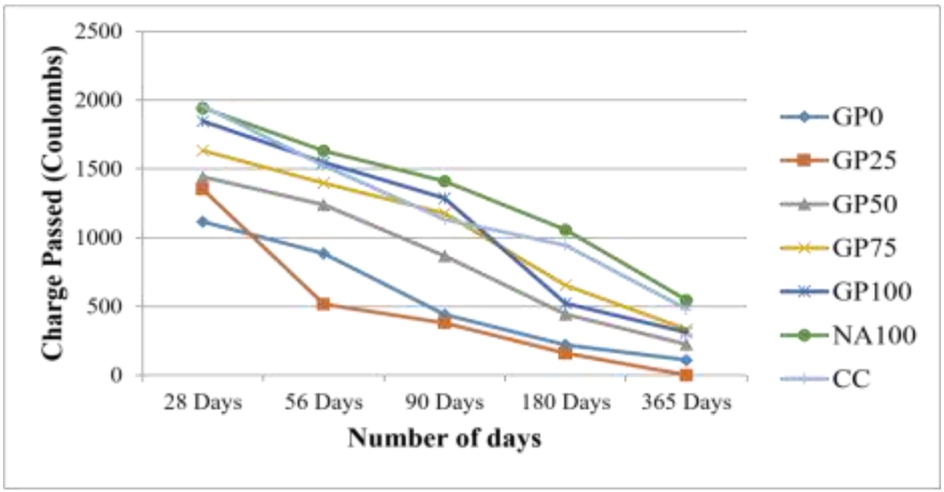

Figure 3.RCPT Values for M60 grade Concrete

V. Conclusion

RCPT was conducted to measure the chloride penetration through concrete in terms of Coulomb charges and the results are given as follows:

a) For M30 grade normal concrete the charges were 812 Coulomb and for 25% granite powder concrete was 941 Coulomb. These charges are categorized as very low.

Corresponding values for M60 concrete were 1141 for normal concrete and 1351 for 25% granite powder concrete. Both values fall under low category.

VI. REFERENCES:

[1] Prabakar, J., Devadas M.P., and Neelamegam, M. Effect of fly ash on the Durability and performance of concrete, The Indian concrete journal, 2011.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

[2] Fernando Pacheco-Torgal and Said Jalali, Compressive Strength and Durability Properties of Ceramic Wastes Based Concrete, Materials and Structures 44(1):155-167, April 2011.

[3] Srinivasa, R.P., Saravana,P., Chandra Mouli, K. Durability studies on glass finer reinforced concrete, International Journal of Civil Engineering, Vol. 7, pp. 1-7, 2009.

[4] Saravana.P., Srinivasa R. P., Sehagiri, M.V. and Sehagiri, T. sekhar, Studies On Impact Strength of High Volume Fly Ash Fibre Concrete with High Volume of Fly Ash as an Additional Material, International journal of civil Engineering, Vol.1, No. 1, 2009.

[5] ASTM International. (American Society for testing and materials) Standard Test Method for Bulk Electrical Conductivity of Hardened Concrete.